The London School of Economics and Political Science

ECONOMIC DISPARITY YET RESULTING SIMILARITY:

The 'Double Paradox' of Argentina's and Mexico's Electric Telegraph and Telephone Diffusion, 1851-1997

Arish Tatiana González

A thesis submitted to the Department of Economic History of the London School of Economics for the degree of Doctor of Philosophy, November 2010

ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

Declaration

I certify that the thesis I have presented for examination for the PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

Abstract

The process of Information and Communication Technology (ICT) diffusion today is one of the major determinants of a country's economic growth and development. A greater understanding of the factors driving this is therefore critical in developing countries. Whilst the literature presents a range of potential factors that explain the difference in diffusion rates across countries, it is the relative level of economic development in one country compared with another that is cited most frequently. This would suggest that the diffusion of the telegraph and the telephone in Argentina should have been decidedly faster than in Mexico, given the former's significant inherent economic advantage throughout the period. This was not found to be the case. Instead, Argentina underperformed while Mexico outperformed, giving rise to an interesting historical episode which I dub the 'Double Paradox'.

This unexpected result is verified via the application of the 'Flexible Logistic Growth Model' (FLOG) and linearisation techniques, which demonstrated that both technologies diffused at strikingly similar rates. The quantitative and qualitative analysis established that the 'Double Paradox' is best explained by the role and actions of the state, rather than the countries' economic development, or the intrinsic traits of the given technology. The findings showed that state action can act as a substitute to the otherwise commonly held prerequisites for fast diffusion, such as economic drivers, thus allowing for Gerschenkronian style catch up. Further investigation determined that Mexico's closed political system was supportive of successful diffusion while Argentina's more open, decentralised and quasi-democratic structure was not, indicating that the state can act as both a promoter and an inhibitor of diffusion. The thesis contributes to the literature on the comparative history of traditional ICT diffusion and growth. This is important both in understanding the economic history of developing countries, and because it has valuable implications for political planning in developing countries regarding future ICT diffusion. The thesis concludes that not only is the choice and implementation of the right reform paramount in inducing faster diffusion, but also the degrees of stability, autonomy and concentration of power within the state. In the discovery and examination of the 'Double Paradox', the overwhelming impact of the role of the state in the traditional ICT diffusion process is illuminated, which lays a framework from which to stimulate and develop further research.

Acknowledgements

This research has only been possible thanks to the continual academic and personal support I received from a number of institutions and individuals. I am eternally grateful to you all.

First and foremost, I would like to thank my thesis supervisors Colin M. Lewis and Tim Leunig. Their support was overwhelming and our conversations were always a source of inspiration and constant guidance. Thank you for always managing to keep track of my progress and for providing me with invaluable advice and clear direction at decisive moments. You have been great mentors for me and it has been a pleasure working with you. My most sincere appreciation. I am particularly grateful to my examiners, Rosemary Thorp and Rory Miller, whose comments and guidance contributed significantly in improving the final version of the thesis.

I would also like to thank my colleagues and fellow students in the Economic History Department at the LSE, who were helpful in so many ways. This thesis has undoubtedly benefited from all your comments throughout the process. You have made my experience at LSE a valuable and enjoyable one. I am grateful to Ernesto Piedras for all his assistance in helping me obtain the latest data sets and publications during my field trip to Latin America, which has materially benefited my research, and to Eileen Power for her patience and technical support during the last stretch. Also a thank you to the staff of the Tornquist Library and the INDEC Institute in Buenos Aires, and to those at INEGI in Mexico City for all their assistance.

Un agradecimiento muy especial para mi familia. Gracias Papa, por creer en mí y por siempre haber intentado guiarme por el camino correcto. Gracias por haber despertado mi curiosidad por aprender desde una edad muy temprana; eres un modelo para mí y una constante fuente de inspiración. Gracias Abu, por tu apoyo incondicional, por tus consejos y paciencia, y por siempre haberme ayudado con todo lo que has podido. A very special thanks to Andrew; without ever having to ask, I received your constant and unconditional support, and for that I am forever grateful. Thank you for reminding me about the important things in life. This thesis would not have been possible without you, your daily encouragement, understanding, and continuous belief in me.

Table of Contents

List of Tables

List of Figures

Introduction

This thesis examines the economic history of the diffusion of Information and Communication Technologies (ICTs), in the context of Argentina and Mexico, in order to demonstrate the dominant role of state action in the process. Through the application of the 'Flexible Logistic Growth' (FLOG) model and linearisation analysis, the rates of diffusion for the electric telegraph and the telephone technologies (traditional ICTs) were quantified.[1] An interesting and unexpected result arose, whereby the two technologies diffused at very similar rates in Argentina and Mexico, despite the two country's differing economic settings (particularly with regards to income levels). Given that much of the literature accounts for the differences in technology diffusion rates by the role of income, this implies that the telegraph and the telephone should have diffused at a relatively faster rate in Argentina than in Mexico, yet this was not the case. Rather, the diffusion of the two technologies in Argentina seemingly underperformed, while relatively outperforming in the case of Mexico. I dubbed this interesting historical episode the 'Double Paradox' (the Paradox hence). Given the inadequacy of economic rationale in accounting for the revealed diffusion rates, the thesis demonstrates that one of the main differentiating drivers of diffusion in the two countries was state action. Upon extensive analysis of the Paradox and the extent of the Mexican 'Success Story', the associated implications are explored. In order to give the reader some insight into the rationale for the context of the thesis, five important questions are posed below: why was ICT, and specifically the telegraph and the telephone, chosen as the basis of study? What are the primary issues researched? How did the research process develop? Why focus on Argentina and Mexico as regions of analysis? Finally, what are the implications of this thesis?

Why study ICT (specifically the telegraph and the telephone) as an economic historian?

ICT diffusion has undeniably contributed to the continued advancement of society and its importance has increased considerably in the past 20 years, as it has become an integral part of our everyday lives. The process of ICT diffusion today is, without

[1] ICTs are commonly divided into traditional ICTs (e.g. telegraph, telephone, radio) and modern ICTs (e.g. internet, mobile phones).

doubt, one of the major determinants of economic growth and at the core of a country's development.[2] Thus it is understandable why the topic takes on such prominence for Economic Historians and is the source of much academic deliberation and investigation within the social sciences. For developing economies, the opportunity to understand a given diffusion process before embarking upon it, provides unrivalled value in the adoption of an ICT, in order to learn from mistakes and replicate success stories. Given the premise that 'history counts', and that past technological achievements influence future ones, examination of a country's traditional ICT diffusion history is also beneficial to the understanding of a country's experience with modern and future ICT diffusion.

ICT diffusion is particularly important in developing countries as it provides them with the opportunity to modernise. As the growing literature suggests, there is vast potential for using ICT to accelerate economic development, offering developing countries a greater opportunity to engage in global economic activity and provide the means to industrialise and catch up with global developments.[3] Often, many of the benefits from ICT observed in the developed world are not always fully realised in developing countries due to inherent system inefficiencies and lack of infrastructure, though the economic and social benefits are potentially far greater. Technologically, the telegraph and the telephone are particularly interesting because they are the closest substitutes within traditional ICTs and in fact, the telephone eventually rendered the telegraph obsolete, something that rarely occurs. They are fascinating in terms of their huge economic and social impact and played an important role in the formation and development of Latin American states. Additionally, their common characteristics make them ideal for the purposes of a comparative study.

[2] Solow R. M., 'A Contribution to the Theory of Economic Growth' *Quarterly Journal of Economics* 70.1 (1956): 65-94, Anderson D., 'Energy and the Environment: Technical and Economic Possibilities' *Finance and Development* 33.2 (1996): 10-13, Porter M. E., *The Competitive Advantage of Nations* London, Macmillan (1990), Findlay R., 'Some Aspects of Technology Transfer and Direct Foreign Investment' *American Economic Review* 68.2 (1978b): 275-279.

[3] Hanna N., Guy K. and Arnold E., 'The Diffusion of Information Technologies' *The World Bank Discussion Paper* 281 Washington D.C., The World Bank (1985), Faye M., 'Developing National Information and Communication Infrastructure (NICI) Policies and Plans in Africa' *Paper presented during the Nigeria NICI Workshop*, Abuja, Nigeria (2000).

What are the primary issues researched?

The main concern of the thesis is to establish and then address the logic behind the existence of the Paradox. The thesis has four guiding core aims, the first of which is to provide a quantitative framework via the application of the FLOG model to show the similar diffusion rates across the two technologies in Argentina and Mexico. This provides the base for the existence of the Paradox. The second aim is to shed light on the factors that could be responsible for the diffusion rates of the two technologies in Argentina and Mexico. The third aim of the thesis is to combine the quantifiable factors with a qualitative appreciation of the concepts in the literature, to ensure that a large range of potential economic, social, natural endowment and institutional drivers are examined. This is very necessary in order to assess the arguments regarding the importance of the political economy of the two countries, which is highlighted as a primary factor behind the Paradox. The fourth aim of the thesis is to assess to what extent the Mexican case study can be regarded as a 'Success Story'. By fulfilling the third and fourth aims of the thesis, five lessons were provided, offering potential guidance to future ICT diffusion in developing economies.

How did the research process develop?

Given the role of technology in explaining economic development, I was very interested in technology diffusion. During previous research projects (for my master's dissertation), I analysed the diffusion of the telephone and the internet across a sample of countries in Asia and Africa. The fact that ICT diffusion had become so important to the future development of these regions was not the only interesting rationale guiding the research, however. I also found that in some of these developing economies, where ICT penetration generally had lagged that of many developed countries, ICT was being diffused at a much faster rate. Moreover, in assessment of the literature, it is clear that relatively less work was carried out on the diffusion of ICT in developing economies, hence there was more opportunity to add value.

It soon became apparent that the diffusion of the telephone, for instance, did not follow the expected s-curve shape in African economies, nor for most of the countries I surveyed in Asia. The explanation is that these countries simply leapfrogged onto newer technologies, often before the 'older' technology reached

saturation. This led me to the examination of Latin America; here surprisingly, I found that many of the countries in my sample did follow the usual s-curve pattern of diffusion (like developed countries), as theory would predict. Consequently, I thought that ICT diffusion within the context of Latin America would be interesting to investigate further, and this is how the research process developed. Within Latin America, I felt that looking at Argentina was important, because Argentina, particularly for the earlier period of the study, was the wealthiest country in the region and consequently theoretically best positioned to diffuse the ICTs under consideration successfully. Initially my inclination was to compare Argentina, the 'best' performer, against one of the less wealthy and hence, theoretically, less successful in diffusing the ICTs under consideration. This led me to look at a range of countries in Latin America, among them Mexico. To my surprise, I found that in Mexico, the telegraph and the telephone actually diffused at a relatively faster rate than in other countries with similar levels of income per capita. Further, the diffusion rate of the telegraph and the telephone was similar to that in Argentina, despite the disparity in their relative levels of economic development. I was intrigued by this unexpected finding, and decided to explore it further, paving a path to the initial steps toward what would become the 'Double Paradox'.

Initially I planned to study a wider range of ICTs, including the telegraph, the telephone, the internet and the mobile telephone. As the research developed this proved to be impractical, and I decided there was more to be gained from focusing on the telegraph and the telephone in more depth to acquire a deeper understanding, rather than trying to include all the technologies that I initially hoped to cover. Some of the problems that I experienced as the research developed included the fact that I had a limited availability of time for fieldwork and a good deal of effort was directed toward collecting quantitative data. This was important because it allowed for the subsequent elaboration of the main data series to measure the rate of diffusion. Unfortunately, extensive focus was directed toward the collection of various quantitative data which later turned out to be much less useful than anticipated. Another issue which I had to be acutely aware of during the research process was the fact that there were various limitations with regard to the data collected and thus I tried to bring this to the reader's attention where relevant throughout the thesis. The focus of the thesis shifted as the research evolved, as the findings provided evidence

that departed from a more quantitative and socio-economic explanation, to one increasingly where the importance of the political economy was demarcated. Ultimately, it became clearer that one of the key drivers behind the diffusion of the telegraph and the telephone in Argentina and in Mexico was the role of the government.

Why focus on Argentina and Mexico as regions of analysis?

The geographical rationale, as explained above, came from the fact that diffusion of both the telegraph and the telephone in many Latin American countries followed the same general pattern as that witnessed within the developed world (i.e. s-curve shaped), despite experiencing lower income levels. This echoes Gerschenkron's latecomer advantage argument, as Latin America adopted these technologies after the developed world, thereby theoretically facilitating their fast diffusion.[4] In the context of Latin America, the Paradox ultimately provided the overriding rationale for the specific country choices of Argentina and Mexico as the base case studies for the thesis. During the years of the diffusion of the telegraph and the telephone (especially the earlier years), living standards, economic growth and notably GDP per capita levels in Argentina were significantly higher than in Mexico.[5] Theory would predict that diffusion should have been relatively faster in Argentina than in Mexico as a result of this economic disparity. Moreover, not only was Argentina leading Latin America socio-economically, but Mexico's GDP per capita was actually below the regional average, demonstrating that its performance in successfully diffusing the telegraph was yet more impressive. An opportunity is presented by the subsequent investigation, to reveal what in fact were important drivers of telegraph and telephone diffusion. Further, by comparing the diffusion experience in Mexico directly to the wealthiest country in Latin America, it offers hope to developing economies around the world.

The thesis demonstrates that ICT diffusion experiences are not necessarily bounded by economic limitations, and developed economic means are not a prerequisite for successful diffusion, as seemingly other factors may act as substitutes. If this study

[4] Gerschenkron A., *Economic Backwardness in Historical Perspective* Cambridge, MA, Harvard University Press (1962).
[5] See appendix A for details.

provides even a modicum of insight into the potential ramifications that various strategies can have on the ICT diffusion process in developing countries, then this thesis serves a valuable purpose.

What are the implications of the thesis?

The thesis contributes to the literature on the comparative history of traditional ICT diffusion and growth by comparing the telegraph and telephone technologies in Argentina and Mexico across the entire period of diffusion for the very first time. The findings suggest that purely economic explanations are insufficient in explaining ICT diffusion rates, and the thesis refocuses attention on alternative factors, such as the role of the government. The analyses in their own right add value to the comparative economic histories of the two nations.

The quantification of the diffusion rates in the two countries augments the technology diffusion literature: in providing quantitative evidence that the telegraph and the telephone technologies diffused at similar rates in Argentina and Mexico despite the difference in their socio-economic conditions, opening the door to further investigations. The identification of the counter-intuitive result of the Paradox is a primary finding of the thesis, providing the fundamental basis for much of the analysis, as its existence offers an opportunity to broaden the accepted set of explanatory outcomes regarding technology diffusion speed.

A closed political system (as in the case of Mexico) was found to be relatively more supportive of successful diffusion than a more open, decentralised and quasi-democratic structure (as in the case of Argentina), which were characteristics of some of the most important administrations during the critical periods of telegraph and telephone diffusion. Moreover, the thesis argues that state action can not only positively stimulate diffusion speed, but it can also serve to hinder it, as per the inefficiency of telephone service provision under nationalisation in Argentina. In the examination of the Mexican case study, it becomes apparent that it was not only the choosing but also the implementation and timing of the diffusion conducive reforms that were important, often influenced by the characteristics of the state. Additionally, the full data series compiled in measuring diffusion rates across the telegraph and telephone technologies in Argentina and Mexico are supplied for future use as

benchmarks for comparison with technology diffusion across other developing countries.

The findings provide a number of potential learning opportunities for political planning in developing countries regarding future ICT diffusion. In consideration of whether the Mexican case study was in fact a success story, various implications for the execution of future technology diffusion in developing countries are outlined.

The structure of the thesis

The thesis was organised in the following manner. Chapter one first provides the historiography of the political economy and refers the reader to the relevant literature during the period of telegraph and telephone diffusion in Argentina and Mexico. Particular attention is directed to the drive toward industrialisation, given the large impact that ICT diffusion had upon this process, as well as the structural importance it rendered for Latin America. This provides the broader context within which the two technologies diffused. The chapter then examines the literature regarding the possible explanatory factors behind the different ICT diffusion rates across countries, by means of four approaches: the economic approach, the social approach, the natural endowments approach and the institutional approach. It presents the main empirical findings of the literature, which provide the basis of analysis for the later chapters. Chapter two presents the theoretical modelling framework and the quantification of the diffusion speeds for the telegraph and the telephone in the two countries. The chapter examines the process of ICT diffusion, and analyses the observed diffusion patterns to determine the requirements of the chosen model. The chapter considers a broad range of theoretical models, before focusing on the FLOG model. This chapter provides the basis for the existence of the Paradox.

Chapter three analyses the development of the telegraph and the telephone in Argentina and Mexico within the political and economic context set up in chapter one. Chapter four examines the main possible diffusion drivers. First it applies a quantitative approach, using multiple regression analysis to test for a range of socio-economic factors highlighted in the literature. In light of the issues in regard to the data and the nature of the most significant factors (see appendix A), there is naturally a heavier focus regarding the second half of this chapter. The second half of the

chapter provides a qualitative analysis to explore the essential themes within the literature in greater depth, providing a basis from which to assess the argument regarding the overall role of the political economy. Chapter five pulls together the ideas and results of previous chapters, to answer the three main questions posed by the thesis, namely: what were the main drivers behind the observed diffusion rates in Argentina and Mexico? What factors caused the Paradox? And, to what extent can Mexico's experience with the diffusion of the two technologies be considered a 'Success Story'? This chapter represents the main contribution of the thesis to the literature, in specifically highlighting the importance of the government in ensuring successful diffusion. The last section concludes the thesis, summarises the key findings, points out a research agenda for future researchers and presents some lessons for future ICT diffusion in developing economies in light of the findings. The appendices A, B and C, at the end of the thesis, present all of the data relating to the economic indicators and the statistical analysis referred to, in the thesis. They present the relevant sources as well as a critical review of the data's validity. Appendices D, E, F and G provide the supplementary information to the modelling work detailed in chapter 2. Appendix H portrays the serving presidents throughout the period under concern.

Chapter 1

Economic History and ICT Diffusion in Argentina and Mexico

Every country is exposed to unique market conditions with '...different resource endowments and factor costs, and, possibly most important of all, different legal, institutional, and cultural milieu'.[1] As a result, the process of ICT diffusion has been a popular subject in academic circles for some time. The hypothesis in this thesis is that the diffusion of the telegraph and the telephone in Argentina and Mexico can be explained to a large degree by the role of the government. This chapter presents the historiography of the political economy in which the diffusion of these technologies took place in the two countries, which is necessary given the perceived importance of the political economy in the process. The next section examines the link between state formation and the role of technology, followed by an exploration on the joint supply of the railways and the telegraph. The second half of the chapter begins with an overview of the historical roots of the research on diffusion of innovations and afterwards focuses on the four different approaches that academics have undertaken in order to understand the different rates of ICT diffusion across countries. These factors are further sub-divided between those which directly influence consumer consumption and those that influence the build-out of the infrastructure. The chapter ends by looking at the gap within the literature and the proposed methodology for the thesis.

1.1 The Historiography of Argentina's and Mexico's Political Economy

It is important to place Argentina and Mexico in their political and economic historical setting for the period of the telegraph and telephone diffusion, that is, from the mid-nineteenth century to the late-twentieth century.[2] This section first documents the economic backdrop during the period under consideration, with a chronological and simultaneous focus on Argentina and Mexico. Economic growth is

[1] Cameron R., 'The Diffusion of Technology as a Problem in Economic History' *Economic Geography* 51.3 (1975): 217-230, p.218.

[2] For a detailed and well balanced account of Argentina's economic history over this period, see Rock, and for Mexico refer to Meyer and Sherman: Rock D., *Argentina, 1516-1987: From Spanish Colonization to Alfonsín* Berkeley, University of California Press (1987), Meyer M. C. and Sherman W. L., *The Course of Mexican History* New York, Oxford University Press (1999). Also see Romero L. A., *A History of Argentina in the Twentieth Century* University Park, Pennsylvania State University Press (2002), Della Paolera G. and Taylor A. M., *A New Economic History of Argentina* Cambridge, Cambridge University Press (2003).

portrayed with relevant acknowledgement in regard to social sensitivities such as distribution of income where applicable. Focus then shifts to the examination of the political setting.

In the social science literature there has been a lot of discussion on terms and ideas that are particularly relevant to this thesis. These include the oligarchic state, authoritarianism, populism and industrialisation. Although similar terms (if not identical) are used throughout Latin America, as will become apparent from the discussion below, the terminology has not only evolved over time but is often also interpreted in different ways. Hence these concepts have been at the centre of long standing (and at times controversial) academic debates.

1.1.1 The Economics of the Political Economy

The period under consideration is divided into three sections: the years of export-led growth (1870-1930), the years of import substitution industrialisation (1930s-1980s), and the years of the debt crisis and the New Economic Model (1982-1990s).[3] The period of export-led growth saw spectacular growth in Latin America, until the years of the Great Depression, which brought the impressive advances in the region to a halt.[4] The Great Depression caused significant changes in the global economic dynamics, which led to the start of Import Substitution Industrialisation (ISI).[5] During the period of ISI, Mexico, in particular, experienced significant economic growth, a period often dubbed the 'Mexican economic miracle' years. The final part of this period corresponds to the years of the debt crisis and the recovery, with the widespread of economic reforms encapsulated in the 'Washington Consensus', leading to trade liberalisation and privatisation reforms across the region.[6] Bulmer-

[3] Glade and Furtado provide a useful generic economic history of Latin America for the whole period under consideration: Glade W. P., *The Latin American Economies* New York, American Book (1969), Furtado C., *The Economic Development of Latin America: Historical Background and Contemporary Problems* Cambridge, Cambridge University Press (1977). Also see Cardoso and Faletto, which is a very good read that combines the conceptual framework with empirical analysis: Cardoso F. H. and Faletto E., *Dependencia y Desarrollo en América Latina* México D.F., Siglo Veintiuno Editores (1971).

[4] For an authoritative account of Latin American history over this period, see Bethell L., *The Cambridge History of Latin America,* volumes IV and V for 1870 to 1930, Cambridge, Cambridge University Press (1986).

[5] Dornbusch R. and Helmers F. L., *The Open Economy, Tools for Policymakers in Developing Countries* Oxford, Oxford University Press (1988).

[6] Díaz Alejandro C. F., 'Stories of the 1930s for the 1980s' in Armella P. A., Dornbusch R. and Obstfeld M., *Financial Policies and the World Capital Market: The Problem of Latin American Countries* Chicago, University of Chicago (1983).

Thomas and Thorp neatly examine these shifts of economic growth modes, from the export-led expansion right through to neo-liberalism.[7]

Argentina's average level of GDP per capita exceeded Mexico's and the rest of Latin America for good portions of the whole period under study. In terms of GDP per capita growth, Argentina's average was also much higher than Mexico's in the latter part of the nineteenth century and earliest part of the twentieth century, but growth rates converged later (see appendix A, tables A.1 and A.2, which reflect the relative economic development and growth of the region throughout the whole period under consideration). As highlighted throughout the argument below, it is not only growth that is important, but also the quality of growth. In terms of living standards, Argentina also tended to lead the region, with a more educated population and higher life expectancy rates (see appendix A, tables A.3 and A.4).[8] One must note that the period of export-led growth in Latin America neatly coincides with the key period of telegraph diffusion (and early diffusion of the telephone).[9] At a time when these countries were obsessed with state building, the telegraph proved to be a strategic tool (see section 1.2 The State and the Role of ICT in Latin America).

The Period of Export-led Growth (1870-1930)

The evolution of the global economy in the 1850 and 1860s paved the way for a brighter future for the countries of Latin America: the expansion of world trade meant that strong demand for foodstuffs and raw materials offered them greater financial means to fund projects.[10] In Argentina and Mexico, institutional stability and successful integration into global capital markets facilitated borrowing and led to significant levels of foreign investment and domestic capital accumulation. [11]

[7] See Bulmer-Thomas V., *The Economic History of Latin America Since Independence* Cambridge, Cambridge University Press (1994), Thorp R., *Progress, Poverty and Exclusion: an Economic History of Latin America in the Twentieth Century* Washington D.C., Inter-American Development Bank (1998).

[8] Astorga P., Bergés A. R. and Fitzgerald E. V. K., 'The Standard of Living in Latin America during the Twentieth Century' *Oxford University Discussion Papers in Economic and Social History* 54, Oxford University (2004).

[9] The 'key period of diffusion' refers to the period of 10-90% diffusion. These are the years when the fastest telegraph and telephone diffusion took place and the period when the two countries diffused these technologies at similar rates - see chapter 2 for details.

[10] For some of the most complete work on the economic history of Latin America towards the end of the nineteenth century, refer to: Cortés Conde R. and Stein S. J., *Latin America: A Guide to Economic History, 1830-1930* Berkeley, University of California Press (1977).

[11] ECLA examines these issues through foreign capital flows across Latin America. See for instance Economic Commission for Latin America (ECLA), *Foreign Capital in Latin America* New York, United Nations (1955). A later book which gives greater depth and background to these issues during the early twentieth century is Marchical C., *A Century of Debt Crisis in Latin America: From Independence to the Great Depression 1820-*

Features of capitalism and civil society quickly emerged under this new state model. Law and administrative institutions strengthened as social investment grew, thereby directly contributing to political order.[12] Argentina led the region both economically and socially, with the highest standards of living. Increasing levels of income per capita impacted economic, social and political structures across Latin America, and helped to resolve the political instability that generally had been the norm after Independence.[13]

States were fairly interventionist, although not to the extent they would become in the 1930s. Expenditure shifted in favour of infrastructure projects, the railways (and in turn the telegraph) was the largest recipient, which would lead to further export growth. Telegraph diffusion in Argentina and Mexico benefited not only from increased investment but from the realisation by those in power of how important the telegraph was in facilitating much needed consolidation of the state and the unification of the country.[14] In the early 1870s, GDP per capita in Argentina was almost 70% of Great Britain's figure and by the 1880s it was almost on par with the U.S. The average rate of growth of GDP per capita in Argentina was more than twice that of the world economy as a whole between 1880-1913. Although in 1913

1930 Princeton, Princeton University Press (1989), Taylor A. M., 'Foreign Capital Flows' in Bulmer-Thomas V., Coatsworth J. H. and Cortés Conde R., *The Cambridge Economic History of Latin America: Volume II, The Long Twentieth Century* New York, Cambridge University Press (2006). For a specific account of Argentina see Díaz Alejandro C., *Essays on the History of the Argentine Republic* New Haven, Yale University Press (1970), Di Tella G. and Zymelman M., *Las Etapas del Desarrollo Económico Argentino* Buenos Aires, Editorial Paidós (1967), Di Tella G. and Platt D.C.M., *The Political Economy of Argentina 1880-1946* New York, St Martin's Press (1985). For an account of Mexico, see Womack, who provides a very useful guide, Womack J. Jr., 'The Mexican Economy during the Revolution 1910-1920: Historiography and Analysis' *Marxist Perspectives 1.4* (1978): 80-123, and Cárdenas E., *La Industrialización Mexicana durante la Gran Depresión* México D.F., El Colegio de Mexico (1987).

[12] Oszlak O., 'The Historical Formation of the State in Latin America: Some Theoretical and Methodological Guidelines for its Study' *Latin American Research Review* 16.2 (1981): 3-32. Oszlak O., *La Formación del Estado Argentino* Buenos Aires, Editorial de Belgrano (1982).

[13] Halperín Donghi T., *The Contemporary History of Latin America* Durham, Duke University Press (1993). Prados de la Escosura L., 'The Economic Consequences of Independence' in Bulmer-Thomas V., Coatsworth J. H. and Cortés Conde R., *The Cambridge Economic History of Latin America, Volume I: The Colonial Era and the Short Nineteenth Century* Cambridge, Cambridge University Press (2006). Dye A., 'The Institutional Framework' in Bulmer-Thomas V., Coatsworth J. H. and Cortés Conde R., *The Cambridge Economic History of Latin America: Volume II, The Long Twentieth Century* New York, Cambridge University Press (2006).

[14] See for example, Díaz Alejandro C. F., 'No Less than One Hundred Years of Argentine Economic History, Plus Some Comparison' in Velasco A., *Trade, Development and the World Economy* Oxford, Basil Blackwell (1988). Also see Thorp (1998), Halperín Donghi (1993), Glade W. P., 'Latin America and the International Economy, 1870-1914' in Bethell L., *The Cambridge History of Latin America* volume IV, Cambridge, Cambridge University Press (1986), Cárdenas E., Ocampo J. A. and Thorp R., 'The Export Age: The Latin American Economies in the Late Nineteenth and Early Twentieth Centuries' in Cárdenas E., Ocampo J. A. and Thorp R., *An Economic History of Twentieth-Century Latin America* Basingtoke, Palgrave Publishers (2000), Cárdenas E., 'A Macroeconomic Interpretation of nineteenth century Mexico' in Haber S., *How Latin America Fell Behind, Essays on the Economic Histories of Brazil and Mexico, 1800-1914* California, Stanford University Press (1997).

Argentina had fallen back to around 60% of absolute U.S. GDP per capita, the country experienced considerable overall economic growth and was still well ahead of most Latin American countries, including Mexico, not only in terms of income per capita, but in more general socio-economic terms.[15] Indeed, due to the uniqueness of Argentina's advancement, Díaz Alejandro departs from most earlier analysis on this period, claiming that Argentina deserves to be examined within an economic framework like the U.S. and Canada.[16]

Table A.6 in appendix A, shows that in terms of the railway expansion, Argentina not only had the highest levels of railroad length per capita in Latin America during this period, but for the entirety of the twentieth century. Moreover, tables A.3-A.5 (in appendix A) demonstrate that literacy rates, life expectancy ratios, and export growth were also among the highest. Mexico, on the other hand, was seriously lagging, consistently underperforming the Latin American averages and among the countries with the lowest life expectancy and highest illiteracy rates. Indeed during the period of export-led growth Argentina and Mexico were markedly different in regard to economic development. Argentina had a wealthier population, fertile land, relative political stability, judicial security and respect for property rights, as well as a large degree of foreign investment.[17] Argentina was seemingly in a stronger position than Mexico to diffuse a technological innovation, such as the telegraph.

---

[15] In terms of GDP per capita, whereas Argentina's average GDP per capita was $3,797 in 1913, Mexico's was just $1,732 and the LA8 average was $1,618 (see appendix A, table A1). For Argentina's relative performance in other socio-economic terms see Davies L. E. and Gallam R. E., 'Argentine Savings, Investment, and Economic Growth before WWI' in *Evolving Financial Markets and International Capital Flows: Britain, the Americas and Australia, 1865-1914* Cambridge, Cambridge University Press (2001). Also see Díaz Alejandro C. F., 'Economía Argentina, 1880-1913' in Ferrari G. and Gallo E., *La Argentina del Ochenta al Centenario* Buenos Aires, Editorial Sudamericana (1980). For an analysis of living conditions during this period, refer to the classic study by Bunge or the more modern piece by Cortés Conde: Bunge A., *Riqueza y Rentas en la Argentina* Buenos Aires, Agencia General de Librería y Publicaciones (1917), Cortés Conde R., *El Progreso Argentino, 1880-1914* Buenos Aires, Editorial Sudamericana (1979). For a specific analysis of living standards of workers, see Marshall A., 'La Composición del Consumo de los Obreros Industriales de Buenos Aires, 1930-1980' *Desarrollo Económico* 21.83 (1981): 351-374.

[16] See Díaz Alejandro (1970). To understand this further, Halperín Donghi offers a very comprehensive text for Argentina for the period 1870 to 1914, while Cortés Conde provides an excellent account of the international economy in Argentina during this period. Halperín Donghi T. H., 'Argentina' in Cortés Conde and Stein (1977), Cortés Conde (1979). For an appreciation of the overall understanding of the nineteenth century, Shumway is an excellent starting point, particularly detailing the influential role of liberalism in Argentina, Shumway N., *The Invention of Argentina* Berkley, University of California Press (1991).

[17] Cortés Conde R., 'The Vicissitudes of an Exporting Economy: Argentina (1875-1930)' in Cárdenas E., Ocampo J. A. and Thorp R., *An Economic History of Twentieth-Century Latin America* Basingtoke, Palgrave Publishers (2000), Díaz Alejandro (1970), Lewis C. M., 'Britain, the Argentine and Informal Empire: Rethinking the Role of Railway Companies' in Brown M., *Informal Empire in Latin America: Culture, Commitment and Capital* Oxford, Wiley-Blackwell (2008), Cárdenas et al. (2000).

The railways was one industry in Argentina that notably expanded helping to increase trade and in turn improve government finances. Argentina achieved a growing role in the world economy, which was characterised by mass immigration, the development of the pampas, and a booming export market of soft commodities. Toward the end of the nineteenth century, Argentina's social and economic landscape was transformed physically and structurally. During this period, urbanisation was also on the rise; the national census revealed that one third of the population lived in urban areas in 1869, compared to over half the population by the First World War.[18] General Julio Roca (1880-1886 and 1898-1904) oversaw mass immigration and free-flowing foreign capital (especially British). New opportunities in the market place induced changes in the use of land and by the 1930s, 'industry' accounted for a larger proportion of GDP than farming.[19] Economic growth was tilted more heavily toward the littoral, and the primacy of Buenos Aires began to grow strongly. The landowners of the riverine provinces enjoyed newly formed alliances with foreign commercial interests.[20] The opportunities offered by the international economy, however, were not open to all: for instance, in the less modernised provinces, the upper classes dabbled in political affairs to achieve some economic prosperity for themselves. Further, workers both urban and rural had little say in politics and were not able to secure any benefits from the new regime (as discussed below). This would turn out to be an issue that would re-emerge and ultimately provoke institutional reform.

The years of export-led growth in Mexico were characterised by the Jóse Porfirio Díaz regime, the Porfiriato (November – December 1876, 1877-1880 and 1884-1911). By its own admission, the Porfiriato was largely successful in finally bringing Mexico overall economic growth and political stability (which lasted 35 years).[21] Porfirio Díaz invoked Mexico's pursuit of development and liberalisation by placing the market at the core, although the role of the state remained vitally supportive, and interventionist where deemed necessary. The economy seemingly prospered during

[18] República Argentina, Comisión Nacional del Censo, *Primer Censo Nacional, 1869* Buenos Aires, Imprenta del Porvenir (1872).
[19] Lewis C. M., *Argentina: A Short History* Oxford, Oneworld Publications (2002).
[20] Especially in Buenos Aires and Santa Fe.
[21] In the 55 years between Independence and the start of the Porfiriato, Mexico had 75 presidents. Haber S., Razo A. and Maurer N., *The Politics of Property Rights: Political Instability, Credible Commitments, and Economic Growth in Mexico, 1876-1929* Cambridge, Cambridge University Press (2003).

the Porfiriato, generating an average annual GDP per capita of 2.0% and export growth of 5.9% in the latter part of his tenure (1901-1913).[22] Mexico also benefited from large influxes of foreign investment between 1900 and 1910 (although not as large as in Argentina).[23] Foreign capital increased by over thirty times during the Porfiriato, a third of which went toward the railway build-out (and in turn the telegraph development), providing economic foundations for further development.[24] Scholars are divided on the achievements of the Porfiriato. New Institutionalists, for example, point to the paradox of growth amid instability, observing a messy process of state consolidation resisted by regional power-brokers and elites.[25] This revisionist view challenges the official accounts of the period which emphasise national progress.[26] Sustained growth in the late nineteenth century fostered the consolidation of the regime, but most scholars now accept that challenges to the state re-emerged in the early twentieth century and there was disagreement within the system about how to respond to those challenges and exogenous economic shocks. Most scholars would also accept that, especially toward the end of the Porfiriato, political favouritism in Mexico resulted in 'immiserising growth', as 'from 1907 to 1911 real wages fell by almost 15 percent'.[27]

This contrasts markedly with Argentina's 'welfare enhancing growth' during this same period, where economic advancement was stronger and real wages were generally rising. In Porfirian Mexico, social class inequality was a particularly pronounced problem, as fast economic growth damaged economic and social structures: the rich got richer and spent their wealth on imported luxuries.[28] But the boundaries between the *peones* (the rural and urban underclasses) and the 'progressive' classes became more defined. The unevenness of regional development further fragmented the country as domestic markets in central Mexico resisted innovation, while the booming export-led markets of the far north and to a lesser

[22] See appendix A, tables A.2 and A.5. Note that export growth is for the period 1900-1912.
[23] Anderson R., *Outcasts in their Own Land: Mexican Industrial Workers, 1906-191* Illinois, Deklab (1976).
[24] Buffington R. M. and French W. E., 'The Culture of Modernity' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).
[25] Haber et al. (2003).
[26] Weiner R., *Race, Nation, and Markets: Economic Culture in Porfirian Mexico* Tucson, University of Arizona Press (2004).
[27] Gómez-Galvarriato A., 'Measuring the Impact of Institutional Change in Capital-Labor Relations in the Mexican Textile Industry, 1900-1930' in Bortz J. L. and Haber S., *The Mexican Economy, 1870-1930* California, Stanford University Press (2002), p.314.
[28] Although note that some of this wealth affected the middle classes in the form of government jobs or opportunities within the export economy, see Buffington and French in Meyer and Beezley (2000).

extent those of the south, encouraged modernisation and attracted the bulk of foreign capital.[29] 'The prophets of modernity had promised material wealth and security. The former was misdistributed and conditional; the latter was a lie'.[30] For further detail on the relative economic divisions, see table A.7 (in appendix A), which compares the HLSI across a number of Latin American countries and the U.S., for selected stages, during this period. The HLSI is a common measurement of poverty and inequality.[31] According to the table, Argentina's living standards were consistently higher than the level of Mexico's in this period, making the economic disparity more apparent. Hence Mexico's late and rapid growth during the years of the Porfiriato benefited a limited few and '...increasingly offended the majority,' as inequality widened.[32]

At the end of the nineteenth century, Argentina was influenced heavily by an ideology of economic liberalism and this paid dividends. By the early twentieth century, Argentina had become the tenth largest commercial economy in the world and was responsible for around 50% of total South American production and trade (a position it would largely retain until at least the Second World War). Except for the disruption of the First World War, Argentina's export-led growth continued relatively undisturbed until the late 1920s, although at a much slower rate, given the declines in foreign investment; with average growth in GDP per capita of 1.10% (1914-1929) versus 2.60% (1901-1913).[33] Mexico's economic growth, however, was interrupted even more abruptly (falling to zero average growth [1914-1929]), due to the Mexican Revolution (1910), as peasants, workers and urban middle class groups became increasingly discontented with the allocation of political power and economic resources under the Porfiriato. The Revolution ensured a period of military tumult triggering further political instability.[34] Yet, in spite of the Revolution there

[29] Ibid.
[30] Ibid., p.401.
[31] HLSI is considered to be a superior measurement of the standard of living of an individual in a given country than simply using GDP per capita. The HLSI index measures for both economic and social indicators. It assigns weights to GDP per capita, life expectancy, and the adult literacy rate. It is a common measurement of poverty and inequality: see Astorga et al. (2004). It is similar in nature to the UN's Human Development Index, used by Crafts, see Crafts N., 'The Human Development Index, 1870-1999: Some Revised Estimates' *European Review of Economic History* 6.3 (2002): 395-405.
[32] Knight A., 'Export-led Growth in Mexico, c. 1900-30' in Cárdenas E., Ocampo J. A. and Thorp R., *An Economic History of Twentieth-Century Latin America* England, Palgrave Publisher (2000), p.131. Also see Astorga et al. (2004), and Haber et al. (2003).
[33] For data see appendix A, table A.2. Also see Lewis C. M. (2002).
[34] Haber et al. (2003).

was considerable institutional continuity from the 1900s to the 1930s.[35] Politically, the 1920s also saw the last change of power for over 60 years in Mexico, as the *Partido Revolucionario Institutional* (PRI) began its long-lasting tenure.[36] Overall, for both Argentina and Mexico, the period of export-led growth was a relatively successful one in terms of absolute economic growth (which ICTs helped to promote) and foreign investment (which ICT harnessed).

The Period of Import Substitution Industrialisation (1930s-1980s)

The years of ISI correspond with the key period of telephone diffusion in Argentina and Mexico. From 1949, the UN Economic Commission for Latin America (ECLA) gained greater influence, as Raúl Prebisch began writing about instigating economic reform in various nations. Indeed ISI across Latin America emerged as a direct result of his scathing yet commanding critique of liberal doctrines, the arguments of which ultimately served as the intellectual foundations of ISI. Indeed, ISI would be the mainstay of the Latin American economic framework until the 1980s. [37]

ISI emerged from the Great Depression, which was a critical time for Latin America and had a significant impact on the economies of the region. The Depression highlighted Argentina's and Mexico's economic vulnerability to changes in the external landscape.[38] The two economies began to suffer as export prices fell and capital inflows reversed, thus public revenues weakened, and the debt servicing costs rose.[39] This all weighed heavily on the state and the political economy, and the

[35] Knight A., 'The Political Economy of Revolutionary Mexico, 1900-1940' in Abel C. and Lewis C. M. *Latin America: Economic Imperialism and the State* London, Athlone Press (1985). Also see Knight in Cárdenas et al. (2000), and Haber et al. (2003).

[36] Note the PRI was originally the *Partido Nacional Revolucionario* (PNR) party and later the *Partido de la Revolución Mexicana* (PRM) before it became the PRI. Knight (2000), Haber et al. (2003).

[37] See Economic Commission for Latin America (ECLA), *Economic Survey of Latin America* New York, United Nations (1950a). Economic Commission for Latin America (ECLA), *The Economic Development of Latin America and Its Principal Problems* New York, United Nations (1950b). Further commentary in Economic Commission for Latin America (ECLA), *Developmental Problems in Latin America: An Analysis by the UN ECLA* Austin, United Nations (1970). There is a substantial amount of research that examines the economic policy-making and the immediate economic performance in the 1930s following ECLA's commentary, see for example Díaz Alejandro (1983), or for one of the most comprehensive studies, see Thorp R., *Latin America in the 1930s* New York, Macmillan (1984). Economic Commission for Latin America (ECLA), *External Financing in Latin America* New York, United Nations (1965) is seen as a turning point in some chapters in Furtado (1977).

[38] O'Connell A., 'Argentina into the Depression: Problems of an Open Economy in the 1930s' in Thorp R., *Latin America in the 1930s* New York, Macmillan (1984), Velasco C., 'El Desarrollo Industrial de México en la Década 1930-40: las Bases del Proceso de Industrialización' in Cordera R., *Desarrollo y Crisis de la Economía Mexicana: Ensayos de Interpretación Histórica* México D.F., Fondo de Cultura Económica (1981).

[39] The issues surrounding foreign investment flows into Latin America after the depression are examined in a number of books, and although it must be noted that the statistics are not always completely reliable, Rippy and ECLA provide a good assessment. Rippy J. F., *British Investments in Latin America, 1822-1949* Minneapolis, University of Minnesota Press (1959), ECLA (1965).

evolution of a protectionist and nationalistic 'centre' made things worse. Export-led growth had had *the* most positive impact upon the landowning oligarchy and their foreign commercial and financial partners (especially in Argentina). For such extensive production to continue it was necessary to maintain the import of capital (and labour, for Argentina; Mexico had not championed immigration as Argentina had), but this proved to be economically and politically difficult. Before the Second World War, Argentina's economy grew as strongly as anywhere else in the world, but afterwards, declining economic performance saw Argentina diverge from global economic trends.[40] Argentina's economic growth was impacted by internal policies, which negatively affected the profitability of economic factors, as well as savings and investment.[41] Given these changes, the 1930s saw induced ISI-led growth; new institutions developed and the role of the state became increasingly more interventionist, as investment in infrastructure in both Argentina and Mexico saw radical social reform.[42]

State intervention in the market alleviated the effects of the economic crisis, and the period after the 1930s saw a significant recovery in economic growth, especially for Mexico, which recovered relatively faster than Argentina. Argentina's average annual GDP per capita growth fell to +0.10% from 1930-1945, versus Mexico's +1.41%.[43] ISI, however, was certainly positive for Latin America overall: from the Second World War until the 1970s there was widespread economic growth as average GDP per capita increased across the region. The extended role of the state focused on improving the economic infrastructure and reducing structural dependence on other countries. These new nationalistic tendencies manifested in the governments' proclaimed intention to defend and protect domestic supplies in

[40] Cortés Conde R., *The Political Economy of Argentina in the Twentieth Century* Cambridge, Cambridge University Press (2009).
[41] Bulmer-Thomas (1994).
[42] For some specific insight over this period, see the following. For Argentina see Díaz Alejandro (1970), Lewis P. H., *The Crisis of Argentine Capitalism* Chapel Hill, University of North Carolina Press (1990). Also see Di Tella and Dornbusch for a particularly useful account of Argentina's economic problems during 1950-1990. Di Tella G. and Dornbusch R., *The Political Economy of Argentina, 1946-1983* London, University of Pittsburgh Press (1989). For Mexico see Cárdenas E., 'The Great Depression and Industrialisation: the Case of Mexico' and Fitzgerald E. V. K., 'Restructuring through the Depression: the State and Capital Accumulation in Mexico, 1925-1940' in Thorp R., *Latin America in the 1930s: The Role of the Periphery in the World Crisis* New York, Macmillan (1984), Medina L., *Del Cardenismo al Avilacamachismo* México D.F., El Colegio de Mexico (1978), Haber S. *Industry and Underdevelopment: The Industrialisation of Mexico, 1890-1940* Stanford, Stanford University Press (2000).
[43] See appendix A, table A.2.

addition to the heavily increased role of public sector enterprises.[44] Most countries in Latin America, including Mexico, experienced their fastest rate of growth after 1945. Argentina's economic dominance during the period of export-led growth had faded, whilst Mexico's growth continued at a relatively fast pace, narrowing the gap between the two countries.[45]

In Argentina, the period of ISI was characterised by populism under Juan Perón (1946-1955 and 1973-1974) which lasted until 1955. Despite a reasonable sense of success in his first term in office, the aftermath of 1955 saw significant political chaos, as military administrations came (1966-1973), and short-lived new democratic administrations followed (1973-1976), only to return to military regimes once again (1976-1982). In Mexico, ISI took place against the backdrop of the stabilising development strategy (1952-1970), a period often referred to as the years of the 'Mexican economic miracle', which was followed by periods of populism again (1970-1981) under the Luís Echeverría administration (1972-1976) and the Jóse López Portillo administration (1976-1982) - see section 1.1.3 The Politics of the Political Economy, for analysis.[46] In Mexico, a new alliance of state and capital took shape, as the Depression enhanced the state's power over capital-accumulation. By the end of the Second World War, key changes occurred as a wave of nationalisations of foreign owned enterprises took place across Latin America (including the Argentinian and Mexican telecommunication providers), as various factors contributed in strengthening the position of the state in relation to the private sector (see chapter 3, section *The Period of Nationalisation*).[47] These nationalisations coincided with the increased importance attached by the state to the telephone as a means of communication, allowing further state consolidation and national security, more so than the telegraph ever had. Moreover given the telecom sector's capacity to promote economic growth, effectively populism translated into nationalisation.[48] Potentially the success of telephone diffusion in Argentina and in Mexico from the early-1940s is linked to this shift in the political economy, as the increased role of

[44] Thorp (1998).
[45] See appendix A, table A.2 for data and sources.
[46] Dornbusch and Helmers (1988).
[47] Thorp (1998), Díaz Alejandro (1988), Bulmer-Thomas (1994).
[48] Casaús C., 'Privatisation of Telecommunications: The Case of Mexico' in Wellenius B. and Stern P. A., *Implementing Reforms in the Telecommunications Sector: Lessons from Experience* Washington D.C., The World Bank (1994).

the state in economic activity led to specific reforms that improved the development of the telephone infrastructure.

The ISI period in Argentina was characterised by regimes that fluctuated between supporters of deregulation, foreign capital, and free enterprise, and those that desired greater state regulation, the suppression of foreign capital, and an expanded state economy.[49] Argentina experienced reasonable economic growth from around 1947 to 1951. Although there were already economic problems towards the end of Perón's first tenure, he consolidated his power through ISI policies and strategic nationalisations, enhanced government intervention and focused on income redistribution through the establishment of a welfare state.[50] Like many other sectors across the economy, the telephone was nationalised during this period and was made into a state monopoly in 1946. This supposedly signalled the end of foreign control. It was a period characterised by high real wages and protectionism, as subsidies were provided to the industrial sector. Perón came to power with the aim of achieving 'economic independence' and tried to do this by targeting strategic sectors, but in the early 1950s (and the beginning of his second term), worryingly for Argentina, there was an ideological shift in the strategies of his administration. The Argentinian administrations attempted to rebuild the national economy whilst simultaneously introducing 'social justice'. In fairness to Argentina, other governments across the world seemed to agree with this strategy, but it was Argentina that suffered and diverged economically from its peers.

The aftermath of Perón's initial tenure was characterised by a heavily subsidised manufacturing sector and a military that would not give up its role in industry. Perón's legacy was material economic imbalance, high inflation and an overly complex regulatory system, which the subsequent administrations from 1955-1973 (a series of relatively ineffective regimes) would attempt to undo, whilst simultaneously

[49] Chua A. L., 'The Privatisation-Nationalisation Cycle: The Link Between Markets and Ethnicity in Developing Countries' *Columbia Law Review* 95.2 (1995): 223-303.

[50] The early Perón government implemented wage hikes at a time of low unemployment and high capacity utilisation (in an attempt to reallocate investment resource to consumption), this saw inflation soar in the early 1950s and due to the corruption in the system, only a chosen few (some businessmen, the Peronist alliance of the military, organised labour and 'national business' groups) prospered. Also, Perón had started to focus more on importing technology and increasing FDI, which would all ultimately see him overthrown. See Lewis P. H. (1990), Gerschunoff P. and Llach L., *El Ciclo de la Ilusión y el Desencanto: un Siglo de Políticas Económicas Argentinas* Buenos Aires, Editorial Ariel (2003).

trying to deregulate the economy partially to create a more stable macroeconomic environment. The new regimes sought to follow a new liberal economic order (as envisaged at Bretton Woods), but these goals were not achieved and the immediate period after Perón (until the coup of 1966) witnessed continuous policy shifts, which exacerbated macroeconomic imbalances.[51] The administrations from the mid-1950s to the early-1960s found it extremely difficult to remedy the situation and re-establish the macroeconomic stability necessary for sustained economic growth.[52] Further state intervention was required, especially with regard to fiscal and monetary policy, as foreign investment had been lacking, but the closed economy's low growth and minimal role for the market did not help matters.[53]

Argentina needed fundamental economic change but this could not be achieved with continuous internal conflicts, hence economic conditions deteriorated further. President Arturo Illía (1963-1966) briefly managed to bring about strong economic expansion as he implemented some Keynesian policies, but by mid-1965 economic growth slowed again.[54] Illía was removed by the military, as Juan Onganía (1966-1970) assumed the presidency.[55] Onganía's new economic minister, Adalbert Krieger Vasena, introduced new policies abandoning the support for the country's exports (a policy which had been in place for over a decade) and instead focused on the strengthening of the state's fiscal position, by devaluing the currency and taxing the now higher earnings of exporters. The plan was successful in 1967-1968, but in 1969 the *Cordobazo* changed the political landscape and permanently obscured the longer term potential of the economic reforms.[56] Ultimately, stabilisation efforts repeatedly failed as the necessary reform policies often conflicted with vested interests and thus the period was characterised by cycles of inflation, devaluation, and recession.[57]

---

[51] Di Tella G. and Dornbusch (1989), Rapoport M., *Historia Económica, Política y Social de la Argentina (1880-2000)* Buenos Aires, Ediciones Macchi (2000). Also see Black for a discussion of the Bretton Woods pact, Black S. W., *A Levite among the Priests: Edward M. Bernstein and the Origins of the Bretton Woods System* Boulder, Westview Press (1991).
[52] Cortés Conde (2009).
[53] Ibid.
[54] Halperín Donghi (1993).
[55] Collier D., *New Authoritarianism in Latin America* Princeton, Princeton University Press (1980).
[56] The *Cordobazo* refers to the civil uprising (and general strike) that occured in the city of Córdoba, Argentina, in May 1969.
[57] With regard to inflation and stabilisation policies in the 1950s and 1960s, see Ferrer and for the 1970s see Di Tella and Canitrot. Ferrer A., *Los Planes de Estabilización en Argentina* Buenos Aires, Editorial Paidós (1967a), Di Tella G. *Argentina under Perón, 1973-1976* London, Macmillan Press (1983), Canitrot A. 'La Experiencia Populista de Redistribución de Ingresos' *Desarrollo Económico* 15.59 (1975): 331-351.

In the 1970s, academic interest shifted toward explaining Argentina's economic weakness.[58] This coincided with Perón's return to power in 1973, which initially brought some very short lived optimism as he successfully endeavoured to maintain wage hikes through investment and public expenditure and also managed to drive up employment growth (especially in the state sector). He focussed on income redistribution and, wage and price controls (under the banner of 'Zero Inflation'). Unfortunately, economic expansion soon contracted and inflation rocketed again. In response, the government actively micromanaged official wages and prices, as well as doubling the currency in circulation, but still failed to prevent deterioration in living standards. Arguably, sustained high inflation, a persistent problem in Argentina, was the product of a conflictive and relatively unstable political setting.[59] Even during short democratic administrations, economic development was stifled not by external conflict but by inter-Peronist confrontation.[60] There was a real need to disentangle the political complexities, but both the military in the 1960s/1970s and Perón in 1973 failed to do so. Despite this, from 1946-1964 GDP per capita growth remained just under 2% and it was not until the end of Perón's tenure, with 100%+ inflation per annum that Argentina experienced a particularly painful period of negative growth (see appendix A, table A.2).[61]

After Perón's death in 1974, his widow, Isabel Perón (1974-1976) tried to engage the original Peronist factions on the right, but her husband's death threw Argentina back into relative economic and political disorder. For instance, the terrorists at the extremity of the right wing attempted to initiate outright war against the left as they tried to exterminate them, murdering industrialists involved in labour disputes along the way. Employment, production and output fell sharply as the real economy looked

[58] The following are some examples of studies that focused on explaining Argentina's economic weaknesses. Cavallo D. and Mundlak Y. 'Agriculture and Economic Growth: The Case of Argentina' *Research Report 36* Washington D.C., International Food Policy Research Institute (1982), and Llach J. J., *Reconstrucción o Estancamiento* Buenos Aires, Editorial Tesis (1987).

[59] Argentina had experienced very high inflation and rates had been more volatile there than in other regions during the late nineteenth century and first half of the twentieth century, however, in terms of long run averages it was not so different. This began to change during the 1940s-1950s, as Argentina's economy was closed and inflation rates soared well above those in comparable countries. There were various stages to Argentina's divergence from world inflation rate averages, but the key shifts came at the end of the 1950s and then through the 1970s-1980s. These effects combined to ensure that average inflation in Argentina was over 25% for the second half of the twentieth century.

[60] The administrations that suffered most from inter-Peronist conflict include those of Cámpora (1973), Rául Lastiri (1973), Perón (1973-1974) and Isabel Perón (1974-1976).

[61] One must note that from the late 1950s to the late 1970s, GDP per capita growth rates were remarkably volatile. Moreover each year between 1974 and 1989 saw inflation of 100% or more. See Cortés Conde (2009).

to be in terminal decline and social tensions mounted. The government was forced to lower wages to deal with the ever increasing inflation, and labour unions succeeded in halting this stabilisation plan. In 1976 as inflation reached 1,000%, the military regime saw their opportunity to regain power. The economic situation worsened and the Peronist left united to overthrow Isabel Perón, and the last military regime took power and implemented state-sponsored violence during the 'dirty war' in 1976-1982 (*El Proceso*).[62] Unlike the militant regimes before them, the military government enjoyed relative institutional stability, which enabled them to focus on reopening the economy and inducing social reform. Although real wages fell by almost half, the military regime oversaw a large inflow of foreign capital and brought inflation somewhat under control. However, they refused to give up their financial interests (acquired since the Second World War) and suitably were defeated. Despite the optimism that followed – from the healthy criticism voiced by business interests, the reorganisation of the union movement and the increased visibility of political parties – the military left Argentina a legacy of indebtedness.[63]

The efforts by Jorge Videla (1976-1981) to restore economic growth also failed. After the proposal to privatise state owned enterprises (SOEs) was abandoned, monetary manipulation was seen as the only other solution. The two years of austerity improved the trade deficit. It was Martínez de Hoz's (incumbent minister of the economy) hope that a stronger peso would make imports more accessible, put pressure on the less efficient industries, and with the modern capital intensive industries being protected by high import tariffs, industrial reform could indirectly be regained. A strong peso, however, soon undercut agricultural export expansion and it was only thanks to a constant flood of easy foreign credit (during the late 1970s) that the balance of payments was kept in check and the commercial and financial sectors boomed.[64] However, political divisions continued and in 1981, international credit dried up, inducing a banking crisis and regime change to boot. The military's attempt to use the Malvinas War (1982) to defuse internal conflict failed, and ironically

[62] The 'dirty war' was a period in which the Argentinian military government killed thousands. See Velasco A., *Trade, Development and the World Economy: Selected Essays of Carlos F. Diaz Alejandro* Oxford, Basil Blackwell (1988), and Dornbusch R. and Edwards S., *Reform, Recovery, and Growth: Latin America and the Middle East* Chicago, University of Chicago Press (1995).
[63] Lewis P. H. (1990), Gerschunoff and Llach (2003).
[64] Halperín Donghi (1993).

brought down the military regime.[65] The structural deficits, massive capital flight and periods of hyperinflation followed as no lasting economic growth could be sustained. From the 1950s to the 1980s there were several attempts to reverse relative and absolute decline. These variously drew on orthodox, structuralist and heterodox policy prescriptions. In the long-term all proved largely unsuccessful. There was a general failure to resolve distributional conflicts associated with savings and foreign exchange crisis. Despite some structural change there was little sustained growth. Rather, the economy appeared locked into a sequence of increasingly volatile cycles which usually ended in regime changes.[66] Before c.1983 the contrast with Mexico's 'stabilised development' was stark. Even by the time Argentina returned to democratic rule with the Radical party under Raúl Alfonsín (1983-1989), the economy could not be stabilised and the debt crisis ensued.[67]

In 1930s Mexico, the PRI was able to forge the necessary links to the U.S. economy and encouraged widespread economic growth through foreign investment and a strengthening of industrial protectionism. Lázaro Cárdenas (1934-1940) created a development agency of the government, which oversaw this flow of financial support to the private sector. Infrastructural build-out was the primary target and the sizeable construction of roads fostered domestic integration and increased tourism, which improved the nation's balance of payments. Cárdenas wanted to promote the working class by creating a nation of prosperous peasants and workers.[68] Raising the living standards of the masses was a key objective for post revolutionary leaders, and redistribution of land was one way to achieve this. From the 1940s, Mexico's fortunes began to change as presidents from Manuel Ávila Camacho (1940-1946) onwards sought to achieve economic progress and maintained support by committing (in rhetoric but not in practice) to the social objectives of the revolution. For Mexico, the restructuring of politics in 1946 was a real turning point in economic terms, going

[65] Ibid.
[66] See for example Di Tella G. and Dornbusch (1989), Lewis P. H. (1990), and Gerschunoff and Llach (2003).
[67] The transition to democracy in Latin America has recently been covered by Smith P. H., *Democracy in Latin America: Political Change in Comparative Perspective* New York, Oxford University Press (2005). Also see Linz J. J. and Stepan A., *Problems of Democratic Transition and Consolidation: Southern Europe, South America, and Post-Communist Europe* Baltimore, Johns Hopkins University Press (1996), Diamond L., Harttlyn J., Linz J., Lipset J. J. and Seymore M., *Democracy in Developing Countries: Latin America* Boulder, Lynne Rienner (1999), Weyland K., *The Politics of Market Reform in Fragile Democracies: Argentine, Brazil, Peru, and Venezuela* Princeton, Princeton University Press (2002)., and Dominguez J. I. and Shifter M., *Constructing Democratic Governance in Latin America* Baltimore, Johns Hopkins University Press (2003).
[68] Hart J., 'The Mexican Revolution, 1910-1920' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).

hand in hand with 'reform' as Miguel Alemán Valdés (1946-1952) accelerated industrialisation, with the help of the state's new alignment to domestic and foreign capital. Mexico's industrial advancement under the pro-business Alemán Valdés regime was quite impressive and the dynamic nature of their economy was recognised globally.[69] The government embarked on a process of resource transfer from agriculture to industry and it was also successful in forging strong alliances with the private sector, as international markets for Mexican exports expanded.[70] The weakness of his administration, however, was an unfortunate tolerance of high inflation and hidden official corruption.[71]

In 1952, Adolfo Ruíz Cortines (1952-1958) succeeded Alemán Valdés and managed to put in place measures to ease inflation and limit corruption. His tenure marked the beginning of stabilising development in Mexico. Ruíz Cortines fixed the Mexican peso exchange rate, a reform that would be unaltered for some 20 years. This was a period of low inflation, relative 'political stability', protectionism, growth in the urban centres, and wage freezes to attract investment were directed towards state-owned sectors (e.g. the telephone). There was seeming acceptance that Mexico had 'stabilised development' as foreign capital and economic growth continued, although at a slower pace. It was originally thought that Adolfo López Mateos (1958-1964) might finally be able to bring the social justice promised by the Mexican Revolution, but this was not the case. Under his tenure, authority was exercised quite differently across regions, as the state attempted to expand agricultural production in the central rural zones to feed the growing urban population, and in the north, capital intensive projects were pursued so that sophisticated technologies could be set up to produce a range of crops that could be consumed internally and externally.[72] However, the benefits of the 'Mexican economic miracle' years saw a significant portion of rural Mexico lag significantly behind their urban peers, while the middle class (small businessmen, bureaucrats and educated professionals) now enjoyed the comforts of

[69] For some economic trend analysis over this period, a good source is Reynolds C.W., *The Mexican Economy: The Twentieth-Century Structure and Growth* New Haven, Yale University Press (1970). Also see Solís L., *La Realidad Económica Mexicana: Retrovisión y Perspectivas* México D.F., Siglo Veintiuno Editores (1970).
[70] Cárdenas E., 'The Process of Accelerated Industrialisation in Mexico, 1929-82' in Cárdenas E., Ocampo J. A. and Thorp R., *An Economic History of Twentieth Century Latin America,* Volume 3: *Industrialisation and the State in Latin America The Post-war Years* New York, Palgrave Macmillan (2000).
[71] For a contemporary account of Mexican inflation from a structuralist perspective at this point, see Noyola J., 'El Desarrollo Económico y la Inflación en México y otros Países Latinoamericanos' *Investigación Económica* 16.4 (1956): 603-48.
[72] Halperín Donghi (1993).

consumerism, although this was not accompanied by an increase in political power.[73] The state had instigated wide-reaching welfare policies under the López Mateos administration, which caused sizeable debts.

Gustavo Díaz Ordaz (1964-70) was the final proponent of the stabilising development strategy, and by this time the foreign indebtedness was becoming a real problem.[74] The ISI policies, deficit spending and market-oriented reforms saw extraordinary growth coupled with fiscal discipline, entirely at odds with the Argentinian situation. In fact, 1960s Mexico experienced one of the most affluent periods of its recent history, boasting annualised GDP per capita increases on average of over 3%, despite increasing population growth of over 3% also (see appendix A, table A.1 and appendix C, table C.4). There was no threat of capital flight, real wages had risen overall and even inflation was below 4.5% on average.[75] At the end of the 1960s, only half the population were still rural dwellers and while growth in the agricultural sector slowed, modern manufacturing industries were demonstrating impressive growth.[76] However, these policies were not sustainable in the long run, and while the growth rate of the overall economy maintained itself, the poorer half of the Mexican population became progressively poorer.[77] Social inequality remained and living standards still lagged, whilst income distribution inequality widened further until the 1970s (see appendix A, table A.7). It is important, however, to be aware of the fact that Mexico was catching up in terms of growth (of GDP per capita), but in absolute levels Argentina's dominance still prevailed (see appendix A, table A.1). The political crisis that ensued in the latter part of the 1960s ended this period of stabilising development for Mexico as industry and agricultural expansion began to wane.[78]

[73] Benjamin T., 'Rebuilding the Nation' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).
[74] Vázquez Castillo M. T., *Land Privatisation in Mexico, Urbanization, Formation of Regions and Globalization in Ejidos* London, Routledge (2004).
[75] Ortiz Mena A. L., *El desarrollo estabilizador: reflexiones sobre una época* México D.F., El Colegio de México, Fondo de Cultura Económica (1998).
[76] Cárdenas (2000).
[77] Stevens E. P., 'Mexico's PRI: The Institutionalisation of Corporatism?' in Malloy J. M., *Authoritarianism and Corporatism in Latin America* London, University of Pittsburgh Press (1977).
[78] Halperín Donghi (1993).

Mexico in the 1970s (specifically 1972-1977) saw a period of populism or 'shared development', under the Echeverría administration.[79] Abroad, external imbalances in the early 1970s put pressure on the fixed Mexican exchange rate, which was a critical facet of their economic stability, and the economy began to show signs of strain. Mexico had become reliant on external investment in remedying social pains and expanding industrialisation. Yet, Echeverría's form of rhetorical radicalism had isolated Mexico further from the international investment community and crisis was avoided only narrowly in his tenure. At home, there were now more people landless than when the land reforms were inaugurated under Cárdenas. At this point, Mexico imported an increasing amount of its staple food from abroad, which the government was already subsidising (see below).[80] Under Echeverría, corruption was widespread and dated accounting methods meant that cash flows were monitored inadequately; and already by 1973 some would argue that his presidency was a shambles.[81] When, Echeverría left the presidency in 1976, economic crisis followed. The situation continued to worsen under the López Portillo administration in the late 1970s.

Initially things started rather fortuitously for López Portillo with the unexpected discovery of sizeable oil deposits just as global oil prices experienced an enormous rally. This addressed certain structural issues in the economy but even though he offered international investors and the private sector greater freedom, he failed to mend these broken relationships. One reason was because crop prices were being held artificially low to subsidise the living standards of the urbanised poor, which also contributed to the minimal positive effect of the *ejido* ('common land') reforms.[82] While stabilising development worked effectively by subsidising private sector investment, under the shared development strategies, the public sector was the only driver of growth. [83] Despite the protests of various economic groups (representing private enterprise), populist policies argued for an increased role of the state in the economy.[84] However, rather than solving the economic issues, a surge in public spending led to economic imbalances that would finally erupt into the debt

[79] Dornbusch and Helmers (1988).
[80] Halperín Donghi (1993).
[81] See for example Benjamin in Meyer and Beezley (2000).
[82] Halperín Donghi (1993).
[83] Ibid.
[84] Stevens (1977).

crisis of 1982, as the peso was devalued, exports plummeted and capital flight ensued.[85]

Across Latin America, the 1979 oil crisis and the resultant recessions in the 1980s crippled the economic feasibility of populism. ISI and welfare policies were addressed increasingly negatively and in the 1980s there was a return to a more market-oriented economy. This would ultimately diminish the state's direct control of economic activity, with greater emphasis placed upon the privatisation of public enterprises, a strategy that was abandoned in the 1930s.

The Debt Crisis and the New Economic Model (1982-1990s)

Although these years represent only a relatively short period in the diffusion of the telephone in Argentina and Mexico, it was a critical one. In the 1980s several Latin American governments defaulted on their debt, as they no longer had access to foreign financing, and were unable to service the borrowings they had accumulated. Latin America's 'debt-led' growth was no longer sustainable, and sizeable net external transfers needed to flow quickly; funds including domestic savings which previously were used to finance domestic investment were reallocated accordingly. The debt crisis emerged after Mexico declared a moratorium in 1982. This period, often termed the 'lost decade', saw Latin America's economic growth stagnate at best, and the distribution of wealth deteriorate further. International investors saw this as an opportunity to coerce Latin American governments (who needed domestic stability and external financing) out of their bad old ways, and the IMF and the World Bank rescheduled their debts, offering finance on the condition that the countries would deploy specific market reforms (particularly a reduced role of the state). This led to a 'New Economic Model' across Latin America in the mid-1980s, whereby ISI was replaced by export-led growth and an emphasis on market forces instead of state intervention. This vision became known as the Washington Consensus, based on free markets, liberalisation of trade and the privatisation of public enterprises.[86]

[85] Collier D. (1980), Ffrench-Davies R. and Muñoz O., 'The Latin American Economic Development and the International Environment' in Meller P., *The Latin American Development Debate* Oxford, Westview Press (1991), Manzetti (1999).

[86] Ffrench-Davies R., Muñoz O. and Palma J. G., 'The Latin American Economies, 1950-1990' in Bethell L., *The Cambridge History of Latin America* volume VI, Cambridge, Cambridge University Press (1994), Thorp (1998),

The handling of the individual crises would determine the positioning of the country going into the 1990s, and therefore condition the success of privatisation reforms such as those experienced in the telecom industry. Historically, orthodox policies proved largely ineffectual in Argentina and so when Alfonsín took the transitional presidency he favoured the deployment of more heterodox policies from the outset. Initially Alfonsín's Austral Plan (to counter inflation) was well received, but without any reduction in the deficits of SOEs (sustained under military rule), long-term success was not achievable. Argentina was languishing: public-sector spending was being financed by printing money, real wages were at worryingly low levels, there was hyperinflation and negotiations concerning foreign debt had stalled, forcing the country to re-adopt more orthodox reforms.[87] The evolution of Argentinian society also reduced the power of the previously colliding forces like the labour unions.[88] Alfonsín tried to bring democracy and foster economic progress without making structural changes to the social and institutional forces that were built over the last 50 years.[89] The economic situation faced by Alfonsín was far beyond his control and after several failed attempts to reform, a period of hyperinflation in 1989 signalled the end of his tenure.[90] By the end of the decade, Peronists reassumed power. The Radicals may not have been successful in restructuring politics or militant mutinies during this period, but thankfully for Argentina, democracy never really seemed to be under threat.[91] Although there was no real growth in average GDP per capita in Latin America as a whole during the 1980s, Argentina would fare much worse than Mexico (see appendix A, table A.2). After this, following years of repression and corruption, both civil society and democracy had to be entirely rebuilt before a broken economy could be reinvigorated.

Bulmer-Thomas V., *The New Economic Model in Latin America and Its Impact on Income Distribution and Poverty* Basingstoke, Palgrave Macmillan (1996).

[87] Lewis C. M. and Torrents N., *Argentina in the Crisis Years (1983-1990): from Alfonsín to Menem* London, Institute of Latin American Studies (1993), Nader N., *Economic Policy and Stabilization in Latin America* New York, M. E. Sharpe (1996).

[88] Further, the labour unions had not done themselves any favours by refusing all efforts to make the SOEs more efficient. See Halperín Donghi (1993).

[89] Further, Alfonsín's opposition to the military, labour unions and Peronists meant he was continually entangled in chronic disputes. For example in the mid 1980s, his attempt to appease labour unions through wage hikes led to dangerous levels of inflation, causing him more problems.

[90] Cortés Conde (2009).

[91] In the political literature, it is pertinent to note that the Argentine Radical party has received the most attention from economic historians and two such important works are: Del Mazo G., *El Radicalismo: Ensayo sobre su Historia y Doctrina* Buenos Aires, Ediciones Gure (1957) and Rock D., *Politics in Argentina, 1890-1930: The Rise and Fall of Radicalism* Cambridge, Cambridge University Press (1975).

By comparison, the Mexican economy was stabilised and generally transformed between 1982 and 1987. The economic emergency that had materialised for Mexico was no easy task to correct, since the collapse of the exchange rate meant that the private banks (the entities through which the country's debt had been channelled) could not meet their international financial obligations. However, they did correct it, as President Miguel de la Madrid (1982-1988) executed structural reforms that controlled inflation and deficits, reforms later continued by Carlos Salinas de Gotari (1988-1994) and Ernesto Zedillo (1994-2000). Mexico's policies proved relatively more successful than Argentina's in stabilising the economy, reducing its foreign debt by 35% and attracting new foreign investment again. [92] The expanding *maquiladora* industry that multinationals had built along the U.S. border was one particularly important aspect in Mexico's recovery.[93] Policy making was heading positively towards economic liberalisation, as Mexico joined the General Agreement on Tariffs and Trade (GATT) in the mid 1980s and the North American Free Trade Agreement (NAFTA) in 1994.[94] NAFTA represented a commitment to regional economic integration for Mexico, with its developed, and wealthy northern neighbours. NAFTA was not just about free trade, it was largely about investment. It was believed that Mexico's preferential ties with the U.S. would then enable it to gain access to the plentiful investment flows of Europe and Japan.[95] In short, NAFTA sought to embed institutional change. By securing membership of such organisations, Mexico was mitigating any perceived shortcomings in its legal framework and signalling to the foreign investor community that it was once more, a reliable economic trade partner.

The early 1990s saw the beginning of recovery in most of Latin America, due to the combined effect of market liberalisation and fiscal reforms (e.g. privatisation), the enforcement of tax compliance and the reduction of government subsidies. The states now focussed on macroeconomic policy, infrastructure build-up and social

[92] See Kaufman and Stallings (1989), Thorp (1998), Nader (1996) and Dornbusch and Edwards (1995).
[93] *Maquiladora* or 'in-bond' industries were assembly plants, which operated under a programme that allowed the entry of supplies into Mexico duty-free.
[94] For an invaluable source on GATT, see Koch K., *International Trade Policy and the GATT, 1947-1967* Stockholm, Almquist and Wiksell (1969). NAFTA was a mutually benefiting agreement, however, and thus Mexico had to ensure the U.S. had access to its oil reserves. NAFTA (the free trade zone spanning Canada down to Mexico) was the largest agreement in the world, with a combined GDP of $6.2tn in 1990 and $720bn combined exports.
[95] See Saborio S., *The Premise and the Promise: Free Trade in the Americas* Oxford, Transaction Publishers (1992).

programmes, while moving away from state-led ISI, economic protectionism, and strong private enterprise regulation, since these could no longer foster sustainable growth, but rather promoted inefficiency.[96] In Argentina, Carlos Menem (1989-1999) made his country the most neo-liberal economy in Latin America as he decided to achieve political stability and economic recovery through privatisation (including that of ENTel, the national telephone provider), and deregulation: reducing inflation to single digits by 1993, as well as stabilising the currency by pegging it to the U.S. dollar. The economy grew particularly strong again, at an annual average rate of almost 4% in GDP per capita terms, between 1990 and 1997 (see appendix A, table A.2). Despite this, Argentina's economy, at an aggregated level, was still smaller than it had been at the start of the 1980s. In comparison to the rest of the world, Argentina's GDP per capita was now just 30% of the level in the U.S., and its average growth rates for the second half of the twentieth century were less than 75% of the global average.[97]

In Mexico, the post-debt crisis presidents collectively sold off over 900 state enterprises, including the privatisation of Telmex (the national telephone provider), whilst opening the economy to foreign competition. Salinas de Gotari's strategy in the 1990s was to transform the country from an inward-looking, state-dominated protected economy, to an outward-looking, privatised, open economy. Mexico's economic performance became closely tied to that of the U.S. and its living standards began to converge with Argentina's (see appendix A, table A.7). Growth returned in 1990-1997 for both countries (see appendix A, table A.2) and economic stability led them to become important recipients of foreign capital.[98] The privatisation of the telephone providers in Argentina and Mexico during this period was a reform which had a large impact on the diffusion patterns of this technology. Indeed, Argentina's and Mexico's restructuring of their telecom sector marked them out from the rest of the developing world due to the rapid speed, vigour and relative success of their turnaround. Privatisation was to theoretically increase efficiency and hence allow for

[96] Ffrech-Davies et al. (1994), Manzetti (1999), Tornell A., 'Economic Crises and Reform in Mexico' in Haber S., *Crony Capitalism and Economic Growth in Latin America: Theory and Evidence* Stanford C.A., Hoover Institution Press (2002).
[97] Lewis C. M. (2002).
[98] Manzetti (1999).

more successful diffusion (see chapter 3, section *The Period of Privatisation*, for further analysis).

The progression of the political economies in Latin America in general, in terms of policy choice, went from the export-led growth period characterised by free-trading, capital-importing hegemonic power, multilateralism in trade and payments under the Gold Standard, towards populism characterised by ISI led growth and an emergence of a more interventionist government. In Argentina and Mexico (as well as in many other countries), this led to the nationalisation of foreign owned enterprises, only to later return to market orientated reforms after the 1980s debt crisis, characterised by liberalism of trade and privatisation of state owned enterprises. One observes a yo-yo effect in the political economy over time (which had a large impact on ICT diffusion), as Argentina and Mexico strove with varying levels of success to achieve sustainable economic growth.[99]

1.1.2 Industrial Growth in Argentina and Mexico

The telegraph and the telephone technologies were very important components of the success of industrial growth. The construction of the railways was also vital to the industrialisation process, in ensuring the efficiency of mass production. The relationship between the railways and the telegraph was mutually dependent and complementary (explored in more detail later in the chapter, see section 1.3 The Joint Supply of the Railways and the Telegraph). However, the telegraph and the telephone simply were not identified characteristics of an industrialising economy; as innovative communicative tools, they were directly supportive of the industrial process.[100] The birth and nature of industrialisation in Latin America has been the source of much academic debate for a long time. Wythe and Lewis present some strong analysis of overall industrialisation process in Latin America, while ECLA published very useful country specific pieces.[101] A fair amount has been written on

[99] For good overviews of the economic problems and subsequent economic policies over the second half of the twentieth century refer to Di Tella G. and Dornbusch (1989) for Argentina. Also see Ferrer, Di Tella G. and Zymelman. Ferrer A., *La Economía Argentina: Las Etapas de su Desarrollo y Problemas Actuales* Buenos Aires, Editorial Fondo de Cultura Económica (1967b), Di Tella G. and Zymelman (1967). For Mexico, see Cárdenas, Lustig and Reynolds: Cárdenas E., *Historia Económica de México* 4 volumes, México D.F., Editorial Fondo de Cultura Económica (1990), Lustig N., *Distribución del Ingreso y Crecimiento en México. Un Análisis de las Ideas Estructuralistas* México D.F., El Colegio de México (1981), Reynolds (1970).

[100] In Latin America, these ICTs fostered state formation and the consolidation of power.

[101] Wythe G., *Industry in Latin America,* New York, Columbia University Press (1945), Lewis C. M. and Suzigan W., 'Industry and Industrialisation in Latin America: In Pursuit of Development' *Cuadernos de Historia*

industrial growth specifically in Argentina, including the work of Villanueva and Dorfman (covering from 1930 to 1980), while for the period in Mexico, Haber offers a good overall review.[102]

There is no acceptable consensus in regard to the origins of industrialisation in Latin America since views depend largely on the definition of industrialisation, of which there are many. There are broadly three main areas of interest that materialised regarding the views of early industry in Latin America: coming from the dependency thinkers, the structuralists and the developmentalists. *Desarrollistas* and *dependistas* associate industrialisation with a growing shift of manufacturing in the composition of aggregated output. It therefore has been a long held belief of early dependency traditions and *cepalista* academics that industrialisation occurred in Latin American only after the global financial crisis of the 1930s. Celso Furtado offers a particularly succinct overview of the *cepalista* hypothesis and makes attempts to incorporate some of the revisionist challenges into his work.[103] In this view, it was thought that the export-led growth period in Latin America was unfavourable to industrial development and that a simple increase in manufacturing did not pertain to outright industrialisation. They argue that the feasibility of industrialisation was only possible post 1929, when traditional import-export dynamics broke down, the 'anti-industry' bias was removed and the industrial bourgeoisie were able to challenge the political oligarchy in matters of commerce and industry.[104] Despite maintaining an expanded definition of industrialisation, structuralists would agree that industrialisation was not attained pre-1929. They observed no coordinated state action/policy that they consider sought to promote manufacturing: such as targeting infrastructure inadequacies or market integration, which were essential components in achieving

Latinoamericana 8 (2000): 227-316. ECLA (1959), Economic Commission for Latin America (ECLA), *The Process of Industrialisation in Latin America* New York, United Nations (1966).

[102] Villanueva J., 'En Origen de la Industrialización Argentina' *Desarrollo Económico* 12.47 (1972): 451-476, Dorfman A., *Cincuenta Años de Industrialización Argentina, 1930-1980* Buenos Aires, Ediciones Solar (1983). See also Altimir, Santamaria and Sourrouille, who address the policies of industrialisation: Altimir O., Santamaria H. and Sourrouille J. V., 'Los Instrumentos de la Promoción Industrial en la Post-guerra' *Desarrollo Económico* 6.24 (1967): 709-734. Haber uses the specific case study of the Monterrey region (a major centre for industry in Mexico) to draw more generalised conclusions: Haber (2000). Also see Rosenzweig Hernandez F., *El Desarrollo Económico de México* México D.F., Colegio Mexiquense, ITAM (1989).

[103] For the original statement of the *cepalista* hypothesis see Furtado (1977). For subsequent, neo-*cepalista* assessments of development, refer to Ffrench-Davies, Muñoz and Palma (1994). Also see Sunkel O., 'Introduction' in Sunkel O., *Development from Within: toward a Neostructuralist Approach for Latin America* Boulder, Lynne Rienner Publishers (1993).

[104] Ferrer gives a strong account of this view from Argentina's perspective. Ferrer A., *The Argentine Economy* Berkeley, University of California Press (1967c).

their definition of industrialisation. Institutionalists, meanwhile, do not typically differentiate between industrial growth (increasing manufacturing output) and industrialisation, and would therefore advocate the earliest advent of industrialisation among these academic views.[105]

The social ramifications of industrialisation and the role that the telegraph and the telephone technologies played in this were vast. For Argentina and Mexico, the inclusion of various parts of society in the process was troublesome to the maintenance of the ruling elites' hegemony and, although the state wanted to promote industrialisation, its continual growth empowered the working classes further. The role of states was particularly important in promoting ISI induced growth, as they established industrial companies that would be government run and invested in privately run ones too. Some states continually implemented protectionist policies like tariff barriers and huge import taxes in order to promote domestic industrial growth. The section below is divided into the tariff protected period of the early twentieth century, the response of industry to the Depression, and the development of structuralist policies from the 1950s.

Industrialisation During the Early Twentieth Century: Tariff-protected Growth

The argument for pre-1930s industrialisation is often related to Gershenkronian type concepts of late development, such as the institutional substitutability in the relatively 'backward' Latin American economies vis-à-vis their developed counterparts. The literature directly dealing with this is limited but there are many reliable texts (with a reasonable Mexican bias) that look for signs of early industrial advancement.[106] Cardoso and Faletto also present a particularly influential statement (*dependista* in nature) of pre-1930s industrialisation and go on to cite various specific contexts where there was clear manufacturing development.[107] One should note that there is a great deal of writing on diffusionist concepts, especially in

[105] Lewis and Suzigan (2000).

[106] For example, Haber is one of the few who directly draws on Gerschenkron's view is a particularly good account, while Reynolds, Solis, Vernon and Glade and Anderson are also excellent (the last three writing from a revisionist perspective) and all address Mexico. Haber (2000), Reynolds (1970), Solís (1970), Vernon R., *The Dilemma of Mexico's Development: The Roles of the Private and Public Sector* Cambridge, Harvard University Press (1963), Glade W. P. and Anderson C.W., *The Political Economy of Mexico* Madison, University of Wisconsin Press (1963). Meanwhile Díaz Alejandro provides an excellent examination of Argentinia's case, Díaz Alejandro (1970).

[107] Cardoso and Faletto (1971).

Argentina, which redefine industrialisation in a manner that firmly dates its arrival to before the Depression.[108]

In nineteenth century Latin America The promotion of manufacturing activities was seen as a way to become a modern society. There were two main routes to take in stimulating industrial expansion. The state could directly aid the manufacturing sector, or take a less direct approach by encouraging individual endeavours in promoting growth. Latin American politicians initially rejected introducing protective tariffs in the latter part of the nineteenth century, due to their lack of suitability. However, in the early part of the twentieth century, tariff-protection policies became a strong driver of growth in infant industries. Despite the fact that industrialisation was not necessarily regarded as occurring at this point by all academic groups, more recent research points out that there was already a reasonable depth to the organisational setting of the manufacturing industry. Some claim that business associations/industrial clubs may have had a greater influence than first thought. [109] The *Unión Industrial Argentina* is one example. [110] Moreover, entrepreneurs introduced vertical integration to the process stages of manufacturing, thereby deepening the industrial process.[111] Neo-structuralists warn, however, that such market deepening throughout the period of export-led growth was not accompanied by much institution building. [112] The lack of institutional structure during export-led growth was also a feature of the very early period of telephone diffusion, since the real formation of the regulatory framework did not come until the 1930s (with the creation of the supervisory board, SECOM, in Argentina in 1936 and the introduction of the Law of General Means of Communications in Mexico in 1938).[113] Nevertheless, export-led growth at the very least, laid the foundations for

[108] For instance see Díaz Alejandro (1970), Cortés Conde (1979), Cortés Conde R. and Gallo E., *La Formación de la Argentina Moderna* Buenos Aires, Editorial Paidós (1967) and Di Tella G. and Zymelman (1967).
[109] Acuña C. H., 'Business Interests, Dictatorship and Democracy in Argentina' in Payne L. A., *Business and Democracy in Latin America* Pittsburgh, University of Pittsburgh Press (1995), Ridings E., *Business Interest Groups in Nineteenth-century Brazil* Cambridge, Cambridge University Press (1994), Schvarzer J., *Empresarios del Pasado: la Unión Industrial Argentina* Buenos Aires, CISEA/Imago Mundi (1991), Lewis P. H. (1990), Quiroz A. W., 'Financial Leadership and the Formation of Peruvian Elite Groups, 1884-1930' *Journal of Latin American Studies* 20.1 (1988): 49-81.
[110] This was a recognised channel in Argentina through which one could voice opinion regarding industry, and by the 1920s it launched a sophisticated campaign that focussed on job creation and tariff reform.
[111] Lewis and Suzigan (2000).
[112] Thorp (1998).
[113] Mexico, Cámara de Diputados del H. Congreso de la Unión, *Ley de Vías Generales de Comunicación, 1938 (General Means of Communication Law)* México D.F., Diario Oficial de la Federación (December 30, 1939).

industrialisation by increasing the availability of important elements such as capital and labour.

In the early nineteenth century, given the large scale of its factory production capabilities pre-independence, Mexico's dynamic and integrated economy seemeed to be well placed for self sustained growth and in turn a strong prospect of advancing its modern industry.[114] Industry, however, did not experience sustained growth until the end of the century. By the 1890s, the barriers to entry were large, as Mexican textile companies for instance were forced to purchase all of the necessary equipment in one go. This structural issue, coupled with the burdensome regulatory environment for finance meant that unlike their U.S. counterparts, Mexican firms were not able to finance expansion or modernise the industry through re-investment of profits.[115] Textiles were also quite a sizeable industry early on in Argentina with domestic consumption at 50%.[116] But aside from textiles, even by 1882 Argentina had employed very few workers in industry (as recorded in the Buenos Aires Yearbook) and by 1914, the overall scale of industry was limited.[117] In Mexico, despite the positive manufacturing traits of 'limited liability' and capacity to implement new technologies, sector rates of industrial growth peaked in 1907 and declined thereafter. As a result it has been claimed, at least in the case of Mexico, that export-led growth (although necessary) was not always an adequate condition for industrialisation.[118] Many would argue, however, that manufacturing was well established in Argentina and Mexico by 1911 already and the composition of their export markets was fairly diverse. This was supported by infrastructural modernisation in the form of railway construction, which was relatively widespread and an industry that would be inextricably linked to the development of the telegraph build-out.

---

[114] Its textile mills, which carried some of the most up-to-date mechanised equipment for production, were especially well positioned as these were established from as early as the 1830s. See Suzigan W., *Indústria Brasileira: Origems e Desenvolvimento* São Paulo, Editora Brasiliense (1986), Weid E. and Rodrigues Bastos A. M., *O filo da Meada: Estratégia de Expansão de uma Indústria Têxtil: Companhia América Fabril* Rio de Janeiro, Fundação Casa de Rui Barbosa, Confederação Nacional da Indústria (1986), Keremitsis D., *La Industria Textil en el Siglo XIX* México D.F., Sep-Sententas (1973), Haber (2000).

[115] Haber S., 'Regulatory Regimes, Capital Markets and Industrial Development: A comparative study of Brazil, Mexico and the United States, 1840-1930' in Harris J., Hunter J. and Lewis C. M., *The New Institutional Economics and Third World Development* New York, Francis Routledge (1995).

[116] Thorp R. and Bertram G., *Peru, 1890-1977: Growth and Policy in an Open Economy* London, Macmillan Press (1978).

[117] Province de Buenos Ayres, Ministère de Gouvernement, Bureau de Statistique Generale, *Annuaire Statistique de la province de Buenos Ayres, 1882* Buenos Aires (1883). República Argentina, Comisión Nacional del Censo, *Tercer Censo Nacional, 1914* Buenos Aires, Talleres Gráficos de L. J. Rosso y Cía. (1916-1917).

[118] Lewis and Suzigan (2000).

Overall, some maintain that due to the amassed scale of export-driven, tariff induced growth in manufacturing during the early part of the twentieth century, there was now a lack of dependence on the export sector and a shift toward 'natural' industrialisation. Di Tella G. and Zymelman argue that this industrial expansion, although fairly constant (amid cyclicality) was not worthy of being called 'industrialisation' still. They labelled the years between 1914 and 1933 as a period of missed opportunities in Argentina, for instance, as the potential prospect of 'natural' industrialisation did exist but was not achieved.[119] Between 1900 and the start of the global financial crisis, there were phenomenal shifts in industrial activity in Mexico.[120] Although official tariffs over this period protected against dramatic falls in the price of imported manufactured goods and a rise in production costs, industrialists were well aware that exchange rate fluctuations influenced both. Nevertheless, this drive toward autonomous industrialisation saw manufacturing assume sector leadership in Argentina's and Mexico's economies, and its growth contributed not only to economic development but also to structural change, which clearly favoured traditional ICT advancement.

The Response of Industry to the Depression

Neo-structuralists claim that the pre-conditions for industrialisation existed as early as the First World War in Latin America but that self-sustained development was only possible after the global crisis, as implied in the first two words of Korol and Sabato's title, 'incomplete industrialisation'. [121] There have been more recent attempts to integrate structuralist and dependency views with a revisionist account and arguably Weaver and Lewis are among the most successful.[122] There are many themes that come about as a result of the growth of the revisionist field of study, but the consequences of the First World War are a particularly dominant theme, with

[119] Di Tella G. and Zymelman (1967).

[120] Average annual growth of manufacturing output was +3.1% between 1901 to 1910, but this turned negative (-0.9%) between 1911-1921, before growing rapidly at +3.8% again between 1922-1935. See Lewis and Suzigan (2000).

[121] Korol J. C. and Sabato H., 'Incomplete Industrialisation: An Argentine Obsession' *Latin American Research Review* 25.1 (1990): 7-30. Also see Di Tella G. and Zymelman (1967), and Lewis P.H. (1990) who provides a particularly detailed and direct overview of these discussions.

[122] Weaver F. S., *Class, State and Industrial Structure: The Historical Process of South American Industrial Growth* Westport, Greenwood Press (1980), Lewis C. M., 'Industry in Latin America' in Bernecker W. L. and Tobler H. W., *Development and Underdevelopment in America* New York, Walter de Gruyter (1993).

some of the best commentary on this topic in Miller and Albert.[123] For an analysis of policy and the growth of manufacturing in this era, Ranis and Thorp provide particularly useful generic accounts of Latin America.[124]

Irrespective of the definition of industrialisation, it is now generally accepted by all schools that by the 1930s, Latin America had achieved some sense of industrialisation, or at least had the opportunity to do so. It is therefore no wonder that much research has focussed on this period. This subject was first written about during the 1950s (consolidated in the 1960s) and was advanced by ECLA.[125] Despite the more recent school of thought claiming that industrialisation pre-dates the Depression (as explored above), it is a commonly held view that Latin America's eventual economic/political response to the Depression brought about industrial advancement and unequivocal 'industrialisation' by even the strictest of definitions. Responses to the Depression are described as having unfolded via three specific phases. First, there is minimal policy reaction, which would turn into uneven event-driven and orthodox state action (c.1929-1931/1932). Secondly, one observes coherent and pragmatic economic policy that assumed external order would return (c.1932-1934/1936). Finally, proto-Keynesian industrially favourable projects were implemented (in the late 1930s).

At the beginning, most Latin American countries responded with limited active policies to tackle crises caused by external events and domestic forces.[126] Mexico was one of the few nations able to internalise this conflict and over time transform reactive measures into pro-active, pro-industrial ones. Despite originally taking a supremely minimalist approach, Argentina was quickly among even fewer economies able to accommodate domestic policy making within their incumbent

[123] Miller R., 'Latin American Manufacturing and the First World War: An Exploratory Essay' *World Development* 9.8 (1981): 717-34, Albert B., *South America and the First World War: The Impact of the First World War on Brazil, Argentina, Peru and Chile* Cambridge, Cambridge University Press (1988).

[124] Ranis G., *Government and Economic Development* New Haven, Yale University Press (1971), Thorp (1984). For Argentina see Guy D. J., 'Carlos Pellegrini and the Politics of Early Industrialization, 1873-1906' *Journal of Latina American Studies* 11.1 (1979): 123-144, Lewis C. M., 'Immigrant Entrepreneurs, Manufacturing and Industrial Policy in the Argentine, 1922-28' *Journal of Imperial and Commonwealth History* 16.1 (1987): 77-108. For Mexico see Arias P., *Industria y Estado en la Vida de México* Zamora, El Colegio de Michoacán (1990).

[125] This is particularly well documented in (ECLA) (1966). Also refer to the country monographs produced throughout the 1950s and early 1960s, as an example see ECLA (1959).

[126] The impact of the crisis was a fall in export and state revenues which induced the pursuit of pro-cyclical policies. Policies such as tax cuts (import duties) and curbs in expenditure were targeted generically across Latin America, while domestic interest rates rose aggressively and loans were recalled.

internationalist economic strategies due to the strength of their relatively well established institutionalised structures. ECLA's classic piece argues that the external shock that hit Latin America at the start of the 1930s was the primary reason for the import substitution that led to rapid industrialisation in the larger countries.[127] Indeed, during this final stage of the Latin American response, macroeconomic policy became more overtly pro-manufacturing as the assumption that global economic 'normality' would resume was abandoned.[128]

The increasing alignment of Mexico with the U.S. is a relationship that deserves greater attention in the examination of deepening industrialisation in Mexico. Mexico was doubly hit during the global financial crisis as its northern neighbour, the U.S., experienced GDP contraction of almost 40%, and rising job losses brought about a mass return of Mexican migrant workers. However, during the 1930s, market forces, particularly real exchange rate depreciation, drove industrialisation further, as its role within the economy expanded. During the Second World War industrialisation had become almost synonymous with economic prosperity and politically, it became easier for regimes to redirect efforts to finance and promote industry. Despite the decline of international trade and the prominence of import substitution for many countries during the war, Mexico's industrialisation process continued to be export-led. The U.S., which had been the cause of initial economic pain in the 1930s (although this was positive for industry), in the 1940s was driving demand in growth for Mexico's commodities due to the absence of trade restrictions between the two countries during wartime.[129] Politically, it was claimed that the Alemán Valdés administration identified most closely with the drive toward industrialisation.[130] Also his administration was connected to the beginning of the drive toward nationalisation of the telephone company in Mexico, as increasing influence was directed toward Telmex from 1947.

[127] ECLA (1966). As part of its early work, ECLA produced a number of monographs by country, which remain very useful on the role of industrialisation in the 1930s, see for example ECLA (1959). Some other very good work in Argentina during this period is done by Díaz Alejandro (1970), and Lewis P. H. (1990).
[128] Lewis and Suzigan (2000).
[129] Cárdenas (2000).
[130] Ibid. This was due to the continuation of protectionist policies aimed at promoting domestic industry – industrialisation became the strategy of economic development.

Overall, the institutional setting and the nature of state action (increasingly pro-active in economic matters) in this period changed for Latin America, and this evolution was generally favourable to the manufacturing as well as the ICT sector. The onset of the Second World War confirmed the structural shift that had taken place in the global economy, in exposing the problems faced by primary producers. Such problems induced the growing diffusion of ECLA developmentalism and interventionist approaches in policy making. Any negative assessment of the external environment therefore was taken positively with regard to the domestic situation and, given the perception of state competence from certain actions, conditions for manufacturing growth and institution-building became very favourable.

The Development of Structuralist Policies from the 1950s

It was during this period and especially the 1960s and 1970s that the dependency debate came about, seemingly because of the perceived flaws in the ECLA structuralist arguments. Levin and Frank's early research on this area (although focussing mainly on Chile and Brazil) are particularly noteworthy.[131] From 1945 until the early 1960s ISI developed and industrialisation expanded as protection from foreign competition increased. For Argentina, coordinated sectoral plans to improve the continuity of industrialisation were established through the creation of the National Development Council (CONADE).[132] In Mexico, the process of 'stabilising development' was already underway by the early 1950s, which meant that state planning was not only more flexible, but more sophisticated at the sector and macro levels.[133] Policy design promoted the advancement of modern manufacturing, with workers now enjoying greater job security and higher wages than they were able to attain in traditional industry or agricultural labour.[134]

Through the 1950s and 1960s, orthodox stabilisation packages (encouraged by the IMF) were common in Latin America. Soon their perceived failings were followed

[131] Levin J. V., *The Export Economies: Their Pattern of Development in Historical Perspectives* Cambridge, Harvard University Press (1960). Frank A. G., *Capitalism and Underdevelopment in Latin America: Historical Studies of Chile and Brazil* New York, Monthly Review Press (1969). Note that Frank has made since slight modifications to his initial view.
[132] Lewis P. H. (1990), Díaz Alejandro (1970).
[133] Cárdenas E., *La Hacienda Pública y la Política Económica, 1929-1958* México D.F., El Colegio de México (1994), Hamilton N., 'Limits of State Autonomy: Post-Revolutionary Mexico' in Hamilton N. and Harding T. F., *Modern Mexico: State, Economy and Social Conflict* Princeton, Princeton University Press (1982).
[134] Thorp (1998).

by neo-liberal type policies through the 1970s. In the 1970s, in various parts of the continent governments aimed to reduce the size of the state, cut subsidies, liberalised financial markets and opened economies. The resulting recessions had an adverse impact and sometimes induced further policy changes.[135] The debt crisis and failed structural adjustment gave way to heterodox programmes in several countries in the 1980s. Advocates of heterodoxy considered that stabilisation with growth and a reinvigorated industrial drive was the best policy.

As history tells us, initial rapid growth in the 1970s quickly turned to debt crises and bankruptcies in the early 1980s, changing the ownership and scale of industrial activity as attempts were made to restabilise manufacturing. When countries like Argentina abruptly opened their economies in the early 1990s there were sharp contractions not only in manufacturing but in exports too.[136] Industry efficiency gains were minimal and resource reallocation (not generation) ensued, as SOEs like Argentina's and Mexico's telephone industries were privatised. This however, did not necessarily amount to full-blown de-nationalisation, as many of those who gained from privatisation were previously partners of the state (as purchasers or suppliers) in countries like Argentina and Mexico. Although the contribution of manufacturing to GDP dropped significantly between 1970 and 1990, the proportion of intermediate products in total industrial output grew substantially in countries like Argentina.[137]

History indicates that industrial expansion (at varying levels) was most rapid at the beginning of the nineteenth century and at the end of the twentieth century. [138] These periods also reflect particularly strong levels of diffusion speed in relation to the two ICT technologies which are the subject matter of this thesis. Indeed, the beginning of

[135] Frenkel R. and O'Donnell G., 'The "Stabilization Programs" of the International Monetary Fund and their Internal Impacts' in Drake P. W., *Money Doctors, Foreign Debts and Economic Reforms in Latin America from the 1890s to the Present* Wilmington, Scholarly Resources (1994). Machinea J. L., 'Stabilisation under Alfonsín' in Lewis and Torrents (1993). Kosacoff B., 'La Industria Argentina: un Proceso de Reestructuración Desarticulada' in Kosacoff B., *El Desafío de la Competitividad: la Industria Argentina en Transformación* Buenos Aires, Alianza Editorial (1993).

[136] Manufacturing had reached over 30% of economic activity by the mid 1970s and the service sector had been growing very quickly since the 1930s in Argentina.

[137] Kosacoff (1993).

[138] Note that overall, despite the frenetic pace of industrial expansion in various periods over the twentieth century; evidence indicates that Argentina and Mexico did not close the industrial productivity 'gap' with leading innovative nations such as the U.S. See for instance Hofman A. and Mulder N., 'The Comparative Productivity Performance of Brazil and Mexico, 1950-1994' in Coatsworth J. H. and Taylor A. M., *Latin America and the World Economy since 1800* Cambridge, Harvard University Press (1998).

the twentieth century coincides with the steepest part of the s-curve shaped patterns of telegraph diffusion in the two countries (see chapter 2, figure 2.10 Approximate Section of the S-curve Measured by this Analysis), while the 1990s alone saw Argentina's telephone diffusion levels double (see appendix B, table B.3). During the inter-war periods, even where development was limited, clearly industrialisation or further industrial expansion was forced upon most Latin American states. By the end of the whole period, Latin America was unquestionably a largely industrialised continent, with Argentina and Mexico experiencing a level of industrialised deepening greater than most. [139] The origins and the precise date of when 'industrialisation' was attained, however, remain subjective and open to debate. But in acknowledging the industrialisation argument in light of tariff-protected growth, the response of industry to the Depression and the structuralist policies from the 1950s, the industrial backdrop during the processes of telegraph and telephone diffusion – two 'modern' bases of industry – can be contextualised more appropriately.

1.1.3 The Politics of the Political Economy

Political characteristics such as the degrees of autonomy and of power concentration (within the executive branch) are considered to have a great impact on a government's ability to implement reforms.[140] Social scientists would argue that a high level of cohesion among policymaking circles (bureaucrats and government) is fundamental for effective state intervention.[141] State autonomy and state capacity in particular are important variables in understanding telegraph and telephone policy change. Autonomy and capacity are not the same thing, but are closely related. State autonomy largely refers to the independence of the state from other groups within society, that is, the degree of freedom enjoyed by the state. Meanwhile state capacity refers to the actual ability of the state to implement objectives, objectives which may be opposed by certain groups within society. Recent neo-Marxist approaches, however, tend to argue for a more direct relationship. They would contend that the

[139] Lewis and Suzigan (2000).
[140] Petrazzini B. A., *The Political Economy of Telecommunications Reform in Developing Countries: Privatisation and Liberalisation in Comparative Perspectives* London, Praeger Publishers (1995).
[141] Haggard S. *Pathways from the Periphery: The Politics of Growth in the Newly Industrialising Countries* Ithaca, Cornell University Press (1990).

very measurement of state autonomy is defined by the 'state's capacity' to function and implement goals at odds with the will of dominant interest groups. [142]

In the context of this thesis, these characteristics can aid the implementation of key policies that fostered faster ICT diffusion. For instance, Mexico's relative degree of greater state autonomy during the first few decades of PRI political dominance from the late 1920s, and the insularity gained by the Argentinian administration of Menem in the 1990s, arguably had a significant impact in allowing for the successful implementation of key reforms (as discussed throughout chapters 3 and 4). However, a high degree of state autonomy does not necessarily guarantee a high degree of state capacity, or governing effectiveness. [143] One could argue that during particularly critical periods in regard to telegraph and telephone diffusion, the effectiveness of the Mexican state was aided by a relatively stronger centralisation of power around the president, and arguably more powerful unity among the various governing elites. [144] In Argentina, by contrast, the distribution of power in the state was affected by the process of opening up politics at the societal level. [145] This resulted in a succession of presidents who faced relatively more difficulties in implementing unpopular reforms as a result of the on-going conflict between the governing elite and interest groups. [146] This was especially highlighted during the transition from nationalisation to privatisation. In terms of the overall regime, it is not clear in the literature which type is necessarily more conducive to faster ICT diffusion. O'Donnell and Huntington argue that a relatively more authoritarian state is necessary for industrialisation once a state reaches a certain level of development and modernisation. [147] Meanwhile, Huntington and Nelson argue that at a certain point, economic growth and

[142] Hamilton (1982)., Evans P. B., Rueschemeyer D. and Skocpol T., *Bringing the State Back in* New York, Cambridge University Press (1985).
[143] Petrazzini (1995).
[144] Smith P. H., *Labyrinths of Power: Political Recruitment in Twentieth-Century Mexico* Princeton, Princeton University Press (1979). Ronfeldt D., 'Prospects for Elite Cohesion' in Cornelius W. A., Gentleman J. and Smith P. H., *Mexico's Alternative Political Futures* La Jolla, Center for U.S.-Mexican Studies (1989).
[145] Waisman C. H., *Reversal of Development in Argentina: Post-war Counterrevolutionary Policies and their Structural Consequences* Princeton, Princeton University Press (1987).
[146] For instance see Oszlak O., *La Reforma del Estado en la Argentina* Buenos Aires, volume 6, Documentos CEDES (1990).
[147] O'Donnell G. A., *Modernization and Bureaucratic-Authoritarianism: Studies in South American Politics* Berkeley, University of California Press (1973), Huntington S. P., *Political Order in Changing Societies* New York, Yale University Press (1968). Also see Apter D., *The Politics of Modernisation* Chicago, University of Chicago Press (1965), O'Donnell G. A., Schmitter P. C. and Whitehead L., *Transitions from Authoritarian Rule* Baltimore, Johns Hopkins University Press (1986).

democracy become incompatible.[148] Others, such as Haggard and Kaufman, alternatively suggest that the type of regime is largely irrelevant to the effectiveness of the state in policy implementation.[149]

The next section is divided into four sub-sections. Focus first turns to a. the structure of the Argentinian and Mexican political systems and a logical analysis of the inter-relationships of the various political actors, in addition to some coverage of authoritarianism and the military. This is followed by a three-sectioned chronological analysis of politics over the whole period, namely, b. the years of the early Argentinian and Mexican oligarchic rule, c. the years leading up to and immediately after the Depression, and the section concludes with d. the years corresponding to the second half of the twentieth century.

a. The Structure of Argentina's and Mexico's Political System

In institutional terms, Argentina and Mexico were characterised by a similar political system. Argentina had a federalist state system of governance and although provinces had their own autonomous systems, they typically replicated the national system. Argentina's system featured a president, a national congress, and a judiciary. Despite this, from the 1930s, this arrangement was honoured more in theory than in practice, as military coup after coup ensured a total of 25 different presidents served in Argentina from then until 1989.[150] Political instability was a relative mainstay for Argentina for much of the twentieth century and it is argued that this was partly a result of the absence of any formation of a dominant coalition in politics that could provide stability of leadership.[151] Argentina was unable to consolidate permanent

[148] Huntington S. P. and Nelson J., *No Easy Choice: Political Participation in Developing Countries* Cambridge, MA, Harvard University Press (1976). Also see Hewlett S. A., 'Human Right and Economic Realities, Tradeoffs in Historical Perspective' *Political Science Quarterly* 94 (1979): 453-473. For an analysis of democracy in respect to the degree of inclusiveness of the population and civilian control of the military refer to Dahl R. A., *Polyarchy: Participation and Opposition* New Haven, Yale University Press (1971).

[149] Haggard S. and Kaufman R., 'Democratic Transitions and Economic Reform' Paper presented at the Southern California Workshop on *Economic and Political Liberalisation*, University of Southern California, Los Angeles (1993).

[150] Petrazzini (1995).

[151] As Di Tella says, 'each group has just enough power to veto the projects originated by the others, but none can muster the strength to run the country as it would like': Di Tella T., 'An Introduction to the Argentine System' in Fagen R. R. and Cornelius W. A., *Political Power in Latin America: Seven Confrontations* Englewood Cliffs, Prentice Hall (1970), p.108. Smith, however, argues that political divisions and conflict are a reflection of the interpersonal conflicts among the elite rather than at the base of society. See Smith P. H., *Argentina and the Failure of Democracy: Conflict among Political Elites, 1904-1955* Madison, University of Wisconsin Press (1974).

competitive pluralism, where '...policy making is the outcome of mutual accommodation and concessions'.[152] In Argentina there was no real bargaining process between interest groups and the state.

Argentina's society was characterised by conflict since there was extensive distrust among all parties involved and any state decision that was in opposition to one's interests was simply not accepted. Since this was known, in order to retain power, the state attempted to avoid widespread inclusion in policy making, which only led to further distrust, and constant questioning of its authority from antagonistic unions, uncooperative entrepreneurs, powerful governors, and an adversarial congress.[153] It has been argued, however, that despite the seeming relative degree of instability in Argentina's political system (for good portions of the overall period in question); below the surface there was a consistent dynamic that reflected quite a stable system of power.[154] In this view the presidency rotated between two groups, the first consisting of agrarian exporters, large industrialists and large financiers, and the second represented by the domestic industrial bourgeoisie, SMEs, and the labour movement. However, this view would not seem to hold given the lack of internal cohesion or discipline, and more importantly the lack of consensus on the policies being implemented. Structural shifts in the local and global economy during the mid-1970s however would ultimately weaken the underlying power structure and by the early 1980s, new (and old) political forces had (re)emerged.[155]

In Mexico, the federalist political system was quite similar in design to that in Argentina, with semi-autonomous local governments. It was also a presidential one, featuring equally independent legislative and judicial branches of powers. But just like Argentina, practice materially detracted from theory as Mexico's relatively higher concentration of power around the executive branch, coupled with a close cooperation among the controlling elites, were dominating characteristics of its political institutions for much of the period in question.[156] These intricately knit

[152] Wynia G. W., *Argentina in the Postwar Era: Politics and Economic Policy Making in a Divided Society* Albuquerque, University of New Mexico Press (1978), p.246.
[153] Petrazzini (1995).
[154] Waisman C. H., 'Argentina's Revolution from Above' in Epstein E. C., *The New Democracy in Argentina* New York, Praeger Publishers (1992).
[155] Petrazzini (1995).
[156] Ibid.

informal networks (with implicit hierarchies) of loyalties between the presidential office and congress could be traced back as far as the 1930s and facilitated lengthy tenures for important political figures.[157] These relationships offered immediate confirmatory powers for the whole of the executive branch and in turn served as a reflection of the highly concentrated power circle, with the elected president at the epicentre. Moreover, the main political party (the PRI) maintained relatively tight control over most of society and although the official historiography of the PRI would stress dominance from the beginning, this varied with time.[158]

Inter-relations of the State, Business Elites, Trade Unions and Workers

One of the most critical debates surrounding economic policy in the latter part of the nineteenth century revolves around the fact that landed and commercial elites virtually controlled the entirety of economic and political decision making in society.[159] In order to understand the relations between these economic actors, it is pertinent to first address the meaning of the state. There is a plethora of literature regarding the state in Latin America, as it became one of the most crucial institutions after independence.[160] The state often claimed a monopoly on the legitimate use of force, and controlled large scale resources. Two key groups within the state are the military and party politicians, while the technocrats and the church constitute other important groups.[161] The specific nature of the state in Argentina and in Mexico differed and nor was this constant through time, as will be apparent from the discussion that follows.[162]

---

[157] Ronfeldt (1989). Additionally, Mexico's federalism meant that historically the state effectively controlled 85% of public revenues.

[158] Note the neglect to account for the turmoil of the Cristero revolts in the west for example, see Cornelius W. A. and Craig A. L., *The Mexican Political System in Transition* California, University of California Press (1991).

[159] The elites were less than 5% of the Latin American population.

[160] The most widely referenced book regarding the state in Latin American is by De Soto H., *The Other Path: The Invisible Revolution in the Third World* London, Harper Collins (1989). For a useful account of state formation at the regional level, see Mallon F. E., *Peasant and Nation: The Making of Postcolonial Mexico and Peru* Berkeley, University of California Press (1995). For a generic comparative analysis of the state, Topik provides a useful assessment of state building in Mexico and Brazil, Topik S., 'The Economic Role of the State in Liberal Regimes - Brazil and Mexico Compared, 1880-1910' in Love J. L. and Jacobsen N., *Guiding the Invisible Hand: Economic Liberalism and the State in Latin American History* New York, Praeger Publishers (1988). Also useful are: Gilbert F., *The Historical Essays of Otto Hintze* New York, Oxford University Press (1975), Hall J. A., *States in History* Oxford, University of North Carolina Press (1988), North D. C., *Structure and Change in Economic History* New York, Norton Press (1981).

[161] Skidmore T. E. and Smith P. H., *Modern Latin America* New York, Oxford University Press (2005).

[162] See Oszlak for a useful account for Argentina, in the earlier part of the period under consideration. For the whole period Díaz Alejandro's work is useful. For the case of Mexico, Haber, Camp and Knight, among others, are useful. Oszlak (1981), Díaz Alejandro C. F., 'The Argentine State and Economic Growth: A Historical Review' in Ranis G., *Government and Economic Development* New Haven, Yale University Press (1971). Haber (2000), Camp R. A., *Entrepreneurs and Politics in Twentieth Century Mexico* New York, Oxford University Press (1989), Hamilton (1982), Collier R. B., *The Contradictory Alliance: State-Labour Relations and Regime*

Generally, until around 1920, the state apparatus was largely controlled by agrarian and commercial oligarchies (and possibly to an extent, allies). Specifically in the earlier period (pre-1930s), export-led growth led to modernisation and a change in the behaviour of the elite, as a new entrepreneurial vigour swept across Latin America. This in turn induced political change as the empowered landowners pursued political power. During this period, one can differentiate between two forms in the quest for political power: firstly, where the political elite (many assumed such status as large landowners) directly took control of government through 'oligarchic democracies' and strong alliances, as in Argentina. And secondly, where dictatorial factions (often in the form of the military) took power by whatever means necessary, with indirect involvement of the elite, as in Mexico. Although the approaches clearly varied, their goals were consistent, as they both attempted to establish stability, retain a tight power circle and claim social control. An example of this was the fact that they both directed significant effort toward developing the telegraph early on, as a means to achieve this (see chapter 4, section *The Government's Attitude towards the Telegraph*). After the 1930s, various urban groups gained political space and influence within the state, including industrialists, the military and technocrats. Finally from the 1950s and 1960s, other social actors, including organised labour and other popular sectors sought to shape economic and political decision making.[163]

In Argentina in the aftermath of the First World War the military became a more important player in politics. Meanwhile the labour movement had been building its opposition to the ruling elite and growing in influence for some time in the early part of the twentieth century, but by the 1930s its role had become rather tame. Notably, the main political party of the state, the *Partido Autonomista Nacional* (PAN), brought together regional oligarchies, consisting of powerful members who collectively held positions in the highest branches of politics, the economy, the

Change in Mexico Berkeley, University of California at Berkeley (1992), Knight A., 'State Power and Political Stability in Mexico' in Harvey N., *Mexico Dilemmas of Transition* London, British Academic Press (1993).

[163] Collier R. B. and Collier D., *Shaping the Political Arena* Princeton, Princeton University Press (1991). Walker, Herzog and Cockcroft provide some of the best specific insight into the relationships of the working classes and the intellectuals for Mexico at the turn of the century: Walker D., 'Porfirian Labour Politics: Working Class Organizations in México D.F. and Porfirio Díaz, 1876-1902' *The Americas 37.3* (1981): 257-287, Herzog J. S., *El Agrarismo Mexicano y la Reforma Agraria* México D.F., Fondo de Cultura Economica (1964), Cockcroft J., *Intellectual Precursors of the Mexican Revolution, 1900-1913* Austin, University of Texas Press (1968). For an analysis of the relations between industry and the agrarian sector in Argentina, refer to Gallo E., 'Agrarian expansion and industrial development in Argentina, 1880-1930' in Carr R., *Latin American Affairs (St. Antony's Papers* No.22) Oxford, Oxford University Press (1970).

military and religion. As a result, this make-up had a profound effect upon the relations of the state and the workers (and their respective unions). Much of the assessment of unionism and its relations with the state in the literature regarding Argentina is linked to analysis of Peronism. Baily's view of Peronism stresses the significance of urban migration and 'massification' of the working classes, generating much revisionist material challenging this (see Murmis and Portantiero, who see support for Peronism as equally shared by the incumbent working classes and the recent urban immigrants).[164] Perhaps the most influential work on the Peronist period of 'resistance' (between his overthrow in 1955 and his return in 1973) is by James, who creates an identity for the Peronist working class.[165]

In relation to this thesis, Latin America's worker unions played quite an important role in sector reforms, particularly during the privatisation of the telephone companies (see chapter 3, section *The Period of Privatisation*). In sharp contrast to Argentina, by the 1960s, unionism had not diffused across Mexico and its peasant masses typically were unprotected and unrepresented politically. In Argentina, Peronist trade unions became a genuine base of political opposition from as early as the 1950s. The relationship differed in Mexico and was largely top down, as the state did not need the labour and hence the labour movement was more independent. However, the dynamics of the worker-ruling political party relationship were not very favourable for workers in Mexico, as the PRI would grant effective wage increases, for instance, when unemployment was relatively high (for a more detailed assessment of the state relations and the outward influence of the PRI over time see the section *The Evolution of PRI control of Mexico [until and from 1960]*, later in the chapter). There is a great deal of work on the labour movement (and their relationships) in Mexico, much of it is multi-volume. One particularly succinct overview is presented by Bizberg.[166]

---

[164] Baily S. L., *Labor, Nationalism, and Politics in Argentina* New Brunswick, Rutgers University Press (1967), Murmis M. and Portantiero J .C., *Estudios sobre los Orígenes del Peronismo* Buenos Aires, Siglo Veintiuno Editores (1971). For an analysis of important labour movements in specific periods, see Torre (during Perón's second tenure) and Gallitelli Thompson (for the subsequent militant dictatorship). Torre J. C., *Los Sindicatos en el Gobierno, 1973-76* Buenos Aires, Centro Editor de América Latina (CEAL) (1983), Gallitelli B. and Thompson A., *Sindicalismo y Regímenes Militares en Argentina y Chile* Amsterdam CEDLA Publications (1982).

[165] James D., *Resistance and Integration: Peronism and the Argentine Working Class, 1946-1976* Cambridge, Cambridge University Press (1969).

[166] Bizberg I., *Estado y Sindicalismo en México* México D.F., El Colegio de México (1990). Over the course of Mexico's labour history, the Cárdenas presidency (1934-1940) possibly received the most academic attention, which Ashby (a leftist critique), Meyer and Chávez Hernández have written some interesting commentary: Ashby J. C., *Organized Labor and the Mexican Revolution under Cárdenas* Chapel Hill, University of North Carolina

Authoritarianism and the Military in Politics

History reveals that Latin America has been relatively more authoritarian in nature than the developed world. It should be noted, however, that although related to dictatorship and totalitarianism, authoritarianism can take on quite different forms.[167] Across Latin America in the nineteenth century typically authoritarian regimes were characterised by *caudillo* style leadership. Later in the twentieth century, authoritarian regimes often took the form of military led governments and although they sometimes allowed for political pluralism, this varied dramatically across countries, most especially between Argentina and Mexico. Due to the enhanced role of the military in the political domain in Latin America, much has been written on them: for example Johnson's classical piece analyses all of Latin America, with O'Donnell providing a more modern view.[168]

It is clear that authoritarian regimes in Argentina and Mexico were markedly different. Moreover, a common question is why Argentina, with such relatively strong overall economic development, was subjected to the pain of so many authoritarian regimes in the second half of the twentieth century.[169] While Potash's assessment on this matter is that of a historian, Rouquie's analysis is particularly useful as it not only extends the analysis to the return of Perón in 1973 but is also written from the perspective of a political scientist.[170] Juan Onganía's 1966-inaugurated-regime, can be thought of as the beginning of a shift within authoritarianism as he sought to suppress the labour movement and attack the

Press (1967), Anguiano A., *El Estado y la Política Obrera del Cardenismo* México D.F., Ediciones Era (1975). Meyer L., *El Conflicto Social y los Gobiernos del Maximato* volume 13, México D.F., El Colegio de México (1978), and Chávez Hernández A. V., 'La Mecánica Cardenista' volume 16, in Cosío Villegas D., *Historia de la Revolución Mexicana* 23 volumes, México D.F., El Colegio de México (1979).

[167] See Veliz C., *Obstacles to Change in Latin America* New York, Oxford University Press (1965), Collier R.B. and Collier D. (1991) and Skidmore and Smith (2005).

[168] Johnson J. J., *The Military and Society in Latin America* Stanford, Stanford University Press (1964), O'Donnell (1973). An interesting relationship that has been analysed with regard to military regimes, or more specifically departing military regimes, is the relations they share with the incoming democratic regimes in post-authoritarian political situations, see for example Goodman L. W., Mendelson J. S. R. and Rial J., *The Military and Democracy: The Future of Civil-Military Relations in Latin America* Lexington, Lexington Books (1990).

[169] There is particularly extensive literature on the military in Argentina, and a good overview for some of the most critical years (1928-1962) is provided by Potash in two volumes: Potash R. A., *The Army and Politics in Argentina: Yrigoyen to Perón* Stanford, Stanford University Press (1969) and Potash R. A., *The Army and Politics in Argentina: Perón to Frondizi* Stanford, Stanford University Press (1980). For an overview of authoritarian groups see Gerassi and for a modern analysis see Rock: Gerassi M. N., *Los Nacionalistas* Buenos Aires, Editorial Jorge Álvarez (1969), Rock D., *Authoritarian Argentina: The Nationalist Movement, its History and its Impact* Berkeley, University of California Press (1993).

[170] Rouquie A., *Poder Militar y Sociedad Política en la Argentina* 2 volumes, Buenos Aires, Emece Editores (1981/1982). A more modern period of analysis comes from Munck: Munck R., 'The "modern" Military Dictatorship in Latin America: The Case of Argentina (1976-1982)' *Latin American Perspectives* 12.4 (1985): 41-47.

manifestations of Argentina's economic and social issues, rather than attempt to locate the root causes.[171]

Argentina's military government of 1976 also continued this 'tradition', and generally these regimes were referred to across Latin America, as a 'bureaucratic authoritarian' state.[172] In Mexico, it is unfortunate that although military regimes were involved closely in politics (especially since the 1930s), the subject is relatively understudied from a contemporary perspective, exactly because of this fact. Liewen provides some analysis of the post-Revolution military, while Ronfeldt and Camp add a modern assessment.[173] In the 1960s, Mexico, unlike Argentina (where there was a 'fuller' bureaucratic authoritarian state) was able to move away from populist authoritarianism to modified bureaucratic authoritarianism as the state gained control of the popular sectors of the economy before the economic downturn. Despite the growing civic participation in politics from the 1980s across Latin America, most of the respective military powers still retained sufficient influence to discretely veto unwanted policies, demonstrating the continuity of the power dynamic (even if informal) between the military and society over time.

b. Argentina's and Mexico's Oligarchic Rule

The PAN's Political Machine and its Growing Opposition

In Argentina, following independence, the nature of the state and the manner in which it would be financed continued to be the most important political questions. The political process during this period around the nineteenth century in Argentina is particularly well documented by the *Academia Nacional de la Historia* and in Ferrari and Gallo.[174] Other issues such as the state's capacity to internalise conflict (a feature

[171] Taylor gives an exceptional analysis of repression under military rule: Taylor D., *Disappearing Acts: Spectacles of Gender and Nationalism in Argentina's 'Dirty War'* Durham, Duke University Press (1997).

[172] The main characteristics of a 'bureaucratic authoritarianism' state are: 1) new joiners have highly bureaucratic career already, such as the military, 2) political and social exclusion of the working class, 3) heavily reduced political activity and 4) dependency on the international economy in promoting domestic economic growth. For some further thoughts, refer to Refer to O'Donnell G., 'Reflections on the pattern of Change in the Bureaucratic-Authoritarian State' *Latin American Research Review* 13 (1978): 3-38.

[173] Liewen E., *Mexican Militarism: The Political Rise and Fall of the Revolution Army, 1910-40* Westport, Greenwood Press (1968), Ronfeldt D., *The Modern Mexican Military: A Reassessment* La Jolla, Center for U.S.-Mexican Studies, Cambridge University Press (1984), and Camp R. A. *Generals in the Palacio: The Military in Modern Mexico* New York, Oxford University Press (1992).

[174] Academia Nacional de la Historia, *Historia Argentina Contemporánea 1862-1930* volumes 1 & 2 Buenos Aires, El Ateno (1964, 1966). Ferrari G. and Gallo E., *La Argentina del Ochenta al Centenario* Buenos Aires, Editorial Sudamericana (1980).

of state formation) began to gain importance as conflicts across classes ensued at the turn of the twentieth century. During this main period of telegraph diffusion, Argentina was run by an oligarchic system (1880-1916), known as the 'Generation of 1880', who ultimately enjoyed several decades of prosperity.[175] The PAN developed in the 1880s, at the same time as the *porteño* party politics declined. The PAN soon monopolised 'national' politics and the only meaningful rivalries that remained were intra-party. There was no real difference in ideology within the PAN, which typically caused internal conflict as presidential candidates often tried to 'buy' support from different provincial factions of the elite. It was also no surprise that the PAN remained in power for so long since they ran elections fraudulently if required. The oligarchy's notion of 'Progress' was built upon limited political participation and economic expansion that benefited the elite and the privileged few (landowners and powerful farmers), whilst excluding most sections of the population.[176]

The PAN, which emerged from the interior oligarchies of the opposition to Buenos Aires, survived unchallenged for so long because of the growth in resources as well as, the supply and distribution of public goods. The state was financed through the taxation, borrowing and inflation, which all had distributional effects. Although perhaps inflation was not a worry for the commercial elite, it very much affected workers and immigrants, and the success of the modernisation project rested on these.[177] The PAN pragmatically tried to target strategic industries by investing heavily in state railways, for instance. Delivering economic progress whilst retaining order, proved to be a necessary justification of the PAN's oligarchic politics, and this 'alliance of elites' controlled all aspects of politics, almost without interruption, for forty years.[178] However, the political economy was shifting even as early as 1890, in the wake of the Baring Crisis, as society acknowledged that authority had become too centralised, and a class of professional politicians who wanted to be recognised

[175] Corradi J. E., *The Fitful Republic: Economy, Society and Politics in Argentina* Boulder, Westview Press (1985).
[176] For distinct approaches to the nature and formation of party politics, the politics of 'representation' and the correspondence of economic and political interest during the pre-1930s period see Rock (1975). Also see Walter R. J., *The Socialist Party of Argentina, 1890-1930* Institute of Latin American Studies, monograph no. 42, Austin, University of Texas Press (1977), Alonso P., *Between Revolution and the Ballot Box: The Origins of the Argentine Radical Party in the 1980s* Cambridge, Cambridge University Press (2000), Hora R., *Landowners of the Argentine Pampas: A Social and Political History, 1860-1945* New York, Oxford University Press (2001), Sábato H. and Lettieri A., *La Vida Política en la Argentina del Siglo XIX: Armas, Votos y Voces* Buenos Aires, Fondo de Cultura Económica (2003).
[177] Alonso (2000).
[178] Alonso (2000) and Hora (2001).

emerged. There was, as Lewis describes it 'a quest for legitimacy'.[179] The intrinsic corruption of the ruling Miguel Juárez Celman regime (1886-1890) became apparent and oligarchic politics were reconstructed in light of the growing distribution of power to the littoral.[180]

In 1906, the death of the incumbent leader, Manuel Quintana (1904-1906), marked a turning point in Argentinian politics, as José Alcorta (1906-1910) and Roque Sáenz Peña (1910-1914) sought to destroy the political machine engineered by Roca. To verify the legitimacy and political institutionalism of the state, the Sáenz Peña administration introduced electoral reforms in 1912 (e.g. an official ballot), which effectively marked the beginning of the end for the PAN.[181] The 'modern' opposition to the PAN's authority emerged in the form of the *Unión Provincial* (landowners and business groups) and the socialist party (the *porteño* working class) but it was the *Unión Cívica Radical* (UCR) that campaigned most successfully against the oligarchic political control and corruption.[182] Their initial efforts at revolt failed, but they stirred widespread social unrest and it was this group that would ultimately assume power from the PAN in 1916. [183]

The Porfiriato: the Range in Authority Exercised

Mexico lost half of its territory to the U.S. in 1848, and the country's initial anger quickly energised the political system. While the liberals wanted to modernise, secularise and democratise the country, the conservatives did not want to increase participation in government and feared such a liberal course of action would be disastrous for Mexico. Instead they preferred to allow the two institutional power bases of the church and the military (as historically was the case) to remain in control. Unfortunately this debate could not be reconciled and Mexico found itself flung into civil war.[184]

[179] Lewis C.M. (2002), p.194.
[180] Alonso (2000) and Hora (2001).
[181] Note that by 1914, about one third of Argentina's total population was foreign born, hence even with the secret ballot, political voting still excluded a large portion of the adult male population.
[182] Walter (1977), Alonso (2000) and Hora (2001).
[183] Lewis P. H., *Authoritarian Regimes in Latin America: Dictators, Despots, and Tyrants* Lanham, Rowman & Littlefield Publishers (2006).
[184] Vanderwood P., 'Betterment for Whom? The Reform Period: 1855-1875' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).

In theory Porfirio Díaz emerged as heir to the Liberal reformists when he took the presidency in 1876. He focused on putting an end to decades of political instability and economic depression. It is important to point out that the first four year term of Porfirio Díaz was significantly different from the second stint. During his first four years in power he faced some struggles with his cabinet, but when he took the presidency again in 1884 the government's power had been consolidated further, as the administration had learnt how to protect itself better from enemies and the country was at relative peace.[185] The *científicos* argued that political stability was the first step toward social evolution and economic development, and only once Mexico was ready could democratic politics (the essence of political legitimacy) be achieved.[186] Whatever the view of Porfirio Díaz and his actions economically or towards the telegraph sector, none can challenge his apparent political mastery. He came to power with military backing, and once in power immediately sought to extend his working coalition. With regard to the other institutional power base, the church, unlike his liberal predecessors, Porfirio Díaz remained neutral. He strategically played potential opponents against one another, such as with the regional *caudillos,* and built the rural police in order to maintain control in the countryside where most Mexicans lived. The most important writings on this aspect of Mexican history date from the 1950s and Villegas provides a particularly detailed account.[187]

Between 1877 and 1910, foreign trade across Latin America increased by nine times, and was marked in Mexico most of all, where its partnership with the U.S. was growing and inducing modest industrial growth. [188] The Porfirian model of industrialisation was a key factor behind this Mexican progress. Industrialisation was based on oligopoly and monopoly manufacturing, characterised by large, vertically integrated firms, protected by tariffs (see section 1.1.2 Industrial Growth in Argentina and Mexico), which would employ the most up to date technology at the expense of the craftsmen. Although the Porfiriato was the result of a cultural revolution, the practices of corruption of the local *jefes políticos* and the like were

[185] Newspaper: *El Monitor Republicano*, (11 October 1855).
[186] Buffington and French in Meyer and Beezley (2000).
[187] Cosío Villegas D., 'El Porfiriato: Su Historiografía o Arte Histórico' *Extremos de América* México D.F., Fondo de Cultura Economica (1949), pp.113-182.
[188] Skidmore and Smith (2005).

hardly revolutionary, but were direct breaches of national trust and moral economics. The political stability that Porfirio Díaz created to foster economic development was characterised, as much by clientage networks and skilful political deal-making, as by anything else. [189] The Porfirian state depended upon the bureaucrats and the technocrats to create a modern nation. But with their support, Porfirio Díaz was able to invoke a social dictatorship that controlled congress, the federal judiciary and the national bureaucracy.

The Porfirio Díaz administration's control over politics was not built on constitutional reform but on an intricate network of national and regional power cliques (notably including the *científicos* and the *reyistas*). He was able to defeat attempts by both the *científicos* and the *reyistas* in making a viable challenge to his presidency since neither group was willing to disturb the order established. Only the *caciques* posed any real material resistance to the Porfirian state in the earliest years, but they were replaced quickly by loyalists when they grew too strong. [190] The removal of independent thinkers from the political scene consolidated the political machine built by Porfirio Díaz. The Porfiriato effectively induced even more definition of social structures, as the regional discrepancies in economic performance grew substantially. The differing primary economic activities of the northern (mining and ranching), central (wheat and grain) and southern (sugar and sisal) districts were the reasons behind the growing inequality of income. By creating an economic structure based on domestic concessions and favours, aided by foreign capital, Porfirio Díaz had effectively suppressed the formation of a viable entrepreneurial class. These classes provided greater political challenges in other Latin American economies.

Despite the complex arrangements of the Porfiriato, Buffington and French argue that the Porfiriato was 'hardly a dictatorship'.[191] In reality Porfirio Díaz held direct centralised power in Mexico City only and required the aid of a 300 strong force of local *jefes políticos* (which he controlled indirectly) to maintain any sort of power in

[189] Buffington and French in Meyer and Beezley (2000).
[190] Ibid.
[191] Ibid., p.415. Having said that, despite sticking to his original policy of no re-election in 1880, the authoritarian tendencies were not far away as he reclaimed power from his handpicked successor four years later, and then held on to the presidency until 1911.

the other regions. [192] These *jefes políticos* had replicated the states power networks for themselves at a localised level, enabling them to frequently undermine municipal governments and serve the state's interests throughout Mexico. This relationship, however, would become increasingly problematic to maintain towards the end of the Porfiriato, as central government simply demanded too much of the *jefes*.[193] It is interesting to examine Mexico's local government of this period in different parts of the country, thereby assessing the centralised power of the state.[194] Perhaps this accounts for the regime's anxiety to promote the expansion of the telegraph's relevance.

During the last quarter of the nineteenth century, for many, the Porfiriato became almost synonymous with the idea of Latin America's progressive dictatorship. On the one hand, Porfirio oversaw the creation and build-out of the country's railroad network, and modern cities, encouraged immigration and foreign investment and oversaw the start of industry.[195] Despite being originally aligned to the liberalists, Porfirio Díaz even gained the support of the conservative hegemony and eventually sought closer ties to the Catholic Church.[196] Yet on the other hand, the rich got richer, while the poor got poorer. Exports boomed but food production slowed and there was increasing concentration of landownership. [197] Hence, although industry produced new products, many could not afford them as wages were low (and falling) while food prices were high. Toward the end of his regime, the situation worsened considerably and two of the largest industries, agriculture and textiles suffered disastrous setbacks after 1907. Rural workers were largely landless, and urban

[192] For an example of local regional power, see the bourgeoisie's successful resistance to *Cardenismo* in the state of Monterrey: Saragoza A. M., *The Monterrey Elite and the Mexican State, 1880-1940* Austin, University of Texas Press (1988), chapter 8.
[193] See Buffington and French in Meyer and Beezley (2000).
[194] Friedrich, Benjamin, Joseph and González González give excellent accounts of regional history and the influence of local institutions. Benjamin A., *A Rich Land of Poor People: Politics and Society in Modern Chiapas* Albuquerque, University of New Mexico Press (1989), Joseph G. M., *Revolution from Without: Yucatán, Mexico and the United States, 1880-1924* Cambridge, Cambridge University Press (1982), Friedrich P., *Agrarian Revolt in a Mexican Village* Englewood Cliffs, Prentice Hall (1970). González González L., *Pueblo en vilo: Microhistoria de San José de Gracia* México D.F., El Colegio de México (1972).
[195] The telegraph network expansion that took place under Porfirio Díaz from 1877 would not stop until 1910, at which point the national network had grown from 8,000 km to 40,000 km and the railways had expanded from 678km to 19,300 km. See Mexico, Memoria de la Secretaria de Fomento de 1865 a 1891 *Archivo General de la Nación* Galera 5 (various years) and Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos* México D.F. (various years).
[196] Halperín Donghi (1993).
[197] For an exploration of the nineteenth century export boom see Topik S. C. and Well A., *The Second Conquest of Latin America: Coffee, Henequen, and Oil during the Export Boom, 1850-1930* Austin, University of Texas Press (1998).

workers (and small businesses) were heavily losing out; Porfirio Díaz did not come to the aid of either.[198] 'The dictatorial state that had earned plaudits during the prosperous years from 1876 until 1899 became, after 1900, the object of a crescendo of criticism. The economically vulnerable regional elites were becoming fed up with Porfirio Díaz and were chafing at their lack of political influence'.[199] Porfirio Díaz's methods in dealing with resistance may not have been in the national interest, but they were certainly effective and maintained his strong reputation abroad, as he frequently paid off potential adversaries rather generously.[200] Such practices would ultimately delegitimize his regime and the hypocrisies of Porfirio Díaz's 'social democracy' by 1910 could no longer be tolerated and the legitimacy crisis that ensued brought about his demise.[201]

A realistic challenge to Porfirio Díaz's monopoly of power was only going to be credible with backing from the powerful northern territories (closely linked to the U.S. economy) and sure enough it came. To the increasing distaste of the localised ruling class, northern Mexico had a minimal role in national politics, but a sizeable role in social and economic importance. In the preceding decades, the region had advanced decidedly faster than the rest of Mexico, and as it began to feel the pain of a U.S. economic downturn, so too did Porfirio Díaz, as his regime crumbled around him, forcing the former dictator to flee into exile. A new constitution was drawn up in 1917, which was more nationalistic and socially progressive in an attempt to institutionalise the revolution.[202] There is an interesting academic debate surrounding this period, which questions exactly why Mexico was so economically underdeveloped. Cardoso and Coatsworth attempt to answer this in quite contrasting ways, addressing issues such as whether it was fair to lay a lot of the blame at the feet of Porfirio Díaz's regime, or whether it was more to do with the lengthy civil wars that pre-dated him.[203] For contemporary (or near-contemporary) research on a broader analysis of the Porfiriato, there are four main works to review. These are particularly insightful and provided contrasting commentaries, with two written by

[198] Hart in Meyer and Beezley (2000).
[199] Ibid., p.437. For an account of political elites see Smith (1979).
[200] Halperín Donghi (1993).
[201] Buffington and French in Meyer and Beezley (2000).
[202] Halperín Donghi (1993).
[203] Cardoso C., *Mexico en el Siglo XIX: Historia Económica y de la Estructura Social* México D.F., Nueva Imagen (1980), Coatsworth D., *Growth Against Development: The Economic Impact of Railroads in Porfirian Mexico* Dekalb, Northern Illinois Press (1981).

Mexicans, Sierra and Bulnes (two of Porfirio Díaz's greatest intellectual supporters) and two by Americans, Turner and Beals (less supportive of the Porfirio Díaz regime and from a foreign perspective).[204]

During the 1890s, first Mexico, then Argentina, experienced anti-oligarchical movements. In Mexico dissonance came from the middle classes and in Argentina, in the form of a new political order: the Argentine Radical party. In Mexico, the mass political mobilisation of the urban workforce continued right through the Revolution and for much of the first quarter of the twentieth century. There was great unity in this plight as radical socialists and conservative Catholics sometimes rallied side by side in the same group (although with little social or economic conviction). In Argentina, it was unfortunate that the newly formed party seemed overly concerned in antagonising the oligarchic authority rather than proposing positive social or economic reform. Subsequently the economic and societal structures of Argentina and Mexico were much unchanged throughout the period of export-led growth, as these movements failed to instigate any real reforms until later.[205] Arguably the first signs of genuine instability and need for wider popular support in these oligarchic hegemonies came during the 1920s, as the power circles built in the aftermath of war were socially, narrowly based. Argentina attempted to improve the situation with democratisation within a more liberal constitutional framework, while Mexico tried to broaden the social base by means of a social revolution. Neither turned out to be particularly successful, as Latin American economies across the board slowed and social progress waned. Following so many years of relatively strong overall economic expansion, the crisis that would ultimately ensue would be a harsh reality for Latin America to face up to.[206]

c. The Politics Leading up to and after the Depression

The relentless attempts to bring about change in Argentina were finally successful in 1916 when Hipólito Yrigoyen (1916-1922 and 1928-1930) became the first 'democratically' elected president of Argentina. He formed an unusual coalition that

[204] Sierra J., *México y su Evolución Social* México D.F., J. Ballescá y Compañía (1901), Bulnes F., *El verdadero Díaz y la Revolución* México D.F., Ediciones Coma (1920), Turner J. K., *Barbarous Mexico* Austin, University of Texas Press (1910), Beals (1932).
[205] Halperín Donghi (1993).
[206] Ibid.

included the support of the middle classes of the riverine provinces, the popular urban vote, and the backing of the disgruntled elite. Yrigoyen formed new governmental allegiances with the labour unions of large cities, offered decisive support and passed beneficial reforms to the rural classes, effectively turning his party into an unassailable electoral machine in alignment with the existing social order.[207] The dwindling power of the previous oligarchs in politics fell further during the course of Yrigoyen's tenure and beyond, as the political voice of the rising urban middle classes grew.

Yrigoyen's UCR party also sought support from the working classes later on, but the opposing Socialist Party was very much its own movement and in the 1920s the party was restructured into the *Partido Socialista Independiente*, which gained ground during the 1930s as the period of 'patriotic fraud' damaged the UCR. By this stage trade unions were largely accepted and hence the *Partido Socialista Independiente* included the defence of consumer interests within its social reforms, with its core base remaining the skilled workers of the railway, utility and capital intensive manufacturing companies. The Radical government could not sustain its position, however, as it was not able to adapt fiscal policy to the economy's changing needs.[208] Further, exports plummeted in 1930, hindering the state's capacity to redistribute income or democratise the political system.[209] Critics argue that the fall of democracy in Argentina, was primarily down to Yrigoyen's abuse of power, political favouritism and unwillingness to strengthen democratic institutions. After 1930, nationalism and socialism, not democracy, became 'the principal ideological forces'.[210]

From the end of the nineteenth century to the start of the Second World War, a number of events, including the collapse of the PAN and the democratic electoral reforms of 1912, seemingly indicated that the political sphere in Argentina was becoming relatively more class conscious and institutionalised. However, despite the various reforms that took place in Argentina, there was no integration of class-based

[207] Ibid.
[208] For instance, it never altered the country's tax structure (which was dependent on imports), and as the crisis hit imports and therefore government revenues, the currency soon lost its backing in gold.
[209] Halperín Donghi (1993).
[210] Lewis C. M. (2002), p.217.

party politics. Whether this was to be blamed on military intervention or the 'explosion' of Peronism was irrelevant; the point was the 'Progress' that was promised by the democratic rule was to a large extent not achieved. In 1946, the trade unions and a section of the military formed the *Partido Justicialista* (PJ). PJ was many things, but first and foremost it was the party of labour and nationalists, which 'continued to be dominant strands in Peronist rhetoric and strategy'.[211]

The Beginning of Peronism in Argentina

Populism across Latin America was borne typically out of the emergence of an industrial elite and a re-energised labour movement, who struck a powerful alliance.[212] In Argentina, populism came under Perón's first tenure in 1946.[213] Perón's populist coalition was one of the most powerful in Latin American history.[214] Under Perón's first term, the salaries of the urban workforce in Argentina were comparable levels to those of Europe. In order to consolidate his political supremacy, Perón made the urban workers the most important ally of the state, and also retained close ties to industrialists and the armed forces. He nationalised the Central Bank, and re-staffed the university and the judiciary, retaining almost full exclusivity of the national press and radio. With his re-election in 1951, he consolidated his power even further and the organised labour movement arguably lost all of its autonomy. Political success came as a result of his unification of previously un-politicised groups, in whom he was able to instil a great sense of loyalty. Possibly two of the best analyses of Perón's rise to power are documented in Potash and Baily.[215]

---

[211] Ibid., p.203.

[212] Populist regimes typically share two features, that is: they are primarily authoritarian and they represent the interests of the classes. However, it must be considered that populism in politics takes on different meanings in different countries and different settings. See Di Tella T. and Dix for some of the best overall analysis: Di Tella T., 'Populism and reform in Latin America' in Veliz (1965). Dix R. H., 'Populism: Authoritarian and Democratic' *Latin American Research Review* 20.2 (1985): 29-52.

[213] Acuña M., *De Frondizi a Alfonsín: La Tradición del Radicalismo* 2 volumes, Buenos Aires, Centro Editor de América Latina (1984), Schoultz L., *The Populist Challenge: Argentine Electoral Behaviour in the Post War Era* Chapel Hill, University of North Carolina Press (1983), James D., 'The Peronist Left' *Journal of Latin American Studies* 8.2 (1976): 273-396.

[214] Note that by 1945 Perón already was simultaneously vice president, minister of war and secretary of labour. For an excellent *coda* on Peronism, see McGuire J. M., *Peronism Without Perón: Unions, Parties, and Democracy in Argentina* Stanford, Stanford University Press (1997).

[215] Potash (1969, 1980), and Baily (1967). Also see Most B. A., 'Authoritarianism and the Growth of the State in Latin America: An assessment of their impact on Argentine public policy 1930-1970' *Comparative Political Studies* 13.2 (1980): 173-203. For a specifically confrontational presentation of Peronist statism, refer to Waisman (1987).

In the beginning of Perón's tenure, he achieved economic success and reduced foreign influence in the Argentinian economy, notably nationalising the British-controlled railways and the U.S.-controlled telephone industry in 1948.[216] However, the scale of his base of working class support (with labour unions doubling in size) grew problematic in the late 1940s. Perón's unsustainable trade-off was now to penalise rural producers for the benefit of urban consumers. During his second term through to the mid-1950s, he opted to change tack and shifted away from the populist and nationalist policies that had characterised his rule in the 1940s. For instance, workers were hit with two year wage freezes to fund investment for long-term growth as he felt further economic growth could only be achieved through a reversal of his previous policies. His meticulously assembled populist coalition was threatened for the first time by class conflict. A battle against the church by Peronist radicals also weakened his grip on power, as his party began to spiral out of control. The opposition opportunistically pounced on Perón's questionable actions in the first half of the 1950s and this perceived weakness ultimately allowed them to overthrow him in 1955.[217] For commentary on Perón's first stint in power, see Luna, and for his second, see Di Tella.[218]

The Evolution of PRI Control of Mexico (until 1960)

In Mexico, over this period, the PRI continued to dominate the political sphere. One can distinguish three main periods in its evolution. First the PRI grew into power from the 1930s and 1940s. Second, from the 1940s to the 1970s, the 'all powerful' PRI dominated politics and third, during the 1980s it is clear that the PRI began to lose control. Interestingly, the erosion of the authority of the PRI was felt in some areas of the country well before others, before it was displaced. It is important to appreciate, however, that the state never lost control of Mexico. For a detailed analysis of the dominant PRI party, see the exceptional pieces by Garrido and Nava.[219]

[216] Economic growth was very robust and Perón achieved particularly strong GDP growth in his first three years, see Skidmore and Smith (2005).

[217] One example of such actions was the relaxing of state restrictions on the exploitation of Argentinian oil fields. See Halperín Donghi (1993).

[218] Luna F., *Perón y su Tiempo,* 3 volumes, Buenos Aires, Editorial Sudamericana (1984-1986) and Di Tella G. (1983).

[219] Garrido L. J., *El Partido de la Revolución Institucionalizada: La Formación del Nuevo Estado en México (1928-1945)* México D.F., Siglo Ventiuno Editores (1986). Nava C., *Ideología del Partido de la Revolución Mexicana* México D.F., Centros de Estudios de la Revolución Mexicana "Lázaro Cárdenas" A.C. (1984).

In 1920s and 1930s Mexican politics, there was certainly a consolidation of regimes. The PRI in its original form was created and Mexico developed what is referred to as a 'soft' authoritarian stance.[220] The PRI (in its various forms) dominated politics and although regular elections took place, only one political party was actually in the race from around the 1930s, with outgoing presidents recommending a successor. Democracy did not really exist (in the conventional form) since the PRI refused to acknowledge electoral defeat, when there was a meaningful challenge to the presidency, meaning they 'won' every election until the 1990s.[221] The typical structures of a Western political society, such as labour unions and opposition parties served quite different purposes in Mexico.[222] Nothing was particularly standard at the PRI, as the main functions of the administrations were to maintain relations with the clientelistic network, and at the societal level to arbitrate between civil society and the central administration. Further, they were to skilfully organise social demands, while the federal bureaucracy implemented their policy directives. There was no broad participation in politics, and even the 'licensed' mechanisms for all sectors of society to have a political voice were more of a theoretical feature than a practical one.[223] In post-revolutionary Mexico, previous proponents of social change such as the landowners or historical sources of resistance like the military, no longer retained a political say. This afforded the PRI a great deal of autonomy in designing and implementing economic policies.[224]

Over time, the nature of the PRI changed. During the Depression in Mexico, peasants and workers became more aggressive as the agrarian reform slowed down and economic crisis continued to grow.[225] This group, with regional revolutionary parties, began to form the basis of the then named PNR party. However, when the populist, Cárdenas came to power in 1934, he was supported mainly by industrial labour and

[220] Skidmore and Smith (2005).
[221] Meyer L., 'Democratisation of the PRI: Mission Impossible?' in Cornelius W. A., Gentleman J. and Smith P. H., *Mexico's Alternative Political Futures* La Jolla, for U.S.-Mexican Studies, University of California Press (1989).
[222] Cornelius W. A., Gentleman J. and Smith P. H., *Mexico's Alternative Political Futures* La Jolla, for U.S.-Mexican Studies, University of California Press (1989).
[223] Petrazzini (1995).
[224] Halperín Donghi (1993).
[225] For an overview of the agrarian analysis over most of the twentieth century, refer to Bartra A., *Los Movimientos campesinos posrevolucionarios en Mexico, 1920-80* México D.F., Ediciones Era (1985). For a more direct assessment of *agrarismo* in light of politics, refer to Brown L. C., 'Cárdenas: Creating a *campesino* power base for presidential policy' in Wolfskill G. and Richmond D. W., *Essays on the Mexican Revolution: Revisionist Views of the Leaders* Austin, University of Texas Press (1979).

segments of the peasantry, but also the military. Cárdenas attempted to strengthen the political core by re-aligning the government with regional *caudillos*, who felt they had been let down by previous presidencies. He even sought to rebuild relations with the church, as well as the left wing of the party. This enabled the creation of large and more empowered worker unions that maintained close links to the state. Cárdenas's reorganisation of the PNR in 1938 led to the birth of the PRM. When Ávila Camacho took power in 1940, he removed the military sector from the PRM in 1941 and strengthened the popular sector in 1943. In the aftermath of the Second World War, the belief that gained ground was that domestic industrialisation would be the best chance yet to boost wealth across the country and combat poverty. A new generation of governing elite came to rule who played no part in the revolutionary conflict. Alemán Valdés was the president to lead the way (unlike his predecessors, he did not have a military background).[226] One of his first actions was to rename (almost rebrand) the party, to mark the potential turning point in Mexico's economic history. The PRM became the PRI, as the word 'institutional' was added to their political title, as if to instil greater credibility or at least signal a drive to pragmatism. Alemán Valdés' objective was quite clearly economic development, and the poor quality of the basic infrastructure seemed like a good starting point from which to introduce a huge scale programme of public works. The Mexican economy thrived in the short term due to protectionist import policies but unfortunately Alemán Valdés' government would become shrouded in corruption allegations.[227]

d. The Politics in the Second Half of the Twentieth Century

Given the economic backdrop described earlier in the chapter to the most recent period under study in this thesis and the fact that this period also coincides with huge structural developments in the telephone industry, an analysis of the political context takes on an elevated role. While a succession of contradictory policy-making evolved in Argentina during the second half of the twentieth century; despite mitigating a surge in population growth and various difficulties in exploiting its inherent natural resources, Mexico's policy-making (at least during the first half of this period) brought even greater relative economic success.

[226] Halperín Donghi (1993).
[227] Vernon (1963) provides some of the most detailed coverage of the overall political economy in Mexico in the first half of twentieth century.

Peronism and Post-Peronism in Argentina

In Argentina, a problematic cycle ensued, whereby nationalist policy-making regimes (typically Peronist and hostile to the market and foreign trade) were replaced by liberal policy-making regimes (strong anti-Peronist) every few years. One of the most effective aspects of Peronist Party politics in the second half of the twentieth century was the labour movement. Perón had continually sought to represent unorganised workers and with the aid of government intervention, wages and working conditions improved materially. Even so, the labour movement was never able to consistently influence the post-1955 regimes and their power diminished further by inter-union feuds. In acceptance of their reduced status, some factions of organised labour thought it would be best to try and work with, rather than against, the incumbent civilian or military regime. Organised labour was now divided into the anti-Peronist (supporters of Pedro Aramburu [1955-1958] and socialist/classist views), and pro-Peronist, which were further split between purists (remaining entirely loyal to the exiled Perón) and neo-Peronists (who favoured cooperation with the government).

The administrations of Eduardo Lonardi (September – November 1955) and Aramburu found it very difficult to overcome and re-establish the macroeconomic stability necessary for sustained growth. However state intervention was required especially since foreign investment was lacking.[228] During the tenure of Arturo Frondizi (1958-1962), the labour unions that had lost strength after Perón began to revive and they worked on rationalising and restructuring state entities, which induced a military response against the strikers. Frondizi faced a difficult situation as he was caught between the Peronists on the one hand, and the military on the other. The military was beginning to claim a greater degree of autonomy compared to the constitutional government. Stronger economic growth during this period would have eased these political pressures, but despite Frondizi making some of the severest adjustment plans in Argentina, fundamental economic change was not attainable in this context of chronic instability. For his radicalism, he faced some 32 attempted military coups, before he was overthrown. José Maria Guido took the transitional

[228] Gerschunoff and Llach (2003), Lewis P. H. (1990), Rapoport (2000).

presidency (1962-1963), for a period which revealed internal military conflicts and further economic deterioration.[229]

President Illía, from the Radical party, followed and was determined to bring back electoral freedom and end military repression toward the government. Argentina experienced strong economic expansion for the following couple of years before the recovery began to weaken by mid-1965.[230] By this point, the Peronists had rebuilt a great deal of their political base and their power was based firmly on the labour unions, but now, '...the labour leader had begun to imagine a Peronism without Perón'.[231] The Peronist movement tried to remerge in the political sphere, but at the threat of this, the military overthrew Illía and swore in the new military president, Juan Onganía (1966-1970).[232] The overthrow of Illía's constitutional government had media backing, as journalists (loyal to the military) took it upon themselves to inform the masses that the armed forces and labour unions were the *real* factors of power in politics. Onganía began his tenure by attacking the threatening cultural revolution that had started over a decade earlier. The targets included universities, and the cosmopolites of Buenos Aires; it was a project of 'cultural and ideological purification'. [233] The labour unions long opposed Onganía's economic policies also.

Halperín Donghi argues that 'Argentina's path through dictatorship and re-democratisation was more turbulent than any other' country.[234] The military already was giving up the idea of control of the national government in 1970, and by 1972 Alejandro Lanusse's (1971-1973) efforts to stop Perón from returning from exile would prove to be in vain. Meanwhile Peronism had returned to Argentina in early 1973, as Héctor Cámpora (May – July 1973) ascended to the presidency. Despite merely asserting that he was holding the fort as it were, until Perón returned, he attempted (in a notably short space of time) to implement wide reaching reforms that would ingeniously try and unite the entire nation. It was a big task and an even bigger one in the face of escalating violence, and although it brought a significant economic boom in the early part of Raul Lastiri's tenure (July – October 1973), its

[229] Halperín Donghi (1993).
[230] Ibid.
[231] Ibid., p.316.
[232] Collier D. (1980).
[233] Halperín Donghi (1993), p.318.
[234] Ibid., p.354.

effect quickly faded. In 1973 the long awaited return of Perón happened. Although divisions had grown among his supporters, increased political violence paved a path for his return. Perón retained his established truce with the Radical party and put together a ruling *Justicialista* coalition, incorporating a wider range of political groups. The fact that the Peronist Youth had received almost an equal amount of legislative slots as the Peronist labour unions induced some inter-coalition conflict. This meant that Perón had to politically isolate the Peronist left, and get rid of the *Justicialista* coalition's left wing elements.[235] During the May Day celebrations of 1974, it was clear how divided Peronism had become.[236] Moreover, organised labour seemingly posed a greater threat now than the insurgent left.[237]

Peronism saw a number of structural changes over time but they were even more pronounced after 1983, when the PJ became relatively more open, allowing its supporters to have greater input in the presidential selection processes. However, the democratic start weakened under Menem from 1989, who ascended to power on vague promises, slogans rather than defined policies and an anti-UCR vote more than anything else.[238] Although the PJ was theoretically 'in power'; in a very short space of time, Menem departed from the party's traditional nationalistic policies favoured by Perón, and instead ruled by continual issuance of decrees of urgency and necessity (thereby reducing the credibility of the political system). A lack of party democracy and discipline ensured that Menem retained the presidency through

[235] For a general Latin American insight into the political left, see Castañeda J. G., *Utopia Unarmed: The Latin American Left after the Cold War* New York, Alfred A. Knopf (1993). For studies on the Argentine political left (especially in the inter-war period), see Tamarin D. *The Argentine Labor Movement, 1930-1945: A Study in the Origins of Peronism* Albuquerque, University of New Mexico Press (1985), Munck R., *Argentina from Anarchism to Peronism* London, Zed Books (1987), and James (1969). For analysis of the Mexican left, Carr is one of the most prominent academic figures. A useful account of the whole twentieth century can be found in Carr B., *Marxism and Communism in Twentieth-Century Mexico* Lincoln, University of Nebraska Press (1992), but for a more detailed view of the specific periods, see Carr B., *El Movimiento Obrero y la Politica en México, 1910-1929* México D.F., Ediciones Era (1981). For the earlier period refer to Fuentes M. M. and Araujo O. R., *El Partido de la Internacional Comunista, 1919-1943* México D.F., Ediciones 'El caballito' (1973), between 1919-1943 see León S. and Marvan I., *La Clase Obrera en la Historia de México: En el Cardenismo 1934-1940* México D.F., Siglo Veintiuno Editores (1985). For the Cárdenas years and for the latter part of the twentieth century see Carr B. and Montoya A., *The Mexican Left, the popular Movements, and the Politics of Austerity* San Diego, Center for US–Mexican Studies, University of California (1986), and Carr B., 'The Creation of the Mexican Socialist Party' *Journal of Communist Studies* 4.3 (1988): 339-341.

[236] One symbolic indication was the way in which the exit of the Peronist Youth (plus sympathisers) from the celebrations was greeted by a wave of noisy insults.

[237] Halperín Donghi (1993).

[238] When Menem came to power in 1989, this was the first time in 70 years that an opposition party had won the elections.

targeted corrupt alliances. His tenure was testament to the instability of Peronism in power and specifically marked a return to populism and authoritarianism.[239]

Throughout the period, it is apparent that Argentina's interventionist policies not only failed to achieve the desired economic and social objectives, but also encouraged greater inefficiency in the administrative and production processes. Rent-seeking was rife, inequality of income increased and a series of economic failings generated substantial social unrest. Neither the neo-structuralist accumulationist strategy nor the neo-authoritarian internationalist strategy that followed solved Argentina's economic woes. In Argentina, the UCR and the PJ in practice held a duopoly over politics from the 1940s to the 1990s. The exclusion of other political parties was most clearly underpinned by the loose structure of the parties. Although Argentinian politics had somewhat 'opened up' in this period, this process did not come without problems. It could be claimed that the political history of Argentina over this period was essentially a story of unresolved conflict. Regional conflict at the end of the nineteenth century, changed into social and political conflict at the turn of the twentieth century, which quickly assumed a class dimension and became intra-sectoral conflict in the second half of the twentieth century. The conflicts may have changed in nature (and visibility) but they remained constant and unresolved, which ultimately contributed to the lack of consensus surrounding the role of the state in the economy as well as society. Politics of all the political parties had brought the role that the state played with the dominant interest groups into question, as the political class was somehow continually able to distribute and safeguard limited strategic resources to itself during the bad times and foster a facade of equality and democracy during the good times.[240] With regard to the telephone sector over this period, it is likely that this story of Argentinian conflict (especially in the third quarter of the twentieth century) was potentially a constraining factor to rapid telephone diffusion (see chapter 3, section *The Period of Nationalisation*).

[239] Walter (1977), Alonso (2000), Hora (2001).

[240] Halperín Donghi provides an invaluable analysis of Argentina's political development over this period: Halperín Donghi T. H., *Argentina, la Democracia de Masas* Buenos Aires, Editorial Paidós (1983).

The Evolution of PRI Control of Mexico (from 1960)

In Mexico, the evolving nature of the PRI continued throughout the period of the 'Mexican economic miracle' years as Alemán Valdés was succeeded by Ruíz Cortines and then by López Mateos, who would together attempt to modernise Mexico while the economic backdrop remained favourable. In the second half of the century, most Mexicans accepted that the ruling developmentalists were not going to come good on their promise of social justice, but effectively they had achieved some sense of political stability (and therefore more time in power) as a result of their overall relative economic successes. Mexico's overall achievements were unmatched largely across all of Latin America. These advances, however, also drove income inequality even higher to a level that could not be matched across Latin America.[241] These were the first signs that the PRI's long lasting stability would not endure, and despite attempts to appease opposing political interests by offering some seats in the Chamber of Deputies, it was clear the PRI had no desire to surrender any of their political power.[242]

The growing concentration and frustration of the middle classes in Mexico City ultimately escalated into serious violence in 1968.[243] For the first time in some time, other large groups such as student bodies, rallied and although the bloody massacre of protestors that followed temporarily silenced political discord, these actions alienated the young political class of Mexico.[244] Protests against the relative authoritarian style regime continued to demand change in the form of new faces, a more modern style of governing, and an open discussion on societal issues. Between 1962 and 1971, not only did the protectionist policies of the state expand, it implicitly indicated that their path of development would ultimately crumble.[245] 'Stabilising growth' was effectively over, and it was Echeverría who took on the task of steering Mexico out of the economic mess. Echeverría failed in his attempt to restore the stability witnessed during the Alemán Valdés era. He combined egalitarian and popular mobilisation with political liberalism to appease the

[241] Halperín Donghi (1993).
[242] For instance when Gustavo Díaz Ordaz (1964-1970) became president in 1964, the PRI leaders rebutted any attempt at internal democratisation. Moreover, when the *Partido de Acción Nacional* managed to win some municipal elections in northern Mexico, the victories were quickly annulled.
[243] Cárdenas (2000).
[244] For interesting analysis of the student movement, see Ramirez R., *El movimiento estudiantil de Mexico: Julio-diciembre de 1968* 2 vols, México D.F., Ediciones Era (1969).
[245] Cárdenas (2000).

protesters' demands (yet simultaneously ending the privileged positions of the governing elite). Despite facing a natural slowdown in the economy and a loss of perceived invulnerability in his party, initially he was able to engage both the young protesting elite and the frustrated masses successfully as he took over the presidency in 1970. However during the 1970s, the PRI undertook an extensive review of its economic options, as other Latin American economies had, in light of greater public unrest.[246] Echeverría had become the most prominent critic of the governmental institutions he oversaw. He attempted to mend the government's relations with the masses by implementing the *Cardeñista* heritage that had been popular in the 1930s, but given the marked discrepancies between the Mexico of 40 years ago and the Mexico of the 1970s he was destined to fail.

During the early 1970s, there was still much unrest from the middle classes of Mexico City, who were aligning themselves increasingly with the resurgent *Partido de Acción Nacional* (PAN party) (parts of industrial labour were also becoming estranged from the political establishment).[247] Echeverría did not help matters when he authorised the landless to invade irrigated properties in the north, and rumours of a military coup quickly surfaced. Individuals grew unhappy with the PRI governments, which were seen more and more as authoritarian and undemocratic. Echeverría's perception was that if the inherent economic problems were solved, people would be happy to continue with the PRI in power. Echeverría had failed to solve these problems, and in 1976 López Portillo (1976-1982) relieved him of his duties.

López Portillo oversaw an institutional revolution that moved toward discipline and austerity. The rules governing the *ejido* were reformed (unsuccessfully) although newly found oil reserves picked up some slack from a poorly productive agricultural sector. Under López Portillo's administration, the state sector expanded so rapidly that by the end of his tenure, the state indirectly controlled some 80% of the total economy.[248] During the 1980s, economic woes (a fall in oil revenue and debt accumulation etc.) turned into political tumult and the PAN party (with allegiances to

[246] Halperín Donghi (1993).
[247] Benjamin in Meyer and Beezley (2000).
[248] Camp in Meyer and Beezley (2000).

the church and conservative business) gained influence. In 1982, de la Madrid was elected into office, with particular backing from the northern part of the country, '...where economic growth had always been less dependent on state patronage and the local elite were therefore less beholden to the government'.[249] De la Madrid inherited a country that faced the worst recession since the Depression. [250] Improvements finally came in 1987, revealing once again the resilience of Mexican political institutions. Politically, he had opened up the system to strong competition from opposing parties. He improved relations with the private sector and began to privatise many of the SOEs. As Halperín Donghi argues, the 1980s for Mexico, in many respects closely resembled the end of the Porfirio Díaz's dictatorship, as the central government once again saw its power eroded along the northern border. This was because the improvements that had come to Mexico were primarily a result of the ever expanding *maquiladora* industry. Moreover, those in power (both de la Madrid and his successor Salinas de Gotari) were technocrats, equivalent to the *científicos* of the Porfirian times. [251]

The changing outward nature of the PRI continued at rapid speed in this period and in the late 1980s despite a lack of credibility, the PRI sought for the first time to make their election of a presidential candidate more transparent. Salinas de Gortari was the chosen one, and despite winning by the smallest of margins, there were widespread accusations of electoral fraud. However, Salinas de Gotari managed to strengthen his hold on the presidency as time passed and eventually secured a larger portion of popular support.[252] In surrendering some political dominance to the PAN, he negotiated unrealistic dominance where he needed it most, such as in areas close to Mexico City. Salinas de Gotari continued the liberalisation programmes that de la Madrid had started and his defining moment in power was seemingly in signing the NAFTA deal (detailed earlier). This afforded him the opportunity to institutionalise his own economic reforms, as it was possible for him to inscribe them into this new internationally binding treaty. However, like many Mexican leaders, Salinas de

[249] Halperín Donghi (1993), p.371.
[250] To solve this, he faced the difficult task of lowering inflation and attracting foreign investment. Fiscal discipline and austerity remained the policies of choice and as the government reduced its subsidies on basic commodities, real wages and employment both moved swiftly to begin with.
[251] Halperín Donghi (1993).
[252] Sherman J. W., 'The Mexican Miracle and its Collapse' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).

Gotari was subjected to widespread accusations of corruption and more unfortunately in regard to the assassination of a senior PRI leader in 1994. Despite this, the PRI managed to retain the presidency until the polls, where finally they would surrender political control.

The PRI's demise was a long time in coming but when it finally did come it was dramatic. The loss of the presidency caused the party to make some harsh revisions to its practices, one of which was the decision that the next presidential candidate was required to hold elected office.[253] Halperín Donghi directs our attention to the continual staying power of the PRI, who effectively had lost their political stranglehold on Mexico in 1968.[254] Despite the erosion of their authority they still retained economic influence and the presidency for many years before they were voted out of office. Moreover, the fact that the PRI was a strong political force almost as far back as the Mexican Revolution was a dominant factor in Mexico's stabilising success and so too, was the 1917 Constitution, as it placed few constraints on presidents.[255] This was potentially an important factor in determining the success of ICT diffusion in Mexico.

Latin American economic history during much of the twentieth century was governed by three main types of states: the economically/socially active state, involved in interventionism and welfarism (1930s-60s); the populist state, involved in ISI/stabilising growth (middle of the twentieth century) and the market-friendly, neo-populist state involved in securing international acceptance again (from the 1970s). Argentina and Mexico adopted these strategies with varying degrees of success and the role of the state is thought to have been the differentiating factor. Although the degree of power of the PRI in Mexico varied with time, it nonetheless was a more politically stable system than that experienced in Argentina for much of the period. One of the few limitations to their executive powers was the *sexenio*, although there was such centralisation of policy making that *presidencialismo's* inter-temporal agreements were reached between incumbent and successive

[253] A rule that disqualified all the PRI presidential candidates since the 1970s.
[254] In October 1968, the Mexican army violently suppressed student demonstrations in México D.F.. This made the urban elite, intellectuals and some government officials aware of the dubious moral stance of an authoritarian state that required violence against students to maintain its position. See Halperín Donghi (1993).
[255] Haber et al. (2003).

administrations, meaning that policies were not only stable but coordinated. [256] Although it may seem that Argentina had a stronger economic platform to leverage from over the better part of telegraph and telephone diffusion, it could be argued that perhaps the nature of the Mexican political domain afforded Mexico greater opportunity to implement ICT diffusion-enhancing policies.

1.2 The State and the Role of ICT in Latin America

The notion that the state matters particularly resonated in the two case studies under consideration. Ordinarily state action is expected to take on an enhanced role in developing economies. It is important to understand the roots of the relationship between the state and the given technology, against the historical and economic backdrop. This section examines the link between state formation and the role of technology across countries in general, and then focuses specifically on this relationship in Argentina and Mexico.

In most countries, the provision of telecommunication services comes under the aegis of the state. The telegraph and the telephone are considered to be types of consumer goods with characteristics of public goods. As they provide positive externalities these should be more easily available. Theoretically, the profit-seeking private sector will not necessarily provide these goods most efficiently, given the generic problems of 'competitive inefficiency' in developing economies. The high costs of infrastructure, and necessary homogeneity of the network to ensure interconnection of the national network, as well as the need to provide universal service, are key reasons why the telecommunication sector is considered a natural monopoly. Given its strategic importance, the solution is therefore often found in government supply, and consequently these goods tend to be monopolies of the state. If there is lack of competition in the market due to private monopolies, theoretically, a nationalised monopoly is a better choice as it can ensure more efficient service. Alternatively, a government may subsidise their production in the private sector. Evans rationalises that as long as the market is not characterised by the text-book model of competition, the role of the state will be important.[257] Moreover, Evans

[256] The *sexenio* is the six year term limit of the Mexican Presidency. *Presidencialismo* is the system whereby all the political and executive power lies with the president.
[257] Evans et al. (1985).

argues that relaxing the assumption of competitive markets eliminates the market's ability to stimulate or discipline entrepreneurial behaviour. Although the importance of the role of the state in allowing for successful diffusion is not necessarily a revolutionary idea, one of the aims of the thesis is to demonstrate in later chapters the extent of the dominant effect it can have on the diffusion process.

The state can act as a substitute to typical diffusion drivers since 'with public enterprises the state becomes an active participant in production and market exchange and partially supersedes the way in which the market meshes knowledge, incentives, and economic power'. [258] In Gerschenkron's theory of delayed industrialisation, Germany and Russia followed a similar path, as the state acted as an institutional substitute for the capitalist class, in their effort to catch up with England. [259] Similarly Amsden argues that Korea's industrialisation was closely linked to the pervasive government intervention which allowed the country to overcome the institutional and skill disadvantages associated with being a late industrialiser, once again placing the government in the role of substitute. [260] Durkheim sustains that the market needs a set of normative underpinnings to function orderly.[261] While North adds, that resources will not be allocated efficiently, unless these normative underpinnings receive institutional guarantees.[262] In the two case studies of this thesis it could be argued that the normative underpinnings were substituted to a certain extent due to the engaged role of the state.

State Formation and the Telegraph and the Telephone in Argentina and Mexico

In Latin America, the provision of the railways, and then the telegraph (and to some extent the telephone) were key facilitators for the formation of the state, as these technologies allowed for national integration and the consolidation of power, as well as aiding economic development. Given the political implications, it is evident why the governments across Latin America (and in Argentina and Mexico specifically)

[258] Ibid., p.57.
[259] Gerschenkron (1962).
[260] Amsden A., *Asia's Next Giant: South Korea and Late Industrialisation* New York, Oxford University Press (1989).
[261] Durkheim E., *On the Division of Labour in Society* (Translated by George Simpson) New York, The Free Press (1981).
[262] North D. C., 'A Framework for Analysing the State in Economic History' *Explorations in Economic History Elsevier* 16.3 (1979): 249-259.

were keen to finance and drive their expansion.[263] When the telegraph first emerged in the 1850s, Latin America was plagued by a significant degree of political instability. Argentina and Mexico were characterised specifically by a great deal of 'disorder'. Having recently gained independence, Mexico became obsessed with protecting its borders, while Argentina faced a continual power-struggle between Buenos Aires and the provinces at least until 1880. The continuous internal struggle and civil wars in Argentina in the post independence period meant that for four decades, it constrained the formation of a national state. Consequently, the political and social environment in which the telegraph diffused in these 'new' regions was characterised by the need for national unification and state consolidation. There was a common need across the two countries for the state to centralise power and establish 'order'. As a result, efforts were geared towards state building in the two countries, as they adopted institutional tools which would allow for the consolidation and legitimisation of their power, one of which was the improvement of communications. Oszlak points out that in order to achieve progress, order had to be established. The telegraph was thus a means to achieve state building, and state actions were critical in order to achieve these infrastructural changes. The period that ensued would be referred to as the era of 'Order and Progress'.[264]

It is interesting to note that despite Argentina's and Mexico's economic disparities during the period of telegraph diffusion, the administrations in the two countries placed a similar emphasis on the telegraph, as they were well aware of its importance in aiding state formation. For a large country like Argentina, the telegraph facilitated wide-reaching control and generally became an invaluable resource. The oligarchic states in the two countries were keen to assert control over the sector early on, and its expansion was largely driven by domestic political considerations. Provision was not exclusively handled by the state. Instead concessions were handed out to private, provincial, and railway companies, in order to mitigate the states' lack of funding and desire to build a network rapidly. The state remained a large consumer of telegraph services, and although they offered state subsidies, this was in part effectively paying for their heavy official use (which was free). The government also had priority use, while the private providers extracted extremely high rents from the

[263] De la Peña J., *Historia de las Telecomunicaciones* Barcelona, Editorial Ariel (2003).
[264] Oszlak (1982).

general public and provided a relatively poor service.[265] It is important to emphasise that the telegraph, although widely publicly available, was first and foremost perceived as a tool for national security and for consolidating the power of the state. Its role as a means of public communication was secondary. Therefore it was not so much that the governments' policies had failed in developing a universal national network at the beginning, but rather that this was not the initial goal.[266]

With regard to the provision of the telephone, when the technology was first introduced, Argentina's and Mexico's governments had heavily invested in the telegraph. Hence the telephone was commonly perceived as a potential threat to the already widespread telegraph system, which to all intents and purposes was a 'successful' means of communication that facilitated their rule. Consequently the administrations in Argentina and Mexico regarded the telephone as a secondary means of electrical communication. It certainly was not viewed as imperative to national security as the telegraph. The lack of initial governmental interest was apparent as no steps were taken to make the telephone a state monopoly initially, nor did they engage in offering state subsidies (as with the telegraph). The telephone's successful expansion was a less pressing matter on the governmental agenda; accordingly, governments assumed minimal responsibility for the regulation of the telephone companies and were happy merely to grant licenses.[267] As a result, despite relatively healthy economic growth and significant foreign investment in the two countries at the start of telephone diffusion, this had a negligible impact on the early years of the process. Only once perceptions began to change towards the telephone, with the Argentinian and Mexican governments taking a more prominent role in its diffusion (through nationalisation, then privatisation), did a significant spurt in its diffusion occur.

---

[265] Noyola L., *La Raza de la Hebra: Historia del Telégrafo Morse en México* Puebla, Universidad Autónoma de Puebla (2004), De la Peña (2003), Bieber L., *Las Relaciones Económicas de Bolivia con Alemánia 1880-1920* Berlín, Colloquium (1982), Telecom, *Historia de las Telecomunicaciones en Colombia* Bogota, Telecom (1970).

[266] Oszlak (1981), Baur C., 'The Foundations of Telegraphy and Telephony in Latin America' *Journal of Communication* 44.4 (1994): 9-25.

[267] Berthold V. M., *History of the Telephone and Telegraph in the Argentine Republic, 1857-1921* New York, AT&T (1921a), Berthold V. M., *History of the Telephone and Telegraph in Colombia, 1865-1921* New York, AT&T (1921b), Berthold V. M., *History of the Telephone and Telegraph in Uruguay, 1886-1925* New York, AT&T (1925), Tesler M., *La Telefonía Argentina, Su Otra Historia* Buenos Aires, Editorial Rescate (1990), Pérez R. M., *Los Telefonistas Frente a la Crisis y la Reconversión* México D.F., Editorial Nuestro Tiempo (1989), Brock G. W., *The Telecommunications Industry, the Dynamics of Market Structure* Cambridge, Harvard University Press (1981).

Theoretically private providers will not supply service to less profitable (rural) areas, and given the fact that the market was 'imperfect', the case for state intervention, as argued by Evans, Rueschemeyer and Skocpol, was even more significant to ensure distributional goals.[268] Whether this happened is not important, but rather the concept is a theoretical one: arguing that due to the nature of the technologies under study and given the environment of the two countries in which diffusion took place, the enhanced role of the state was logical. Having said this, it is essential not to '...fall into the functionalist trap of assuming that because the state is "necessary" it will therefore have the inclination and capacity to fill the required role'.[269] This argument is explored in chapter 5 (see sections 5.1.1 The Telegraph and 5.1.2 The Telephone). Furthermore, Evans et al. assert that 'even if state managers hit on an essentially correct policy, they will not be able to implement it unless they have at their disposal, previously constructed bureaucratic machinery with appropriate capacities for action'.[270] Hence state action can potentially positively and negatively impact the ICT diffusion process. Given its central role in this thesis' hypothesis, the state's ability to drive diffusion is examined throughout.

1.3 The Joint Supply of the Railways and the Telegraph

An important connection exists between the railways and the telegraph that is both mutually beneficial and present throughout the entire diffusion process. The telegraph was essential for the efficient operation of the railways (not just in Latin America) by allowing railway dispatchers to control the movement of trains, guaranteeing both the safety of the system and observation of the timetable. Likewise, the railways promoted the diffusion of the telegraph; as telegraph stations were set up along railway routes and as the right-of-way had been cleared it was easier to set up additional poles to carry the telegraph wires. The continuously reinforcing relationship cemented the railway's importance to the telegraph's future diffusion particularly in large 'new' countries (such as Argentina and Mexico), irrespective of whether or not the railways were built by the state. Hence with the expansion of the railways came the expansion of the telegraph network. Much research has been done on the railways, given their importance and the large amounts of foreign capital they

[268] Evans et al. (1985).
[269] Ibid., p.46.
[270] Ibid., p.61.

attracted, with Lewis and Coatsworth providing particularly useful accounts for the two countries under consideration.[271]

Internationally, Britain is perhaps one of the best examples where the development of the telegraph was almost immediately accompanied by the global expansion of the railway network: as early as 1839, railway construction became closely associated with telegraph expansion. Promoters of the telegraph concentrated significant amounts of effort upon gaining the interests of railway companies, for both financing and demand for the technology. Many developed countries (European, then later the U.S.) followed the British example by running railway and telegraph systems parallel to each other.[272] Meanwhile in Latin America the telegraph's primary use was not public communication (but rather state communication). In Europe once it was introduced, its provision became much more responsive to the needs of the public. For much of the world, in fact, the primary rationale for state control of the telegraph was due to the shared characteristics of a public good; the government could theoretically protect general public interests. However, sole construction of the network was not a financially viable option for the governments in Argentina or in Mexico.

In Argentina and Mexico, as in the rest of Latin America, the close relationship between the telegraph and the railways prevailed, mutually developing their financial and commercial markets through integration.[273] The economic and social utility of an efficient communications network is important for any country, although this was magnified in Latin America due to the vastness of its terrain and its sparse population. The telegraph and the railway were thus quickly identified as fundamental instruments to civilise the nation, unite the different regions and eventually play a key role in industrialisation and the export-led growth economy. The first telegraph was introduced in Argentina as a necessary tool for the first railway in 1857 (it

[271] Lewis C. M., *British Railways in Argentina, 1857-1914* London, The Athlone Press (1983), Coatsworth (1981). Also see Goodwin P. B., 'The Central Argentine Railway and the Economic Development of Argentina, 1854-1881' *Hispanic American Historical Review* 57.4 (1977): 613-632.

[272] The railways exclusively used the telegraph system to begin with, as Britain's first commercial public telegraph did not open until 1845.

[273] Reggini H. C., *Los Caminos de la Palabra: Las Telecomunicaciones de Morse al Internet* Buenos Aires, Ediciones Galápago (1996).

belonged to the Western Railway of Buenos Aires).[274] It was not until 1860 that the railway line was extended and the first public telegraph line was opened simultaneously, parallel to the railway, following the British example.[275] The Mexican experience, by contrast, seems closer to the U.S. The first Mexican telegraph was built by Juan de la Granja with private foreign capital, and the telegraph was only years later, in 1875, linked to the railway companies. However, because the telegraph network in Mexico took longer to develop in tandem with the railways, it does not necessarily follow that once it did, it was not even more successful than in Argentina. Indeed, in Mexico, the government actually managed to take greater advantage of this relationship earlier on (see chapter 3, section *The Role of the State: the Impact of New Laws*).

Argentina's popularity, especially among British investors, grew during 1907-1913, and from 1907 to 1916 the railway network expanded by more than 50%. Telegraph diffusion grew in line with this, as the majority of British-owned lines (between 69% and 80% of the national total from 1900-1914) initiated large-scale building programmes throughout Argentina.[276] Initially disorganised telegraph networks developed in both Argentina and Mexico, as they were constructed simultaneously by the federal and provincial government, private enterprises and the railway companies. It was hardly reminiscent of the typical European model, where the government alone coordinated all efforts, or indeed of the U.S. model, where service was privatised entirely, with little government involvement. Unsurprisingly, the administrations' decisions in Argentina and Mexico to employ a strategy mix resulted in partial regulation, shared financing and a slow and intermittent service.[277]

The focus of the chapter now shifts, and concentrates on addressing technology diffusion more directly. The roots of technology diffusion are explored first,

[274] Bahía M. B., *Los Telégrafos de la República Argentina* Estudio Técnico presentado al Director General, Buenos Aires, Imprenta La Universidad de J. N. Klingelfuss y Cía (1891). Reggini H. C., *Sarmiento y las Telecomunicaciones: La Obsesión del Hilo* Buenos Aires, Ediciones Galápago (1997). Berthold (1921a).

[275] Zalduendo, Wright, and Lewis C.M. provide particularly comprehensive accounts of the railway expansion in Argentina: Zalduendo E. A., *Libras y Rieles* Buenos Aires, Editorial El Coloquio (1975), Wright W. R., *British-owned Railways in Argentina: Their Effect on Economic Nationalism 1854-1948* Austin, University of Texas Press (1972), Lewis C. M., 'Problems of Railway Development in Argentina, 1857-1890' *Inter-American Economic Affairs* 22.2 (1968): 55-75, and Lewis C. M. (1983).

[276] Argentina accounted for more of British overseas investment than any other country in 1910, the majority of which went toward British owned Argentinian railroad development. See Lewis C. M. (1983), Lewis C. M. (2002).

[277] Bahía M. B. (1891).

followed by a review of the relevant approaches that explain the differences in ICT diffusion rates across countries.

1.4 The History of Technology Diffusion

Diffusion is defined in this thesis as the process by which an innovation is adopted by the members of a social system. Research on technology diffusion started as a series of independent intellectual enclaves. Diffusion research was divided by discipline and it was not until the 1960s that the similarities of diffusion across disciplines became widely recognised. Today boundaries between such traditions have been broken down, and there has been a complete convergence.[278] There is a significant degree of commonality regarding the diffusion of most innovations, because the pattern of diffusion almost always follows an s-shaped distribution curve.[279] In the beginning of the twentieth century, Gabriel Tarde became the pioneer of the study of diffusion of innovations, dubbed '...the main European forefather of the diffusion field'.[280] It was another 20 years, however, before further studies on diffusion followed. These were few and predominantly carried out in the field of anthropology. It was not until the 1940s that a real interest in the diffusion of innovations developed, particularly after Ryan and Gross' study, which established the original formulation of the diffusion paradigm, in considering not only why, but how, an innovation actually diffused.[281] During the 1950s studies proliferated across the U.S. and in the 1960s interest began to arise in developing countries in Asia, Africa and Latin America. Research increased significantly from the mid-1960s, testament to the fact that innovation diffusion started to be viewed as '...an integral aspect of efforts to promote economic development'.[282] Indeed, research began to reveal the specific importance of telecommunications, as infrastructure for economic and social development.[283]

---

[278] Different diffusion research traditions include: anthropology, agricultural economics, communications, education, early sociology, geography, general economics, general sociology, industrial engineering, marketing & management, public health and medical sociology, psychology, public administration and political science, rural sociology and statistics.

[279] In 1903, Gabriel Tarde was the first to observe that innovations diffused following an s-shaped curve distribution. Tarde G., *The Laws of Imitation* New York, University of Chicago Press (1969).

[280] Rogers E. M., *Diffusion of Innovations* 4th edition, New York, The Free Press (1995), p.40.

[281] Ryan B. and Gross N. C., 'The Diffusion of Hybrid Seed Corn in Iowa Communities' *Rural Sociology* 8 (1943): 15-24.

[282] Brown L. A., *Innovation Diffusion, A New Perspective* London, Methuen & Co. (1981) p.197.

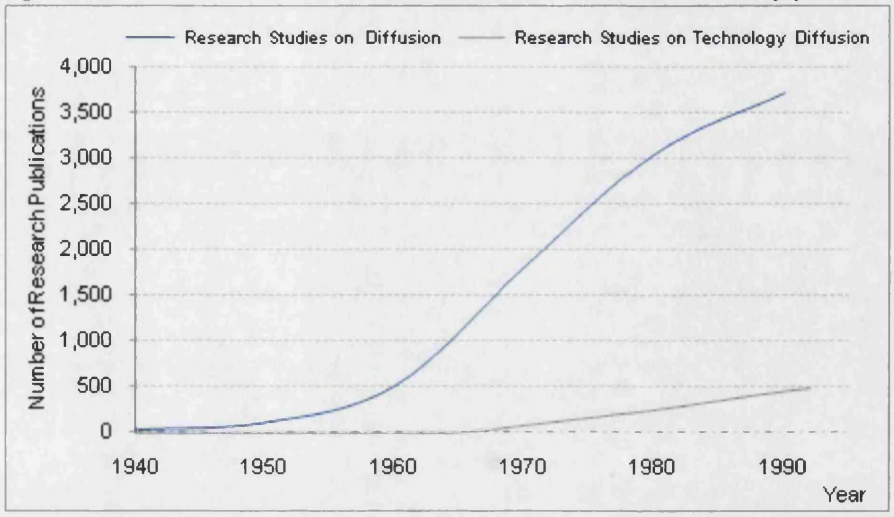
[283] Wellenius B. and Stern P. A., *Implementing Reforms in the Telecommunications Sector: Lessons from Experience* Washington D.C., The World Bank (1994).

Initially, as Rogers and Shoemaker astutely observe, diffusion studies in developing countries were carried out by North American or European researchers, or researchers from developing countries who had studied in the U.S. or Europe.[284] Consequently, these studies were characterised by, as these authors described it, a 'made in America' stamp. In other words, these studies generally portrayed the diffusion process in developing nations as similar to their counterpart in the industrialised nations. Even by the early 1970s, almost nothing of a critical nature had been written with regard to this field of research, and 'such absence of critical viewpoints may have indeed been the greatest weakness of diffusion research'.[285] The late 1970s marked the beginnings of genuine criticisms on diffusion research; questions arose about the importance of culture and different socio-cultural conditions in developing countries compared to the U.S. or Europe. This in turn sparked the debate as to whether these two types of countries could be treated in the same manner, since innovations may diffuse differently in developing countries compared to the developed world.

ICT diffusion in particular, which is the component within the general field of technology diffusion research that this thesis is concerned with, surfaced during the 1930s/1940s. However, it did not become important until the 1960s. In fact, in 1962 only around 1% of total diffusion research studies were on technological innovations, and by 1995 this had grown to 12%, or the equivalent of 484 publications.[286] This is shown in figure 1.1, which displays the number of published studies on diffusion research since 1940.

[284] Rogers E. M. and Shoemaker F. F., *Communication of Innovations: A Cross Cultural Approach* New York, Free Press (1971).
[285] Rogers (1995), p.99.
[286] Ibid.

Figure 1.1 Cumulative Number of Diffusion Research Publications (by year)



Source: Rogers (1995).

From figure 1.1, it is evident that historically research on technology diffusion has been relatively light and this gives further justification for the subject matter of this thesis, since there is obviously scope to add to the existing knowledge. During the 1970s communication scholars began to investigate the diffusion of technological innovations throughout the U.S., applying various methods; sometimes using the communities themselves as the adopting units. By the 1980s these scholars began to research the diffusion of the new communication technologies such as cable television and e-mail systems. This thesis is categorised as communications research and within that broader field, it is part of the diffusion of innovations research that concerns itself with the rate of adoption of innovations in different social systems: specifically in Argentina and Mexico.

1.5 Review of the Approaches to Different Rates of ICT Diffusion

This section provides the context from which to understand the potential explanatory factors behind the diffusion of the telegraph and the telephone in Argentina and Mexico. A survey of the literature in regard to the approaches that can explain different ICT diffusion rates across countries is detailed below. It is important to note that much of the literature review is modern-centric simply because much of the relevant and insightful literature is recent. For simplicity, the principal explanatory factors are divided into four main approaches; the economic approach (which dominates the literature), the social approach, the natural endowments approach and the institutional approach. First, each approach is defined, followed by an exploration

of their merits and the presentation of their main empirical findings. The factors within each approach were then subdivided into two groups, supply and demand. The supply side factors are those influencing the direct infrastructure build-out (network expansion). These affect diffusion since the larger the telegraph network, the greater its availability and therefore its capacity for usage in society. The other set of factors, drive telegraph diffusion by directly affecting consumer demand.

1.5.1 The Economic Approach

The economic approach encompasses those scholars who affirm that economic factors are the fundamental considerations in understanding the different rates of ICT diffusion across countries. In their work, factors such as GDP per capita, urbanisation, and human capital are seen as key explanatory variables. The supporters of this approach include the pre-eminent scholar, Everett Rogers, who formalised the renowned 'Diffusion of Innovations' in 1962.[287] The economic approach is perhaps the most commonly explored technique, and there is extensive evidence supporting the central role of economic factors in determining the rate of diffusion of a new technology. In general, a crucial deficiency of many of these studies is that they tend to focus solely on developed countries and therefore generalisations with regard to global diffusion are restricted to the developed world. Meanwhile, studies that do explore the effect of economic factors on developing countries tend to focus on modern ICTs. [288] This again means that one must be careful when making

[287] Rogers (1995). Other advocates include Hargattai and Norris who claim that economic activity is the key behind cross-country differences in the rate of diffusion of the internet: Hargattai E., 'Weaving the Western Web: Explaining Differences in Internet Connectivity among the OECD Countries' *Telecommunications Policy* 23.10-11 (1999):701-718, Norris P., *Digital Divide: Civic Engagement, Information Poverty and the Internet Worldwide* Cambridge, Cambridge University Press (2001). Other well known advocates of the economic approach are Griliches and Mansfield, although not in the context of ICT diffusion, they are still important as the pioneers in the diffusion field. Griliches used a logistical growth model on a cross-regional study in the U.S. on hybrid corn (1932-56) and shows that different diffusion rates can be explained by economic variables, and that the impact of social factors will cancel each other out. See Griliches Z., 'Hybrid Corn: An Exploration in the Economics of Technological Change' *Econometrica* 25.4 (1957): 501-522, Mansfield E., 'Technical Change and the Rate of Imitation' *Econometrica* 29.4 (1961): 741-66, Mansfield E., 'The Speed of Response of Firms to New Techniques' *Quarterly Journal of Economics* 77.2 (1963a): 290-311 and Mansfield E., 'Intra-firm Rates of Diffusion of an Innovation' *The Review of Economics and Statistics* 45.4 (1963b): 348-359.

[288] Scholars that explored ICT diffusion in developing countries include Rouvinen, and Kiiski and Pohjola. Rouvinen studied mobile telephones and divided his sample, into one with only developed countries, and one with both developed and developing countries. Rouvinen P., 'Diffusion of Digital Mobile Telephony: Are Developing Countries Different?' *Telecommunications Policy* 30 (2006): 46-63. Kiiski and Pohjola examined the diffusion of the internet across both developed and developing countries. Kiiski S. and Pohjola M., 'Cross-country diffusion of the Internet' *Information Economics and Policy* 14 (2000): 297-310. Antonelli's work is also interesting, he examined the diffusion of advanced ICTs, such as the capacity of electronic switching, across 44 developing countries in 1977-87: Antonelli C., *The Diffusion of Advanced Telecommunications in Developing Countries* Paris, OECD (1991), and Antonelli C., 'Investment and Adoption in Advanced Telecommunications' *Journal of Economic Behaviour and Organisation* 20 (1993): 227-45. Caselli and Coleman looked at the cross country diffusion of personal computers across 155 developed and developing countries from 1970-90. Caselli F.

generalisations about traditional ICTs, such as the telegraph or the telephone. Studies with large representative samples are preferred, although problems can arise precisely because of this. Accounting for differences in diffusion rates across as many as 184 countries for instance (as done by Dekimpe, Parker and Sarvary)[289], means one can end up with a more limited set of testable explanatory variables due to the difficulties in sourcing a complete data set for such a large number of countries.[290]

Economic Factors that Influence Consumption Growth

Within the economic approach, the key factors that tend to influence consumption are GDP per capita, network externalities and education as explored below.

Gross Domestic Product per capita

The extent of economic development/wealth is the best documented and most empirically tested economic variable responsible for the varying rates of ICT diffusion.[291] Often GDP or GNP per capita are used as proxies to represent this factor and they will be part of most empirical analysis on ICT diffusion. However, the fact that 'national income is the single most obvious influence' does not mean it is de facto the most important.[292] In analysing a range of disciplines, it was Rogers who originally asserted that countries with higher income levels will tend to experience a more rapid diffusion rate of new technologies.[293] Although Rogers' work is not focussed purely on ICT, it is essential reading for any researcher looking at the diffusion of an innovation, as he is one of the most prominent scholars of the wider field within which this study sits.

---

and Coleman W. J., 'Cross-country Technology Diffusion: The Case of Computers' *American Economic Review* 91.2 (2001): 328-335.

[289] Dekimpe, Parker and Sarvary examined the diffusion of the mobile telephone across both developed and developing countries (184 countries). See Dekimpe M.G., Parker P. M. and Sarvary M., 'Staged Estimation of International Diffusion Models: An Application to Global Cellular Telephone Adoption' *Technological Forecasting and Social Change* 57 (1998): 105-132.

[290] As commented upon in Singh J., 'Measurement Issues in Cross-national Research' *Journal of International Business Studies* 26 (1995): 597-618.

[291] Wealth is treated here purely in terms of economic wealth.

[292] Foreman-Peck J., 'Competition and Performance in the UK Telecommunications Industry' *Telecommunication Policy* 9.3 (1985): 215-228, p.219.

[293] Rogers (1995).

The importance of income is extensively researched, and possibly some of the most useful studies are those of Dekimpe, Parker and Sarvary.[294] In their 1998 study, which looked at mobile telephone penetration between 1972 and 1992, they found that wealth and ethnic homogeneity promoted telephone diffusion across their sample. They later discovered in their study in 2000 that network externalities were also key. Their study is useful since it engages in both insightful qualitative and rigorous quantitative analysis, providing consistent and substantial empirical evidence throughout, whilst affirming Rogers' earlier findings, in the context of ICT diffusion.[295] Dekimpe et al.'s is also one of the few studies that look separately at both the determinants of adoption and the subsequent rate of diffusion, as opposed to treating them as one.[296] Further, for comparative purposes, their extensive country sample size and unique application of sample matching, allow for powerful conclusions.[297] Studies applying global databases, such as Dekimpe et al.'s, provide a higher quality of result as they ensure the largest possible variation in both the dependent and independent variables. Gatignon and Robertson, and Mahajan and Muller, test similar variables to Dekimpe et al. and arrive at the same conclusions with regard to ICT, although they use smaller samples, and Mahajan and Muller focus on developed countries only. [298]

Another influential study is that of Littlechild, whose informed opinion – as the first official regulator of the U.K. telephone system – clearly commands a great deal of respect.[299] Littlechild used data across 99 countries in his 1975 study and although narrowly focused on regression analysis, it adds further support to this argument.

---

[294] Dekimpe et al. (1998), Dekimpe M. G., Parker P. M., and Sarvary M., 'Global Diffusion of Technological Innovations: A Coupled-Hazard Approach' *Journal of Marketing Research* 37 (2000a): 47-59. Dekimpe M. G., Parker P. M., and Sarvary M., 'Globalisation: Modelling Technology Adoption Timing across Countries' *Technological Forecasting and Social Change* 63 (2000b): 25-42.

[295] Antonelli is another researcher that used GNP as a proxy for the country's wealth and also found significant evidence to support the claims that higher degrees of economic growth within a country lead to a faster rate of modern ICT diffusion, as faster growing economies are more likely to witness a higher degree of direct investment in technological innovations. Antonelli (1993).

[296] Some studies which focus on the adoption side only include Graham S., 'Class and Conservatism in the Adoption of Innovations' *Human Relations* 9.1 (1956): 91-100, Milner H. V., *The Global Spread of the Internet: the Role of International Diffusion Pressures in Technology Adoption* New York, Columbia University (2003), Glazer A., 'The Advantages of Being First' *The American Economic Review* 75.3 (1985): 473-80.

[297] Sample matching improves comparable observations across countries, i.e. it forces researchers to make comparisons within comparable social networks to make valid statements across countries.

[298] Gatignon H. and Robertson T. S. 'A Propositional Inventory for New Diffusion Research' *Journal of Consumer Research* 11 (1985): 849-867. Mahajan V. and Muller E., 'Innovation Diffusion in a Borderless Global Market: Will the 1992 Unification of the European Community Accelerate Diffusion of New Ideas, Products and Technologies?' *Technological Forecasting and Social Change* 45 (1994): 221-237.

[299] Littlechild S. C., 'The Effect of Ownership on Telephone Penetration' *Telecommunications Policy* 7.3 (1983): 246-247.

Similarly, the International Telecommunication Union's study provides some of the most definitive empirical evidence, showing that GDP per capita explained as much as 84% of the variance of telephone penetration in their 1965 study of 30 countries (an extension of their previous ICT studies in 1955–1960).[300] The problems with these studies are twofold; firstly, they focus mostly on developed countries, and secondly and perhaps more disconcertingly, they assess the effect of GDP per capita on the rate of telephone diffusion in an isolated year. Diffusion is not a snapshot event; consequently, testing the effects of a given factor over a single year can never provide reliable generalisations for that factor's role in the rate of diffusion as a whole. The work of this thesis will thus observe the entire diffusion period in order to provide more significant findings. Despite these shortcomings, a relationship between the degree of economic development and the rate of ICT diffusion exists to a certain extent. Theoretically and even intuitively, one would expect that the wealthier a country is, the faster will be its adoption and rate of ICT diffusion, as individuals can more easily afford the 'economic sacrifice'.[301] Although higher GDP per capita should equate to more demand, the problem may not be with respect to demand, but rather supply (and poor infrastructure).[302] The Argentinian telephone diffusion case study neatly illustrates this point; where waiting lists for fixed telephone line installations were as long as 12 years in the 1960s (during nationalisation).[303] There was no lack of demand, individuals had sufficient income and desire for telephones, but they had no access as a supply problem persisted, which is directly linked to the institutions providing the telephones.

Caselli and Coleman's study is interesting because alternatively they find that the level of income had at best a weak impact on the rate of diffusion of computers across 155 countries for the period 1970-1990.[304] Meanwhile Rouvinen finds that while the rate of mobile telephone diffusion was partly explained by the income effect in developed countries, it did not have a significant effect in developing countries, across his sample of 165 countries between 1990 and 2000.[305] One may

[300] Consultative Committee for International Telephony and Telegraphy (CCITT), *Economic Studies at the National Level in the Field of Telecommunications (1964-68)* Geneva, United Nations (1968).
[301] Lee C., 'Determinants of National Innovativeness and International Market Segmentation' *International Marketing Review* 7 (1990): 39-49.
[302] Kiiski and Pohjola (2000).
[303] Noam E. M., *Telecommunications in Latin America* New York, Oxford University Press (1998).
[304] Caselli and Coleman (2001).
[305] Rouvinen (2006).

argue that in developing countries, due to their inherent economic 'backwardness', economic wealth plays a less prominent role, whereby all that is needed is a certain economic threshold, and beyond the threshold, other factors, such as the institutional environment, may be the driving force that dictates the rate of ICT diffusion (alluding to Gerschenkron's ideas in regard to industrialisation).[306]

Further, it is not just the absolute level of wealth, but the distribution of wealth within a country that is important. A high degree of income inequality can lead to a similarly unequal distribution of ICT, as it distorts diffusion patterns by becoming an elitist activity. Felix and Franco imply that this rationale was potentially an important factor in explaining the pattern of ICT diffusion in Latin America.[307] As Felix points out, the deep divisions witnessed in Latin America's socio-economic structures represent a fundamental challenge facing policy makers. Latin America, more than any other capitalist region, is characterised by concentrated pockets of wealth and, despite output growth, there have been limited positive spill-over effects for the masses. Accordingly the wealthy can adopt these ICTs quickly, as they can afford them, whereas the less wealthy cannot.

Network Externalities

Network externalities arise when technologies produce increasing returns to scale and scope. If more individuals make use of the new technology its marginal value per user increases, and there is more to be gained by new and existing users from having it. Hence, theoretically, the greater the number of users, the faster the diffusion rate should be. Unfortunately this is an issue which has not been tackled to the same degree within the literature as many of the other variables, with the notable exceptions of Milner (on internet diffusion), Katz and Shapiro (on telephone networks and facsimiles) and Rouvinen (on mobile telephones).[308] Katz and Shapiro, in particular, developed a simple model to capture the importance of these externalities, and demonstrated their significance in the context of their chosen ICTs.

---

[306] Gerschenkron (1962).

[307] Felix D., 'Income Distribution and the Quality of Life in Latin America: Patterns, Trends, and Policy Implications' *Latin American Research Review* 18.2 (1983): 3-33. Franko P. M., *The Puzzle of Latin American Economic Development* New York, Rowman and Littlefield Publishers Inc. (1999).

[308] Milner (2003). Katz M. and Shapiro C., 'Network Externalities, Competition, and Compatibility' *American Economic Review* 75.3 (1985): 424-440. Katz M. and Shapiro C., 'Technology Adoption in the Presence of Network Externalities' *Journal of Political Economy* 94.4 (1986): 822-841. Rouvinen (2006).

Network externalities are particularly relevant for the case of telegraph and telephone diffusion, since in the extreme case that you are the only person to own a telephone, it is rendered useless. As Antonelli points out, however, these types of telecommunication technologies, which experience such (positive) network externalities, are also likely to experience negative externalities as the number of subscribers increases.[309] Congestion effects will negatively impact the quality of communication and the failure rate of calls. Moreover, as Rouvinen's study shows, these issues are likely to be more important in developing countries, where infrastructure is, in relative terms, more expensive to build and maintain and the possibility of increasing returns to scale is further incentive. Dekimpe et al. provide strong corroborating evidence in the case of mobile telephones.[310] Indeed, although primarily a consumption driver, a '...widely recognised imperfection in infrastructure services is economies of scale due to network externalities'.[311]

Education

Although more emphasis is often placed on the degree of economic wealth, economic factors such as human capital are also given a high level of priority in explaining a country's rate of ICT diffusion. Mokyr, in his largely historical narrative, declares that 'in the lingo of economics, human capital and technology are complements'.[312] The argument that enhanced education will result in individuals becoming aware of the new technology sooner and increase their ability to utilise it, was originally proposed by Nelson and Phelps in their analysis of capital structure and technological progress.[313] Notionally, literacy levels may not be directly correlated with the diffusion of the telegraph and the telephone since users do not need to know how to read or write. However, Caselli and Coleman argue that an educated population will feel more empowered to use such technologies. Although these authors make no reference to the existing literature, they provide strong

[309] Antonelli (1986).
[310] Dekimpe et al. (2000b).
[311] Esfahani H. S. and Ramirez M. T., 'Institutions, Infrastructure, and Economic Growth' *Journal of Development Economics* 70.2 (2003): 443-477, p.447.
[312] Mokyr, J., 'Thinking About Technology and Institutions' presented at Macalester International College Roundtable Prometheus's Bequest, *Technology and Change* (2002): 1-31, p.1.
[313] Nelson R. and Phelps E., 'Investment in Humans, Technological Diffusion, and Economic Growth' American Economic Review 56 (1966): 69-75.

empirical evidence (for the diffusion of computers) and it is one of few studies that examines diffusion as a process (rather than a snapshot).[314]

Perhaps one of the most powerful research pieces is the work of Kiiski and Pohjola, who add critical depth to the education argument, examining the rate of diffusion of the internet and the associated role of education.[315] In the sample of developed countries, education had no significant impact on the rate of internet diffusion, whereas for the whole sample (developed and developing countries), education became a key explanatory variable. Rosenberg also argues that it is not just the existence of education/technical skills that is of relevance, but more importantly how these skills are acquired.[316] Although Rosenberg's study is of a much more general nature (in focussing on a range of technologies), his work is important because he is a prominent figure in the literature and many of his arguments were key in originally driving this research field. He argues that the extent to which skills can be transferred from the old to the new technology will also play an important role in determining the speed of diffusion rates. Wozniak interestingly argues that since education reduces information costs and uncertainties of adoption, the effect of education diminishes after a certain threshold is achieved.[317] Therefore education is likely to have a positive impact on the diffusion rates of traditional ICT only up to a certain level, in the same way that after a certain level of income, further income will not necessarily translate into faster rates of diffusion. This is logical since, as the population reaches a given degree of literacy, diffusion rates for these types of technologies (which require no prior knowledge to use) are not affected by a marginal increase in the rate of education.

[314] Caselli and Coleman (2001). Also see Milner for corroborating findings for internet diffusion: Milner H. V., 'The Digital Divide: The Role of Political Institutions in Technology Diffusion' *Comparative Political Studies* 39.2 (2006): 176-199.

[315] They used average schooling years as their educational proxy, which some may argue is not the best assessment of educational attainment, although their findings are innovative and rigorous, Kiiski and Pohjola (2000).

[316] Rosenberg (1972).

[317] Wozniak G., 'Human Capital, Information and the Early Adoption of New Technology' *Journal of Human Resources* 22 (1987): 101-112. Also see Romer P. M., 'Endogenous Technological Change' *Journal of Political Economy* 98.5 (1990): 71-102.

Economic Factors that Influence the Expansion of Infrastructure and Access

Within the economic approach the key factors that tend to influence infrastructure expansion are urbanisation and population growth, FDI and the latecomer advantage, as explored below.

Urbanisation and Population Growth

Two closely linked variables which many advocate as going a long way towards explaining ICT diffusion rates are urbanisation and population growth (and population density). This is pertinent in the context of Latin America, as the region underwent significant growth of both especially during the earlier years of the period under examination, which in the case of Argentina and Mexico led to the development of primate cities.[318] There is a strong relationship between the level of urbanisation (or population density in general) and the availability of infrastructure. Infrastructure typically clusters in urban hubs since these areas tend to be more profitable. Therefore, increased urbanisation rates potentially translate into faster diffusion.

Best and Maclay observe modern ICTs in developing countries and maintain that a high degree of urbanisation will provide the 'best' environment for rapid diffusion, as large telecommunications companies will give priority to urban markets and will be more reluctant to enter smaller (and less profitable) rural ones.[319] Although their logic seemingly holds, their findings are not supported empirically or by means of a theoretical model. Fischer and Carroll's claims are stronger as they examined U.S. telephone diffusion between 1902 and 1937, and provide evidence that commercialisation in urban centres created an economic environment which generated faster telephone diffusion.[320] However, Fischer and Carroll's theoretical model of diffusion is rather limited and perhaps overly simplistic.

Proenza, Bastidas-Buch and Montero explain that in urban areas the necessary infrastructure for ICT diffusion is established already and argue further that in rural

[318] Davis K. and Golden H. H., 'Urbanization and the Development of Pre-Industrial Areas' *Economic Development and Cultural Change* 3 (1954): 6-26.

[319] Best M. L. and Maclay C. M., 'Community Internet Access in Rural Area: Solving the Economic Sustainability Puzzle' *The Global Information Technology Report 2001-2002: Readiness for the Networked World* Oxford, Oxford University Press (2002).

[320] Fischer S. C. and Carroll G. R., 'Telephone and Automobile Diffusion in the United States, 1902-1937' *The American Journal of Sociology* 93.5 (1988): 1153-1178.

areas the costs of building infrastructure and the costs associated with maintenance/operations are higher.[321] In an extreme example in Peru, for instance, by 2003, Lima had 45% of its urban households fitted with a fixed telephone line, compared to only 0.5% of the rural areas.[322] As Morse explains, there is a 'contrast between high-primacy urban-systems (Argentina, [...] Mexico) and low-primacy ones (Brazil, Chile...)'.[323] Consequently one may infer that the high rates of urbanisation in Argentina and Mexico, their elements of 'urban primacy' (by being dominated by primate cities), may be part of the explanation for their similar diffusion rates.[324] Mehta, on the importance of urbanisation, argues that these 'metropolis dwellers are faced with the requirements of urban living...' which forces the adoption and diffusion of '...innovations, which those in the countryside, if left to themselves, would never make'.[325] Milner's work also finds a positive correlation for this school of thought, claiming that 'more dense populations support more interaction'.[326]

In Gruber's study of Europe, he finds a strong positive correlation between urbanisation and mobile phone diffusion rates: a result supported by the more international study of Liikanen, Stoneman and Toivanen, who also examined mobile diffusion rates, but across a larger sample of 80 countries between 1992 and 1998.[327] Although both of these studies look at a very short number of years, they provide strong support for the relationship. Rouvinen's study is particularly powerful to this argument as he finds that urbanisation plays a significant role in both developed and

[321] Proenza F. J., Bastidas-Buch R. and Montero G., *Tele-centres for Socioeconomic and Rural Development in Latin America and the Caribbean* Washington D.C., Inter-American Development Bank (2001).
[322] Fernández-Maldonedo A. M., 'Telecommunications in Lima: Networks for the Networks?' *Paper for the Conference Cities in the Global Information Society*, Newcastle-upon-Tyne (1999).
[323] Morse R. M., 'Trends and Patterns of Latin American Urbanisation 1750-1920' *Comparative Studies in Society and History* 16.4 (1974): 416-447, p.427.
[324] Wilkie J. W., *Latin American Population and Urbanisation Analysis: Maps and Statistics, 1950-82* California, Latin American Centre Publications (1984).
[325] Mehta S. K., 'Some Demographic and Economic Correlates of Primate Cities: A Case for Revaluation' *Demography* 1.1 (1964): 136-147, p.139.
[326] Milner H.V., 'The Global Spread of the Internet: the Role of International Diffusion Pressures in Technology Adoption' Paper presented at the second conference on 'Interdependence, Diffusion and Sovereignty,' held at UCLA, March (2003): 1-44, p.10. For other good studies on the diffusion of modern ICTs see Kiiski and Pohjola, Goolsbee and Klenow, who produce similar findings. Kiiski and Pohjola (2000), Goolsbee A. and Klenow P., 'Evidence of Learning and Networking Externalities in the Diffusion of Home Computers' *National Bureau of Economic Research*, Working Paper 7329 (1999): 176-199.
[327] Gruber H., 'Competition and Innovation: The Diffusion of Mobile Telecommunications in Central and Eastern Europe' *Information Economics and Policy* 13.1 (2001): 19-34, Liikanen J., Stoneman P. and Toivanen O., 'Intergenerational Effects in the Diffusion of New Technology: The Case of Mobile Phones' Swedish School of Economics and Business Administration Working Paper 3 (2001).

developing countries.[328] Alternatively, Canning ascertains that urbanisation is more strongly positively correlated with telephone diffusion rates in developing countries than in developed countries.[329] In fact, the only reviewed study which found a negative correlation between telephone diffusion rates and the degree of urbanisation was that of Wallsten, where the results were not statistically significant.[330] However, Wallsten was exploring Latin America and Africa primarily during the period after privatisation, which was characterised by already high levels of urbanisation. Once the infrastructure is available, the impact of urbanisation diminishes, perhaps explaining Wallsten's insignificant result.

Foreign Direct Investment

Realised and implied economic growth rates alone cannot determine the speed of technology diffusion; as Antonelli argues, the degree of investment is just as important.[331] The leading role of FDI is further supported by UNCTAD, Dicken, Soete, and Findlay who emphasise the particular importance in developing countries.[332] Investments by transnational corporations in the form of FDI played a significant role in the rate of diffusion of ICT in developing countries, as infrastructure often was funded by it. Despite much work on the role of international trade in the rate of diffusion, there is much less empirical work that concentrates on the role of FDI.[333] Some would argue that the only available systematic evidence is indirect and comes in the form of analyses of the relationship between FDI and economic productivity, where results are mixed.[334]

---

[328] Rouvinen (2006).

[329] Canning D., 'A Database of World Stocks of Infrastructure, 1950-95' *The World Bank Economic Review* 12.3 (1998): 529-547.

[330] Wallsten S., 'An Econometric Analysis of Telecom Competition, Privatisation and Regulation in Telecommunication Markets in Africa and Latin America' *Journal of Industrial Economics* 49.1 (2001a): 1-19.

[331] Antonelli (1993).

[332] United Nations Conference on Trade and Development (UNCTAD), *World Investment Report 1999: Foreign Direct Investment and the Challenge of Development* Geneva: United Nations (1999), Dicken P., *Global Shift: Reshaping the Global Economic Map in the 21st century* London, Sage Publications (2003), Soete L., 'International Diffusion of Technology: Industrial Development and Technological Leapfrogging' *World Development* (1985): 409-422, Findlay R., 'Relative Backwardness, Direct Foreign Investment, and the Transfer of Technology: A Simple Dynamic Model' *American Economic Review* 92.1 (1978a): 1-16.

[333] Van Pottelsberghe de la Potterie B. and Lichtenberg F., 'Does Foreign Direct Investment Transfer Technology Across Borders?' *The Review of Economics and Statistics* 83.3 (2001): 490-497.

[334] Blomstrom found a positive relationship, while Aitken and Harrison, and Mencinger found a negligible or a negative one. Blomstrom M., 'Foreign Investment and Productive Efficiency: The Case of Mexico' *Journal of Industrial Economics* 35 (1986): 97-110, Aitken B. J. and Harrison A. E., 'Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela' *American Economic Review* 89 (1999): 605-618, Mencinger J., 'Does Foreign Direct Investment Always Enhance Economic Growth?' *Kyklos* 56 (2003): 491-508.

Perkins and Neumayer examine diffusion across three technologies, including digital telephones, covering between 75 and 147 countries. Theoretically they support the above argument and link it to the degree of openness of international trade.[335] However, their empirical evidence failed to provide statistical support for the idea that FDI accelerates diffusion speed. This is surprising, but may be explained partly by the fact that their FDI measure may be poorly suited to identifying sector-specific effects, since it is not technology-specific, but rather at an aggregated level. A strong positive relationship between international trade and FDI with the rate of technology diffusion is, however, corroborated by Wheeler and Martin, Grynspan, and Caselli and Coleman.[336] They explain the relationship through market liberalisation, which allows for better technology diffusion.

The work of Ochoa-Morales is significant for the contemporary understanding of the role of FDI, as he finds that privatisation of the telecommunication sector must be carried out by foreign investment, asserting that FDI is the *only* way they can bridge the 'digital gap'.[337] Nevertheless, this strong view loses some of its persuasive power as it is purely qualitative. His views, are strongly in line with the work of Schuler and Brown who argue that developing countries must ensure that institutions are set up to support FDI so as to encourage foreign investors to initiate and develop technology.[338] Schuler and Brown spell out however, that although FDI is key to fast diffusion rates, it is the associated institutions that provide the appropriate environment for successful FDI and, consequently, it is the institutions which are directly responsible for the rate of diffusion. Ochoa-Morales agrees, arguing that the state must provide a viable atmosphere for firms and entities controlling ICT in order to invite foreign investment. This foreign investor engagement is facilitated via membership of international organisations to support any shortcomings of the existing legal framework such as the WTO or GATT (as per Mexico's experience).

---

[335] Perkins R. and Neumayer E., 'The International Diffusion of New Technologies: A Multi-technology Analysis of Latecomer Advantage and Global Economic Integration' *Annals of the Association of American Geographers* 95.4 (2005): 789-808.

[336] Wheeler D. and Martin P., 'Prices, Policies and the International Diffusion of Clean Technology: The Case of Wood Pulp Production' in Low P., *International Trade and the Environment Discussion* paper 159, Washington D.C., The World Bank (1992), Grynspan D., 'Technology Transfer Patterns and Industrialisation in LDCs: A Study of Licensing in Costa Rica' *International Organisation* 36.4 (1982): 795-806, Caselli and Coleman (2001).

[337] Ochoa-Morales H. J., 'The Dynamic Changes in the Telecommunication Sector in Latin America and its Effects on the Knowledgeable Society' *Communications of the IIMA* 2.1 (2002): 84-93.

[338] Schuler D. A. and Brown D. S., 'Democracy, Regional Integration and Foreign Direct Investment' *Business and Society* 38.4 (1999): 450-473.

Paus asserts that Latin America's governments must specifically 'identify and support those types of foreign investment that are most beneficial to their countries' development' and resist the temptation of reverting to rigid and misguided nationalistic tendencies that view foreign investment negatively.[339] Although her study does not focus on the diffusion of ICT, it is useful as it provides an accurate account of FDI in Latin America and particularly resonates with the shifting ideologies of the states in Argentina and Mexico across the period under review.[340] She additionally argues that a prerequisite for increased FDI in Latin America is the achievement of successful technology diffusion, thus indicating the importance of institutions in sustaining FDI in the long-run by successfully using the funds. Hence, even though the degree of FDI can be key for fast ICT diffusion, the 'right' institutions are required to foster this type of behaviour and, consequently, will dictate the rate of technology diffusion.

The Latecomer Advantage

Another factor often argued to drive the speed of diffusion of a given technology is the latecomer advantage. This fundamentally argues that if an innovation is adopted by a country later, there is a greater chance that it will diffuse at a faster rate, as 'latecomer' benefits will arise. These benefits include learning investments and a lack of previous capital stock, which result in substantial costless benefits.[341] Supporters of this argument are Gerschenkron, Rogers, Perkins and Neumayer, Ames and Rosenberg, and Todaro and Abramovitz.[342] The views regarding the lack of previous investment versus the accumulated learning advantage are generally mixed.[343] Either way, the very best studies (including those above) tend to account for both.

---

[339] Paus E., 'Direct Foreign Investment and Economic Development in Latin America: Perspectives for the Future' *Journal of Latin American Studies* 21.2 (1989): 221-239, p.239.

[340] Albeit her work is largely confined to the period of the 1980s onwards.

[341] Ray G. F., 'The Diffusion of New Technology: A Study of Ten Processes in Nine Industries' *National Institute Economic Review* 48 (1969): 40-83.

[342] Gerschenkron (1962), Rogers (1995), Ames E. and Rosenberg N., 'Changing Technological Leadership and Industrial Growth' *Economic Journal* 73.289 (1963): 13-31, Perkins and Neumayer (2005), Todaro M. P., *Economic Development* Reading, MA, Addison Wesley Longman (2000), Abramovitz M., 'Catching-up, Forging Ahead and Falling Behind' *Journal of Economic History* 46.2 (1986): 385-406.

[343] For an argument on the advantages of previous investment see Clark G. L. and Wrigley N., 'The Spatial Configuration of the Firm and the Management of Sunk Costs' *Economic Geography* 73 (1997): 285-304, Dekimpe et al. (2000a). For an argument on the accumulated learning advantage see Grubler A., 'Time for a Change: On the Pattern of Diffusion of Innovation' in Ausubel J. H. and Lagford D. H., *Technological Trajectories and the Human Environment* Washington D.C., National Academy Press (1997), Ravn H.F., and Valqui Vidal R. V., 'Operational Research for Developing Countries-A Case of Transfer of Technology' *The Journal of the Operational Research Society* 37.2 (1986): 205-210.

Ray empirically demonstrated that pioneers are characterised by an array of 'teething troubles', while Ames and Rosenberg actually quantified the 'penalty for taking the lead'. [344] They argue, however, that despite the penalties, latecomers are not necessarily better off than innovators. These studies, although limited in scope, create the basic tools for much future research. Indeed, there are subsequently numerous studies providing corroborating evidence of the positive effects of latecomer advantages, such as those on technology transfer and leapfrogging by Sharif, Ravn and Valqui Vidal, and on mobile telephones by Rouvinen.[345]

The theoretical modelling work of Eaton and Lipsey, Schmalensee and Spence contends that early adopters actually encounter substantial benefits as a result of economies of scale, learning by doing and strategic opportunities.[346] While all of this is true, there are defined benefits for latecomers too. The accumulated learning aspect centres on the establishment of 'best practice', since once any element of the diffusion process is '...demarcated, other and easier routes to obtain that objective may become obvious'.[347] Thus a latecomer country can benefit by avoiding the costs of initial learning and experimentation (paid for by the pioneers), allowing them, as Rosenberg argues, to see technology diffuse at a faster rate.[348] Additionally, their lack of previous investment provides a larger spare capacity for the new technology to be absorbed.[349]

Antonelli, Perkins and Neumayer merit particular attention as they took this strand of research to the next level. [350] Antonelli, on his research on advanced telecommunications within developing countries, found that the latecomer position was only advantageous for technologies which are not highly complementary. Meanwhile, Perkins and Neumayer revealed that the degree of the latecomer

[344] Note that Ray (1969) used a small sample of Western European countries. Ames and Rosenberg (1963).
[345] Sharif M. N., 'Technological Leapfrogging: Implications for Developing Countries' *Technological Forecasting and Social Change* 36 (1998): 201-208, Ravn and Valqui Vidal (1986), Rouvinen (2006).
[346] Eaton B. C. and Lipsey R. G., 'The Theory of Market Pre-emption: The Persistence of Excess Capacity and Monopoly in Growing Spatial Markets' *Económica* 46 (1979): 149-58. Schmalensee R., 'Product Differentiation Advantages of Pioneering Brands' *American Economic Review* 72 (1982): 349-365. Spence A. M., 'The Learning Curve and Competition' *Bell Journal of Economics* 12 (1981): 49-70.
[347] Rosenberg N., 'Economic Development and the Transfer of Technology: Some Historical Perspectives' *Technology and Culture* 11. 4 (1970): 550-576, p.551.
[348] Rosenberg (1970).
[349] Clark and Wrigley (1997).
[350] Antonelli C., 'The international diffusion of new information technologies' *Research Policy* 15 (1986): 139-47, Ravn and Valqui Vidal (1986), Perkins and Neumayer (2005).

advantage varies across technologies. Moreover, their work is of particular value since, with the exception of Dekimpe et al. no other study has empirically examined the impact of a lack of existing capital stock by a latecomer on the rate of their technology diffusion.[351] Dekimpe et al. revealed that the costs associated with the replacement of an old technology can hinder full adoption of a new technology, thereby reducing diffusion speed for countries with a larger installed base of an old technology (a factor that was present during early telephone diffusion in Argentina and Mexico, given the size of the telegraph network).

Overall, the economic approach revealed the importance of a plethora of factors as potential drivers of ICT diffusion, including GPD per capita, urbanisation, inequality, human capital, network externalities, and the latecomer advantage. Succar shows that developing countries in particular require an economic environment resembling that of developed countries in order to see technology successfully diffuse quickly.[352] However, since the economic circumstances of most developing countries do not resemble those of developed countries, one could argue that there is more reason to emphasise the role of institutions and specifically the government, to provide the tools or act as substitutes for the limited economic environment. It is not suggested that economic factors are not important explanatory variables, but rather that they are not necessarily the most important factors driving the process.

1.5.2 The Social Approach

The social approach argues that the rates of ICT diffusion across different countries can be explained by a country's specific social and cultural characteristics. These refer, more specifically to those intrinsic characteristics, history, values, beliefs and behaviours shared by members within a given society. The importance of the social approach stems from the fact that, in the words of Gurevitch and Loevy: '...the cultural conditions determine if, when, how, and in what form the new [technology] item will be accepted'.[353] Advocates of this approach maintain that factors such as the degree of homogeneity among the population, the social perceptions about the

[351] Dekimpe et al. (2000a).
[352] Succar P., 'International Technology Transfer: A Model of Endogenous Technological Assimilation' *Journal of Development Economics* 26 (1987): 375-395.
[353] Gurevitch M. and Loevy Z., 'The Diffusion of Television as an Innovation: The Case of the Kibbutz' *Human Relations* 25.3 (1972): 181-197, p.181.

attributes of the innovation and whether these are compatible with the beliefs of that society, as well as, the degree of cosmopolitanism among the population, are some of the most popular social factors in understanding the rates of ICT diffusion. Given the nature of the approach, these factors, as explored below, tend to primarily affect consumer behaviour, rather than influence the expansion of infrastructure.

Rogers is again important to this school of thought.[354] He claims that technology diffusion can partly be explained by looking at the characteristics of the adopting individuals, and that diffusion rates will depend upon the innovations compatibility with the values and norms in the social system.[355] The main issue with Rogers, however, is that he assumes that this takes place within a fixed size social system. This is an unrealistic assumption, as it is impossible to identify the size of the social system when looking at the process of diffusion, as the size is likely to vary with time.[356]

Although social factors are difficult to quantify, there are some studies which have done this exceptionally well. In regard to generic international technology transfer, Davidson and McFetridge agree on the vital role that culture plays in developing countries when determining the rate of technology diffusion.[357] Meanwhile Keida and Bhagat's conceptual model accounts for the differences *within* cultures, as 'cultural variations across nations and organisational culture-based differences are considered two major factors'.[358] They draw attention to the importance of language, common ancestry and shared history, in order to explain the rate of diffusion, accepting that '...economic development is a major factor, [but] cultural predispositions play an important role'.[359]

---

[354] Rogers (1995). Other important advocates of the social approach include Dekimpe et al. (1998, 2000a, 2000b) Gatignon and Robertson (1985), Gurevitch and Loevy (1972), Takada H. and Jain D., 'Cross-national Analysis of Diffusion of Consumer Durable Goods in Pacific Rim Countries' *Journal of Marketing* 55.2 (1991): 48-54, Gatignon H., Eliashberg J. and Robertson S., 'Modelling Multinational Diffusion Patterns: An Efficient Methodology' *Marketing Science* 8.3 (1989): 231-47, and Bowden S. and Offer A., 'Household Appliances and the Use of Time: the United States and Britain since the 1920s' *Economic History Review* 47 (1994): 725-748.

[355] Factors such as personality, social background and network location can predict the adoption rate of a new technology in his view.

[356] Note that the size of the social system that will adopt the new technology will not be the same as the whole population.

[357] Davidson W. H. and McFetridge D. G., 'Key Characteristics in Choice of International Technology Transfer Mode' *Journal of International Business Studies* 6.2 (1985): 5-21.

[358] Keida B. L. and Bhagat R. S., 'Cultural Constraints on Transfer of Technology Across Nations: Implications for Research in International and Comparative Management' *Academy of Management Review* 13.4 (1988): 559-571, p.559.

[359] Ibid., p.562.

Homogeneity

Rogers claims that a high degree of homogeneity (i.e. similar religion, ethnicity, language, etc.) among the population will result in greater communication and increased social emulation, thereby aiding the rate of technology diffusion.[360] In a more homogeneous society, individuals with shared traits and backgrounds are able to relate and interact more effectively and thus encourage a higher degree of information exchange and communication.[361] Gatignon and Robertson follow on from Rogers' work, emphasising the importance of accounting for the social framework in which diffusion takes place, because 'diffusion occurs within a social system that possesses a set of values and norms' and these are likely to have a strong impact on the diffusion rate of new communication technologies.[362] Gatignon and Robertson's study, although purely theoretical, is very helpful as it separates the adoption process from the diffusion process. The main shortcoming is the fact that little of their theory is actually put into context and no empirical work was carried out. Nevertheless their work is fundamental to this research area and many researchers have subsequently adopted their ideas, namely that high heterogeneity will negatively impact the rate of technology diffusion, due to reduced interaction among members of the social system. Although these two studies do not provide empirical evidence to support this view, they supply the building blocks from which other studies have verified the relationship, these include Dekimpe et al.'s, Putsis, Balasubramanian, Kapkan and Sen, Gatignon, Eliashberg and Robertson's, whom together cover a range of ICTs.[363] Of these empirical studies, once again Dekimpe et al. must be recognised for providing robust and highly practical work. They measure homogeneity by accounting for the number of ethnic groups within each country, and find a positive correlation with the rate of mobile telephone diffusion. Takada and Jain, also provide evidence for this effect for the diffusion of radios (among other consumer technologies) across four countries in the Pacific Rim, although they do not look at the whole process of diffusion.

[360] Rogers (1995).
[361] Dekimpe et al. (1998).
[362] Gatignon and Robertson (1985), p.857.
[363] Dekimpe et al. (1998), Putsis W. P., Balasubramanian S., Kapkan E. H. and Sen S. K., 'Mixing Behaviour in Cross-Country Diffusion' *Marketing Science* 16 (1997): 354-69, Gatignon et al. (1989).

Putsis et al. enhance the argument for modern ICT by providing evidence suggesting that diffusion rates will be faster, when the degree of homogeneity is greater, not only among the country's population, but also between the adopting country and the country it is adopting from, as this will facilitate external contact as well.[364] Thus the rates of diffusion will be faster for countries with similar cultures. Gatignon et al. actually developed a specific methodology which accounts for heterogeneity across social systems for six consumer durables (including ICTs such as radios) in 14 European countries.[365] By accounting for the countries social boundaries, they concentrate on the patterns of social communication across a country and the impact this has on the rate of diffusion. They found evidence that the level of cosmopolitanism and mobility were particularly important in explaining ICT diffusion.

Perceptions

Individual perception is another tested social variable often held accountable for the rate of ICT diffusion. The collective perceptions individuals have about the innovation, perceptions which are shaped by culture, are deemed important. Takada and Jain's later work, for example, finds strong supporting evidence of this effect. Unlike the more theoretical study of Gatignon and Robertson, they provide rigorous mathematical support.[366] Their work is also an improvement on Rogers' propositions (since these were just proposals with no mathematical testing). Consequently, Takada and Jain make a significant contribution to the literature on this issue. As Casson stresses, part of the reason for the relatively fast telephone diffusion collectively in Latin America was that by the time diffusion began, individuals were far more aware of the telephone's potential advantages and no longer viewed it merely as a 'scientific toy' as Europe had.[367]

[364] Putsis et al. (1997).
[365] Gatignon et al. (1989).
[366] Takada and Jain (1991), Gatignon and Robertson (1985).
[367] Casson N. H., *The History of the Telephone* Chicago, A.C. McClurg & Co. (1910). Wallsten S., 'Returning to Victorian Competition, Ownership, and Regulation: An Empirical Study of European Telecommunications at the Turn of the Twentieth Century' *Journal of Economic History* 65.3 (2005): 693-722.

Hollenstein argues that the benefits associated with a technology will ultimately dictate its rate of diffusion.[368] Clearly the perception regarding the attributes of an innovation must affect the subsequent rate of diffusion, as evidenced in the lack of enthusiasm toward telephone diffusion in Argentina and Mexico when the technology first arrived. Bowden and Offer categorised new consumer technologies into 'time saving' or 'time using' technologies and claimed that some technologies diffuse faster than others (e.g. the refrigerator versus the radio) due to the differences intrinsic in their nature.[369] Meanwhile Gurevitch and Loevy find strong support for the relationship of 'cultural compatibility' between society and the new technology after examining television diffusion rates within the kibbutz society in Israel (note that kibbutz societal values wholly rejected television). This extreme example demonstrates the huge impact that social values can have on ICT diffusion.[370]

Cosmopolitanism

Generally, diffusion research relating to the degree of cosmopolitanism in a given social system has found generally that it has a positive impact on the rate of diffusion. Proof of this is given in the rural sociology tradition by Rogers.[371] Indeed, cosmopolitans are individuals oriented beyond their immediate social system, whereas locals are oriented towards their immediate social system.[372] Cosmopolitans are therefore seen as important communicators of innovations across boundaries; hence the more cosmopolitan the members of a population are, the faster the diffusion rate, as information spreads faster. Theoretically this could impact ICT diffusion rate differentials across Argentina and Mexico since high migration of Europeans took place in Argentina early in the period under consideration.

This positive relationship was formalised by Rogers, Gatignon, Eliashberg and Robertson, and Gatignon and Robertson.[373] The last is perhaps the most useful study

[368] Hollenstein H., 'The Decision to Adopt Information and Communication Technologies (ICT): Firm-Level Evidence for Switzerland' *The Economic Impact of ICT, Measurement, Evidence and Implications* Paris, OECD Publications (2004).

[369] They argue that individuals' preferences dictate the differing diffusion speeds. In the U.S. and the U.K., for instance, individuals placed more emphasis on the quality of their free time as opposed to the quantity of it, thus one observed a faster rate of diffusion for time-using goods. See Bowden and Offer (1994).

[370] Gurevitch and Loevy (1972).

[371] Rogers (1995). The cosmopolitanism variable has its roots in the 'cosmopolitan-local' dichotomy initially proposed by Gouldner. See Gouldner A. W., 'Cosmopolitans and Locals: Toward an Analysis of Latent Social Roles' *Administrative Science Quarterly* 2 (1957): 281-306.

[372] Gatignon et al. (1989).

[373] Rogers (1995), Gatignon et al. (1989), Gatignon and Robertson (1985).

of the group as it tests an extensive number of social factors over communication technologies across European countries, before finding that the degree of cosmopolitanism is one of the most important in shaping the rate of diffusion. Easingwood examined the diffusion of colour televisions in ten Western European countries in the 1970s and Gatignon and Robertson is an improvement on this, because they provide an analogical approach to diffusion patterns, as well as a useful diagnostic tool for comparing the determinants of diffusion across countries.[374] Further, Gatignon and Robertson develop their own economic model to account for the diffusion rates of innovations, predominantly analysing the impact of social factors, building upon their previous theoretical work with added empirical rigour.

Overall the social approach emphasises the importance of social and cultural factors. Specifically, it highlights the role played by the degree of homogeneity and cosmopolitanism within society, as well as individual perceptions of the new technology, as important factors in explaining ICT diffusion. Social factors therefore, should have some role in the rate of diffusion, and hence (despite the difficulty in quantifying many of these factors) some attempts were made to include these types of variables in the regression analysis in chapter 4.

1.5.3 The Natural Endowments Approach

The natural endowments approach explains differences in ICT diffusion rates by examining the inherent characteristics of a region, which cannot be changed, or can only be changed in the very long run. Advocates of this approach include Hägerstrand, Takada and Jain, Fischer and Carroll, Milner, Felix and Canning.[375] These all commonly demonstrate the importance of the natural environment of the recipient society for the rate of diffusion of ICT. They maintain that certain characteristics inherent in a country's natural environment, for instance, the impact of geographical location, or the country size, will play a decisive role in speeding up (or slowing down) the rate of technology diffusion. In contrast to the social approach, these variables tend to directly influence the capacity for the expansion of infrastructure, as opposed to consumer demand itself.

---

[374] Easingwood C. J., 'An Analogical Approach to the Long-term Forecasting of Major New Product Sales' *International Journal of Forecasting* 5 (1989): 69-82. Gatignon and Robertson (1985).

[375] Hägerstrand T., 'A Monte Carlo Approach to Diffusion' *Archives Européennes de Sociologie* 6.1 (1965): 43-67, Takada and Jain (1991), Fischer and Carroll (1988), Milner (2003), Felix (1983) and Canning (1998).

Geographical Positioning

The impact of spatial diffusion on rates of diffusion has been ignored by many economists. This concept refers to all processes that contribute to moves, to migration within geographical space, and to backlash effects generated in the space by those moves. Spatial diffusion was introduced to the field of geography by Hägerstrand who, on the basis of several case studies, emphasised the existence of temporal and spatial regularities in the processes of spatial diffusion of innovations.[376] Spatial diffusion works to a large extent through contagion effects, i.e. the probability of contact between adopters and non-adopters of a new technology rapidly decreases as a function of distance.

Work on the role of geography rests on the initial pillars built by Hägerstrand and although his classical piece examined agricultural innovations, his work is noteworthy as he is one of the pioneers on spatial diffusion.[377] In a more directly related study for the purposes of this thesis, Hägerstrand investigated migration and telephone calls, calculating the probability of face-to-face contact with a given person living X distance away, to in turn attempt to explain technology diffusion speed. In theory, the shorter the geographical distance between adopters and non-adopters, the faster the rate of diffusion, sometimes referred to as the contagion effect, or the 'neighbourhood effect'.[378] The main limitation of Hägerstrand's work was that he placed almost too much emphasis upon spatial variables, excluding more sociological and economic variables. Hägerstrand's work has been corroborated by Brown, Takada and Jain, Gatignon and Robertson, and Audretsch and Feldman, who collectively argue that geographical location is a primary driver of ICT diffusion rates.[379]

Country Size

The size of the country is important in determining the rate of ICT diffusion, as this will be closely related to the economic issues of infrastructure, economies of scale

[376] Hägerstrand T., *Innovation of Spatial Process* Chicago, University of Chicago Press (1953).
[377] Ibid.
[378] Hägerstrand (1965).
[379] Ibid., Brown (1981), Takada and Jain (1991), Gatignon and Robertson (1985) and Audretsch D. B. and Feldman M. P., 'R&D Spillovers and the Geography of Innovation and Production' *American Economic Review* 86 (1996): 630-640. This is also supported by the later work of Milner (2003), Bonaccorsi A., Piscitello L. and Rossi C., 'The ICT Diffusion: A Spatial Econometric Approach' *Social Science Research Network* 120 (2005): 1-18, and Dekimpe et al. (2000a), who provide evidence within ICT diffusion at a globalised level.

and in turn population density or population growth. Clearly the larger the area of a country, the more infrastructure that is necessary, and Antonelli finds evidence supporting that ICT diffusion rates were relatively faster in smaller countries (particularly those countries with also a higher level of income).[380] The justification may be that infrastructure is relatively easier to build for smaller countries. Canning verifies this inversely correlated relationship in the case of telephone diffusion and finds that the provision of infrastructure is significantly correlated with a country's geographical endowment.[381] Fischer and Carroll also demonstrate the importance of the availability of infrastructure for faster ICT diffusion rates: a country's structural features 'can accelerate or retard the internal dynamic of diffusion' especially in the long-term.[382]

Overall, the natural endowments of a country must inevitably, to some extent, affect its rate of ICT diffusion, by largely affecting the establishment and availability of the necessary infrastructure. The natural endowments approach argues that factors such as the country size and geographical location have a direct impact on ICT diffusion rates. These factors, however, are unchangeable (at least in the short-medium run), consequently underlining the importance of the state in mitigating or taking advantage of a country's intrinsic makeup.

1.5.4 The Institutional Approach: The Role of the State

The chapter now focuses on the institutional approach, and more specifically the role of the state. The fundamental argument of this thesis is that no other variable can explain the observed rates of ICT diffusion in Argentina and Mexico more comprehensively. The institutional approach argues that the differences in ICT diffusion rates can be explained by a country's institutions and more specifically its political institutions. These factors primarily affect the expansion of ICT infrastructure but can also affect consumption in various ways. One must consider the fact that even if the government sees the potential benefits of a given technology it is still up to the individual consumer to decide whether to adopt it. Nevertheless, the role of the government will be important due to their role in the provision of the necessary infrastructure. Whether it be the direct impact of the role of the state, the

[380] Antonelli (1986).
[381] Canning (1998).
[382] Fischer and Carroll (1988), p.1173.

degree of stability within the government, or the indirect need for institutions to coordinate the supply of the innovation, arguably institutions are found at the end of every explanatory road.

Institutions are defined by North as the 'rules of the game' whereby humanly devised constraints shape human interaction.[383] These comprise formal constraints (explored below) such as laws or regulations, and informal constraints (addressed in the social approach above) such as social norms or customs, which are all affected by the state. Formal constraints within the telecommunications industry incorporate government policy, regulatory bodies, the legal framework, the market structure and the degree of government intervention, as well as their evolution over time. There is a substantial literature indicating the importance of institutions, but fewer detailed practical applications. The literature regarding this approach includes the work of Rosenberg and Mokyr, who generically look at new technologies while Wallsten, Henisz and Zelner, Schuler and Brown focus specifically on ICT.[384]

Rosenberg is at the forefront of this research field and his narrative served as the reference base for much of the subsequent literature. Although not solely concerned with ICT, his paper is central to the understanding of this thesis.[385] He stresses the importance of institutions, since they have the power to shape and protect the economic and social environment in which technology diffusion takes place. He marked a turning point in the literature, since earlier '...our ignorance of the rate at which new techniques were adopted, and the factors accounting for these rates... [was]... no cause for professional self-congratulation'.[386] Indeed, the inspirational work of Rosenberg motivated the primary question of this research, the fact that similar diffusion rates in Argentina and Mexico could not be explained by their economic environment, and thus could be better understood by examination of their respective institutional settings.

[383] North D. C., *Institutions, Institutional Change and Economic Performance* Cambridge, Cambridge University Press (1990), pp.3-4.
[384] Rosenberg (1970, 1972), Mokyr (2002), Wallsten (2001a, 2005), Henisz and Zelner (2001), Schuler and Brown (1999).
[385] Rosenberg (1970).
[386] Ibid., p.3.

Brown's study provides an overview of technology diffusion, and in it he finds that 'institutional factors...influence the diffusion process by affecting the context within which the technological factors operate'.[387] He argues that historically diffusion research has underemphasised the significance of the role of the government. It typically gives a disproportionate power to the individual choice of adoption of a new technology, which although important, is set within the constraints established and controlled by the government and private institutions.[388] Until the 1980s in Latin America, the telecom industry was provided largely monopolistically, either via a state-owned or a heavily regulated private entity, hence the importance of the role of the state.

Mokyr's paper, like Rosenberg's, is on the wider field of technology, and it is of central importance since he addresses the historical links of technology with institutions and income levels (the two most important explanatory factors of this thesis).[389] Indeed, Mokyr attests that 'not all roads to economic prosperity have followed the same institutional pattern'.[390] Rosenberg similarly cautions against generalisations, since '...a wide diversity of institutional forms have proved to be successful under differing conditions' and vice versa.[391] His work is very much aligned with Gerschenkron's on the industrialisation of late developers. Gerschenkron claims that countries like Italy and Russia were able to industrialise faster than Britain (the early industrialiser) by making more extensive use of their institutional setting (i.e. the state), in order to compensate (acting as a substitute) for their inherently larger degree of 'backwardness'.[392]

The institutional factor was a principal explanatory variable in various cases, namely in Henisz and Zelner, and Levy and Spiller who argue that the development of basic infrastructure for telecommunications is directly dependent upon the quality of a country's institutions.[393] Henisz and Zelner find a strong and significant link between

[387] Brown (1981), p.188.
[388] Ibid.
[389] Mokyr (2002).
[390] Ibid., p.9.
[391] Ibid., p.573.
[392] Gerschenkron (1962).
[393] Henisz W. and Zelner B., 'The Institutional Environment for Telecommunications Investment' *Journal of Economics and Management Strategy* 10.1 (2001): 123-147, Levy B. and Spiller P., *Regulations, Institutions and Commitment* Cambridge, Cambridge University Press (1996).

the commitment of political institutions and telecom infrastructure. Meanwhile Levy and Spiller argue that the goals of regulatory reform in telecommunications (improved service and fair prices) may not be achieved consistently in developing countries, due to the interaction between political institutions and economic conditions. Petrazzini studies the role of government intervention in the provision of telecom services in developing economies throughout the 1970s-1990s.[394] He argues that political factors such as state autonomy and concentration of power had a key role in the successful privatisation of state owned telecommunication enterprises.

The institutional approach is prominent within the diffusion of ICT in the context of Latin America since local governments were the ones that decided how these ICTs would be introduced. Thus from the very outset, the diffusion of these technologies was dictated by state actions. Having appraised the macro-institutional literature, the market structure, the role of the government and government types, and political incentives are reviewed below.

Market Structure, Competition and State Intervention

Mansfield was one of the first to explore the impact that an industry's market structure had on the rate of innovation diffusion and although it was at the firm level and not specifically on ICT, it is very important since many researchers in the diffusion literature built on these ideas.[395] Following this study, a substantial amount of work has been carried out by the likes of Wallsten, Ochoa-Morales, Hollenstein, Littlechild and Foreman-Peck on the impact of market structure and state intervention upon ICT diffusion rates (although mostly post-privatisation).[396]

Various studies by Wallsten and by Hollenstein provide substantial evidence that market structure is correlated closely to the rate of telephone diffusion. Wallsten in particular demonstrates that a faster rate of telephone diffusion is encountered in a competitive environment and typically a slower rate is found under a monopolistic system. Bennett goes so far as to say that to make the telephone system more

[394] Petrazzini (1995).
[395] Mansfield E., 'Size of Firm, Market Structure, and Innovation' *Journal of Political Economy* 71.6 (1963c): 556-576.
[396] See Wallsten (2001a, 2005), Hollenstein (2004), Littlechild (1983), Foreman-Peck (1985) and Ochoa-Morales H. J., 'The Effect of Information and Communication Technology (ICT) on the Globalization Paradigm' *Issues in Information Systems* 5.2 (2004): 647-653.

efficient all monopolies must be eliminated.[397] North and Williamson maintain that because infrastructural investments suffer from a number of market imperfections, such as economies of scale resulting from network externalities, the role of the government increases.[398] Indeed, it is Holcombe's belief that a government operated telephone system is preferred, but Casson would argue that the lack of a higher level of telephone diffusion was actually due to too much government involvement.[399] There is no definitive answer and thus no all-encompassing generalisations can be made, although the views of key authors coincide in claiming that privatisation (with competition and limited political favouritism) allows for faster telephone diffusion.[400] Further, Littlechild finds that telephone diffusion rates were in fact more responsive to economic variables such as GDP per capita, under private systems than under government-owned systems.

James points out that privatisation, like competition, generally had a positive impact on the rate of telephone diffusion, as it encouraged service providers to supply more telecom technology. [401] The lower cost associated with a greater degree of competition means that an increased diffusion rate should be found; consequently policies which encourage this must be supported. In Wallsten's analysis of telephone diffusion in 33 countries (most in Europe), he found that different types of telecommunication ownership impacted the rate of diffusion.[402] Wallsten's study (of the period 1892-1914) is refreshing in that it is one of very few which did not concentrate solely on the period of privatisation. However, he looks at 4-year periods (not constant across his countries), which is problematic because diffusion rates are best measured over time, nevertheless, his findings are very significant. Although less rigorous, it is also worth mentioning Wallsten's earlier work on Africa and Latin

[397] Bennett A. R., *The Telephone Systems of the Continent of Europe* London, Longmans, Green and Co. (1985).
[398] North (1990), Williamson O., 'The Logic of Economic Organisation' *Journal of Law, Economics and Organisation* 4 (1988): 65-93.
[399] Holcombe A. N., *Public Ownership of Telephones on the Continent of Europe* Boston, The Riverside Press (1911), Casson (1910).
[400] Wallsten (2001a, 2005), Littlechild (1983).
[401] James J., 'Pro-Poor Modes of Technical Integration into the Global Economy' *Development and Change* 31 (2000): 765-783.
[402] Wallsten (2005), Wallsten S., 'Ringing the Twentieth Century: The Effects of State Monopolies, Private Ownership, and Operating Licenses on Telecommunications in Europe, 1892-1914' *Regulation and Competition Policy, Development Research Group* Washington D.C., The World Bank (2001b): 1-38.

America.[403] This was one of the first studies to test the effect of competition econometrically in developing countries in the telecom industry.

Wallsten's work is supported by Littlechild and Hollenstein, the latter providing substantial evidence that policies which strengthen competition in ICT markets contribute significantly to its more rapid diffusion rate.[404] Conversely, Foreman-Peck found evidence that competition and privatisation in the ICT sector actually became significant factors in explaining telephone diffusion rates only after the 1980s. He claims that the effects of state-owned government monopolies posed significant disadvantages only once a certain level of economic development was reached. He is not claiming that a certain degree of competition was not beneficial, but rather that it was not a primary driver. A key limitation of Foreman-Peck's work is that his conclusions are derived from assessment of just one year (1913).[405] Overall both Wallsten's and Foreman-Peck's studies are immensely useful due to their focus on the earlier period; but Wallsten's is perhaps more useful here, due to the larger data set and support from other well-respected researchers.[406] The role of competition in determining the rate of ICT diffusion is not clear, however. On the one hand, studies such as Gatignon and Robertson's suggest that 'the greater the level of competitive activity, the faster the rate of diffusion' of ICT, whereas Dekimpe et al. find only a marginal effect on the diffusion rate of mobile telephones.[407] Further, many argue that competition should be limited to allow for economies of scale, but limited competition can lead to abuses of monopoly power, which generates demand for a regulatory regime to protect customers/suppliers.[408] A widely accepted view is that ICTs like the telegraph and the telephone, as natural monopolies, are best supplied by the government (see section 1.2 The State and the Role of ICT in Latin America from earlier in the chapter).

[403] Wallsten (2001). This study is less rigorous since Wallsten only examines the post privatisation period (1980s onwards), and he fails to define what he actually means by the degree of government ownership or what constitutes private service under 'harsh conditions' etc., and does not acknowledge the fact that different countries obviously experienced differing degrees of these variables, but it is still an interesting read.
[404] Littlechild (1983), Hollenstein (2004).
[405] Foreman-Peck (1985). Note that the other variables Foreman-Peck accounts for (besides government ownership) are GNP per capita and population.
[406] E.g. Littlechild (1983).
[407] Gatignon and Robertson (1985) p.861, Dekimpe et al. (1998).
[408] Hill A. and Abdala M. A., 'Regulation, Institutions, and Commitment: Privatisation and Regulation in the Argentine Telecommunications Sector' Policy Research Working Paper 1216, Washington D.C., The World Bank (1993): 1-41.

Initially Latin America's telecommunication services, like those in most developing countries, were run by foreign private companies and government agencies. In developing countries, state monopolies ordinarily operate quite differently to those in developed countries. They tend to cause shortages of supply, and this was apparent during telephone diffusion. Moreover, reliability and quality of service were inconsistent and generally substandard: for instance, Wellenius and Stern report that cities would be left without telephone service when it rained and the lines would take weeks or months to repair when they broke down. Latin America's limited telecommunication infrastructure meant it was heavily congested, making telephone connections very difficult during peak business hours. The efficiency of the provision of ICT diffusion where government monopolies existed was quite varied. This led many users often to pay in excess of official tariffs to get a telephone connection in 'secondary' (some illegal) markets or by renting properties with telephones already installed.[409]

Resistance

Mokyr claims that successful technology diffusion depends to a very large degree on a conducive environment, since 'resistance to innovation is identified as a central element governing the success of new inventions'.[410] Resistance comes from those whose assets are threatened; this may be an individual, at the political level, or an influential institution. Udell and O'Neill agree that the process will be most successful in a conflict-free environment.[411] Mokyr concludes that governments need to implement policies to protect and encourage technology diffusion, especially where resistance is apparent. Incidentally, Argentina's experience regarding the first two failed attempts to privatise ENTel neatly demonstrate this point (see chapter 3, section *The Period of Privatisation*).

Government Policies

According to Hanna, Guy and Arnold market forces in developing countries are insufficient to induce investment in new ICTs.[412] As a result, institutions in these

[409] Wellenius and Stern (1994).
[410] Mokyr J., 'Technological Inertia in Economic History' *The Journal of Economic History* 52.2 (1992): 325-38, p.325.
[411] Udell G. G. and O'Neill M. F., 'Technology Transfer: Encouraging the Non-corporate Inventor' *Business Horizons* 20.4 (1977): 40-45.
[412] Hanna et al. (1985).

countries should implement strategies which promote an integrated approach to incentives and capabilities. Henisz and Zelner found a strong statistically significant correlation between political institutions and the diffusion rate of telecommunications. Indeed, if there are credible commitments by political actors that the state will not expropriate assets, diffusion should be faster. [413]

ICT is also typically characterised by large sunk costs, economies of scale and large consumption, thus creating a situation of political interest in telecoms pricing. The dual influence of economic opportunity and political motivation brings about an intrinsic contracting problem as demonstrated by Levy and Spiller, or by the more formal analysis of Sidak and Spulber.[414] Since technologies like the telegraph and telephone rely on large sunk investments and huge output demand by the general public, Bergara, Henisz and Spiller argue that the contracting process is highly politicised, hence the dependence on the country's political institutions. [415] This dependence is even greater for traditional ICTs. Henisz and Zelner also imply that, in countries with more manipulative political systems, diffusion will not be successful where substantial financial resources are diverted from economic activity to political rent seeking.[416] James' study on information technologies emphasises the role of the government, particularly in affecting the rate of technology diffusion in developing countries.[417] Meanwhile Cameron and Baker conclude that institutions, in fact, often serve as a barrier to faster technology diffusion.[418] Bath and James specifically argue that in the case of Latin America, the rate of technology diffusion was restrained by external forces, and there was a need for a shift in policies to enhance economic incentives, which in turn would increase their access to technical knowledge, which could potentially generate improved prospects for technology diffusion. They argue

[413] Henisz and Zelner (2001).
[414] Levy and Spiller (1996), Sidak J. G. and Spulber D.F., *Deregulatory Takings and the Regulatory Contract: The Competitive Transformation of Network Industries in the United States* New York, Cambridge University Press (1997).
[415] Although this study is not directly on the diffusion of ICT (they examined hydroelectric power in electricity production), their study is interesting because they show that the role of the government was key given the large sunk investment costs in the provision of utilities, just as there are in ICT. Bergara M., Henisz W. and Spiller P., 'Political Institutions and Electric Utility Investment: A Cross-Nation Analysis' *California Management Review* 40.2 (1998): 18-35.
[416] Note that in ICT diffusion, it is not just the policies of the recipient government that matter, restrictive licensing in the innovating country will also be a crucial determinant of the new technology's diffusion rate, see MacLeod C., 'Strategies for Innovation: The Diffusion of New Technology in Nineteenth-Century British Industry' *Economic History Review* 45.2 (1992): 285-307.
[417] James J. (2000).
[418] Cameron (1975), Baker E., 'Institutional Barriers to Technology Diffusion in Rural Africa' *American Agricultural Economics Association* (2005): 1-30.

that incumbent policies maintain Latin America's status quo, and policy changes that could be beneficial to the society at large are sometimes vetoed, as those in power are easily influenced by foreign interests. These illustrations all serve to demonstrate how influential the government can be in shaping the rate of ICT diffusion.

Ochoa-Morales links this component of the literature back to the economic approach as he argues that government policies in the adopting countries are essential for successful ICT diffusion and must be geared towards the provision of an environment which enhances FDI.[419] Schuler and Brown agree that the emphasis must be on setting up the 'right' type of institutions in developing countries, while Dahlam argues that only government policies can rectify market failures.[420] Henisz and Zelner acknowledge the magnitude of political institutions and comment that institutions which allow for appropriate infrastructure development are vital in shaping the diffusion of new technologies, as supported by Brown.[421]

Government Type, Legal Framework and Political Incentives

It is not sufficient to survey the policy choices faced by governments; it is important that these choices are contextualised, i.e. under what systems were these decisions formed. Petrazzini and Duch see domestic political and institutional arrangements within the given country as a key explanatory factor in determining the degree of success of telecom reforms (and in turn diffusion rates). Petrazzini found support (in developing countries) for closed policy processes and a high concentration of power in the state, and Duch argued the case for open decentralised political systems (but in developed economies).[422] Duch looks at the telecom privatisation and liberalisation reforms in Britain and Germany and argues that privatisation and liberalisation are more likely to be implemented in pluralist countries, such as Britain, which managed to put forward larger telecom reforms than countries with statist styles, where a dominant group or coalition can more easily block reforms. Critically these findings both hold, since initiatives to reform the telecoms sector are largely endogenous in

[419] Ochoa-Morales (2004). Also see McCullock who emphasises the need for favourable international policy: McCulloch R., 'Technology Transfer to Developing Countries: Implications of International Regulation' *Annals of the American Academy of Political and Social Science* 458 (1981): 110-122.
[420] Schuler and Brown (1999), Dahlman C. J. And Westphal L. E., 'The Transfer of Technology: Issues in the Acquisition of Technological Capability by Developing Countries' *Finance and Development* 20.4 (1983): 6-9.
[421] Henisz and Zelner (2001), Brown (1981).
[422] Petrazzini (1995), Duch R. M., *Privatising the Economy: Telecommunications Policy in Comparative Perspective* Ann Arbor, University of Michigan Press (1991).

developed economies (as in Duch's study), whilst they are typically exogenous in developing ones (as in Petrazzini's) requiring the state to assume responsibility in the promotion of diffusion-conducive reforms.

Milner focuses on 190 countries during the 1990s and finds that speedy internet diffusion was not driven mainly by economic factors but by political institutions, concluding that democratic governments play a key role.[423] Further, Milner argues that technology diffusion rates are dependent upon domestic policy, which in turn is dependent upon the choices that political leaders make about the rules governing the new technology. Similarly, Wilson states that 'when countries have environments that promote stability and respect for law and democratic rights... rapid ICT diffusion is more likely'.[424] Ultimately, as Kalathil and Boas colloquially argue, in regard to ICT the 'states still call the shots'.[425]

A discussion of the choices and types of government rule would similarly be incomplete without any mention of regulations, which ultimately determine the structure of the financial markets and the quality of institutions that govern the market. Well developed and regulated financial markets will provide adequate potential returns on investments and attract capital that is important for faster rates of ICT diffusion. In turn, the structure of political incentives and political institutions in each country can shape its system of property rights and the regulation of the communications system. According to Wellenius and Stern, the form of the electoral and party systems, the way power is divided in the national government, as well as the degree of federalism, will strongly influence the choice of telecommunication policies.[426] They also maintain that the political structures of Argentina and Mexico made for important policy differences at the time of privatisation. For instance, both countries chose to privatise and allow foreign ownership of the telecommunications

[423] Milner (2006).
[424] Wilson E., *The Information Revolution and Developing Countries* Cambridge, MA, MIT Press (2004), p.327. Kedzie also finds that democratisation has a positive impact on ICT diffusion rates as political regimes that suppress freedom of speech may want to control the diffusion of ICT (since these are primarily communication media). Kedzie C., *Communication and Democracy: Coincident Revolutions and the Emergent Dictator's Dilemma* Santa Monica, Research And Development (RAND) (1997).
[425] Kalathil and Boas examine eight authoritarian governments and analyse the way the internet is used by societal, economic and political actors. See Kalathil S. and Boas T. C., *Open Networks, Closed Regimes: The Impact of the Internet on Authoritarian Rule* Washington D.C., Carnegie Endowment for International Peace (2003), p.137.
[426] Wellenius and Stern (1994).

provider, but Mexico opted for a single national company whereas Argentina opted for two separate regional monopolies.

From Andonova and Díaz-Serrano's perspective the development of the necessary telecom infrastructure will inevitably depend on the quality and nature of the country's political institutions (a view endorsed by Esfahani and Ramirez, Henisz and Zelner, Levy and Spiller).[427] In an earlier study, Andonova found that the difference in ICT diffusion rates (specifically in mobile telephones and the internet) between developed and developing countries was largely due to the difference in the quality of their institutions; particularly with an institutional environment associated with lower investment risks and better property rights protection.[428] Despite a potential limitation of the study in regard to their accounting of institutional heterogeneity, it is undeniably a key study addressing the 'quality' factor.[429]

Overall, the institutional approach shows that there are a plethora of factors that can explain the different rates of ICT diffusion across countries. It seems that a potentially important factor, especially in developing economies, is the role of the state. The intrinsic traits, views and actions of the state can markedly affect the experience of diffusion from the very point of adoption to ultimate saturation, as it can control or oversee many aspects of any given technology. Identifying this factor as key is just the starting point, since Rosenberg famously conjectured '...there has been no single institutional formula for success'.[430] If the state operates successfully in diffusing a single technology, it does not necessarily follow that similar actions in another country, or for a different technology, will yield the same positive outcomes. It is important, therefore, to note that this thesis examines more than one technology across two countries.

[427] Andonova and Díaz-Serrano specifically analyse the diffusion rate of three ICTs (fixed-line telephones, cellular telephones and the internet), across 183 countries for the period between 1990-2004. They find that the diffusion of these were closely dependent on political institutions. Andonova V. and Díaz-Serrano L., 'Political Institutions and the Development of Telecommunications' Institute for the Study of Labour, Discussion Paper 2569 (2007): 1-28. Esfahani and Ramirez (2003), Henisz and Zelner (2001), Levy and Spiller (1996).

[428] Andonova V., 'Mobile Phones, the Internet and the Institutional Environment' *Telecommunications Policy* 30 (2006): 29-45.

[429] Andonova used internationally comparable indices regarding institutional quality, which were drawn up at a national level. However some political scientists recognise institutional heterogeneity within a country.

[430] Rosenberg (1970), p.575.

1.5.5 Summary of the Literature

One of the findings of the thesis is that the telegraph and telephone diffusion rates in Argentina and Mexico were similar. Given the differences in their economic settings, economic factors are seemingly unable to account for such an occurrence. The review above examined an extensive range of factors within the existing literature that could account for differences in the rates of ICT diffusion across the two countries. The economic, institutional (and to some extent social) approaches are clearly the most relevant to this specific thesis, although some attempts will be made to account for the natural endowment approach (e.g. country size via the population density variable). In developing economies, the role of the government ultimately requires greater emphasis due to its ability to shape and determine the economic and social environment in which ICT diffusion takes place, especially in regard to the provision of the necessary infrastructure. Without government support in the process of ICT diffusion, all other important factors, will become largely inconsequential, hence its paramount importance.

1.6 Gap in the Literature

Technology diffusion is well documented in the academic literature, however, there has been no technology diffusion research that comparatively analyses these traditional ICTs in Argentina and Mexico over the whole period of their diffusion, from adoption to saturation, whilst accounting for a wide range of variables. Numerous studies have looked at the diffusion of the two technologies from static perspectives. However, this is problematic since diffusion is a process and as such one cannot hope to view a snapshot and draw meaningful conclusions or provide much insight in regard to the primary drivers of a given diffusion rate for the whole period of diffusion.[431] As indicated, much of the ICT literature primarily focuses on the most recent period and although there is some work on telephone diffusion in Argentina, there is a significant lack of work on the diffusion of the telegraph in Argentina or Mexico.

A considerable amount of research has focused on investigating innovations as standalone episodes, as if they were entirely independent of all other innovations.

[431] Rogers (1995).

This is a dubious assumption, especially in the case of technologies that are so closely interrelated, where the experience of one innovation is likely to influence the diffusion of the next. As Rogers acknowledges, 'it is much simpler for diffusion scholars to investigate the spread of each innovation as an independent event, but this is a distortion of reality'.[432] For instance, few studies examining internet diffusion pay attention to previous fixed-line telephone diffusion. This study somewhat mitigates these issues in terms of making generalisations across ICTs by analysing the telephone and its predecessor, the telegraph. In terms of the technique of analysis, it is true that the application of an institutional emphasis (particularly focussing on the role of the state) is not unique in the technology diffusion literature but what this thesis contributes is corroborating evidence to support these claims. Through careful consideration of Argentina's and Mexico's particular political economies and various other potential explanatory factors, this comparative study is able to evaluate their respective dynamics regarding ICT diffusion.

1.7 Methodology

The thesis applies a modelling framework that includes the Flexible Logistic Growth model as well as linearisation techniques. As a consequence of the s-curve shape of the diffusion process, linearisation techniques were necessary to quantify the rate of diffusion across the two technologies. This process demonstrated that diffusion in Argentina and in Mexico took place at similar speeds, providing part of the foundations upon which the thesis is based. Once the Paradox was quantified, regression analysis coupled with very necessary qualitative analysis followed, in order to assess the extent to which the main factors surveyed in the literature review explained the diffusion rates in Argentina and Mexico most effectively. The quantitative analysis, however, must be considered in light of the inherent limitations regarding the reliability and consistency of all the official data (see the introduction to the appendices and appendix B). This is a long experienced problem faced by academics and one must take great care when interpreting the findings. The qualitative section is naturally more focused upon the institutional factors, given their intrinsic inability to be quantified with a great degree of accuracy, whilst the quantitative approach deals with the socio-economic factors in greater detail. The

[432] Ibid., p.15.

methodology of the thesis is based on four databases: Argentina's telegraph diffusion, Mexico's telegraph diffusion, Argentina's telephone diffusion, and Mexico's telephone diffusion. This thesis defines telegraph diffusion as the number of telegrams sent per 100 inhabitants. The telegrams sent are those sent by the public and exclude telegrams sent through the radiotelegraph. Telephone diffusion is defined here as the number of telephone handsets per 100 households. Information for the four main databases was predominantly collected from the census and yearbooks of national statistics. These were constructed from extensive field research and archive work (see appendix B for all the relevant sources). A range of socio-economic data were also collected in relation to the quantitative analysis (see appendix C).

The perception that economic indicators need to be treated with care was contemplated by some international organisations in the 1950s/1960s. It was noted in various ECLA publications that certain statistics in particular Latin American economies faced a rather serious issue of reliability. The problems are twofold: first, there was a methodological issue, and secondly, the politically sensitive nature of this kind of data.[433] As indicated, one must remain sceptical regarding the precision of the collected data, specifically around the turn of the twentieth century, since official data compilation in this period unfortunately may not be as reliable as one would wish. Collecting data such as population growth or urbanisation during the earlier period under consideration naturally presented a great logistical challenge for countries like Argentina and Mexico. Moreover, there are obvious political sensitivities surrounding the nature of socio-economic variables such as GDP per capita, or income inequality, and it is therefore prudent to acknowledge the potential for bias. Inconsistencies also exist, for example, with regard to the telegraph and telephone data presented in Mitchell, compared to that of INEGI (see appendix B for details and further discussion).[434] The accuracy and reliability of the data, however, generally has improved over time. This was reinforced during the 1960s, as foreign agencies started to compile the data simultaneously due to the insistence of the U.N.,

[433] For instance, see ECLA especially publications in the *Serie Distribución del Ingreso*, for example, No. 3, 'Antecedentes Estadísticos de la Distribución del Ingreso en Chile, 1940—82' (Santiago, Chile, 1987).

[434] An explanation for this particular issue is that Mitchell and INEGI account for the variables in slightly different ways, even if the general trends of the data are very similar. Despite this, some inconsistencies among different sources of data are apparent, which provide insight into their reliability. See the introduction to appendices and appendices A and B.

that countries must adopt a standard definition for categorisations like urbanisation.[435] Comparisons between any two countries (like Argentina and Mexico) have to be made with care, since it must be borne in mind that criteria definitions differ over time and across countries. Urbanisation data is one such area where accuracy varied materially over time as a lack of continuity at the census offices induced continual criteria change. [436]

Despite this shortcomings, some fairly reliable earlier data does exist, for instance for the decades around the Second World War (specifically 1930-1946). ECLA perhaps provides the most rigorous statistical data compilation for Argentina and Mexico.[437] The yearly Economic Surveys and Statistical Yearbooks of ECLA are two very good source of data across Latin America. [438] Meanwhile, Argentina's national census of 1914 provides particularly useful for data before the First World War.[439] Further analysis of Latin American economic development over this period can be found in Maddison and Bairoch.[440] For socio-economic factors such as GDP per capita and population, I primarily used Maddison's data because this spans the longest period (hence allows for consistency) and is particularly reliable as he draws much of his data for Latin America from ECLA.[441] In addition to ECLA, the Argentina data is supplemented by CONADE, and the data for Mexico by INEGI and the World Bank.

---

[435] For a detailed overview of the classification changes see Goyer D. S. and Domschke E., *The Handbook of National Population Censuses. Latin America and the Caribbean, North America and Oceania* Connecticut, Greenwood Press (1983).

[436] Urban population growth trends and differences in definitions in how to measure urban populations are treated in the United Nations, *Growth of the World's Urban and Rural Population 1920-2000* New York, United Nations (1966). Also see United Nations *Patterns of Rural and Urban Population Growth* New York, United Nations (1980).

[437] ECLA (1959).

[438] For example see Economic Commission for Latin America and the Caribbean (ECLAC), Statistical Yearbook for Latin America and the Caribbean Santiago, United Nations (1996). Economic Commission for Latin America and the Caribbean (ECLAC), Economic Survey of Latin America and the Caribbean 1998-1999 Santiago, United Nations (1999). Note that ECLA is now called ECLAC. Another important ECLA publication is ECLA *Dirección y Estructura del Comercio Latinoamericano* Santiago, United Nations (1984). It must be noted, however, that there are some discrepancies between the work of ECLA and that of the U.N., which are discussed in Wells J., *Latin America at the Cross-Roads* Santiago, CEPAL (1988).

[439] República Argentina, Comisión Nacional del Censo, *Tercer Censo Nacional, 1914,* Talleres Gráficos de L. J. Rosso, Buenos Aires (1915-1917). For other economic data for this period, also see Tornquist E. and Cía. Limitada, *The Economic Development of the Argentine Republic in the Last Fifty Years* Buenos Aires, United Nations (1919).

[440] Maddison A., *Growth and Slowdown* in Advanced Capitalist Economies: Techniques of Quantitative Assessment' *Journal of Economic Literature* 25.2 (1987): 649-698. Maddison A., *Phases of Capitalist Development* Oxford, Oxford University Press (1982). Bairoch P., *The Economic Development of the Third World since 1900* London, Methuen & Co. (1977).

[441] Indeed, the work of ECLA represents the most thorough attempt by an international organisation to ensure data consistency across Latin America.

As stipulated, for the purposes of this study a full data set is necessary, to be able to build the diffusion s-curves for the telegraph and telephone. As a result, I decided to use data collected from Maddison, instead of using Mitchell's data for instance (as I had done initially).[442] Mitchell's historical data on Latin America is used widely and is an excellent source (especially for large comparative studies), due to its consistency, wide range of factors, and the large number of countries under coverage. Yet for the purposes of this thesis, since the focus here is only on two countries, there are other preferred sources which included more specific and detailed Argentinian and Mexican data. For instance, in Mitchell there are no telegraph or telephone data for the intra-war years for Argentina, while for Mexico, much of the data for the early years of diffusion is missing. Further, Mitchell's data do not differentiate between the telegrams sent by the government and those sent by the public. As a result of the field trip to Latin America, I obtained a fuller data set and hence was able to attempt to fill some of the gaps in Mitchell's work.

Other data, used in the regression analysis of chapter 4, was collected from various sources, including the Organisation for Economic Co-operation and Development (OECD), the International Telecommunications Union (ITU) and the Interuniversity Consortium for Political and Social Research (ICPSR) to name a few (see appendix C for full details). For the period 1950-1990 the yearly publications and databases of the OECD and the World Bank, as well as the IMF's, are also especially useful. [443] As a result of the variable degree of quality and date intervals of official data in Latin America, many demographers typically draw on the standardised data compilations of the *Centro Latinoamericano de Demografía* (CELADE).[444] CELADE is a good source for more recent data, but urban population data in Latin America, for instance, was collected only from 1950 onwards, while this thesis analyses data from as far back as the nineteenth century.[445] This is a typical problem posed by many statistical publications, since most historical data often includes only the second half of the

[442] Mitchell B. R., *International Historical Statistics: Australasia and Americas* London, Palgrave Macmillan (1983).
[443] Organisation for Co-operation and Development (OECD), Historical Statistics and National Accounts (various years) (http://www.oecd.org). The World Bank, *World Bank Tables* Washington D.C. (various years), The World Bank, *World Development Report 1994* Washington D.C. (various years), IMF: (http://ww.imf.org/external/pubind.htm).
[444] Centro Latinoamericano y Caribeño de Demografía (CELADE), *Boletín Demográfico* (various years) provides periodic summaries of the most important demographic indicators.
[445] CELADE is the population division of ECLA and its data are available online: (http://www.cepal.org).

twentieth century. Again, the demands of this thesis, in requiring data sets that pre-date the twentieth century, mean that many statistical publications do not readily provide sufficient data.[446] For further commentary on the data used and its specific sources, refer to the introduction to the appendices and appendices A, B and C. Appendix A details the relevant socio-economic data over the period, citing and discussing the sources used, as well as acknowledging the inherent limitations of the data. Appendix B and C follow the same process, with appendix B presenting a full list of the telegraph and telephone data, while appendix C reveals the other relevant quantitative data used in this thesis. In summary, although it is prudent to have an appreciation of the validity issues of a given data set, it is also important to acknowledge that no single option is perfect.

[446] For instance, the IMF are only available from 1950 onwards, for the World Bank and ITU from 1960, while UCTAD only goes back as far as 1970.

Chapter 2
The Flexible Logistic Growth Model

This chapter provides the theoretical modelling framework which allowed for the quantitative exploration of the traditional ICT diffusion process in Argentina and Mexico. The chapter demonstrates that the diffusion paths in Argentina and Mexico abided by s-curve theory, and then applies a critical analysis of the potential applicable diffusion models. The origins of the accepted theory on generic diffusion of innovations are traced from their theoretical beginnings with Rogers to the latest type of innovative flexible modelling.[1] The remaining focus of the chapter is on the Flexible Logistic Growth Model (FLOG), which is chosen as the most appropriate model to statistically examine diffusion in Argentina and Mexico. The chapter provides a justification for the choice of methodology, and then applies the model (and linearisation techniques), in order to measure the diffusion speeds. This chapter provides some sense of mathematical basis for the arguments of the comparative case studies by demonstrating that the two technologies diffused at a similar rate in Argentina and Mexico, thereby revealing the Paradox.

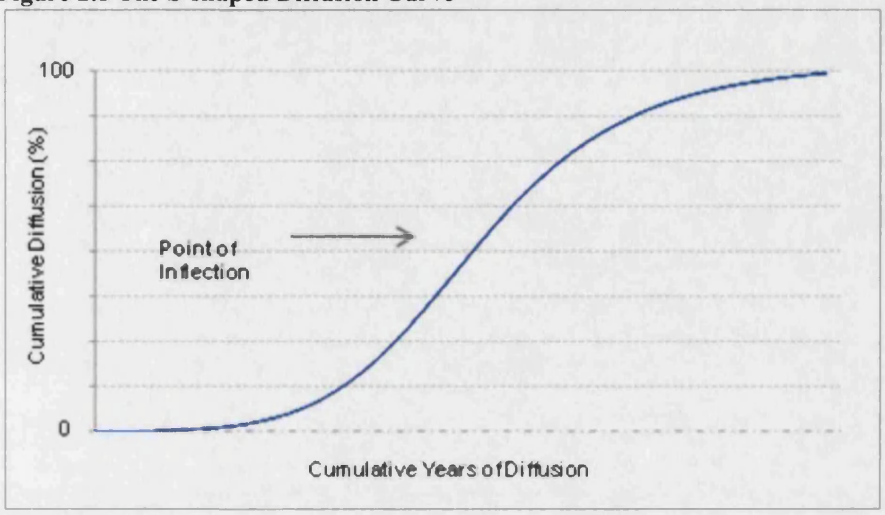
2.1 The Process of ICT Diffusion

The process of technology diffusion is a complex one, and should not be taken simplistically, as differing technologies will diffuse in entirely dissimilar fashions. Different countries will adopt and diffuse a given technology at different points of inception and at different rates because they may for instance have different economic or environmental settings, which impact the facilitation of technology transfer. The process of ICT diffusion refers to the practice by which new ICTs spread across their potential markets over time. Diffusion does not happen instantaneously; instead it is a long, drawn-out process which commonly tends to take many years until the saturation of the new technology is finally attained.[2] The Theory of Diffusion of Innovations, formalised by Everett Rogers in 1962, predicted that an innovation will diffuse following an s-shaped distribution curve (or Pearl

[1] Rogers (1995).
[2] Stoneman P., *The Economics of Technological Diffusion* Oxford, Blackwell (2002).

curve) as in figure 2.1. This theory established the basis for all studies related to the diffusion of a new technology. [3]

Figure 2.1 The S-shaped Diffusion Curve

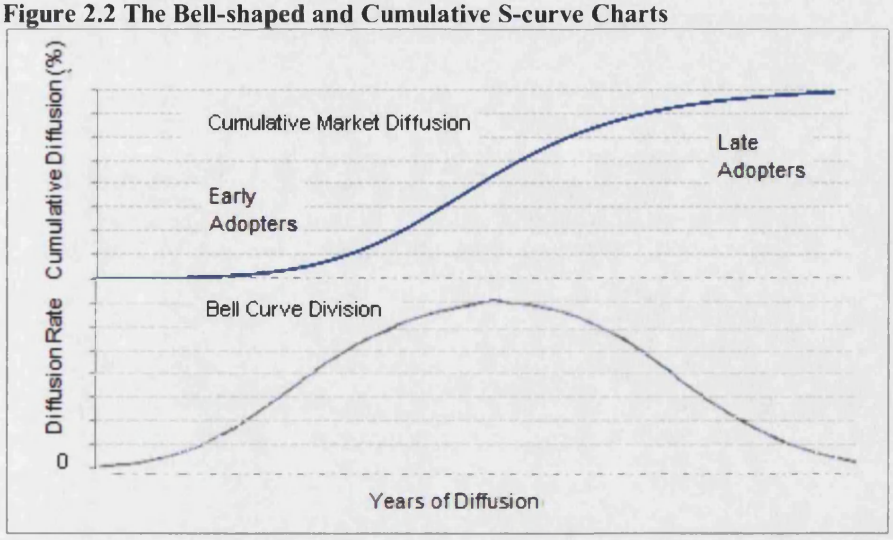


Source: Own elaboration.

The logic behind the s-shape diffusion curve in figure 2.1 is that the rate at which a new technology diffuses begins at a low level and increases gradually, until it reaches a point of inflection (i.e. where the maximum rate of diffusion is reached). After this point, the level of diffusion increases but at a decreasing rate, as progress is harder to achieve the closer one gets to the upper limit (the saturation point). [4] Theoretically the telegraph and the telephone, are expected to follow this s-shaped path. The s-shaped curve is derived, fundamentally, from a symmetric Bell curve mathematical division, which maps the rate of adoption over a given period to form a normal distribution. [5] The resulting s-curve shown in figure 2.2 is a cumulative graphing of the Bell-curve distribution.

[3] Rogers (1995), Griliches (1957), Linstone H. A., and Sahal D., *Technological Substitution* New York, American Elsevier (1976).
[4] Mahajan V., Muller E. and Bass F. M., 'New Product Diffusion Models in Marketing: A Review and Directions for Research' *Journal of Marketing* 54.1 (1990): 1-26. Griliches (1957).
[5] Adoption is typically characterised by the following: innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%). Rogers (1995).

Figure 2.2 The Bell-shaped and Cumulative S-curve Charts



Source: Adapted from Mahajan Muller and Bass (1990).

Figure 2.2 shows that, as the Bell-curve distribution and the cumulative distribution curves tend away from one another, the maturity stage in the rate of adoption and ultimately the saturation levels are attained (i.e. when the curves flatten). Saturation often coincides with the growth stage of a competing technology; examples of which can be found in various studies.[6] Unsurprisingly, the saturation stage of the diffusion of the electric telegraph coincided with the growth stage of the telephone and the spread of radiotelegraphy.

2.2 The Diffusion S-curves in Argentina and Mexico

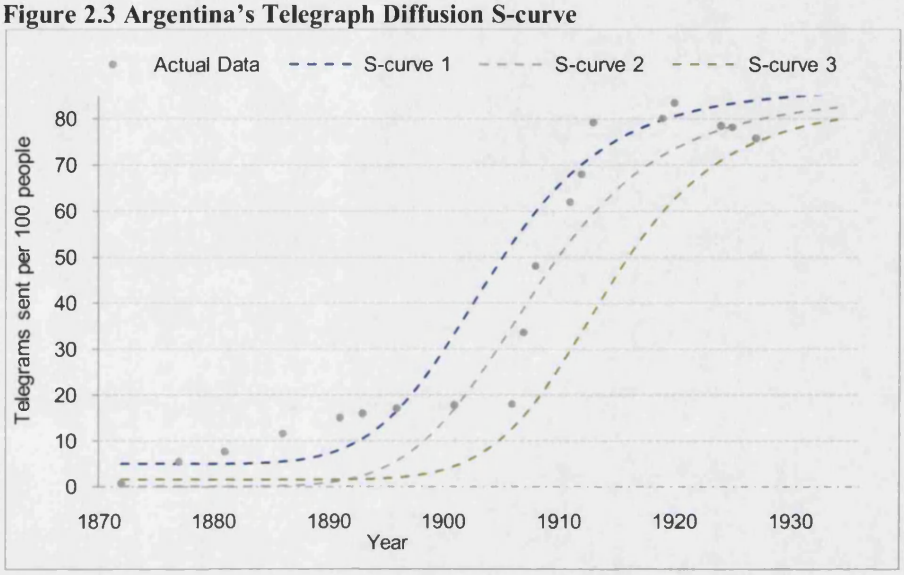
Argentina's and Mexico's pattern of ICT diffusion closely followed that of the developed world (by adhering to an s-shaped curve). In practice, in the developing world few technologies achieve complete diffusion through the population. Instead, what tends to happen is that a new substitutive technology will take the place of the earlier one (an example being the mobile telephone). In some cases, in developing countries where people may not have adopted the earlier technology (such as a fixed line telephones for instance), they may simply leapfrog onto the next technology before anything resembling saturation materialises.[7] The actual diffusion paths of the telegraph and the telephone in Argentina and Mexico are shown below (figures 2.3 –

[6] For instance, see Fisher J. C. and Pry R. H., 'A Simple Substitution Model of Technological Change' *Technological Forecasting and Social Change* 3 (1971): 75-88. Fisher and Pry demonstrated this via the substitution of synthetic/natural fibres and synthetic/natural rubbers.

[7] Menezes C., 'Development of the Information Society in Latin America and the Caribbean' *UNESCO Report* (2000): 1-7.

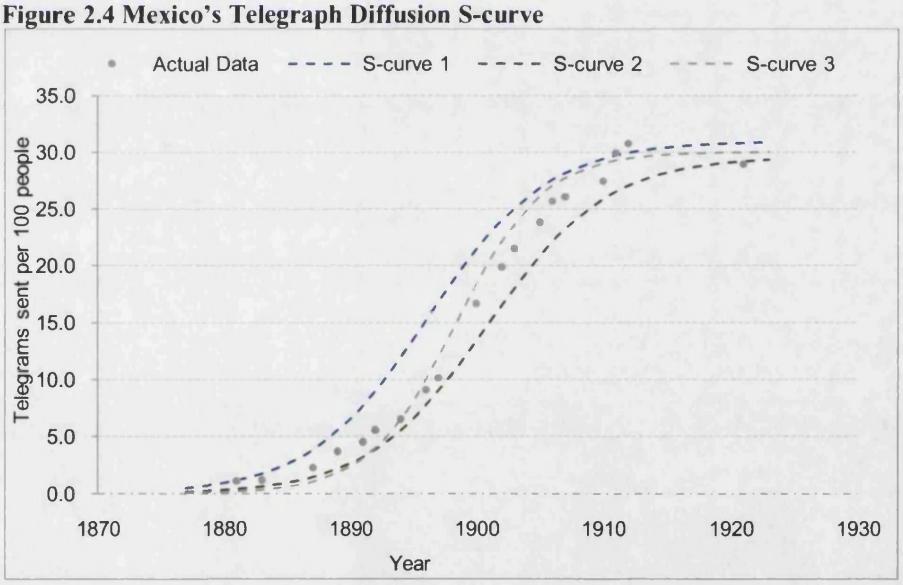
2.6) and generic s-curves were added for illustrative purposes.[8] The diffusion of the telegraph is represented by the cumulative number of telegrams sent by the public (excluding official telegrams) per 100 inhabitants and for telephone diffusion the data is graphed as the number of telephone handsets per 100 households, against time.

Figure 2.3 Argentina's Telegraph Diffusion S-curve



Source: Own elaboration. For detailed sources on the data collection see appendix B.

Figure 2.4 Mexico's Telegraph Diffusion S-curve



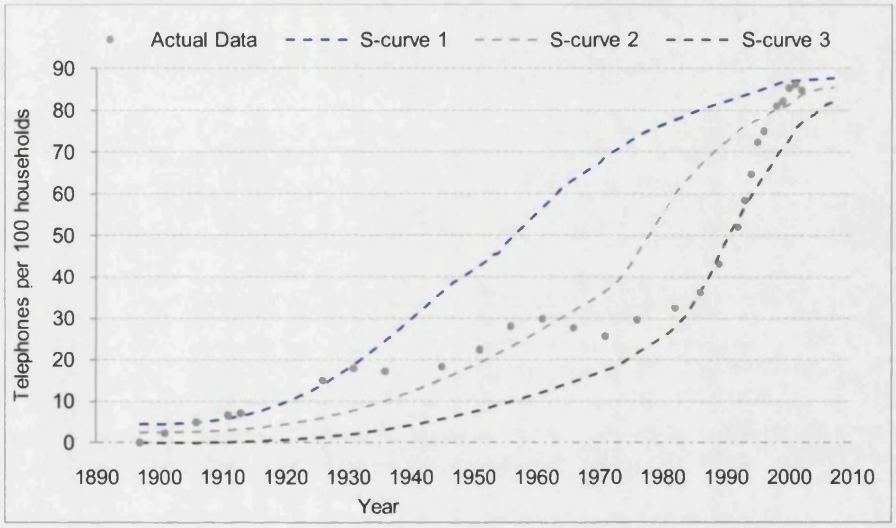
Source: Own elaboration. For detailed sources on the data collection see appendix B.

This study is concerned with the relative speed with which a country diffuses a technology. Despite this, it must be noted that the absolute level of telegraph diffusion in Argentina was much greater than in Mexico. This is discussed further in

[8] These were drawn with the help of Loglet Lab2.

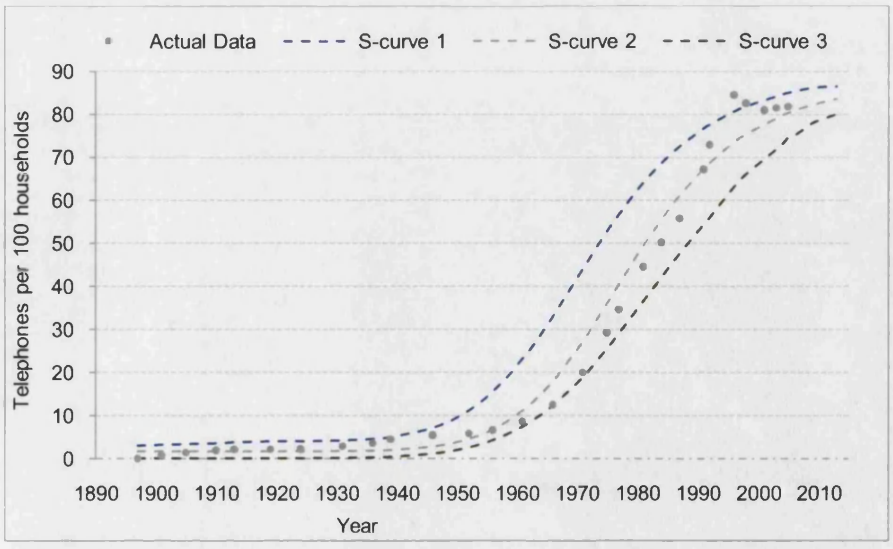
chapter 3, section 3.1.3 The Years of Telegraph Saturation. However, perhaps what is more remarkable is just how close the absolute levels of diffusion were for the telephone technology (see figures 2.5 – 2.6). There are obviously many factors that distort a country's final level of diffusion, such as the period in time in which diffusion takes place and their access to newer substitutive technologies, but this study remains primarily concerned with the speed at which a given country diffuses to *their* respective saturation level and since the study accounts for more than just one technology, any cause for concern is reduced further. It is pertinent to note that 100% of diffusion here and throughout the thesis is observed endogenously as the actual level of saturation reached, as opposed to the market potential.

Figure 2.5 Argentina's Telephone Diffusion S-curve



Source: Own elaboration. For detailed sources on the data collection see appendix B.

Figure 2.6 Mexico's Telephone Diffusion S-curve



Source: Own elaboration. For detailed sources on the data collection see appendix B.

Figures 2.3 to 2.6 show that the diffusion of the two technologies in Argentina and Mexico followed the expected s-shaped curve, as predicted by the literature. However, simply stating that the diffusion pattern will follow an s-shaped curve is not enough, since part of the complexity within the process of technology diffusion rests on the fact that different technologies will diffuse in different fashions and at different speeds. Mansfield, Stoneman and Toivanen revealed this across different industries, Lehr and Lichtenberg proved it across different firms, and Stoneman and Battisti showed that the diffusion path of the same technology can differ across regions, an argument supported by Alderman and Davies, and Nabseth and Ray.[9] Although it is a common finding that the diffusion of a new technology, when plotted against time, will ordinarily produce an s-shaped curve[10] (as confirmed by studies as early as Griliches and Mansfield's), the exact shape can take various forms (as considered in table 2.1 later in the chapter).[11] In closer examination of Argentina's and Mexico's respective diffusion s-curves (figures 2.3 – 2.6), the most appropriate type of s-curve model must be chosen for the statistical mapping of the telegraph and telephone diffusion paths.

2.3 Conditions for the Theoretical Modelling Framework

One aim of the thesis is to gain greater understanding of the logic behind the observed diffusion rates for the telegraph and the telephone in Argentina and Mexico in order to explain why these technologies were diffused at remarkably similar rates in both countries, despite experiencing significantly different economic environments. The hypothesis is that it was due to the role played by the state, but before any explanations can be tested, one must be in position to demonstrate statistically that the two technologies did indeed diffuse at a similar rate. In order to test this, it is critical to use a formal model.

---

[9] Mansfield E., 'Industrial Robots in Japan and the USA' *Research Policy* 18 (1989): 183-192, Stoneman P. and Toivanen O., 'The Diffusion of Multiple Technologies: An Empirical Study' *Economics of Innovation and New Technology* 5 (1997): 1-17, Lehr W. and Lichtenberg F., 'Computer Use and Productivity Growth in US Federal Government Agencies, 1987-1992' *Journal of Industrial Economics* 21.1 (1990): 27-44. Stoneman P. and Battisti G., 'Intra Firm Diffusion of New Technologies: The Neglected Part of Technology Transfer' *International Journal of Industrial Engineering* 4.4 (1997): 270-282. Alderman N. and Davies S., 'Modelling Regional Patterns of Innovation in the UK Metal-working Industries' *Regional Studies* 24.6 (1990): 1451-1461, Nabseth L. and Ray G. F., *The Diffusion of New Industrial Processes: An International Study* Cambridge, Cambridge University Press (1974).

[10] See Sharif M. N. and Islam M. N., 'The Weibull Distribution as a General Model for Forecasting Technological Change' *Technological Forecasting and Social Change* 18 (1980): 247-256.

[11] Griliches (1957), Mansfield (1961). Mansfield looked at the diffusion of 12 different new technologies, across different sectors, which confirmed the aforementioned s-shaped diffusion pattern.

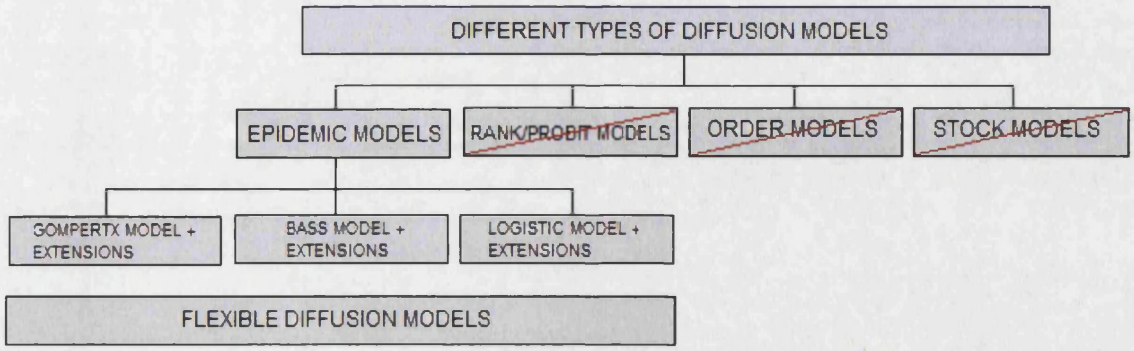
The choice of a diffusion model is no simplistic task, given the wide range available. The appropriate model for this thesis must accurately be able to measure the rate at which the telegraph and the telephone diffused in Argentina and Mexico. The telegraph and the telephone are technologies specifically characterised by positive network externalities, i.e. their associated value grows as the number of customers using it increases. Consequently, the model must account for network externalities, as this factor to some extent explains an individual's rationale in adopting such a technology. Most importantly the model must fit the data presented in figures 2.3 – 2.6, that is to say, it must be flexible enough to allow for the given s-curve characteristics of asymmetry and varied inflection points. Finally, the thesis requires a model which addresses the diffusion of a technology in terms of the market in aggregate (i.e. not at the individual level) as the thesis measures diffusion within a country (as opposed to just within a household or firm). It is also important to note that the chosen technologies are characterised by a lack of significant improvements or changes since their initial diffusion.[12] Consequently, the chosen model does not need to be the most complicated, especially since there is no need for predictive powers, as the data set is historical. The available theoretical models are examined below, and ultimately the FLOG is chosen as the most suitable.

2.4 Theoretical Models to Measure the Rate of Technology Diffusion

Although the physical shape of the empirical s-curves and the requirements listed above enabled us to discount many of the models initially surveyed below, this section has remained generic to demonstrate more transparently the top down approach that was adopted in choosing a model. In general, a diffusion model will attempt to measure 'the spread of an innovation among a given population... in terms of a simple mathematical function of the time that has elapsed from the introduction of the innovation'.[13] There are four main model types which explain the s-shaped diffusion curves, namely, the Epidemic models, the Rank (or Probit) models, the Order models and the Stock Adjustment models. Table 2.1 summarises the model branches that were considered.

[12] One may argue that the services of the telephone and telegraph improved, but ultimately these technologies remained largely unchanged, in comparison with more complex technologies such as computers.
[13] Mahajan V. and Peterson R. A., *Models for Innovation Diffusion* California, Sage Publications (1985), p.10.

Table 2.1 Different Category Types of Diffusion Models



Source: Own elaboration from information mainly in Karshenas and Stoneman. (1993).

As indicated by table 2.1, Epidemic models are the relevant branch required for this thesis and these models are accordingly divided into further sub-categories (disregarded models are indicated with a red strike through their name). The key rationale for choosing the Epidemic models are because they are the only ones which, in addition to accounting for the s-shaped diffusion curves, also account for network externalities. This factor often proves most problematic when choosing a model to measure technology diffusion.[14] Consequently, the Rank, Probit (e.g. David 1969, Davies 1979), Order (e.g. Ireland and Stoneman 1985, Fudenberg and Tirole 1985) or Stock Adjustment models (e.g. Reinganum 1981, Quirmbach 1986, Schumpeter 1984) are unsuitable.[15] Moreover, the Rank, Stock and Order models tend to focus on the diffusion of a new technology at the micro level (e.g. the firm) rather than the macro level, as required here.[16]

The Epidemic models are the earliest and most common type of models aimed at explaining the s-shape curve within the diffusion literature. They are based on the

[14] Rogers (1995).

[15] For more information see Karshenas M., and Stoneman P. L., 'Rank, Stock, Order, and Epidemic Effects in the Diffusion of New Process Technologies: An Empirical Model' *Research And Development (RAND) Journal of Economics* 24.4 (1993): 503-528, For Probit models see David P., *A Contribution to the Theory of Diffusion* Sanford, Centre for Research in Economic Growth Research Memorandum 71, Stanford University (1969), Davies S., *The Diffusion of Process Innovations* Cambridge: Cambridge University Press (1979). For order models see Ireland N. and Stoneman P. L., 'Order Effects, Perfect Foresight and Inter-temporal Price Discrimination' *Recherches Economiques de Louvain* 51 (1985): 7-20, Fudenberg D. and Tirole J., 'Pre-emption and Rent Equalization in the Adoption of New Technology' *Review of Economic Studies* 52 (1985): 383-401. For stock adjustment models see Reinganum J., 'Market Structure and the Diffusion of New Technology' *The Bell Journal of Economics* 12 (1981): 618-624, Quirmbach H., 'The Diffusion of New Technology and the Market for an Innovation' *Research And Development (RAND) Journal of Economics* 17 (1986): 618-624, Schumpeter J., *The Theory of Economic Development* Cambridge, MA: Harvard University Press (1984).

[16] Kemp R., *Environmental Policy and Technical Change: A Comparison of the Technological Impact of Policy Instruments* U.K., Edward Elgar (1997), Barreto L., 'Gaps and Needs in Technology Diffusion Models: The Perspective of an Energy-systems Modeler' Paper presented to the *Workshop on Clean Technologies Diffusion Modelling* (2003): 1-11.

principle that dissemination of information and/or contagion is key in driving technology diffusion. As Griliches and Geroski identified, the rate of diffusion is predetermined by the degree of information available regarding the new technology, leading different countries to adopt and diffuse new technologies at different times and speeds.[17] These types of models are highly appropriate for measuring the different rates of diffusion of the telegraph and the telephone because the underlying assumption regarding the rate, at which non-adopters adopt, is determined by the volume of existing and future potential users.[18] Indeed, existing users are essential in increasing cumulative diffusion because they act as test-cases/sources of information for prospective users, and the more their numbers grow, the greater the probability that a prospective adopter will adopt.[19]

Epidemic models assume that there is a potential population of adopters, that the innovation cannot be lost once it is adopted and that it is diffused when contact between two individuals occurs, with the frequency of contact remaining constant. Thus the start of the diffusion of a new technology will see a given number of subscribers, followed by users and non-users mixing within society making contact over time. The key assumption is that by making contact with a user of the new technology, it is more likely that the non-user will become a user. Consequently, over time the number of non-users will decrease and the number who can convert will fall. Due to the increased probability of contact, the growth in the number of users (as a proportion of the total number of potential users) results in an s-shaped distribution curve. The main criticism of these models rests on the fact that many new technologies take many years to saturate, and it seems unrealistic to think that the only reason why late adopters have not acquired the technology is because they do not know of its existence. For the telegraph or the telephone, a response to this criticism would be that, in fact, all potential adopters *know* of the existence of the new technology but it is rather the knowledge of its *performance* and utility that is transferred through contact. Thus the mere contact between a user and non-user does not necessarily result in the non-user converting. The non-user may need to meet

[17] Geroski P. A., 'Models of Technology Diffusion' *Research Policy* 29 (2000): 603-625.
[18] Swann G. M. P., 'Sales Practice and Market Evolution: the Case of Virtual Reality' *International Journal of Industrial Organization* 19 (2001): 1119–1139.
[19] Yeon S., Park T. S. and Kim S., 'A Dynamic Diffusion Model for Managing Customer's Expectation and Satisfaction' *Technological Forecasting and Social Change* 73 (2006): 648–665.

many users before deciding to become a user him/herself. Epidemic models are also advantageous because they assume that the quality of the technology being diffused remains constant. Moreover, Epidemic models are most successful when populations are dense and '...where the new technology is clearly superior to the old one and no major switching costs arise,'[20] which is the case in this thesis.

An examination of the different sub-divisions within the epidemic models follows below.

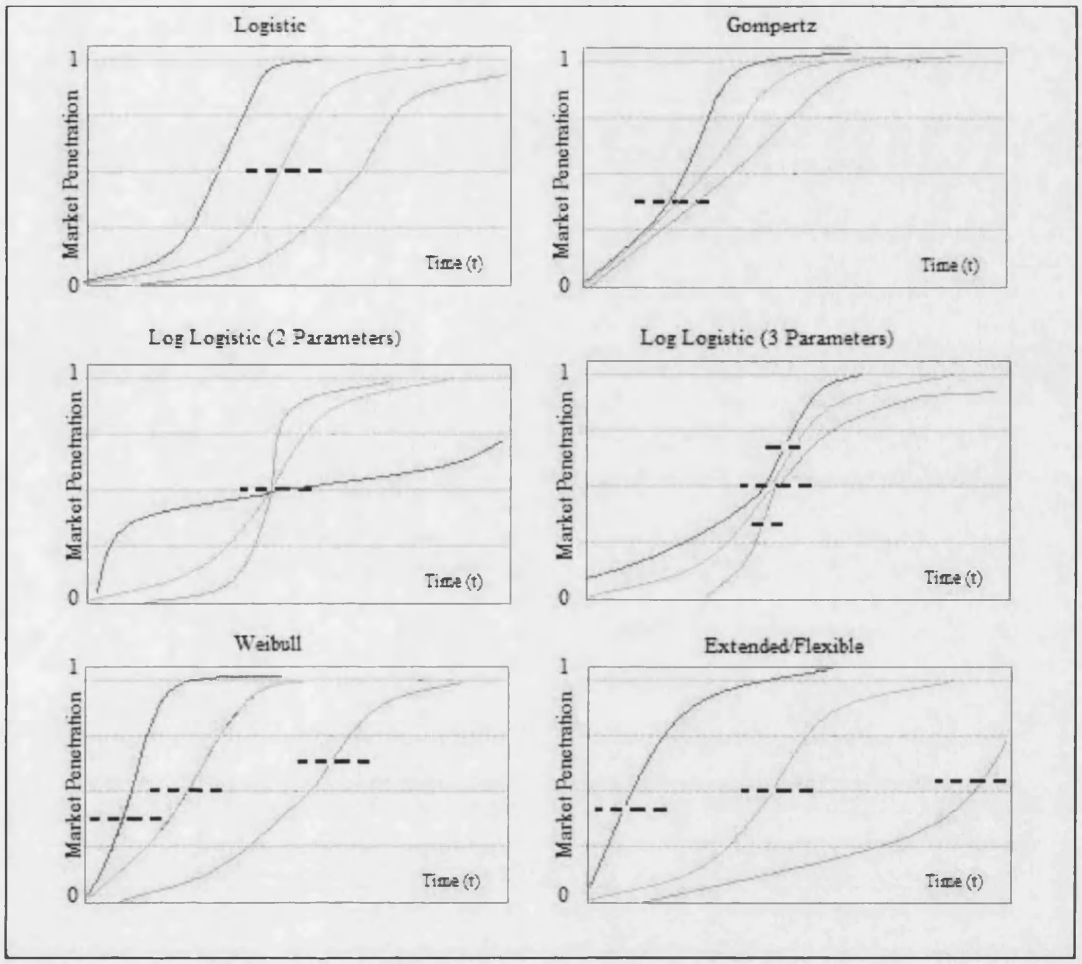
2.4.1 Diffusion Models within Epidemic Models

Having established that Epidemic models are the most appropriate type of models for the purposes of this thesis, one must ascertain which specific type best serves the study's needs. Figure 2.7 illustrates the main types of Epidemic s-shaped diffusion curves and their points of inflection.[21]

[20] Geroski (2000), p.607.

[21] The point of inflection relates to the point on a curve where the curvature (second derivative) changes signs and shape, from concaving upwards (positive curvature) to downwards (negative curvature). It is a very important variable to consider in determining a suitable diffusion model.

Figure 2.7 Different Types of Epidemic S-curves



Source: Adapted from Meade and Islam (1998).

As depicted in figure 2.7, the effective structure of the basic diffusion s-curve is explained mathematically by two properties: the point of inflection (indicated by the dashed lines) and the degree of curve-symmetry. For instance, if the diffusion pattern has a point of inflection at the 50% level and the s-curve is symmetrical at the mid-point, the s-curve is said to be Logistic (as per the first graph in figure 2.7). Indeed, the Logistic curve is the best known and most common type of diffusion s-curve. It is worth noting that there are many models with a point of inflection below 50% but few above 50%. The table depicts six of the main Epidemic model shapes and shows clearly that a fixed inflection point, whether at 50% (e.g. Logistic) or 37% (e.g. Gompertz), is very much the norm.

There are numerous examples within the generic Epidemic models, and it seems most appropriate to divide them as Geroski labels them, between 'true' Epidemic models (i.e. with no extensions), and 'flexible' Epidemic models (i.e. with

extensions). The most common, true Epidemic models are the traditional Logistic models (e.g. Griliches' model and Mansfield's model with its numerous extensions, such as the Fisher-Pry and the Blackman models).[22] However, given that the empirical s-curves for the telegraph and telephone diffusion in Argentina and Mexico (as per figures 2.3 – 2.6), are not all symmetrical around the mid-point and, that the given points of inflection are not seemingly consistent, it means an extended or flexible Logistic model (as in the last graph within figure 2.7) is required. These findings eliminate the use of rigid models such as the Logistic, often termed crudely mechanical in nature.[23] Even the alternative Gompertz models with an inflection point at 37%, or similar models such as the Floyd (inflection point at 33%) are still too rigid, since the point of inflection continues to be predetermined at a fixed level.[24]

The real shortcoming of these fixed inflection point models is that there is no data determination. Both in practice and in theory, the point of inflection of the diffusion of a technology should be free to occur at any given point of the diffusion process and this is where the flexible diffusion models come in.[25] Ultimately, although individual graphs may display logistic characteristics, not all do. Thus one can confidently conclude that the diffusion of the telegraph and telephone in Argentina and Mexico must be modelled by a broader, more flexible group of models than can for instance account for both a Logistic and Weibull curve if necessary.

2.4.2 Epidemic Flexible Diffusion Models

The model of choice should be capable of illustrating several patterns of diffusion by, ideally, allowing entire data-determination of both the point of inflection and degree of curve-symmetry.[26] Table 2.2 presents the main flexible diffusion models, with their main characteristics and previous practical applications.

---

[22] Griliches (1957), Mansfield (1961), Fisher and Pry (1971), Blackman A. W., 'The Market Dynamics of Technological Substitutions' *Technological Forecasting and Social Change* 6 (1974): 41-63.
[23] Silverberg G., Dosi G. and Luigi O., 'Innovation, Diversity and Diffusion: A Self-Organisation Model' *The Economic Journal* 98 (1988): 1032-1154.
[24] Chow G. C., 'Technological Change and the Demand for Computers' *The American Economic Review* 57 (1967): 1117-1130. Floyd A., 'A Methodology for Trend Forecasting of Figures of Merit' in Bright J., *Technological Forecasting for Industry and Government: Methods and Applications* NJ, Englewood Cliffs, Prentice Hall (1968).
[25] Mahajan et al. (1990).
[26] Bewley R. and Fiebig D. G., 'A Flexible Logistic Growth Model with Applications in Telecommunications' *International Journal of Forecasting* 4 (1988): 177-192.

Table 2.2 Flexible Diffusion Models

Model	Inflection Points (%)	Symmetry	Applications
Bass (1969)	0-50	NS	Consumer goods, retail, education, industrial innovations
Jeuland (1981)	0-50	S or NS	Consumer durable goods innovations
Stanford Research Institute (1986)	0-50	NS	Energy innovations
Sharif and Kabir (1976)	33-50	S or NS	Industrial innovations
Non-Uniform Influence: NUI (1983)	0-100	S or NS	Consumer goods, retail, education innovations
Non-Symmetric Responding Logistic: NSRL (1981)	0-100	S or NS	Medical innovations
Von Bertanlanffy (1957)	0-100	S or NS	Agricultural innovations
Flexible Logistic Growth: FLOG (1988)	0-100	S or NS	Telecommunications innovations

Source: Adapted from Mahajan et al. (1990) Note: The symmetry of the curve is S (symmetric) or NS (non-symmetric).

For the reasons already stated, some of the models in the table were discounted immediately but they were all included at this point for completeness. Looking at the curves in figures 2.3 – 2.6, it is possible that Mexico's telegraph diffusion is close to symmetric (tested formally later in the chapter) and thus it would be wrong to apply a model that did not account for this. One can directly discount the Bass and the Stanford Research Institute models since these do not account for a symmetric s-curve.[27] Given the cap on the inflection points set by Jeuland, and Sharif and Kabir, these were eliminated too.[28] Only four of the models in table 2.2 offer complete flexibility in capturing the diffusion pattern, in other words, the point of inflection can be anywhere between 0-100% diffusion and the s-curve can be either symmetric or non-symmetric. These are the Von Bertalanffy model, the NUI model and the NSRL models (both by Easingwood, Mahajan and Muller), and the Flexible Logistic Growth model (FLOG) by Bewley and Fiebig.[29]

[27] The Stanford Research Institute model is recorded in Teotia A. P. S. and Raju P. S., 'Forecasting the Market Penetration of New Technologies Using a Combination of Economic Cost and Diffusion Models' *The Journal of Product Innovation Management* 3.4 (1986): 225-237. Bass M. F., 'A New Product Growth Model for Consumer Durables' *Management Science* 15 (1969): 215-227.

[28] Jeuland A. P., 'Parsimonious Models of Diffusion of Innovation Parts A and B: Derivations and Comparisons' *Working Paper 8* (1981), Sharif M. N. and Kabir C. A., 'A Generalised Model for Forecasting Technological Substitution' *Technology Forecasting and Social Change* 8 (1976): 353-364.

[29] Von Bertalanffy L., 'Quantitative Laws in Metabolism and Growth' *Quarterly Review of Biology* 32 (1957): 217-231, Easingwood C. J., Mahajan V. and Muller E., 'A Nonsymmetric Responding Logistic Model for Technological Substitution' *Technological Forecasting and Social Change* 20 (1981): 199-213. Easingwood C. J., Mahajan V. and Muller E., 'A Non-uniform Influence Innovation Diffusion Model of New, Product Acceptance' *Marketing Science* 2 (1983): 273-296, Bewley and Fiebig (1988).

The Von Bertalanffy model is at a disadvantage compared to FLOG and Easingwood et al.'s models because it only allows for the coefficient of internal influence (or imitation) to be decreasing to a constant zero. Note that the coefficient of internal influence is the accepted behavioural theory of the population, used in almost all the mathematical models that map the process of technology diffusion.[30] In other words, it assumes that the network effect (or the coefficient of internal influence) decreases over time. Meanwhile the FLOG and Easingwood et al. models allow for this coefficient to increase, decrease or remain constant over time, thus imposing fewer restrictions and therefore providing a better fit for this study.[31] Intuitively it makes sense to allow for the coefficient of internal influence to vary with time given that, as Bundgaard-Nielsen argues, late adopters may actually adopt an innovation faster than early adopters, provided that information regarding the technology is freely available, since late adopters are positioned better to evaluate the new innovation.[32] On the other hand, Kotler contends that in some instances the coefficient of internal influence will decline over time, since 'the remaining potential adopters are less responsive to the product and associated communications'.[33] What is clear is that the norm of most models, that is to hold the coefficient of internal influence constant over the diffusion process, is a potential misrepresentation and lacks some theoretical rationale.[34]

Indeed, while the FLOG offers a closed-form solution like the Von Bertalanffy model, it also allows for a varied coefficient of internal influence in the same way as the Easingwood et al. model. After much deliberation, the FLOG was selected as the best model to use in review of the demands of this particular thesis and the fact that it has been applied successfully in the field of telecommunication innovations.

[30] Mansfield E., 'Technological Change and the Rate of Imitation' *Econometrica* 29 (1981): 741-765.
[31] Mahajan et al. (1990).
[32] Bundgaard-Nielsen M., 'The International Diffusion of New Technology' *Technological Forecasting and Social Change* 9 (1976): 365-370.
[33] Kotler P., *Marketing Decision Making: A Model Building Approach* New York, Holt, Rinehart and Winston (1971), p.53.
[34] Hernes G., 'Diffusion and Growth: The Non-Homogeneous Case' *Scandinavian Journal of Economics* 78 (1976): 427-436, Mahajan et al. (1990).

2.5 The Theoretical Framework of the FLOG Model

The FLOG model proved to be very useful as it could be applied to all four diffusion processes and, in terms of standardisation, it could be readily applied to other countries or regions, if future research demanded.

In comparison with the simpler Epidemic diffusion models, flexible models like the FLOG, although they provide a better fit to the data, often it is argued that this feature is a result of the incorporation of additional parameters, which always create a better 'within-sample' fit.[35] The FLOG model's wider applicability also comes under scrutiny for two main reasons. Finding four parameters (as required to mathematically define a FLOG curve) is clearly more difficult than finding two and this presents a greater challenge in the absence of time series data for the given process.[36] However, this is not a big issue here because of the availability of a full time series. Indeed, the FLOG's flexibility in modelling both symmetrical and asymmetrical properties, whilst allowing the point of inflection to be completely data determined is what differentiates it from its peers. The FLOG is also the preferred model as it allows for possible extensions to the study, since its ability to forecast internal saturation levels means that the case studies examined here can be directly compared to modern ICT studies subjected to similar analysis.[37] Furthermore, as the analysis will reveal, there is no single distribution that ranks first on the 'goodness of fit' tests for all four modelled data sets, which vindicates the choosing of the FLOG .

Here, a brief explanation of the mathematical concepts behind the diffusion curves is provided (see appendix E for details). Following on from the s-curve theory, the FLOG can be examined in more depth. Then the linearisation methods are explained and applied to the empirical data collected in order to determine relative 'speeds' of diffusion in the two countries.

[35] Flexible diffusion models have fitted the data better in Easingwood C. J., 'Early Product Life Cycle Forms for Infrequently Purchased Major Products' *International Journal of Research in Marketing* 4 (1987): 3-9.
[36] Mahajan et al. (1990).
[37] Meade N. and Islam T., 'Forecasting with Growth Curves: An Empirical Comparison' *International Journal of Forecasting* 11 (1995): 199-215.

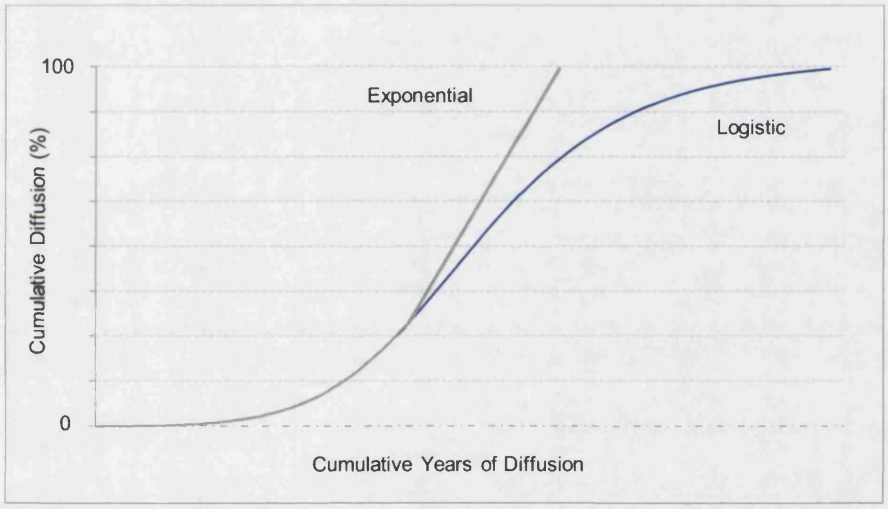
The Diffusion Curves

Technology diffusion was originally modelled by Roger's theoretical two-step process, which is defined by the initial point of adoption (data determined) and the rate or speed of diffusion (calculated from the plotted graph). The growth rate of adoption, i.e. the number of adopters over the time, $N(t)$ is proportional to the total number of adopters. Ultimately, a point of saturation, *M*, is reached. This relationship can be represented fundamentally by the exponential growth model (in differential form) as follows, where α represents the growth rate constant:

$$\frac{dN(t)}{d(t)} = \alpha N(t)$$

Another mathematical property of the s-curve is based on the fact that the Logistic curve initially maps that of the exponential curve, as illustrated in figure 2.8.[38]

Figure 2.8 The Path of the Logistic Curve



Source: Own elaboration.

Figure 2.8 indicates why the mathematics describing the exponential and the Logistic curves have commonality. The coefficient of internal influence, β is then taken into account in addition to some other small modifications, at which point one is able to define an s-curve mathematically.

The FLOG Model

Here the main mathematical concepts on which the FLOG model is based upon are considered. Easingwood et al. argue that the diffusion process can be described by

[38] The Logistic curve is the most common type of s-curve.

the following differential process (the solution of which depicts the raw substitutive process of diffusion):[39]

$$\frac{dN(t)}{dt} = \beta t N[M - N]$$

This equation is the fundamental premise of analysis for the Blackman, Mansfield, Fisher-Pry, Floyd and Sharif-Kabir models and for several others.[40] The FLOG model builds upon this generalised fundamental 2 parameter model (α and β) and adds a further two parameters (κ and μ). Parameter κ controls the horizontal scale of the s-curve, while μ affects the curvature of the s-curve in a way that enables it to predict an internal saturation level that is neither necessarily pre-determined nor struck at a level of unity.[41] The full derivation of the FLOG model is beyond the scope of this thesis, what is important is to appreciate that the main benefit of the FLOG is derived from the fact that it has many useful models nested within it.[42] The precise model formulation and specifications of the FLOG are summarised in table 2.3.[43]

Table 2.3 FLOG Formulae Specification

Differential Form	$\frac{dN(t)}{d(t)} = \beta\left[(1+kt)^{\frac{1}{k}}\right]^{(\mu-k)} N(M-N)$	
Equation Solution	$N = \{1 + e[-\alpha - \beta\, t\,(\mu,k)]\}^{-1}$	
Internal Saturation Level	$N^* = \left\{1 + e\left[-\alpha - \frac{\beta}{\mu}\right]\right\}^{-1}$	
Point of Inflection	$(1-2N)\, ln\{[(N^*)^{-1} - 1]/[(N)^{-1} - 1]\} = (K-\mu)/\mu$	
Where	$t(\mu,k) = \left\{\left[(1+kt)^{(1/k)}\right]^{\mu} - 1\right\}/\mu$	$\mu \neq 0,\ k \neq 0$
	$= (1/k)\, ln(1+kt)$	$\mu = 0,\ k \neq 0$
	$= (e^{\mu t} - 1)/\mu$	$\mu \neq 0,\ k = 0$
	$= t$	$\mu = 0,\ k = 0$

Source: Bewley and Fiebig (1988).

[39] Easingwood et al. (1981).
[40] Fisher and Pry (1971), Floyd (1968), Sharif and Kabir (1976).
[41] Although advantageous, this is not an essential feature for this study (but perhaps for future ones), since there is no forecasting element.
[42] Including the Log-logistic and Box-Cox Transformation for instance.
[43] For the full derivation, refer to Bewley and Fiebig (1988).

Table 2.3 shows why the FLOG is such a useful base from which to model diffusion curves since at the extreme, when μ and $\kappa = 0$, the FLOG can be mathematically reduced to the Logistic form (the basic two-parameter model). As mentioned, four parameters fully specify the FLOG model formulae: α, β, μ and κ. Depending on the curve being modelled to the FLOG, the parameters α, β are always estimated but μ and κ do not need to be estimated in some special cases:

Table 2.4 Special Variant Cases of the FLOG

Model	μ	κ	t (μ, κ)	Location of Inflection Point
Normal	1	1	T	M/2
Log-logistic	0	1	Ln (t)	$M/2 \times [1 - 1/\beta]$

Source: Adaptation from Bewley and Fiebig (1988).

The specific point of inflection (N = 0 - 100%) is determined by the values obtained for the four parameters and since the FLOG encompasses both the standard Normal ($\kappa = 1$, $\mu = 1$) and Log-logistic ($\kappa = 1$, $\mu = 0$) models (see table 2.4), it accounts for symmetric and asymmetric responses. The standardised parameters were estimated using statistical software due to the many curves that can be proposed as possible best-fits.[44] There are many possible methodologies when estimating distribution parameters based on available data sets, and this particular modelling does not limit itself to just one. The parameter estimation methods used here were: i). the method of moments (MOM), ii) the maximum likelihood estimates (MLE), iii) the least squares estimates (LSE), or iv) the method of L-moments.[45] In observing the plotted empirical s-curves in Argentina and Mexico, and given the simplicity of the data set, it was decided to estimate the FLOG model using the following potential s-curve types: Normal, Logistic, Log-logistic (2 and 3 parameter) and Weibull (3 parameter). Upon several 'goodness of fit' tests (outlined below), the model which presented the highest overall ranking was used to parametise the FLOG formulae.

[44] All the calculations are based on modelling executed in EasyFit 4.1 Professional Edition (Mathwave Technologies) and Microsoft Excel.
[45] Where possible, EasyFit uses the least computationally intensive method.

Tests for Distributional Adequacy and Supremacy

There are a number of useful tests to accurately curve-fit data sets. The Kolmogorov-Smirnov (K-S) test was used for testing the 'goodness of fit' here.[46] The test proves whether a sample data set comes from a given distribution. It tests the maximum distance between curves (one empirical, the other standardised) and the lower the test statistic, the better the fit. One particular advantage of applying this method is the fact that the K-S test statistic itself is not dependent upon the underlying distribution that is being tested. Indeed, the K-S test is a very useful and general nonparametric method for curve comparison, since it has sensitivity to differences in shape and location of the curves. It is appropriate in this instance because it can be applied to many distributions and the highest ranked distribution can safely be used as the best-fitting s-curve in estimating the FLOG. On the other hand, the K-S test can sometimes be overly sensitive around the middle of a distribution vis-à-vis the tails. Hence statisticians often find it prudent to apply the Anderson-Darling (A-D) 'goodness of fit' test as well.[47] The A-D test is a modification of the K-S test, and it simply gives more weight to the tails of the data in order to validate the ranking of the given curves. For this study the ranking awarded to a given curve estimation will be primarily determined by the order of its K-S test statistic since this is where most of the emphasis is placed, but if it is accompanied by a particularly poor A-D ranking this will obviously be taken into consideration (for more information on the tests, see appendix G). Upon completion of table 2.3, the modelled FLOG curve can be applied to the data set and further investigation can begin.

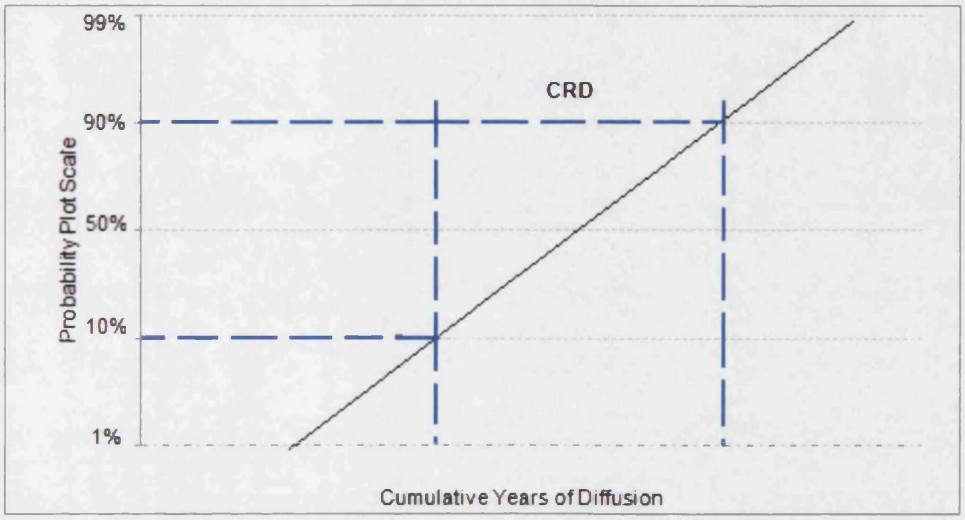
S-curve Transforms

In order to transform a s-curve, the tested data set must be approximately close to the normal distribution (i.e. at the 1% level under the K-S and A-D testing methods). Upon verification of this, it is possible (using the relevant statistical software) to linearise an s-curve (once the data are transformed) and render it a straight line when plotted on a semi-log plot (log-lin) scaled axis, historically referred to as a normal probability plot.[48] This is done by taking the point of saturation as unity (1 or 100%),

[46] Chakravarti I. M., Laha R. G. and Roy J., *Handbook of Methods of Applied Statistics* Volume I, New York, John Wiley and Sons (1967).
[47] Anderson T. W. and Darling D. A., 'Asymptotic Theory of Certain "Goodness-of-fit" Criteria Based on Stochastic Processes' *Annals of Mathematical Statistics* 23 (1952): 193–212.
[48] All linearisations were done using Loglet Lab 2 Statistical software.

plotting the subsequent calculations of the 1st, 10th and xth percentiles of saturation onto the transform graph, and then drawing a best-fitted line through them. Therefore, as the data grows (or declines) in Logistic/flexible-logistic fashion in the s-curve, it will grow (or decline) linearly when transformed as seen in figure 2.9 below:

Figure 2.9 Linearisation of the S-shape Curve

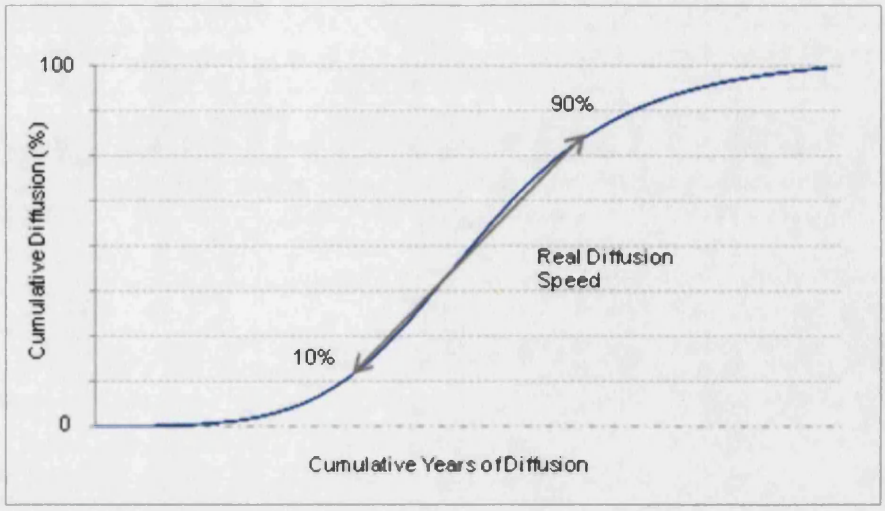


Source: Own elaboration using Loglet Lab2 Statistical software.

Figure 2.9 shows the result of the linearisation technique. The rationale for doing this is that it enables one to compute a value of relative speed, in order to compare diffusion-experiences across countries. This value will be called the characteristic rate of diffusion (CRD) and it is calculated by measuring the time it takes for the transformed curve to travel between 10% and 90% of total diffusion.[49] It is standard practice to use the period of 10% to 90% as this measures the 'real' diffusion speed i.e. the steep part of the s-curve as illustrated in figure 2.10.

[49] Very close in nature to what Fisher-Pry refer to as the characteristic duration. See Fisher and Pry (1971).

Figure 2.10 Approximate Section of the S-curve Measured by this Analysis



Source: Own elaboration.

Figure 2.10 approximates the relevant portion of the s-curve under scrutiny (that is the 10-90% diffusion portion) when measuring the CRD, with the percentage of cumulative diffusion on the y-axis and cumulative time taken on the x-axis. Using a period of 1-99% for instance, would be too broad, as this would include too much of the start-up period in a technology's adoption, which can vary materially across countries, depending on their given intrinsic characteristics. Moreover using a tighter section of say 25-75% would likely be too narrow and much too short of a period (for a technology like the telegraph), in attempting to examine diffusion in any meaningful depth.

2.6 Applying the FLOG Model

To map the diffusion process statistically, before quantifying the rate at which the telegraph and telephone diffused in Argentina and Mexico, the application of the FLOG follows. The respective FLOG formulae and the accompanying s-curve estimations are presented below. It is pertinent to point out that, the finalised s-curves (with representative mathematical formulae) in the upcoming figures 2.11 - 2.14 correspond directly to the illustrative s-curves depicted back in figures 2.3 - 2.6.

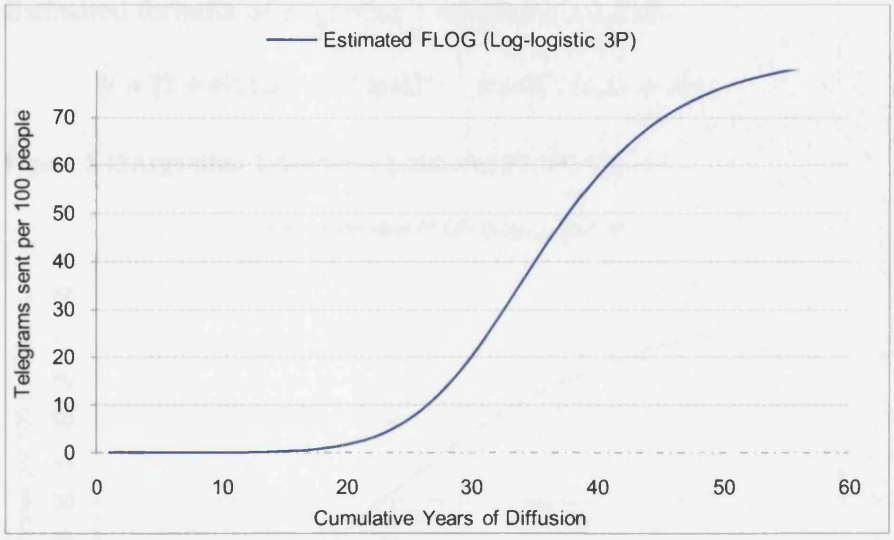
2.6.1 Estimated FLOG Curves

Telegraph Diffusion in Argentina

Estimated formula of Argentina's telegraph s-curve:

$$N = \{1 + e[24.286 - 6.8 \ln t]\}^{-1} \text{ since, } t(u,k) = \ln t$$

Figure 2.11 Argentina Telegraph: Estimated FLOG Curve



Source: Own elaboration.

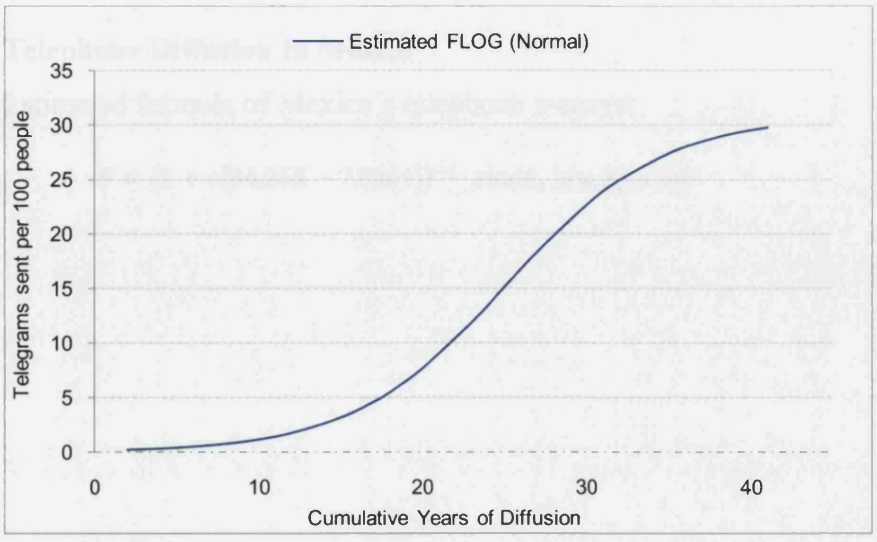
Telegraph diffusion in Argentina is most accurately mapped by a Log-logistic (3 parameters) diffusion curve. The point of inflection in figure 2.11 is 35.61 telegrams sent per 100 inhabitants (i.e. [Saturation/2] x 1 – 1/ β %).

Telegraph Diffusion in Mexico

Estimated formula of Mexico's telegraph s-curve:

$$N = \{1 + e[5.354 - 0.2127\, t]\}^{-1} \text{ since, } t(u,k) = t$$

Figure 2.12 Mexico Telegraph: Estimated FLOG Curve



Source: Own elaboration.

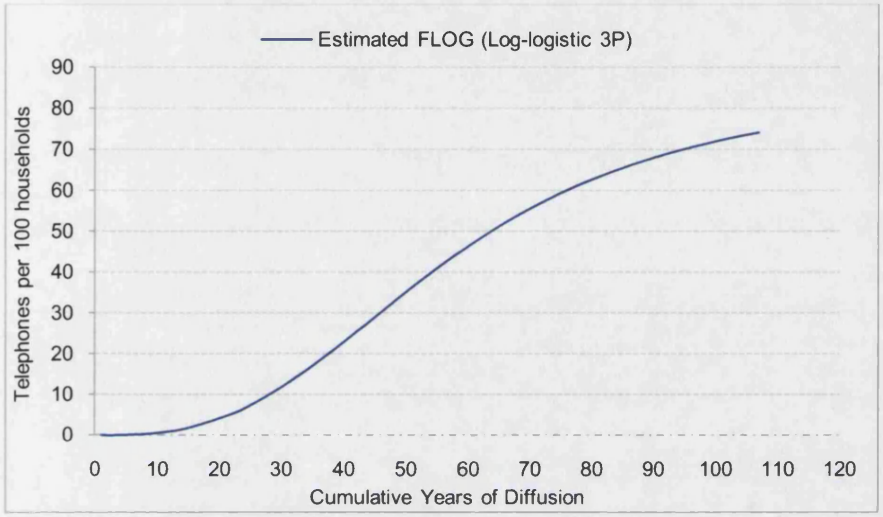
Telegraph diffusion in Mexico is most accurately mapped by a Normal diffusion curve. The point of inflection in figure 2.12 is 15.40 telegrams sent per 100 inhabitants (i.e. Saturation/2 = 50%).

Telephone Diffusion in Argentina

Estimated formula of Argentina's telephone s-curve:

$$N = \{1 + e[11.6 - 2.87 \ln t]\}^{-1} \quad \text{since, } t(u,k) = \ln t$$

Figure 2.13Argentina Telephone: Estimated FLOG Curve



Source: Own elaboration.

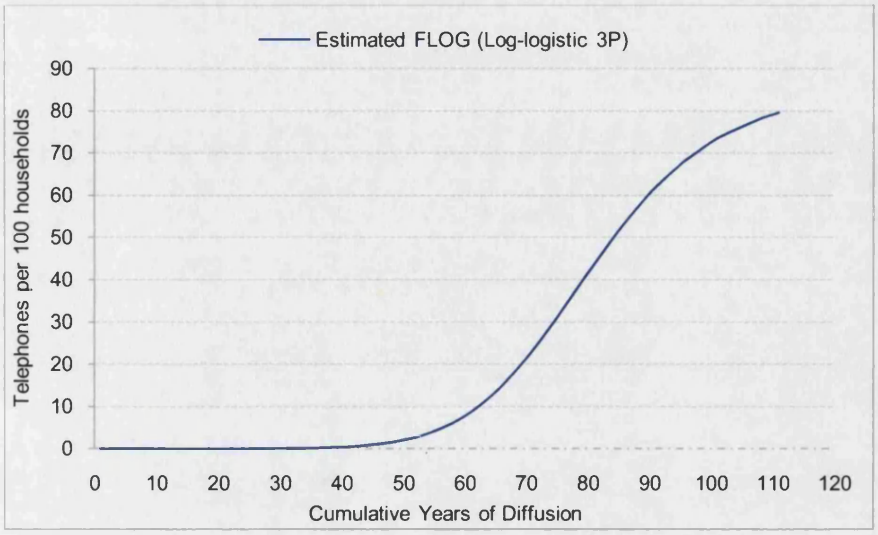
Telephone diffusion in Argentina is most accurately mapped by a Log-logistic (3 parameters) diffusion curve. The point of inflection in figure 2.13 is 28.08 telephones sent per 100 households (i.e. [Saturation/2] x 1 – 1/β %).

Telephone Diffusion in Mexico

Estimated formula of Mexico's telephone s-curve:

$$N = \{1 + e[34.255 - 7.8 \ln t]\}^{-1} \quad \text{since, } t(u,k) = \ln t$$

Figure 2.14 Mexico Telephone: Estimated FLOG Curve



Source: Own elaboration.

Telephone diffusion in Mexico is most accurately mapped by a Log-logistic (3 parameters) diffusion curve. The point of inflection in figure 2.14 is 37.62 telephones sent per 100 households (i.e. [Saturation/2] x 1 – 1/ β %).

For a complete account of the s-curve formulae determination, see appendix F.

2.6.2 Linearisation of the S-curves

To measure the speed of diffusion, the s-curves must be linearised. Before the data can be linearised, it must be verified that all four diffusion curves are approximately close to a normal distribution (see table 2.5).

Table 2.5 Acceptance to the Normal Distribution

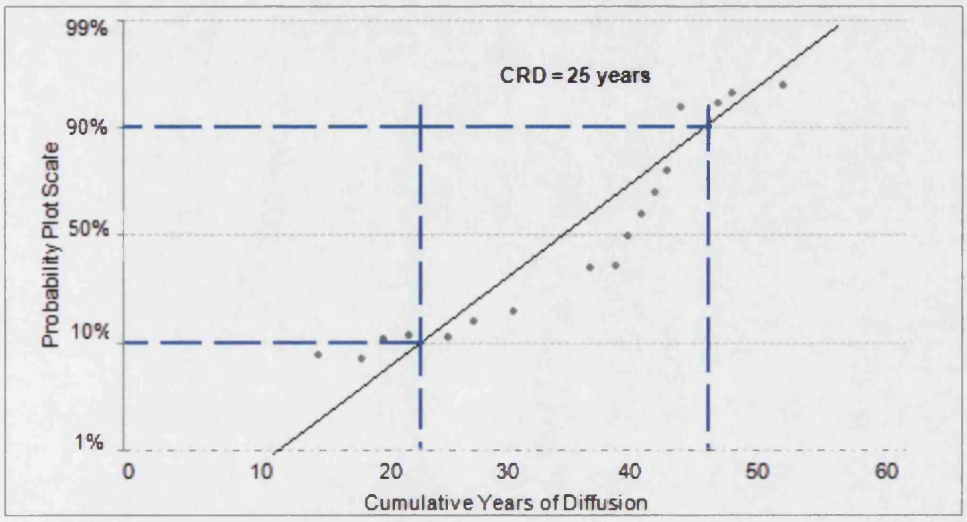
Data set	1% Critical Value of α (K-S)	K-S Statistic	1% Critical Value of α (A-D)	A-D Statistic	Accept Normal Distribution
Argentina Telegraph	0.36117	0.2171	3.9074	1.0792	Y, Y
Mexico Telegraph	0.37062	0.1413	3.9074	0.7076	Y, Y
Argentina Telephone	0.28987	0.1508	3.9074	1.2213	Y, Y
Mexico Telephone	0.29971	0.2540	3.9074	2.5694	Y, Y
Argentina Telegraph	0.36117	0.2171	3.9074	1.0792	Y, Y

Source: Own calculations using EasyFit 4.1 Professional Edition (Mathwave Technologies). Note Y = Yes.

Table 2.5 shows that all of Argentina's and Mexico's s-curves were accepted as approximations to a normal distribution curve (at the 1% level) under the K-S and A-D testing methods. The curves were then linearised by transforming the data points

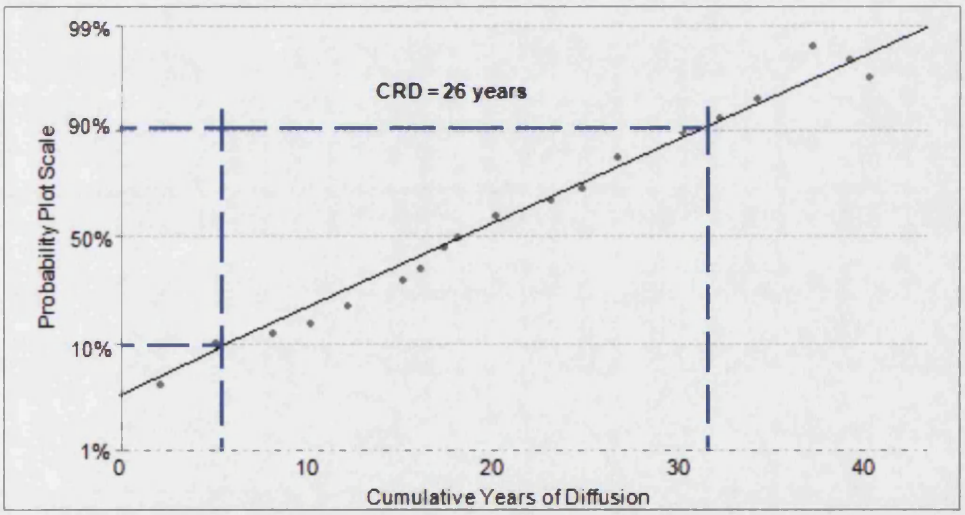
onto a normal probability plot scaled graph, with a best-fitted line drawn through them (see figures 2.15 – 2.18).

Figure 2.15 Linearisation of the Telegraph S-curve for Argentina



Source: Own elaboration. Drawn with Loglet Lab 2.

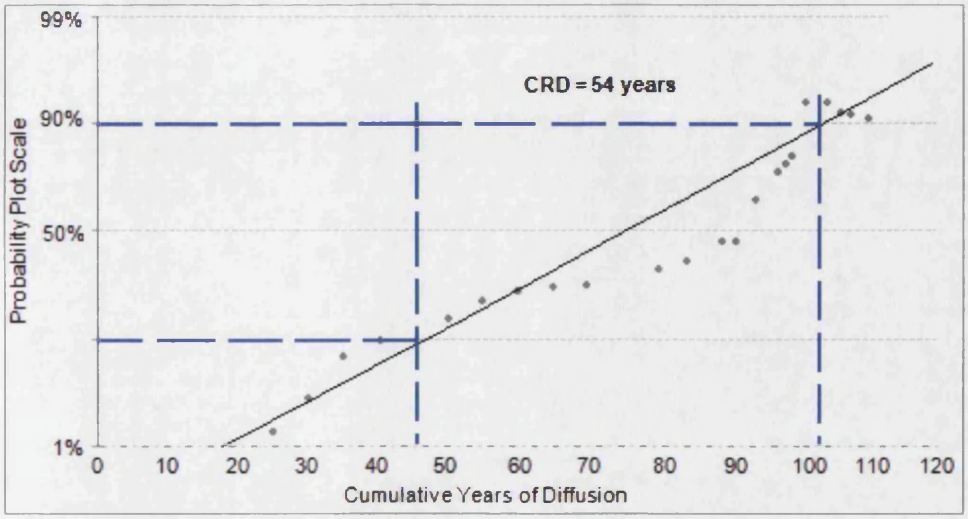
Figure 2.16 Linearisation of the Telegraph S-curve for Mexico



Source: Own elaboration. Drawn with Loglet Lab 2.

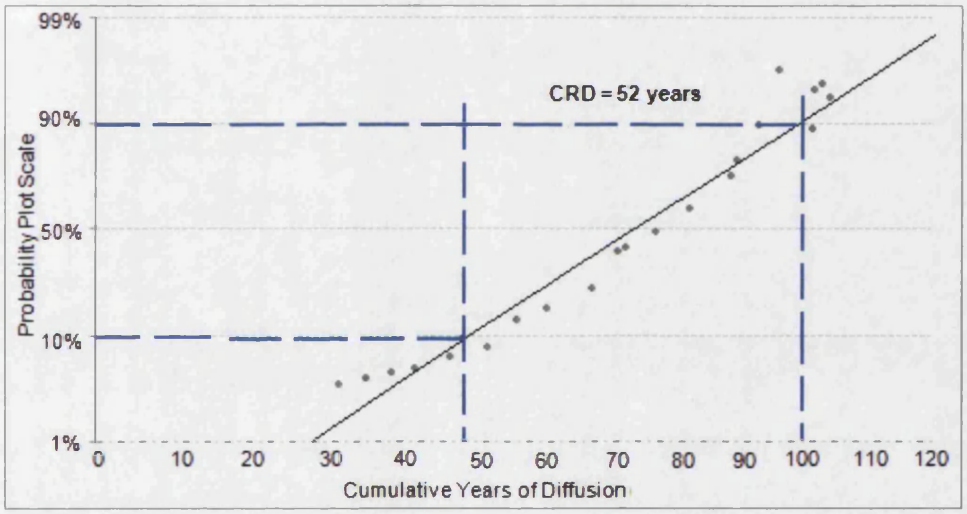
The linearised telegraph diffusion s-curves in Argentina and Mexico (figures 2.15-2.16) show diffusion speeds measured in CRDs of 25 and 26 years respectively, which is remarkably similar. The same logic was used for the telephone.

Figure 2.17 Linearisation of the Telephone S-curve for Argentina



Source: Own elaboration. Drawn with Loglet Lab 2.

Figure 2.18 Linearisation of the Telephone S-curve for Mexico



Source: Own elaboration. Drawn with Loglet Lab 2.

The linearised telephone diffusion s-curves in Argentina and Mexico (figures 2.17 – 2.18) show diffusion speeds measured in CRDs of 54 and 52 years respectively. As with the diffusion of the telegraph, these are very similar. It is important to note that the years corresponding to the 10% and 90% levels of diffusion (as per the linearisation analysis above) will be the reference periods that are analysed in detail in the chapters that follow. The relevant period for the telegraph corresponds to the years 1891-1916 in Argentina and 1881-1907 in Mexico, and for the telephone, these are 1943-1997 in Argentina, and 1945-1997 in Mexico.

2.7 Conclusion

The process of telegraph and telephone diffusion in Argentina and Mexico followed an s-shape diffusion curve as predicted by Rogers.[50] The application of the FLOG and linearisation techniques allowed the diffusion process of the two ICTs in Argentina and Mexico to be quantified. It is clear that the diffusion rates were similar in the two countries; for the telegraph CRDs were 25 and 26 years respectively, and for the telephone CRDs were 54 and 52 years respectively. This took place despite the countries' different economic settings. Table 2.6 provides an overview of the key findings.

Table 2.6 Summary of Results from the Analysis

Data set	Best Fitting Model Estimator	FLOG Formula	Saturation Point	Inflection Point	CRD
Argentina Telegraph	Log-logistic(3P)	$N = \{1 + e[24.286 - 6.8 \ln t]\}^{-1}$	83.5	35.6	25
Mexico Telegraph	Normal	$N = \{1 + e[5.354 - 0.2127\, t]\}^{-1}$	30.8	15.4	26
Argentina Telephone	Log-logistic(3P)	$N = \{1 + e[11.6 - 2.87 \ln t]\}^{-1}$	86.2	28.1	54
Mexico Telephone	Log-logistic(3P)	$N = \{1 + e[34.255 - 7.8 \ln t]\}^{-1}$	86.3	37.6	52

Source: Own elaboration.

Table 2.6 shows that three of the four curves had a best-fit most closely approximated to the three-parameter Log-logistic distributions, while the pattern of telegraph diffusion in Mexico was the exception as it was best fitted to the Normal distribution curve. The four diffusion curves have points of inflection which range from 32-50%, which vindicates the need for using the FLOG model, since no single distribution ranked first for all data sets, nor was there any consistency in the points of inflection. This chapter quantified the finding of the 'Double Paradox', which was facilitated by using a carefully constructed theoretical framework. The next chapter will document the development of the Paradox, by taking a closer look at the expansion of the telegraph and the telephone sectors in Argentina and Mexico. Following this necessary grounding, more meaningful analytical work and discussion can be contemplated in the subsequent chapters.

[50] Rogers (1995).

Chapter 3

The Development of Telegraph and Telephone Diffusion

It is imperative to place Argentina and Mexico in their historical, political and economic contexts, in order to provide the reader with a greater understanding of the broader environment as well as the various nuances of each country (see chapter 1 section 1.1 The Historiography of Argentina's and Mexico's Political Economy). This chapter comparatively examines the evolution of the diffusion of the telegraph and the telephone technologies within this framework. The historical backdrop was necessary since it is only in appreciation of this that the comparative analysis regarding the major determinants of the diffusion process can be assessed, first in chapter 4 and then consolidated in chapter 5. This chapter explores in greater depth the elements of the political economy that are believed to have materially impacted telegraph and telephone diffusion in Argentina and Mexico, giving particular attention to the role of the state. The thesis divides the diffusion periods into the critical segments represented on the s-shaped diffusion curve used in the linearisation analysis: broadly the 0-10%, 10-90% and 90-100% diffusion levels.[1] Measuring the success of a country's diffusion path is no simple task, and for the purposes of this study, although diffusion advancement is the primary measure in assessing the relative 'progress', obviously the quality of service and the financial performance of the relevant companies are considered also.

3.1 The History and Development of the Electric Telegraph: The Argentinian and Mexican Experiences

The diffusion of the telegraph mainly took place in Argentina and Mexico during the period of export-led growth (see chapter 1, section 1.1.1 The Economics of the Political Economy). This context had a marked impact on the diffusion of the telegraph, as the railways (and implicitly the telegraph) expanded to allow for more effective trade (see chapter 1, section 1.3 The Joint Supply of the Railways and the Telegraph), and both countries sought to consolidate the power of the state and unite their respective nations. The evolution of the railway and of the telegraph were

[1] The levels were determined by the linearisation analysis in chapter 2, section 2.6 Applying the Flog Model. Also recall that the 100% diffusion level is defined as 100% of the maximum diffusion rate observed.

heavily dependent on one another and it was this mutually benefiting relationship that drove the diffusion of both. Meanwhile, the role of the state, as will be revealed throughout this chapter (and an argument that will gain focus in chapters 4 and 5), was continuously a primary promoter (or inhibitor) of fast diffusion.[2] Given the bouts of political instability in Argentina and Mexico in the earlier part of the nineteenth century, governments believed that in achieving consolidation and some sort of centralist success they would continue to attract foreign investment and help their economies grow.[3] These regions were also expanding, and with increasing foreign investment flooding into Latin America, governments felt the need to control industries that would cement their authority across the country. The telegraph became an extremely useful political tool in this process.

To address the discussion of the diffusion of the telegraph more effectively, the period of telegraph diffusion is divided into three sub-sections: the adoption and early years of diffusion (0-10%), the years of expansion (10-90% diffusion), which are the primary focus of the thesis, and the years of saturation (90-100% diffusion).[4] This section examines and compares these periods across Argentina and Mexico, in order to place diffusion within its historical context.

3.1.1 The Adoption and Early Years of Telegraph Diffusion

This section is concerned with the years from the start of the use of the telegraph usage until its diffusion reached the 10% level; equivalent to the years of 1857-1891 in Argentina, and 1851-1881 in Mexico. It is interesting to note that the electric telegraph was available to the public in Mexico six years earlier than in Argentina, despite Argentina's relative economic advantage over Mexico, which is what the Paradox is built upon. An observation common to both countries on the diffusion of the telegraph was the close relationship it bore not only to the country's economic

[2] See chapter 1, section *State Formation and the Telegraph and the Telephone in Argentina and Mexico,* which provides an overview for the rationale behind this.

[3] These were obviously not easy objectives to achieve, but centralism had some early success in Argentina with the selection of Buenos Aires as a federal district in 1880, and in Mexico, Porfirio Díaz was able to enhance national power through the deployment of policies that weakened regional powers.

[4] The 10-90% diffusion years are the specific period of focus in the regression analysis in chapter 4, section 4.2 Analysis of Diffusion – A Quantitative Approach.

development but to their respective political developments, in addition to the importance of the technology to the military.[5]

In Argentina, during Domingo Sarmiento's administration (1868-1974), the telegraph took on added importance, demonstrated in his passing of special laws to reallocate funds from road/bridge building to allow further telegraph construction. Argentina's administration was financially more able than Mexico's to construct the lines themselves, and in 1869 Sarmiento ensured that the first national government telegraph line was built. As the link between the telegraph and national security became clearer, the support for retention of state ownership only increased.[6]

In Mexico, during Maximilian's empire (1864-1867), the unstable financial position made it impossible to build-out a national network, so instead he opted for granting private concessions, enlisting the 'help' of private providers under a callable option condition, ultimately enabling Maximilian to re-purchase the rights at any time.[7] Maximilian made it clear, however, that the telegraph network was state property and if the state chose to grant private concessions, this was merely for their convenience.[8] Later on, the Benito Juárez (1867-1872) administration would do something similar in 1867, when the telegraph theoretically became the property of the Mexican federal government, though in practice they continued to be built by private companies. In Argentina, by 1878, 6,000km of telegraph lines had been built out in less than 10 years; and Sarmiento had managed to connect many distant points within the Republic through the diffusion of this new technology.[9] While that may be impressive, by the same year in Mexico, 9,000km of lines were built.[10] Porfirio Díaz put a clear emphasis on promoting infrastructure build-out, which would continue throughout his presidency. He began to rebuild lines (most of which ironically he had

[5] Álvarez C. L., *Historia de las Telecomunicaciones en México* México D.F., Revista del Doctorado en Derecho (2007).
[6] Benavides García R., *Hitos de las Comunicaciones y los Transportes en la Historia de México* México D.F., Secretaría de Comunicaciones y Transportes (1987). Argentina, Fundación Standard Electric *Historia de las Comunicaciones Argentinas* Buenos Aires, Fundación Standard Electric Argentina (1979). Also see Reggini (1996).
[7] It should be noted that this was a standard feature of utility contracts of this era. See Cárdenas de la Peña E., *Historia de las Telecomunicaciones y los Transportes en México. El Telégrafo* México D.F., Secretaría de Comunicaciones y Transportes (1987a).
[8] Noyola (2004).
[9] Argentina, *Memoria* of the Director General of Posts and Telegraphs, submitted to the Minister of Interior for 1878.
[10] Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos* México D.F., (various years).

destroyed in his ascent to power) and despite the difficult financial situation of the treasury, most of the telegraph lines that were destroyed were soon rebuilt, and new lines were constructed everywhere.[11]

With regard to structural progress, Mexico was arguably ahead of Argentina, especially in terms of developing telecom policy and a regulatory framework, which began in 1855.[12] The telegraph network in Argentina developed from the very beginning in tandem with the railway expansion (while in Mexico this only took place in 1875), but despite the installation of a relatively sizeable network by 1862, Argentina had done very little in regard to the regulatory framework. By 1869, while Mexico was cementing the rules for the telegraph offices, Argentina was only finally creating a national telegraph of sorts, and in 1875, after lengthy debate, Argentina passed the first telegraph law.[13] This established the telegraph as a monopoly of the state and remained unchanged in statute for many years. Under this new law, no telegraph lines (aside from those for internal railway use) were to be constructed without the sanction of the Argentinian government, nor were private companies allowed to provide telegraph service without prior government consent. In Mexico these rules were established as early as 1865. Although the two countries had private, provincial government and railway companies building telegraphs in tandem with the federal government, in Argentina there was little coordination until 1892 (when attempts to integrate all the different lines were encouraged). This became problematic as the lines, rather than complement each other, ended up competing with one another, leading to competitive inefficiencies.[14] The system was therefore theoretically more efficient in Mexico given that all the lines were consolidated into a national system from 1869.

[11] For example see Noam (1998), Berthold (1921a), Noyola (2004), Cárdenas de la Peña (1987a) and Hodge J. E., 'The Role of the Telegraph in the Consolidation and Expansion of the Argentine Republic' *The Americas* 41.1 (1984): 59-80.
[12] Griffith K. A., 'Mexico' in Noam E. M., *Telecommunications in Latin America* New York, Oxford University Press (1998).
[13] Telegraph Law (Law no. 750) of October 7, 1875, for laws and decrees relating to the telegraph in Argentina see Ministerio del Interior, *Legislación Postal y Telegráfica. Convenciones, Reglamentos, Administración, 1858-1900* Buenos Aires (1901).
[14] Berthold (1921a).

Telegraph diffusion in Mexico reached 10% diffusion faster than in Argentina, despite the relatively better economic situation of Argentina.[15] Perhaps this was because the collective administrations in Mexico often seemed one step ahead of Argentina's in terms of the regulatory framework and general strategic planning. Mexico's network expansion was overseen by the government 10 years earlier than in Argentina. Moreover, a key difference was the actual resemblance to a national network that was formed; Mexico had made a real attempt by granting various concessions early on, as indeed most of the lines were built by private companies, meanwhile in Argentina the network was uncoordinated and messy. The willingness of Mexico's administrations to promote fast diffusion could be viewed as somewhat forced due to the strategic threats posed at their borders. As mentioned, the U.S. seized half of Mexico's land in 1848 and Mexico suffered long before this too, having experienced decades of economic and political instability (although Argentina faced political instability too). Any tool, such as the telegraph, that could potentially alleviate these problems would clearly get a lot of attention. In Mexico, the prominence of first the Maximilian empire and then Juárez's administration within the industry, compounded by the decisiveness of Porfirio's Díaz's actions towards the sector, meant that in Mexico efforts were coordinated in the beginning relatively more effectively than in Argentina. Naturally telegraph expansion in Argentina was aided by its leading economic stance, but in Mexico, the administrations made a real attempt to make the network as effective as possible through more explicit interventionist measures.

3.1.2 The Years of Telegraph Expansion

The years of telegraph expansion (i.e. the period of 10-90% diffusion) are the focus of the thesis since these are the years where the fastest (and similar) rate of diffusion took place. This period corresponds to the years of 1891-1916 in Argentina, and 1881-1907 in Mexico. Table 3.1 displays the actual levels of diffusion as measured by the number of telegrams sent per 100 people over this period.

[15] Telegraph diffusion in Mexico reached 10% diffusion 30 years after the official inauguration of the telegraph versus 34 years in Argentina.

Table 3.1 Telegraph Diffusion during the Years of Expansion (telegrams sent per 100 people)

	1882	1884	1886	1888	1890	1892	1894	1896	1898	1900	1902	1904	1906	1908	1910	1912	1914	1916
Argentina	8.0	9.9	11.6	13.0	14.6	15.6	16.4	17.1	17.6	17.8	17.8	17.9	18.0	48.1	73.8	68.0	64.3	68.8
Mexico	0.7	0.6	1.0	3.1	4.7	5.6	6.5	9.1	10.2	16.7	19.9	22.2	25.7	25.4	27.4	30.8	14.2	15.1

Source: See appendix B.

Table 3.1 shows that diffusion in Mexico was initially slower, for instance, between 1882 and 1898 there was only an increase of 9 telegrams in the average number of telegrams sent per 100 people, while a further 9 telegrams increase from 1898 took just half the time. The rate of diffusion in Mexico significantly lagged Argentina's until 1902. However, by 1902 it actually exceeded Argentina in absolute levels (despite Argentina's wealthier economy) and continued to grow at a considerable rate until 1906. After 1906, telegraph usage seemingly stagnated in Mexico (while surging in Argentina) and growth ultimately stalled soon after the Mexican Revolution, thus reaching its saturation point (albeit lower than in Argentina). One should be aware that there are various limitations with the data that underlie the analysis presented. For instance, for the early years of telegraph diffusion in Argentina there is very little statistical information available (especially regarding the private companies). It was claimed that it was entirely useless to inquire into the financial results of the national telegraph at least until 1890, given the lack of appropriate account keeping and fraudulent information in some areas.[16] In fact, up to the First World War, Argentina's government did not publish any official sectoral data either (see introduction to the appendices and appendix B for a detailed account of the reliability of the data).[17]

In order to assess the diffusion speeds further, is useful to get some perspective on the growth of the telegraph network and the growth of the traffic on it, so that the effects of growing intensity of usage can be differentiated clearly (see tables 3.2 and 3.3).

[16] Argentina, *Memoria* of the Director General of Posts and Telegraphs, Dr. Estanislao Zeballos, submitted to the Minister of Interior in 1891. It was not until 1896 that the first official publication on telephone statistics was drawn up, see Province de Buenos Ayres, Ministère de Gouvernement, Bureau de Statistique Generale, Annuaire Statistique de la Province de Buenos Ayres, 1896 Buenos Aires (1897).

[17] This changed when the first Telephone Census was ordered by Ricardo Pillado (the then incumbent Director General of Telegraphs), see Argentina, Telephone Census *Boletín Mensual de Correos y Telégrafos* Buenos Aires, No. 16, Teléfonos, (1912).

Table 3.2 Argentina's National Telegraph Network Size and Traffic (during 10-90% Diffusion)

	1904	1906	1908	1910	1912	1914	1916
Length of the Network (km)	23,237	24,757	25,335	26,173	33,477	38,674	40,492
Network Usage (per km)	42.07	42.86	120.51	192.76	149.61	131.17	139.73

Source: See appendix B. Note: network usage = total telegrams sent/total km of telegraph lines.

Table 3.3 Mexico's National Telegraph Network Size and Traffic (during 10-90% Diffusion)

	1882	1886	1890	1894	1898	1902	1906
Length of the Network (km)	16,252	17,151	24,774	30,202	32,194	33,017	34,914
Network Usage (per km)	4.39	6.72	22.47	26.80	41.97	83.73	106.84

Source: See appendix B. Note: network usage = total telegrams sent/total km of telegraph lines.

Tables 3.2 and 3.3 show that during this critical portion of telegraph diffusion, network build-out and network usage occurred at different times. In Argentina, the heaviest growth in usage took place between 1906 and 1908, where the rate almost trebled, despite the real pickup in network size taking place from 1910 onwards. In Mexico, the network build-out was relatively steadier throughout the period and the largest shifts in usage took place between 1886-1890 (230% increase), and between 1898-1902 (100% increase, but from a higher base). The following sections provide the historical background for Argentina and Mexico on three important aspects: economic growth, the degree of foreign investment and the role of the state during the period of 10-90% diffusion. These are important recurring themes, which may provide potential explanations for the observed diffusion trends.

In terms of socio-economic development, as examined in chapter 1, the period of export-led growth was positive overall not only for these two countries but for all of Latin America. Over the whole period, both countries experienced economic growth (although not equally distributed among the population) and enjoyed significant foreign investment inflows, particularly in the first part of the twentieth century.[18] Also note that much of the growth came at the beginning of this period (although Mexico's growth was interrupted by the Revolution). Moreover there was geographical unevenness in both countries. In Mexico, the northern region was much more prosperous than the central parts of the country, while in Argentina economic progress was heavily tilted toward the littoral. In terms of the importance of the role

[18] See chapter 1, section *The Period of Export-Led Growth (1870-1930).*

of the state (and specific laws) in affecting telegraph diffusion, this was a clear common factor across the two countries. Again, as explored in chapter 1, the role of the state was critical because it essentially controlled the build-out of infrastructure, by directing the necessary resources.[19] The critical difference was perhaps that, although both states emphasised the importance of the diffusion of this technology, they introduced key reforms at very different times. Toward the end of the nineteenth century, both countries experienced anti-oligarchical movements and although they largely failed, during the first quarter of the twentieth century there was a growing need to cement political stability and widen the base of support for both regimes. Ultimately, it is no surprise that the administrations in both countries placed a significant emphasis on the diffusion of the telegraph, both perceiving it as a key tool for state unification.

Economic Development during Export-led Growth

As argued in chapter 1, Argentina had significantly faster overall economic growth, rising real wages and higher levels of social development (in terms of a more educated population and higher life expectancy rates) vis-à-vis Mexico, during the period of fastest telegraph diffusion (see appendix A, tables A.3 and A.4).[20] In Mexico, Porfirio Díaz's dedication to boost the economy provided economic growth at a level that Mexico had never seen before, but it was nowhere near Argentina's rate. To offer some perspective, from 1880 to the start of the First World War, Argentina's GDP per capita was the highest in Latin America (growing at a rate more than twice that of the world economy), while Mexico was below the Latin American average.[21] Argentina's growth during this period was also relatively more constant, while most of Mexico's economic growth occurred in the early stages of export-led growth. Furthermore, despite Mexico's strong annual average GDP per capita growth during the Porfiriato, it must be noted that scholars' views on the achievements of the Porfiriato are mixed, as explored in chapter 1. This is because although the economy as a whole expanded, this went hand-in-hand with very skewed patterns of wealth distribution, and falling average living standards.

[19] See chapter 1, section 1.2 The State and the Role of ICT in Latin America.
[20] Haber (2000). Also see Thorp (1998), Knight (2000) and Lewis C. M., 'Industry in Latin America before 1930s' in Bethell L., *The Cambridge History of Latin America* Volume IV Cambridge, Cambridge University Press (1986).
[21] See appendix A for the data.

Although both countries were characterised by high income inequality, this was particularly pronounced in the case of Mexico. Theoretically, in economic terms, the average Argentinian consumer was in a better position to make use of the telegraph services than the average Mexican consumer, and it seems reasonable to assume that this more 'sophisticated' population would appreciate the benefits and adopt the telegraph at a faster rate than in Mexico. The analysis of diffusion speed in chapter 2 however, showed that this was not the case (see chapter 2, section 2.6 Applying the Flog Model).

Foreign Investment: A Common Plight

Given the key role that foreign investment had in financing the expansion of the necessary infrastructure, it played an important role in the diffusion of the telegraph, if not directly through telegraph network build-out, indirectly through railroad construction.[22]

In the very early part of telegraph diffusion, toward the end the first Barings Crisis (1889), foreign investment started to dry up in Argentina as the country faced economic crisis.[23] The government had no capital left to apportion to the telegraph's advancement and for a short period in the 1890s, it had to interrupt all the works on the network due to the heavy foreign debt.[24] Meanwhile, Mexico had just returned to international capital markets in the 1880s and benefited from a strong positive reversal of foreign capital outflow, but also faced an economic downturn during the early 1890s (although not as severe as Argentina's).[25] In spite of this, Argentina and Mexico quickly recovered and began to profit from extensive foreign investment; large amounts of capital inflows came from the U.S. and Europe, and significant portions went towards the development of the railways (and thus de facto into the expansion of the telegraph network, as explored in chapter 1). One third of capital inflows were going toward the construction of the railways in Mexico, while Argentina had the highest rates of both foreign investment and railway expansion in all of Latin America during this period. Argentina was the recipient of 42% of all

[22] Bulmer-Thomas (1994), Noam (1998), D'Estrabau G., *Historia de las Comunicaciones y los Transportes en México: El Ferrocarril* México D.F., Secretaría de Comunicaciones y Transportes (1988).
[23] Lewis C.M. (2002).
[24] Hodge (1984).
[25] Mexico had remained cut off international capital markets until the 1880s due to its inability to pay for its public debt. See Bortz and Haber (2002).

Latin American FDI in 1914, versus 15% in Mexico.[26] As referred to throughout the thesis, the expansion of the railways was a key intrinsic factor aiding faster telegraph diffusion, with the two technologies growing in tandem and the administrations in Argentina and Mexico providing significant subsidies to incentivise this build-out (see chapter 1, section 1.3 The Joint Supply of the Railways and the Telegraph). This was compounded in Mexico by the government's requirement for the railway companies to build an extra telegraph line for free for the government from as early as 1881 (as explored below). From 1902-1903, half of Mexico's new telegraph lines were installed on new telegraph posts, and the other half were installed on the existing railway posts.[27] By the same token, by 1919 in Argentina, railway telegraph services as a proportion of the total telegraph network had increased to 54%.[28] The railway network in Argentina was significantly more advanced than in Mexico, and in per capita terms they were comparable to those of the developed world. Overall from an investment perspective, Argentina was theoretically in a better position to diffuse the telegraph.

The Role of the State: The Impact of New Laws

Already by the late 1890s, the telegraph was seen as a very efficient and indispensable form of communication. The telegraph enabled rapid dissemination of information, allowing the state to keep abreast of the happenings in far away regions, and facilitated the immediate dispatch of orders from the government across the whole country.[29] As argued, the telegraph was a useful tool in consolidating the state's power, and its role as a consumer good came secondary.[30] Proof of this is that in the 1860s the Mexican government actually 'prohibited the general public from using the telegraphs...while demanding expedited services' for its own communications.[31] The telegraph's importance to the military was realised quickly and lines were built (especially in Mexico) along strategically key routes where there were credible fears of local uprisings, civil wars, or even foreign invasions. From

[26] Islas Rivera V., *Estructura y Desarrollo del Sector Transporte en México* México D.F., El Colegio de México (1992), García Merodio G. G., 'Technological Innovation and the Expansion of México D.F., 1870-1920' *Journal of Latin American Geography* 5.2 (2006): 109-126, Haber (2000).
[27] Noyola (2004).
[28] Berthold (1921a).
[29] Hodge (1984).
[30] See chapter 1, section *State Formation and the Telegraph and the Telephone in Argentina and Mexico*.
[31] Cárdenas de la Peña (1987a), p.38.

1875 in Argentina, the telegraph became more central to their territorial expansion as well.[32]

The telegraph's necessity for the advancement and protection of the state meant that in Argentina and in Mexico, the government adopted an active role in its promotion, although until the turn of the century this translated into numerous concessions given to private companies. The Mexican government continued to allow many of the lines to be constructed by private companies, as it had done in the earlier period of diffusion, since this remained the most economically viable choice.[33] Government ownership increased particularly after 1905, when the Mexican railways were nationalised. Meanwhile, in Argentina, unlike in Mexico, the railway companies constructed most of the telegraph lines and retained ownership, meaning that they owned more of the network than any other group.[34]

An important law linked to the railways in Mexico was introduced in 1881, as the Mexican state made it obligatory for the railways to build a telegraph line at the side of the track to accompany their service (a reform introduced in Argentina 16 years later, in 1897).[35] The Mexican law also made it compulsory to build an extra telegraph line for the government free of charge to them (this equivalent further step would not come into effect in Argentina until the introduction of the Mitre Law on the 1st October 1907).[36] Despite the earlier establishment of the telegraph and railway relationship in Argentina, the country waited 50 years to fully exploit this relationship. The administrations in Mexico waited just 6 years.[37]

The Mitre Law in Argentina also extended the scope of the statute to include provision extensions, and this free wire would then become part of the national

[32] For a detailed account of the role of the telegraph in the territorial expansion in Argentina see Hodge (1984).
[33] Benavides García (1987).
[34] Bear in mind however that in Argentina, the government would give 50 year concessions, after which the line would become the property of the state.
[35] México, 'Reglamento de Ferrocarriles, Telégrafos y Teléfonos' *en Sabas y Munguía*, Recopilación, 1870-ss, t. XXXVIII, (16th December 1881), pp.346-347. This initial law in Argentina actually put in statute that it was obligatory for railway companies to construct a telegraph line at one side of the railway (for the service of the railway and often for public use).
[36] Argentina, *Leyes Nacionales 1907-1908* (Law no. 5315) Publicación Oficial de la Secretaria del Honorable Senado de la Nación, Buenos Aires (1912).
[37] In Argentina other positive steps were taken however, for instance in the introduction of the 1905 law, which authorised the construction of new lines connecting all important commercial centres with Buenos Aires. However by 1911, less than 50% of the proposed lines had been built. Berthold (1921a).

telegraph network.[38] Data collected showed that diffusion in Argentina for the period between 10% and the introduction of the Mitre Law grew at an average annual rate of 1.4%, compared with 17.6% in the period between its introduction and 90% diffusion. These rate differentials are quite staggering, with the number of telegrams sent per capita almost trebling between 1906 and 1908 alone.[39] The Mitre Law may not have established any new principles, and as Lewis suggests, it would be an oversimplification to claim that its introduction alone was the cause of the rapid railway investment during the years immediately before the First World War but the effects on telegraph diffusion were quite dramatic (see tables 3.1 and 3.2).[40] Note that the 1875 Law actually stipulated something similar to the Mitre Law, however, most companies failed to comply with regard to the provision of the public telegraph lines.[41] The Mitre Law, among other things, ensured compliance.[42] The Mitre Law marked an important moment in the telegraph diffusion process for Argentina: previously Argentina's administrations had been very generous in giving financial concessions to both the railway and private telegraph companies, and had received little benefit in return. After the Mitre Law, Argentina's national telegraph system expanded significantly, particularly in 1911, when the year on year telegraph network grew by 15% (versus 1-2% growth in the previous years). By 1915 (1 year before 90% diffusion), the government had received 5,293 km of free wire from the railway companies.[43] This was almost 40% of the total telegraph network build-out since 1907 (see appendix C, table C.1 for details). Additionally, the Mitre Law attracted significant foreign investment by granting interested investors a range of financial privileges.[44]

It is important to bear in mind that there was significant telegraph diffusion growth immediately after the Mitre Law's introduction, even though the law was only introduced in the fourth quarter of 1907. This is because the Mitre Law also critically stipulated (in further extension of the original 1875 Law) that the telegraph network

[38] Argentina, Fundación Standard Electric, *Historia de las Comunicaciones Argentinas* Buenos Aires, Fundación Standard Electric Argentina (1979).
[39] See appendix B, table B.1 for data and sources.
[40] Lewis C. M. (1983).
[41] Berthold (1921a).
[42] For a full account of the Mitre Law see Argentina, *Leyes Nacionales 1907-1908* (Law no. 5315) Publicación Oficial de la Secretaria del Honorable Senado de la Nación, Buenos Aires (1912).
[43] Berthold (1921a).
[44] For example the exemption from all import duties on materials used and instead paying a fixed 3% contribution, being exonerated from any further taxes.

owned by the railways, which was not always available for public use (or not previously available at the same price until the unified telegram tariff programme was introduced in 1907), had to be connected to the existing national telegraph network.[45] Moreover, even where railroad telegraph lines were publicly available, there was a distinct order of priority of usage, which did not encourage public usae.[46] Simply allowing for the connection of adjacent lines was naturally a much quicker and simpler process than constructing entire new lines. Hence this had a positive effect on diffusion, by suddenly opening up network coverage, connecting more useful commercial hubs (in terms of sending telegrams), even though the actual network (in km) did not grow substantially until after 1910-1911, due to the lagged time effects.[47] It is this part of the law that can potentially explain the significant immediate growth in the usage of the telegraph network; note that there was over 91% year on year growth in traffic of the network in 1907.[48] Given the potentially important impact of this law, it is assessed in further detail in chapter 4.

The Progress Achieved during 10-90% Diffusion

Any success needs to be examined in light of factors such as the quality of service, since a huge national network is irrelevant if it is constantly out of service or the quality of its provision is poor. During this period, as much as promoting demand for telegraph usage was important to the industry, a large part of inducing diffusion was concerned with the supply side (i.e. the infrastructure build-out). As shown by tables 3.2 and 3.3 (and appendix C), while the build-out of the national network was relatively stable in Mexico, growing at an average annual rate of 3.4% between 1882-1907, Argentina's build-out was much more erratic, with very little growth achieved between 1904-1910, and then a surge between 1910-1916 (55%).

The independent construction of the telegraph lines in Argentina and Mexico resulted in a largely fragmented network structure, which reflected a series of expansions rather than a systematic grid akin to those in Europe. Despite various attempts to

[45] Argentina, *Leyes Nacionales 1907-1908* (Law no. 5315) Publicación Oficial de la Secretaria del Honorable Senado de la Nación, Buenos Aires (1912).
[46] Hodge (1984).
[47] Argentina, *Leyes Nacionales 1907-1908* (Law no. 5315) Publicación Oficial de la Secretaria del Honorable Senado de la Nación, Buenos Aires (1912).
[48] Usage of telegraph network = total number of telegrams sent/total length of the national telegraph network. See appendix C for sources and further details.

unify all the lines, an uncoordinated network remained.[49] In Argentina the grid looked much better on paper than in reality and the reason why much of the network was frequently out of order was because of the poor quality of line construction, at least in the beginning. Indeed, as much time went into reconstructing lines as it did on extending new routes.[50] In addition to the lack of systematic development, the lines deteriorated quickly because basic repair maintenance was never carried out on a timely basis, therefore small problems became large ones.[51] The situation was similar in Mexico. Despite earlier planned strategies on the building of a national system, a lack of finance often forced the state to opt for many private concessions.

Many lines were often out of service (for prolonged periods) and even when they were fully functional, they were not particularly efficient. This critically impacted demand; even if individuals wanted to send a telegram, the system was not effective or timely. In Argentina messages would have to be re-transmitted at different stations in order to reach their final destinations and this structural failing ultimately resulted in an inferior quality of service. For instance, it would take as many as eight operators and many hours to send a telegram from Buenos Aires to the northernmost city of Jujuy.[52] The situation in Mexico was perhaps even worse: in an extreme example in the very early period, sending a telegram from Mexico City to Chihuahua could actually take up to 20 days, in part due to structural factors such as faulty networks (over 50,000 posts were regularly down) and also due to intrinsic performance factors such as a lack of workers to repair the lines.[53] Moreover, the problems were compounded by a lack of public understanding of how the system worked. A given customer would typically go to their nearest telegraph office to send a message, but if they walked a little farther and sent it from a different telegraph office, their telegram might have taken a more direct and therefore quicker route to the required destination.[54] Although the service in Argentina did slightly improve in the 1890s as efforts to integrate the network were put forward, the truth is that poor

[49] Moreover, where connections did exist, they were so poorly joined together that the lines were unusable. See Hodge (1984).
[50] Other specific problems included: Indian raids, high winds, rotting or poorly positioned poles, and inferior metal insulators. See Hodge (1984).
[51] Argentina, *Memoria* of the Director General of Posts and Telegraphs, submitted to the Minister of Interior in 1892.
[52] Hodge (1984).
[53] This extreme example was recorded in 1885. See Cárdenas de la Peña (1987a).
[54] This was especially the case in Buenos Aires, where there were so many different choices of telegraph stations. See Hodge (1984).

service continued, as the network was characterised by no proper 'accounting of the telegraph service...they are full of mistakes and...[there were] a mass of de-fraudations'.[55] Moreover because of the system's physical condition, the whole network required reconstruction, with the need for standardised methods of transmitting and reporting.[56]

After a series of reviews by various agencies, little progress had still been made and in a 1917 report by the Director of Telegraphs, he sadly commented that the condition of the country's telegraph system was 'truly deplorable'.[57] The situation continued to worsen and more information was disclosed in relation to the rationale for such a predicament in the 1919 report. He argued that budgets had been too small to meet the scale of the tasks required and that despite some successes in regard to the telegraph's provision, the existing problems were made worse by an increase in traffic volume. However, the greatest disappointment was the fact that the deteriorating quality of the lines amid increased traffic had gone hand in hand with increasing tariffs.[58] In Mexico, a multitude of complaints were gathered each year regarding the poor performance of the service, ranging from incompetent staff to long waiting times. Although both countries invested in trying to understand the root of the problems, these problems were too difficult to solve in the short term and the reality was that by the time some real improvements took place, telegraph diffusion had reached its saturation stage and the rising appeal of the telephone was dominating the interests of capital markets, as well as the attention of those empowered to act.

In absolute levels, by 1907, when Mexico reached 90% telegraph saturation, the country had 35,153 km of telegraph lines, compared to Argentina's 25,098 km.[59] Since Mexico is a smaller country, in terms of line length per square km, telegraph network expansion was seemingly more impressive in Mexico. Overall, the role of the state was apparent in both experiences but was perhaps more visible in the case

[55] According to the Director General of Posts and Telegraphs in Argentina, quoted in Berthold (1921a), p.12.
[56] Argentina, *Memoria* of the Director General of Posts and Telegraphs, Dr. Estanislao Zeballos, submitted to the Minister of Interior in 1891, in the chapter 'Line Construction'.
[57] Translated from Spanish, 'cuyo estado es realmente deplorable', Director General of Posts and Telegraphs, Berthold (1921a) p.14.
[58] Argentina, *Memoria* of the Director General of Posts and Telegraphs, submitted to the Minister of Interior in 1919.
[59] See appendix C for data sources.

of Mexico, due to the need to attempt to substitute for lower economic means. Moreover, the joint supply of the railways and associated key laws were important to the development of the telegraph in both countries, but especially so in Argentina given the seemingly negative impact that the lack of enforceable reforms had upon diffusion (until the Mitre Law was passed in 1907).

3.1.3 The Years of Telegraph Saturation

The telegraph saturated in 1913 in Mexico and in 1922 in Argentina.[60] The saturation of the electric telegraph did not mean that the technology became entirely obsolete, but rather there was no longer an incremental growth in its usage (the s-curve flattens as per figures 2.1 and 2.2 in chapter 2, section 2.1 The Process of ICT Diffusion). Consequently for the purposes of this study, these are regarded as the *last* years of the telegraph diffusion. The demise of a technology often coincides with the growth of an improved version or the innovation of a more advanced technology. The telegraph was no exception and in fact faced both. This period was also marred by the tumult of war, which negatively impacted telegraph diffusion.

When telephone companies began to settle in Latin America as early as the 1880s the importance of the telegraph over the telephone to the state was apparent, as they viewed the new technology as a threat to the telegraph. However, by the turn of the century, the telephone quickly became a major factor in urban telecommunications, while further experiments with radiotelegraphy almost completely limited any future progress in the electric telegraph (radiotelegraphy did not require physical construction of posts, therefore previously inaccessible areas became accessible). In the specific case of Mexico, it is interesting to note that it was not only the increased availability and popularity of the new telegraph substitutes (radiotelegraphy and telephones) that drove its demise, as was largely the case in Argentina, but significantly for Mexico, the Mexican Revolution severely destroyed infrastructure making it simply easier to leapfrog onto newer technologies than to repair old lines, and thus it may have acted as a catalyst for radiotelegraph diffusion. In truth it is easy to see why Mexico would place such emphasis on radiotelegraphy, given its history

[60] Although not the primary concern of the thesis, it must be noted that at saturation, Argentina's absolute level of diffusion was greater (81.7 telegrams sent per 100 people versus 29.6 telegrams sent per 100 people in Mexico).

of building and rebuilding lines up and down the country.[61] Moreover, the maintenance of the lines often cost more than the initial construction, and thus a system that did not require physical lines/posts was readily welcomed.[62] One may argue that the electric telegraph may not have saturated when it did in Mexico had it not been for the Mexican Revolution, since right up until this point, further improvements were being addressed. Mexico's experience could thus be seen as premature saturation. Having said this, the collected data shows that the s-curve had begun to grow at a slower rate well before 1910, consistent with the saturation phase of typical diffusion (see chapter 2, figure 2.4 Mexico's Telegraph Diffusion S-curve).

During much of the period of telegraph diffusion, the overall economic experiences of Argentina and Mexico were quite disparate (see chapter 1, section *The Period of Export-led Growth (1870-1930)*: particularly the final paragraphs). Theoretically, given the considerably higher overall levels of socio-economic development in Argentina, telegraph diffusion should have been faster there than in Mexico. Economic differences between the two countries were obviously not linear and the economic backdrop to telegraph diffusion was a volatile path for both, however the economic gap between the two countries remained sizeable (see appendix A). Despite this, not only were the telegraph lines introduced on Mexican soil first, but diffusion of this technology throughout the key 10-90% period took place at a relatively similar speed. It is true that Argentina had amassed a sizeable 40,000 km of telegraph lines in 1916, but because this was spanning an area covering approximately 2,700,000 sq km, it was not so impressive, at least when compared to Mexico, where by 1914, there were almost as many lines (approximately 37,000km) spread over 1,900,000 sq km.[63] This potentially can be seen as a question of political economies: at the beginning of the diffusion of the telegraph, having lost more than half its national territory, it was natural for regimes in Mexico to become obsessed with state-building and the telegraph provided an opportunity to establish order. In Mexico the telegraph became the property of the state well before it did in Argentina,

[61] For instance, as mentioned at the beginning of Porfirio Díaz's tenure when he rebuilt the lines he destroyed when he came to power.
[62] Noyola (2004), Merchán Escalante C. A., *Historia de las Comunicaciones y los Transportes en México: Telecomunicaciones* México D.F., Secretaría de Comunicaciones y Transportes (1988), Noam (1998).
[63] Castro Esteves R., *Historia de Correos y Telégrafos de la República Argentina* volume V, Buenos Aires, Ediciones de la Dirección General de Correos y Telégrafos (1952), Berthold (1921a), Cárdenas de la Peña (1987a).

and Mexico's regimes began overseeing the construction of the network earlier on, as well as taking advantage of the railways' right of way earlier too. In Mexico, the diffusion of this technology soon was perceived as necessary for the unification and prosperity of the nation, as well as the consolidation of state power, and it was the resultant comparable diffusion speed in Mexico combined with Argentina's economic advantage that gave rise to the Paradox.

3.2 The History and Development of the Telephone: The Argentinian and Mexican Experiences

The historical account of the adoption and diffusion of the telephone is broadly divided into three stages: the initial years of telephone adoption, the early years of telephone diffusion, and the years of telephone expansion. These groupings differ slightly from those examined in the diffusion of the telegraph due to the larger time-frame under consideration. The years of 0-10% diffusion (used for the examination of the telegraph) have been split here between the initial years of telephone adoption (0-1%) and the years of its early diffusion (1-10%). The years of telephone expansion (10-90%) is the period of fastest diffusion, and remain consistent with the telegraph analysis, since this is the most important period for the purpose of the thesis. The years of telephone saturation (90-100%) are not investigated in the thesis. One may argue that for the study of telegraph diffusion, exploring the saturation years was relatively more important because this represented the transitional period in which the telephone developed and to some extent explains why initial telephone diffusion was so slow (see chapter 1, section *State Formation and the Telegraph and the Telephone in Argentina and Mexico*). However, for the purposes of telephone diffusion there is more gained by examining the 0-90% period of diffusion in greater detail.

3.2.1 The Initial Adoption Years of Telephone Diffusion

The initial adoption of the telephone in both countries was very much characterised by local private entrepreneurial initiatives, although soon enough it would become dominated by foreign private capital (predominantly U.S. in Mexico and British in Argentina).[64] This foreign presence in the telephone sector was in line with the

[64] Petrazzini (1995).

attitude of the prevalent administrations towards the telephone at the time. The telegraph was the states' tool of choice for national security and consolidation of state power, and the telephone was initially perceived as a threat. Telephone providers operated in a largely competitive and unregulated market and the initial years of diffusion were admittedly slow (it took over 20 years before reaching 1% diffusion). Widespread adoption of the telephone was limited in the beginning as a means to communicate over long distance by its initial meagre 20 mile radius and to some it was experimental rather than practical. For instance, the first telephone network in Mexico was seen as an administrative aid to officials and as a consumer good only secondarily. [65] Argentina's network came first in 1881, but Mexico followed just one year later, quite impressively given the prominent economic position of Argentina.[66]

In Buenos Aires there were three foreign private companies and one local provider competing against each other and by 1886, the foreign providers merged into The United River Plate Telephone Company (UT). This merged entity was wholly financed by English capital and as the largest telephone provider in Argentina, it soon forced the solitary local firm out of business.[67] Meanwhile, in Mexico, the U.S. firm Greenwood was first to be given a domestic federal licence in 1881 to build a national network and connect all the growing local networks. However, due to financial and technical constraints Greenwood was forced to sell his concessions to U.S.-owned, Continental Telephone Company (CTC), which in 1882 created the *Compañia Telefónica Mexicana* (Mextelco).[68]

Although there were no more than one or two large, main providers, theoretically there was competition in both markets and this was something which the governments were keen to promote; especially in Mexico since the constitution

[65] Mexico's first telephone connected six police stations, the Office of General Inspection, the Mayor's Office and the Ministry of Interior.
[66] Refer to the economics section in the earlier part of chapter 1, section *The Period of Export-led Growth (1870-1930)*, for a comparative overview of the respective socio-economic situation.
[67] The three foreign companies were *Compañia de Teléfonos* Gower-Bell (British), *Compañia de Teléfonos* Graham-Bell (U.S.) and *Compañia Pan Teléfonos* Loch (Belgium) and the local company was Cayol and Newman Sociedad de Hecho. Petrazzini (1995).
[68] Noam (1998). Note that in 1905 Mextelco changed its name to Compañia Telefónica y Telegráfica Mexicana (CTM). Espada V. C., 'Corporate Policy in Mexico During the Porfirian Age. The Telephone Companies, 1881-1905' *Munich Personal RePEc Archive* 1740 (2005): 1-29. Kuuse J., Olsson U. and Jacobaus C., *L. M. Ericsson: 100 Years* Orebro, Interbook Publishers (1977). Hill and Abdala (1993).

specifically prohibited monopolies. Competition was theoretically positive for the fast growth of the sector since this meant that different providers competed for the same subscribers. Unsurprisingly, telephone diffusion followed skewed patterns of distribution among the population, and usage was focused in the big cities. In reality, the smaller companies operated mostly in the regions, which were not covered by the main large providers, precisely because they were less profitable. On reflection, the American shareholders of Mextelco (the largest telephone provider) were probably more concerned with high short-term profits, than with implementing a quality national system. This changed in 1905 with the arrival of competition in the form of Ericsson's Mexeric.[69] In Argentina, although there was a monopoly provider for a brief period, as early as 1887, *Sociedad Cooperativa Telefónica (*SCT) was set up to compete against UT for fear of a monopoly becoming firmly established. Between 1882 and 1912, Argentina's various administrations provided a total of 71 concessions, and consequently there was a sense of competition.[70] However, in 1912, with the introduction of the *Castillo* Law further expansion of existing lines, as well as the construction of new ones was negatively impacted.[71] Moreover, in practice, while Mexico had a duopoly, the three main providers in Argentina also controlled most of the market. By the time the telephone reached 1% diffusion in Argentina (in 1900) and in Mexico (in 1906), both countries had some notion of a 'competitive' market: however, an efficient service is not the guaranteed product of competition.

3.2.2 The Early Years of Telephone Diffusion

The early years of telephone diffusion refer to the period of 1-10% diffusion: these correspond to 1900-1943 in Argentina, and 1906-1945 in Mexico. In terms of growth rates, telephone diffusion in Argentina was higher than in Mexico, as would be expected given Argentina's stronger economic position at least until the 1930s. As mentioned, Argentina became the tenth largest commercial economy in the world, while in comparison, by 1929 Mexico's GDP per capita was just 40% of Argentina's

[69] Previously, the government struggled to promote effective competition in Mexico and resorted to simply making it harder for Mextelco to renew its contract at expiry. Unfortunately for Mextelco, the slow-down in demand, along with its costly obligations to retain its licences, meant that the company was also undergoing a difficult transition period as it acquired various independent companies.

[70] Argentina, *Telephone Census: Boletín Mensual de Correos y Telégrafos* No. 16, Teléfonos, Buenos Aires (1912).

[71] The 'Castillo' Law in Argentina decreed that any inter-state telegraph and telephone line constructed henceforth would become the property of the state after just 30 years, and the licensee would receive no compensation in return. See Berthold (1921a).

(see chapter 1, specifically the last part of the section *The Period of Export-Led Growth (1870-1930)*).[72] During this period, Argentina experienced relatively faster telephone diffusion, with a teledensity of 7.1 telephones per 100 households by 1913, compared to just 2.4 in Mexico; moreover, by 1939 Argentina had 18.4 telephones per 100 households, while Mexico languished on 4.5 (see table 3.4).[73]

Table 3.4 Telephone Diffusion (Handsets per 100 households)

	1900	1905	1910	1913	1920	1925	1930	1935	1939	1946
Argentina	1.7	4.5	6.4	7.1	15.1	16.1	18.1	16.9	18.4	18.2
Mexico	0.7	1.5	2.2	2.4	2.1	2.3	2.7	3.4	4.5	5.4

Source: see appendix B.

Table 3.4 displays the levels of telephone diffusion during the early part of the whole diffusion period. In these years it is clear that telephone diffusion in Mexico significantly lagged the levels in Argentina.

The key shift during the 1-10% period was the change in perceptions regarding the telephone, which unsurprisingly coincided with the demise of the electric telegraph. An indication of this can be seen in Argentina, in the repeal of the *Castillo* Law in 1920, which was a continual hindrance to telephone network expansion. Indeed, in Argentina, the notable progress of export activities and the urban economy had combined to create '...the largest, most articulate middle class in Latin America', a population grouping that would no doubt demand the latest communication devices and drive their diffusion.[74] The shift in attitude toward the importance of the telephone in Argentina was reflected at the highest levels, as the General Director of Posts and Telegraphs made his discontent with the government's attitude towards the industry quite clear. In numerous reports he tried to convince the Minister of the Interior to change the government policy of granting multiple concessions, claiming that although the private companies are '...careful in living up to their obligations, they always put their own interests first, interests that are generally incompatible with [the provision of a]...public service' such as the telephone.[75] A government

[72] Maddison (2006).
[73] Teledensity here is defined as the number of telephone handsets per 100 households.
[74] Lewis C. M., 'Industry in Latin America before 1930s' in Bethell L., *The Cambridge History of Latin America* volume IV, Cambridge, Cambridge University Press (1986), p.314.
[75] Berthold (1921a), p.23.

monopolisation of this ICT was, in his words, 'the future solution of this subject'.[76] Although this would not happen for some years, it demonstrates how perceptions, nationalistic feelings, and the view on foreign dependence had begun to reverse during the First World War and particularly in its aftermath. Indeed, these feelings would continue to grow in Argentina and Mexico throughout the 1920s and eventually the 1929 Depression caused such an economic dislocation that it forced change upon Latin America.

In regard to structure, the 1-10% diffusion period was one of market consolidation across the two countries, whereby the telephone ended up under monopoly provision in Argentina, and under a duopoly in Mexico. In 1927 in Argentina, the International Telephone and Telegraph Corporation (ITT) gained full control of SCT and its well developed network. For a couple of years UT competed against ITT, until it was also acquired in 1929.[77] By the mid-1940s ITT dominated the Argentinian telephone market (owning approximately 90% of the market, with CAT [Ericsson] operating 6% and some 40 small local cooperatives controlling 4% of the market).[78] In Mexico the market was dominated by a duopoly consisting of ITT also (which had bought Mextelco in 1924) and Mexeric (Ericsson). At this point there was limited competition and still a strong foreign presence, which meant that telephone diffusion was not driven particularly quickly in either country. Ultimately, the change in economic mode (and political economy) would see the emergence of the interventionist state in the 1930s, which led to a number of nationalisations (including the telephone industry) as disputes over foreign ownership of basic economic sectors took on a more prominent role on the government's agenda (see chapter 1, section *The Period of Import Substitution Industrialisation [1930s-1980s]*).[79]

This shift in the political economy coincided with the increased importance attached by the state to the telephone as a means of communication, allowing economic development, further state consolidation and national security, more so than the

[76] Ibid., p.23.
[77] Petrazzini (1995).
[78] CAT was owned by Ericsson and it operated in six provinces, remaining the only private provider until the privatisation process in 1990. See Petrazzini (1995).
[79] Cárdenas et al. (2000), Fitzgerald (1984), Thorp (1998).

telegraph ever had. Consequently there were growing calls for a more pro-active role of the state in the sector. Argentina's government gradually began to discontinue the normal practice of extending private concessions and experienced increased teledensity, while a similar shift in terms of attitude took place in Mexico.[80] Successful diffusion in Mexico took on elevated importance, and from the mid-1930s there was greater government intervention in the sector; for instance, in 1938 the Cárdenas administration set out a regulatory framework that granted the state extraordinary interventionist powers over the telecommunications sector. This framework ultimately manifested itself in the Law of General Means of Communications (1938) and was perhaps the single most important governmental act in telephone diffusion of the post-revolution period, since it was still in force in 1990.[81] In Argentina, the federal government also began to assume a more visible role in the control of the telephone sector, and although the scale of their actions was not as extensive, in 1935 they ensured that companies made arrangements for inter-provincial connections. A year later, however, the government issued an executive decree which stated that telephone services now came under federal jurisdiction and that any concession granted to a private firm could be revoked at any time, thus demonstrating a real lack of commitment to property rights, which would obviously not spur investment. Nevertheless, it was seemingly this shift in state perceptions towards the technology that ultimately spurred the need to develop the telephone industry.

It was only after the 1930s that industrialisation by all definitions was attained and a new economic model that focussed on the domestic (import substitutive) side of economic policy making was encouraged (see chapter 1, section 1.1.2 Industrial Growth in Argentina and Mexico). The increased role of the state in economic activity led to specific reforms that improved the development of telephone infrastructure. Politically (and critically for the regulatory landscape of the telecoms industry) times were changing as Argentina had seen its first democratically elected president sworn in (and out). Meanwhile in Mexico, the PRI political party, which would ultimately run the country without interruption until the 1990s, was also

[80] Casaús (1994). Also see Petrazzini (1995).
[81] Mexico, Cámara de Diputados del H. Congreso de la Unión, *Ley de Vías Generales de Comunicación, 1938 (General Means of Communication Law)* México D.F., Diario Oficial de la Federación (30th December 1939).

growing in power. At the same time there was an important shift in economic growth: although in absolute terms, Argentina's GDP per capita was still significantly ahead (see appendix A, tables A.1 and A.2), the momentum and departure in direction of growth rates was important, as this could have impacted the diffusion of the technology even more, since the incremental impact of higher income may have been more significant. It is interesting that until the end of the 1940s and in spite of Mexico's economic growth spurt (although not to the extent Mexico would experience during the economic miracle years), telephones per household in Mexico still significantly lagged those in Argentina (refer back to table 3.4).

3.2.3 The Years of Telephone Expansion

The years of telephone expansion (10-90% diffusion) saw similar rates of diffusion for Argentina and Mexico.[82] The years in question correspond to 1943-1997 in Argentina, and 1945-1997 in Mexico. The very similar periods show that not only was diffusion growing at a similar rate, but actually in tandem. Chapter 4 will assess some possible reasons as to why this occurred. This period was largely dominated by two key reforms in the telephone sector in Argentina and Mexico: the nationalisation reform (1946-1990 in Argentina, and 1947-1990 in Mexico – note that 1947 marks the beginning of the process towards nationalisation in Mexico rather than the actual years of majority state ownership, which were 1972-1990) and the privatisation reform (1990-1997 for the two countries).[83] The period of nationalisation dominated the years corresponding to the 10-90% diffusion and it was during this period that telephone diffusion in Mexico caught up to the levels in Argentina, both in relative and absolute terms. The privatisation years were also very important, because although they correspond to a shorter time frame, significant telephone diffusion occurred then, especially in Argentina.

The Period of Nationalisation

The inter-war years saw the administrations in Argentina and Mexico express increasing concern over the function of private capital as nationalistic and

[82] During this period of diffusion, CRDs were calculated as 54 and 52 years respectively. See chapter 2, section 2.6 Applying the FLOG Model.

[83] The year 1997 was chosen as the 'end' year because this was the year in which both countries were supposed to allow for competition in their telephone markets as well as corresponding to the years around 90% diffusion.

protectionist tendencies became the new policy mantra of Latin America.[84] To this end, a new model of ICT development was necessary and a more European style model of technology integration was adopted widely. 85 In the aftermath of the Second World War, a combination of increased government control and foreign corporate withdrawal strengthened the position of the state in relation to the private sector. Given the telecom sector's capacity to promote economic growth in both nations, it seemed logical for the government to increase their influence.

In the telecommunications sector at least, 'populism translated into the nationalisation of the telephone company'.[86] Indeed, populism in its various forms was characteristic of much of Latin America during this period. In Argentina a government monopoly was seen as the best strategy to ensure fast diffusion, whilst in Mexico it was believed that service would be best provided by a private monopoly, with full governmental backing: '...private enterprise should have complete freedom and be able to count on support from the state, so long as it acts on behalf of the general interest'.[87] Argentina fully nationalised the telephone under Perón much earlier than Mexico (1946 versus 1972), but the process of nationalisation began at the same time in the two countries. In Argentina, the government purchased a controlling share of ITT in 1946 to form *Empresa Mixta Telefónica Argentina* (renamed *Empresa Nacional de Telecomunicaciones* [ENTel] in 1956).[88] In a single event the Argentinian government acquired majority ownership of the main telephone provider, and complete ownership soon after.[89] In Mexico it was a progressive shift in ownership which started in 1947 under Alemán Valdés's administration, with the creation of *Teléfonos de Mexico* (Telmex), which eventually

[84] Díaz Alejandro 'Latin America in the 1930s' in Velasco A., *Trade, Development and the World Economy* Oxford, Basil Blackwell (1984), Fitzgerald (1984).
[85] Under this system, the state would co-run the post, the telegraph, and the telephone (PTT). See Noam E., *Telecommunications in Europe* New York, Oxford University Press (1992).
[86] Casaús (1994), p.179.
[87] This was said by Miguel Alemán (Mexico) in Chua (1995), p.233. An interesting issue for consideration here, as explored in chapter 1, is the relationship of the state and other interest groups in society, particularly with the elites and working classes. See chapter 1, section *Relations between the State, Business Elites, Trade unions and Workers.*
[88] *Empresa Mixta Telefónica Argentina* became *Teléfonos del Estado* just a few months later before it would become ENTel 10 years afterward.
[89] Herrera A., 'The Privatisation of Telecommunication Services: The Case of Argentina' *Columbia Journal of World Business* 28.1 (1993): 47-61. Cook P., 'Privatisation and Utility Regulation in Developing Countries: The Lessons So Far' *Annals of Public and Cooperative Economics* 70.4 (1999): 549-587.

became majority government owned in 1972 under Luiz Echeverría's administration (explained in more detail below).[90]

The differences in the two strategies can be best understood in light of their political economies (as explored in chapter 1). In the run up to the Second World War, Argentina's economic growth altered quite dramatically and between 1930 and 1945 the overall economy barely expanded, following the impressive levels it had attained in the earlier part of the century. It was therefore necessary for the state to take on a larger role in industry and perhaps this is why full nationalisation occurred in Argentina. In Mexico, the state of the political economy was rather different at the beginning of a period that would later be referred to as the 'Mexican economic miracle' years. Despite the import substitutive mode of industrialisation that had been fully embraced in other parts of Latin America (including Argentina), in Mexico, the close ties to the U.S. were paying dividends since they allowed some sense of export-led growth to continue, via commodity exports. Domestically, the government was attempting to transfer resources from agriculture to industry but it was not planning for a big shift overnight and therefore their greater desire not to overly change the status quo was indicative of its gradual nationalisation strategy. This difference in ownership structure was an important feature of the respective nationalisation paths, as ENTel was completely government owned, and Telmex's preservation of 'private flavour' potentially enabled the Mexican telephone provider to diffuse the technology more efficiently (an argument further explored in chapter 5, section 5.2.3 The Traits of the Government Administrations in Mexico).[91]

Aligned with the political economy of the era, nationalisation was a global event and occurred in Argentina and Mexico under two very different settings. In Argentina it occurred during Perón's first term; a time when public support for all things Peronist was overwhelming and the cries for state intervention could not go unanswered (indeed Perón's 'Third Position' unequivocally supported the nationalisation of foreign enterprises). This led Perón to argue that state provision of the telephone

[90] Telmex was formed in 1947 as a result of a government induced merger of two companies with incompatible networks (Mexeric and ITT). See Teléfonos de México, S.A. de C.V. *Datos Internos* México D.F., Telmex (1994).

[91] If the government had approached the nationalisation of ENTel in a manner similar to the one used in nationalising the railways in 1947 creating a mixed private/public company, much like Mexico's Telmex, the outcome would likely have been significantly different.

services was not only an option to be explored but '...essential for the economy and defence of the country'.[92] Argentina's nationalisation of the telephone provider theoretically signalled the end of foreign control, 'incompatible with sentiments of national sovereignty and the level of domestic development'.[93] The government's involvement in the telephone sector in Argentina was in fact part of a larger project of economic nationalism and was pursued very ideologically.[94] Meanwhile in Mexico, the state was not trying to gain control but rather to consolidate the fragmented network that had materialised, recognising that the ideal of a connected national system could not be achieved otherwise. Both states were keen to assert control over strategic sectors and so Argentina and Mexico decided independently to go it alone.[95] In Mexico the influence of the state throughout this period was a progressive occurrence, from simple guidance and approving nudges, to induced mergers, tariff setting and finance offering: all in an attempt to accelerate integrated network development. The nationalisation of the telephone sector, however, was not driven by any one political force (although it was one political party) compared to the early Perón years in Argentina. Instead, between the 1950s and early 1970s Mexico was governed by a series of administrations that slowly exerted an increasing influence on Telmex, which culminated in majority government ownership in 1972. Although these administrations would collectively be bracketed under the 'economic miracle years' heading, in terms of economic advancement, it must be noted that there were varying degrees of overall success, given the sizeable debts that were amassed and the hefty rises with regard to income inequality.

Just as institutions in Mexico had been active early on in the telegraph's diffusion, in 1947, Argentina had created the Ministry of Communications and the Secretary of State for Telephones. The government thought that this would stamp its authority over the telecom sector and make it clear to the market that ENTel's growth was due to the government's active management. ENTel absorbed a large number of cooperatives and by 1955, when Perón was overthrown, CAT was the only private

[92] Petrazzini B., 'Telephone Privatisation in a Hurry: Argentina' in Ramamurti R., *Privatising Monopolies: Lessons from the Telecommunications and Transport Sectors in Latin America* Baltimore, Johns Hopkins University Press (1996), p.111.
[93] Petrazzini (1995), p.56. Donikian L., Raúl V. A., Vito D. L. and Roberto V., *Teléfonos: de la Política Nacional al Saqueo Privatista* Buenos Aires, Foetra (1990).
[94] Proof of this was the retention of state telecommunications control despite Perón's removal from office in 1955.
[95] Knight (1985), Thorp (1998), Díaz Alejandro (1983), Lewis C.M. (2002).

provider remaining.[96] ENTel continued to expand, however, and by the 1970s it controlled 92% of the market. In the case of Argentina, the strategic importance of telecommunications meant that the government would retain absolute control of this sector until 1990, when ENTel was privatised. Throughout this period, sector policy was the responsibility of the Secretary of Communications and the 1971 National Telecommunications Law would explicitly make all telecoms a legal monopoly of the state.[97] Unlike ENTel, Telmex was initially mostly foreign owned.[98] Although it was acknowledged widely that the infrastructure and services in the telecom sector were inadequate, it was not until the presidency of Ruíz Cortines that there was a significant increase in investment in communications, something which his successors continued as nationalisation neared. The aim was to create an integrated national system, and although several small firms continued to exist, Telmex had consolidated the market as Mexico's main provider (controlling 96% of the market by 1957).[99] In 1958 the López Mateos administration 'Mexicanised' Telmex by persuading (coercing) heavily invested foreign owners to sell their shares to Mexican investors. This period perhaps coincided with some of the PRI's most authoritatively stable years in power, as many largely accepted that the ruling developmentalists might not be bringing social justice, but they had achieved overall economic success.

During the 1950s Telmex was to all intents and purposes a private enterprise which cooperated closely with the Mexican government, who maintained good relations with the private sector in order to meet public needs.[100] Mexico's government continued to take on a more prominent role in the development of the telephone sector, through official loans and re-investment of revenues into the sector in order to aid in its expansion in the 1960s. Indeed, Mexico's period of stabilising development was beginning to receive global recognition. ENTel, by contrast, was solely state owned and its interests were fully government-originated consequently, which resulted in significant inefficiencies. For instance, the existence of '*compre nacional*' meant that only a few local suppliers were used, eroding price competition. Indeed,

[96] Scobie J. R., *Argentina a City and a Nation* New York, Oxford University Press (1964), Hill and Abdala (1993), Petrazzini (1995).
[97] Hill and Abdala (1993).
[98] Temex's ownership was 51.24% Continental Corporation, 48.75% Ericsson and 0.01% owned by 3 Mexican companies.
[99] Székely G. and de Palacio J., *Teléfonos de México: Una Empresa Privada* México D.F., Grupo Editorial Planeta Mexicana (1995).
[100] Thorp (1998).

prices paid were often twice or three times higher than those of the international market.[101] ENTel's procurement policy was connected closely with the regime. As military and civilian regimes followed each other in rapid succession between 1955 and 1976, procurement policy and ENTel's development strategy became inconsistent and contradictory, with incoming administrations cancelling the pre-existing contracts with suppliers and negotiating new ones, providing a high incentive for corruption.

In Mexico, Telmex was in fact performing relatively well compared to its performance in the earlier years of telephone diffusion and although diffusion in Mexico had not yet caught up to Argentina's absolute levels, it was growing materially faster (see table 3.5).

Table 3.5 Telephone Diffusion (handsets per 100 households)

	1947	1950	1955	1960	1965	1970	1975	1980	1989
Argentina	18.7	21.4	27.8	29.4	28.1	27.2	29.5	30.4	43.1
Mexico	5.7	5.4	6.3	8.3	11.4	18.3	29.3	41.6	61.4

Source: see appendix B.

Table 3.5 shows that, although Mexico continued to lag Argentina's telephone diffusion levels until the 1970s, the increased role of the government in the sector seemed to develop in tandem with diffusion growth. Telephone diffusion in Argentina meanwhile remained fairly stable throughout the period as rapid growth was frustrated by regime changes and sporadic policy turmoil. In Mexico in the 1970s, Echeverría's administration embarked upon an ambitious task of making state-owned enterprises more effective in sectors that had been dominated by private ownership for a long time, and 'the role of the state, already significant, expanded sharply'.[102] Nationalism began to deepen in Mexico, and the government's role gradually expanded to the point where its ownership of Telmex reached 51% of voting shares in 1972. Echeverría argued that the telecommunications sector could *now*, under state ownership, contribute to national development and security. It was indeed *now* that diffusion increased significantly. From 1972, the Mexican government took executive decisions regarding Telmex, although it is imperative to

[101] Petrazzini (1995).
[102] Smith P. H., 'Mexico Since 1946: Dynamics of an Authoritarian Regime' in Bethell L., *Mexico Since Independence* Cambridge, Cambridge University Press (1991), p.371.

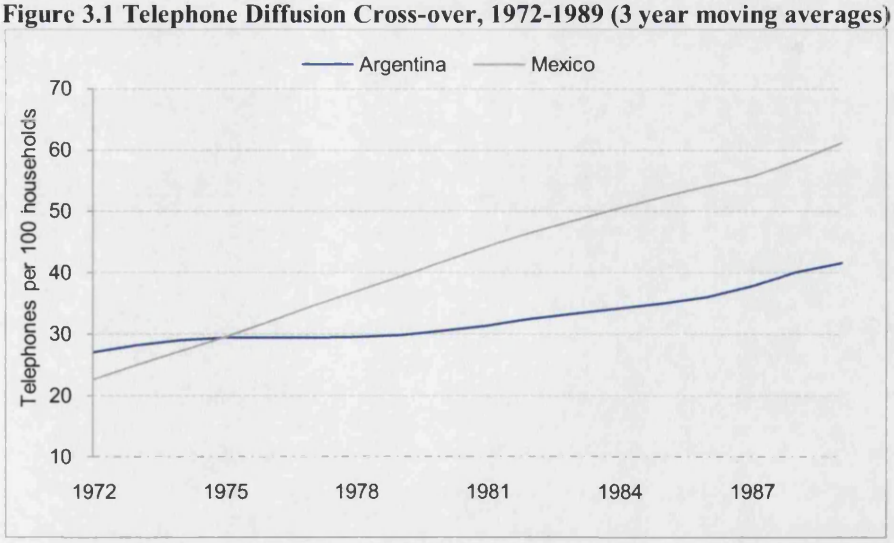
note that, unlike ENTel, Telmex still retained some notion of private-company status. This was evident from the fact that the majority of Telmex's management kept their jobs and various private individuals were board members. However, it is interesting that while the state strengthened its grip on the telephone sector, the PRI's grip on political power loosened. As shown in figure 3.1 below, telephone diffusion in Mexico increased significantly in the early 1970s, and by 1976 it exceeded Argentina's absolute levels, with 41 handsets per 100 households in Mexico in 1980 compared to 30 in Argentina (see table 3.5 above).

The Progress Achieved during the Nationalised Era

The focus of the thesis is to understand the factors behind the given telephone diffusion rates, be they factors that affected the build-out of infrastructure or those impacting consumer demand directly. But in order to appreciate fully the extent of any relative success during this critical period of nationalisation, the growth in diffusion must also be examined with respect to the quality of the service and the providers' respective financial performances. In the years of nationalisation (and those leading to it for Mexico), there was a strong state commitment to network expansion in the two countries, and they borrowed heavily during the 1960s and 1970s from foreign lenders to reinforce this expansion.[103] In Argentina economic stabilisation efforts repeatedly failed during cycles of inflation and devaluation, while in Mexico they were nearing the end of their stabilising development phase. Nationalisation brought some progress in the two countries' telephone diffusion rates but a key difference was that in Mexico, Telmex continued to operate partly as a private company. To this end it is interesting to analyse the whole period of nationalisation before and after 1972 for Mexico, in measuring the effect of nationalisation with private flavour, as one can observe that household teledensity levels tripled during the latter period (see table 3.5 above).[104] Yet more impressive is that on the eve of privatisation, telephone diffusion in Mexico not only caught up to the absolute levels in Argentina, but exceeded it by almost 1.3 times (see figure 3.1).

[103] Tuman J. P., 'Comparing Modes of Privatisation: A Study of the Telecommunications Sectors in Argentina and Mexico, 1990–2000' *Industrial Relations Journal* 38.2 (2007): 155-177.
[104] See appendix B for data and sources.

Figure 3.1 Telephone Diffusion Cross-over, 1972-1989 (3 year moving averages)



Source: see appendix B for data.

Figure 3.1 shows the cross-over of when telephone diffusion in Mexico caught up with the levels in Argentina. The observed trend would prevail for the rest of the period of nationalisation, whereby after almost 80 years of telephone diffusion leadership in Argentina over Mexico, the relationship reversed. Mexico's telephone diffusion outperformance and the relative underperformance in Argentina during the years of nationalisation are further explored in chapters 4 and 5. It is worth noting, however, that the economic disparity between the two countries in absolute GDP per capita levels at this point had reduced (see appendix A, table A.1).

State ownership in ENTel resulted in poor service and poor maintenance prevailed and although there were periods of progress, the predictable economic and socio-economic problems began to emerge. For instance, underinvestment meant supply-demand dynamics were imbalanced, over-employment crept in, political interference was abundant, and prices were kept artificially low. For ENTel, Cook, along with other observers, believed their 'highly politicised management and lack of entrepreneurial spirit' were the main reasons behind the poor quality of service and its poor financial performance.[105] As an example, ENTel's labour policies were linked closely to national politics, so the size of the firm's workforce and hiring strategies were not based on efficiency or productivity but rather on larger national issues such as the employment rate.[106] Also, as ENTel's senior management were appointed at the president's discretion and as the presidency changed hands

[105] Cook (1999), p.558.
[106] Petrazzini (1995).

numerous times in the years during ENTel's nationalisation, it was similarly no surprise that there was significant instability among the senior management at ENTel (along with their individual visions), as they frequently came and went. ENTel faced significant managerial inconsistencies, and in the 30 years leading up to privatisation, the company had 28 different executive directors.[107] The changing faces of ENTel's management effectively were a reflection of the changing faces of Argentinian politics. Consequently, there was a distinct lack of investment planning, as projects were carried out randomly; for instance in 1975, 6,000 lines were delivered, compared to 200,000 in 1979.[108] This was also in part a result of the often contradictory policies issued by different government departments, as ENTel had to respond to up to seven different bodies, each pursuing their own agenda. This was very different to the situation in Mexico where private and state management shared responsibilities. Further, during Telmex's period of nationalisation, via the PRI, there was relatively greater political stability within the Mexican state (although on the wane in the 1980s) vis-à-vis Argentina (although this varied), and thus longer term goals could be more easily set and achieved.[109] Telmex suffered political pressures of a different kind in the immediate period before privatisation, however, as it was viewed and exploited by the government as a source of revenue.[110] As a cash cow, Telmex's eventual privatisation sent a very meaningful signal to world markets, indicating that Mexico was well on its way to embracing economic liberalism.

Indeed, in judging the success of these enterprises from the quality of the service perspective, despite their rapid expansion, neither excelled, but problems were perhaps more pronounced at ENTel. For instance, in 1989 there was an average waiting period of 12-14 years to install a new phone, compared to an average of 3 years at Telmex.[111] Waiting time for repairs, on average, were 11-14 days in Argentina compared to just 4 days in Mexico.[112] Having said that, at any one time, roughly 10% of all of Mexico's telephone lines would be out of service. Nonetheless,

[107] Hill and Abdala (1993).
[108] Noam (1998).
[109] See chapter 1, section *The Evolution of PRI control of Mexico (until 1960 and from 1960).*
[110] For details see Casaús (1994).
[111] See Cook (1999).
[112] For more details on the quality of service, see Mairal H. A., 'The Argentine Telephone Privatisation' in Wellenius and Stern (1994). Also see Cook (1999), Tuman (2007), Ramamurti R., *Privatising Monopolies: Lessons from the Telecommunications and Transport Sectors in Latin America* Baltimore, Johns Hopkins University Press (1996).

the overall situation at ENTel was arguably worse: for example, labour productivity lagged Telmex's considerably, with ENTel producing 75 lines per employee versus 105 lines at Telmex.[113] Furthermore, in terms of first-time connectivity, ENTel had a success rate of less than 50% on local calls and 30% on long-distance calls versus Telmex levels of roughly 92% of all local calls and 90% of long-distance calls.[114] In terms of influencing further diffusion growth, long waiting times for installation and unsuccessful connections were obviously two potential inhibiters. As the 1980s debt crisis progressed, ENTel's profits continued to suffer and consequently the quality of service worsened further, as connection delays exceeded historical averages.[115] Overall, the quality of service was not spectacular in either country, although ENTel's offering was surely worse as, by the 1980s, most Argentinian voters were so discontent that they actually began to call for liberalisation of the market (not necessarily privatisation), as a means of getting better service.

In terms of financial profitability, a factor often used to evaluate state enterprises, Telmex was clearly the relative outperformer. Although Telmex's profits were not always sizeable, their revenues were consistently strong, and although ENTel proved profitable during the 1960s/1970s, their revenues were not on the same scale. Despite various difficulties, Telmex delivered a reasonable rate of return during the late 1970s and early 1980s. But it was heading in to privatisation that Telmex became particularly profitable, with an average of U.S.$193 million net profit from 1982-87.[116] By the late 1980s, it was growing at double-digit average annual percentage growth.[117] In contrast, during the 1980s, ENTel saw its financial performance worsen, and from *memoria* to *memoria*, ENTel revealed losses as year-on-year installation growth fell equally dramatically.[118] This period proved very difficult indeed for the telephone sector as governments reduced their level of investment which hindered expansionary plans. Moreover, for ENTel, profitability swung violently, depending on the given politically-motivated tariff structure of the time and as tariff income was eroded by inflation, so was the financial performance of the

[113] Labour productivity is measured as lines per employee.
[114] Abdala M A., 'Institutional Roots of Post-privatisation Regulatory Outcomes' *Telecommunications Policy* 24.8-9 (2000): 645-668.
[115] Tuman (2007), Cook (1999), Mairal (1994), Petrazzini (1995), Casaús (1994).
[116] Note that this period was dubbed the 'lost decade' in Latin America. See Petrazzini (1995).
[117] Casaús (1994).
[118] Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1984).

company.[119] The problem was that the evolution of the tariffs was well below the value of inflation registered over the equivalent period.[120] Tariffs were not adjusted in a timely fashion and due to ENTel's historical reliance on credit and the finances of the state, a vicious cycle was created that saw the company's financial deficit worsen.[121] Moreover exchange rate fluctuations led to an increase in already sizeable debts, and problems worsened as interest rates increased from 1979, which would ultimately be followed by the debt crisis.[122]

Telmex's success over ENTel can be explained in part by the policies implemented by de la Madrid, who quickly realised that change was needed in the telecom sector and thus implemented various initiatives, which led to the privatisation of Telmex. Despite some earlier difficulties as mentioned, especially in the 1970s, Telmex headed into privatisation on a strong financial footing. In truth, both state-owned telephone monopolies faced difficulties; but Telmex, unlike ENTel, remained comparatively more profitable. Thus the impact of the crisis was much more negative for ENTel than for Telmex.[123] Consequently in financial terms, although both providers were profitable going into privatisation, Telmex was again, relatively more successful than ENTel.

Overall, in review of the developments during the period of nationalisation, Telmex performed relatively better in diffusing the telephone compared to ENTel, as indicated by teledensity growth, quality of service and financial performance. A critical facet of Telmex's success was seemingly related to the government's progressive approach to nationalisation and retention of private flavour when finally in majority control, versus ENTel's complete government ownership in a single act. This resulted in ENTel potentially facing more inefficiencies. Meanwhile, the very fact that nationalisation in Mexico was a relatively shorter period was also seemingly positive for diffusion.

[119] The tariff structure would involve supporting government's welfare programmes, or aligning tariffs with anti-inflationary plans. See Cook (1999) and Hill and Abdala (1993).
[120] Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1984).
[121] Ibid. Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1975).
[122] Schaeffer R. K., *Understanding Globalization: The Social Consequences of Political, Economic and Environmental Change* Lanham, M.D., Rowman and Littlefield Publishers (1997).
[123] Telmex had become the envy of many other Mexican companies due to its performance over this period.

The Period of Privatisation

As the twenty first century approached, private provision came back into vogue. There was a renewed emphasis on competition and transparency as the New Economic Model emerged, resulting in a favourable political environment to implement reforms in the telecommunications sectors and in part motivated Argentina's and Mexico's administrations to implement the privatisation of their telecom providers.[124]

ENTel's privatisation was not only a response to international pressures to introduce neo-liberalism, but it was also a means to reduce foreign public debt, as ENTel's debt, in the form of state subsidies and privileges since the 1940s, could no longer be serviced.[125] The significance of the reform was underscored further by the style of transaction, as it was at the time, the largest debt-equity swap transaction in Latin American history.[126] In the case of Mexico, by privatising Telmex (*now* a large and profitable entity), the Salinas de Gotari administration was sending a message to the global community that Mexico was now a more liberal and competitive economy. In addition to the symbolism that Telmex's privatisation rendered, it was also the strategically rational option since privatisation was expected to increase efficiency further. [127] As expected, both countries faced opposition to the reforms and overcoming this domestic resistance was key for successful privatisation and subsequent diffusion.

Unionism was one important form of resistance and their relationship with the state came under scrutiny during this period. The unions were very different in nature in the two countries. In Argentina, trade unions, by the time privatisation came about, were a well established base of political opposition.[128] In Mexico, the dynamic was very different, as independent unionism had not really grown in tandem with industry, however, they still had an important role to play during privatisation. Salinas de

[124] Manzetti (1999). Moreover, as detailed in chapter 1, the arrival of the debt crisis, which preceded the reform, was viewed in international financial-circles as a unique opportunity to force Latin American governments toward an ideology based on liberalisation and a reduced role of the state.
[125] Indeed public sector enterprises were responsible for much of the fiscal deficit (ENTel accounted for 4.86% of the total debt in 1989). See Manzetti (1999) and Herrera (1993).
[126] Petrazzini (1995), p.22. In fact, a US$214 million cash ceiling was imposed in order to encourage potential buyers to compete on the debt side of the deal, see Manzetti (1999).
[127] Petrazzini (1995).
[128] See chapter 1, section *Inter-relations between the State, Business elites, Trade unions and Workers.*

Gotari successfully blocked this by incorporating various labour concessions in his finalised reform package, which caused the unions to quickly reverse tack and publicly support the sale of Telmex. Meanwhile in Argentina, opposition was part of the reason why Menem's privatisation reform was attempt number three. When privatisation was attempted first under the military regime during *El Proceso*, it failed due to a lack of cohesion among governing elites. In the second attempt in 1988, the Alfonsín democratic administration failed to block domestic opposition (from unions, equipment suppliers, Peronists, and ENTel's management) and did not secure the necessary congressional backing.[129] By the third attempt to privatise in 1990, although Argentina faced more resistance than Mexico, the Menem administration was prepared for it, having learned from the failings of his two predecessors. It was in anticipation of this resistance that a swift bidding and reform process was timetabled.[130] Menem, unlike Salinas de Gotari, was unwilling to negotiate with unions and warned that any labour strike would be deemed illegal, and ultimately fired many employees in the process (around 400). He also faced strong opposition from within his own Peronist party, as their strong statist philosophies were in direct opposition to his methods. He thwarted this opposition by replacing them with external workers who supported his policies.[131]

In 1990, Argentina and Mexico successfully privatised because the reform was government-led and largely commanded by public opinion.[132] Both sales were executed by just a few government officials and employed presidential intervention wherever necessary. The PRI's authority may have been on the wane, but despite this, they managed to remain a strong enough force in politics during the privatisation reform. Their relative (though waning) stability in Mexico versus the very fragmented Argentinian political arena in the build-up to privatisation was very important and helps to understand why in Mexico, unlike in Argentina, privatisation was successfully implemented at its first attempt.

[129] See Manzetti (1999).
[130] Cornelius and Craig (1991).
[131] See Xelhuantzi-López M., *El Sindicato de Telefonistas de la República Mexicana: doce años (1976–1988)* México D.F., Sindicato de Telefonistas de la República Mexicana (1990). Luxner L., 'Argentine Telco Sale Causes Uproar' *Telephony* 218.7 (1990): 9-10, Tuman (2007), Cornelius and Craig (1991), Cook (1999).
[132] Wellenius and Stern (1994).

Although tactically divergent, both Menem and Salinas de Gotari were able to overcome opposition, and had they not done this as swiftly as they did, surely telephone diffusion would have stalled. Although reforms were supposedly free-market reforms, they did not put an end to monopolistic or oligopolistic practices. ENTel and Telmex were not necessarily sold to the highest bidders, but rather to those that the government saw as most beneficial, demonstrating how difficult it was for a nation to shed its legacy ties of favouritism in business. For instance, most of Telmex was sold to a Mexican financial and commercial group, *Grupo Carso*, thus in effect converting Telmex from a state monopoly to a private Mexican monopoly. Meanwhile in Argentina a duopoly emerged as ENTel became *Telefónica de Argentina* and *Telecom*, which would be an important structural factor. Although it could be argued that ENTel's sale potentially was mismanaged, the creation of a duopoly provided a certain degree of competition, which was important in a non-liberalised market.[133]

Following privatisation in the 1990s, telephone diffusion in Argentina managed to catch up very quickly with that in Mexico and the two countries ultimately saturated at approximately the same time and level (see table 3.6).

Table 3.6 Telephone Diffusion during Privatisation (handsets per 100 households)

	1990	1992	1994	1996	1998
Argentina	41.2	52.0	64.7	75.0	81.1
Mexico	64.5	72.9	86.3	84.5	82.8

Source: see appendix B.

Table 3.6 shows that the recovery in Argentina in terms of telephone diffusion during the period of privatisation was spectacular, as telephone handsets per 100 households doubled from 1990-1998. This was similar to Mexico's experience in the 1970s when its telephone diffusion speed caught up with Argentina.

In the years prior to privatisation, both countries carried out various important reforms in order to make their respective telecom providers more attractive to private capital. Indeed, part of Argentina's and Mexico's shared success pre-privatisation

[133] Manzetti (1999).

was the fact that in neither country was the responsibility for positive change wholly placed on the acquirers. On the financial restructuring side both decreased taxes and upgraded tariff policies. Mexico sensibly reduced the debt, and Argentina decided to guarantee a debt-free balance sheet of sorts. But while ENTel stopped there, Telmex restructured the entire capital of the firm in order to retain Mexican majority voting rights yet still attract maximum foreign capital interest.[134] As far as institutional changes went in preparation for privatisation, these were quite different. Mexico entirely restructured its regulatory framework, while Argentina did not formulate a regulatory regime until late in the bidding process.[135] Although both governments took steps to facilitate the sale of their respective telecom providers, it was perhaps Mexico's changes in the law that various analysts agree was the crucial factor in determining the success of Telmex's privatisation process.[136] This was important since international investors played a key role in the process, and Argentina, due to the relatively greater volatility of its economic and political domains leading up to privatisation, was regarded as a risky investment, '...a high risk country, and ... not worth it to bid for ENTel'.[137]

Investors' high degree of uncertainty about the future macroeconomic environment in Argentina meant that foreign private buyers had a significant degree of bargaining power during the sale process (evidenced in the ultimate degree of liberalisation [lack thereof] in the market). In Mexico there was a high level of centralisation in the management, and there was seemingly greater stability in the political environment carved out by the transformation of the Mexican economy, especially in the first five years after the debt crisis. This meant that the government was able to exert more control over international investors during the privatisation process. Given the

[134] Telmex provided 3 types of common stock: those sold to the consortium (22.11% of Telmex's total equity) and those already in private hands (3.64%) – both of which had full voting rights – whereas the third type of shares (74.25%) had limited voting rights. Indeed, maintaining the voting in Mexican hands was a key objective of Salinas' privatisation. See Casaús 'Privatisation of Telecommunications: The Case of Mexico' in Wellenius and Stern (1994). In Argentina, on the other hand, no special voting structure was implemented, although the end result was still significant domestic ownership (43% in Telecom and 47.4% in Telefónica), however, unlike at Telmex, this was not an initial aim. See Hill and Abdala (1993) and Mariscal J. and Rivera E., 'New Trends in the Latin American Telecommunications Market: Telefónica & Telmex' *Paper at the 32nd Annual Telecommunications Policy Research Conference (TPRC)* October (2004): 1-35.

[135] For a detailed account on restructuring see Wellenius and Stern (1994). Also see Mariscal J. and Rivera E., 'New Trends in the Latin American Telecommunications Market: Telefónica & Telmex' *Telecommunications Policy* 29.9 (2005): 757-777 and Petrazzini (1995).

[136] See Tandon P. and Abdala M., 'Mexico: Teléfonos de Mexico' in Galal A., Jones L., Tandon P. and Vogelsang I., *Welfare Consequences of Selling Public Enterprises: Case Studies from Chile, Malaysia, Mexico and the UK* Washington D.C., The World Bank (1992), also Griffith in Noam (1998).

[137] Newspaper: *El País*, (14th June 1990). Comment by one Telefónica manager on behalf of the executive board.

Argentinian situation, ultimately there was just one interested buyer in each region, and the government felt *forced* to grant monopoly privileges rather than embrace competition.[138] Argentina failed to liberalise, because to attract private capital it had to make clear the possibility of high revenue growth opportunities. Unlike ENTel, on the eve of privatisation, Telmex was a very attractive investment: as the second largest company in Mexico and one of the 30 largest telephone companies worldwide. Its privatisation was an exciting and lucrative prospect (since it had already grown into a profitable business) and its geographical location (U.S.-neighbour) translated into an important flow of call demand to be serviced.[139] FDI was increasing and general investor sentiment was high (given the dramatic fall in inflation and observed GDP growth). However, despite the higher degree of governmental bargaining power, Mexico was only able to liberalise its service partially, as a monopoly was granted on local and long-distance telephone service, as in Argentina.[140] Hence, both countries initially failed to liberalise the telephone market, but took significant steps in improving the sector.

Another difference between the Argentinian privatisation and the Mexican one was the decision to privatise before deregulation of the economy and before the achievement of economic stability.[141] Argentina drafted new telecom laws, but they were flawed severely in terms of clarity and depth. The scheme outlined was executed poorly and it took more than a year after privatisation for the regulatory body to begin to address matters. Argentina's regulatory agency did next to nothing until 1992. It was dogged by political interference, and its '...lack of autonomy...and restricted finances placed Argentina's regulatory agency...at odds with the technically and politically difficult task assigned to it'.[142] From 1992 the situation improved and from 1993 one sees a significant jump in telephone diffusion in Argentina. In the case of Telmex, the regulator for the first five years after privatisation was successful and thus Mexico was in a better position to experience

[138] The monopoly privileges were for 7 years extendable to 10 years. See Cook (1999) and Petrazzini (1995).
[139] De la Garza Toledo E., 'Reconversión Industrial y Cambio en el Patrón de Relaciones Laborales en Mexico' in Angiano A., *La Modernizacion de México* México D.F., Universidad Autónoma Metropolitana (1990).
[140] There was a monopoly on long distance telephony until 1997 and on local telephone until 1998. Although proposals to enter local services came as early as 1994, concessions were not offered until 1998, thus, in effect there was no competition in the fixed local telephone market in Mexico until 1998. See Mariscal and Rivera (2004), Walter J. and González C. S., *La Privatización de las Telecomunicaciones en América Latina* Argentina, Editorial Universidad de Buenos Aires (1998).
[141] The deregulation decree in Argentina did not come until October 1991, see Manzetti (1999).
[142] Petrazzini (1996), p.138.

faster diffusion (compared to Argentina before 1992). In the initial period post privatisation, Mexico accordingly continued its strong diffusion rate, and by 1994, it had a household teledensity of 86.3% compared to Argentina's 64.7%.[143] However, from 1996, the new agencies established in Mexico lacked meaningful autonomy to act and the teledensity situation quickly reversed, as Argentina's regulatory landscape improved.[144]

The Progress Achieved during the Privatisation Era

The period under consideration in the following assessment of privatisation is from 1990, when privatisation was implemented, until 1997, when liberalisation was supposed to begin.[145] Coincidentally, this period not only marks the advent of liberalisation but also represents the 90% telephone diffusion level. In order to assess the relative success of telephone diffusion in Argentina and Mexico during these years, the household teledensity growth, the quality of service and the overall financial performance are examined.

In terms of teledensity growth over the period of privatisation, diffusion in Argentina grew by an average of 7.7% per annum compared to 4.0% in Mexico during 1990-1997 (note that this was from a lower base, however).[146] In absolute terms, telephone diffusion in Argentina clearly performed strongly in the privatisation years. In terms of quality of service, Argentina's telephone providers also managed to make significant relative improvements versus Telmex. For the first three years after privatisation, Telmex failed to meet its service targets, whereas Argentina's Telefónica and Telecom exceeded theirs (admittedly theirs were less demanding).[147] Targets were set with respect to network expansion and quality of service. For the expansion targets these specifically included annual percentage network growth and the number of new lines and public phones. For quality, targets were set on call

[143] See appendix B for data.
[144] Mariscal and Rivera (2004).
[145] Ultimately, it was extended until 2000 for Argentina, but for comparability purposes this is the period that will be examined.
[146] See appendix B for data.
[147] For a detailed account on Argentina's targets see the 'Pliego de Bases y Condiciones para la Privatización del Servicio Público de Telecomunicaciones' (Document of the Terms and Conditions for the Privatization of Telecommunications Services) contained in the Executive Decree 62/1990 of 5 Jan 1990. For Mexico, see Telmex, *Informe* México DF, Telmex (1995), and SET (Consultores en Sociología y Economía del Trabajo, Secretaría de Asuntos Profesionales de FOETRA), *Análisis de la productividad en las empresas telefónicas según balances contable. Matriz básica de datos* Buenos Aires, Argentina, FOETRA (1996). Also see Petrazzini (1996) and Noam (1998).

completion rates, time taken to repair faulty lines and the duration of installation delays.

In Mexico, service quality continued to draw numerous complaints, particularly in Mexico City where at one point they 'averaged a million customer complaints per month'.[148] By contrast, Argentina significantly improved its service (from a low base again, however), with the number of successful calls at first attempt increasing from 49% to 85% for local calls and 30% to 80% for long distance.[149] During the 1991-1995 period, employee productivity improved in relative terms: for Telefónica and Telecom it grew by 100% and 121% respectively, compared with 54% at Telmex.[150] The waiting time for a repair also fell sharply in Argentina, from 11 days to 2 (1990-1998). This was amid much increased demand also, with the number of new lines to be installed in Argentina almost tripling by 1994.[151] Although Telmex was experiencing further price hikes (from $11 to $21), and in Argentina prices were falling slightly, it must be noted that Telefónica's and Telecom's tariffs were still extremely high ($30 to $28) for 1990-1997.[152] Some rationale for is found in the fact that there was zero competition in Mexico's telephone market, whereas in Argentina the duopoly meant that when Telecom reduced rates (for whatever reason) this placed some pressure on Telefónica to follow suit.[153] Therefore, in terms of relative improvement, Argentina's telephone diffusion was more successful, as post-privatisation it significantly increased investment and Telefónica and Telecom improved the quality of service; although one must consider the fact that given the state of the telephone sector in Argentina before privatisation, there was considerably more scope for improvement than in Mexico.[154] The effects of privatisation in terms of teledensity therefore were even greater in Argentina as a result of the lack of progress made during nationalisation.

[148] Cho S., *The Dynamics of Institutional Reform in Telecommunications: Globalization, Liberalisation, and Regulatory Change* New York, Garland Publishing Inc. (1998), p.200.
[149] Abdala (2000).
[150] Petrazzini (1996), p.138.
[151] Walter and González (1998).
[152] Prices are for total average monthly rates in U.S. dollars (average of 450 minutes). Mariscal and Rivera (2004).
[153] Mariscal and Rivera (2004).
[154] Abdala (2000).

On a financial performance level, Telmex was a world-class operator, with 'operating margins of over 50 percent'.[155] For the period 1991-1993 the telephone providers in both Argentina and Mexico experienced positive growth, but Telmex in particular managed to increase its revenues by more than 115% during this period.[156] While both boosted their capital spending, Telmex's efforts were greater. From capital expenditure of U.S.$500m in 1989, Telmex spent U.S.$2.75bn in the first year after privatisation (1991) and for 'the six years 1991-96, the total was U.S.$12bn' versus its counterparts in Argentina with an average spend of 'U.S.$1.2bn per annum after privatization'.[157] In relative terms, Argentina did well, with Telefónica and Telecom increasing their net profits by 19% and 16% on average (1991-1995). Indeed, Argentina's two telecoms operators improved the situation so much that in terms of net profits and net value added per employee, they actually surpassed Telmex's in 1995.[158] But for the period as a whole, Telmex was more successful in financial terms: in 1996 it impressively recorded the second highest earnings of any Latin American company. Thus overall, Argentina's performance was not comparable on a 'bottom-line' assessment, but to its credit it turned ENTel from a loss-making company into a profitable one, generating yearly profits of $400million by 1992.[159]

In terms of household teledensity growth and quality of service during the years of privatisation, telephone diffusion in Argentina was relatively more successful than in Mexico, although in financial terms, Telmex relatively outperformed. It would have been logical to assume that Mexico was in a better position to diffuse the telephone faster during these years, given the relatively limited opposition, the greater pre-privatisation restructuring and the clearer and more efficient regulatory framework, after all the priority in Argentina was to sell ENTel as quickly as possible. Nonetheless, telephone diffusion in Mexico had experienced a major spurt in growth already in the 1970s and thus the continued stable diffusion growth was less a reflection of the success of privatisation and more a factor of their achievements to date. ENTel's privatisation reform, in relinquishing government control (and thus the

[155] Griffith in Noam (1998), p.180. Note that this was before the 1994-1995 economic crisis.
[156] Ibid.
[157] For Mexican information see Griffith in Noam (1998), p.180 and for Argentinian see Cook (1999), p.564.
[158] Tuman (2007).
[159] Newspaper: *International Herald Tribune*, (7th September 1992).

associated inefficiencies) and partly in the structural duopoly formation, which provided some degree of competition in the market ultimately supported the advancement of telephone diffusion. Overall, it is interesting that what was most impactful upon the diffusion of the telephone was institutional reform strategy and implementation. A good example was the Mexican government's gradual, rather than full blown, nationalisation of Telmex, which was aligned with the political economy of the era, as explained earlier.

3.3 Conclusion

The aim of this chapter was to provide a deeper understanding of the development of the telegraph and telephone diffusion, within the political and economic backdrops of Argentina and Mexico. In essence, relating the context provided in the first part of chapter 1, to the direct events of the diffusion processes. Despite the large relative strides taken by the Mexican economy as a whole over this period, as the economic disparity narrowed, Argentina from a socio-economic perspective remained at a much higher level of development throughout the period. Theory would predict that diffusion of the telegraph and the telephone in Argentina should have been relatively faster than in Mexico, yet this did not happen. A possible explanation for the Paradox may be found in an examination of the state's role, operating within the bounds of the prevailing political economies.

To substantiate the argument, consider that during the early period of telegraph diffusion, Mexico had generally experienced a period of serious political flux post-Independence (75 presidents in 55 years), hence its regimes became obsessed with state building and seized on the opportunities provided by the telegraph to establish order. Mexico's administrations perceptively exploited the railways' right of way earlier on and implemented a regulatory framework ahead of Argentina, thereby enhancing the necessary infrastructure build-out, in order to boost consumer demand for the telegraph and in turn support its diffusion rate. With regard to telephone diffusion, the Mexican governments' retention of some private-run elements during the nationalisation years aided the transition of the telecom company into state hands, rather than by a single event (as in Argentina). However, Argentina's administrations rapidly managed to reclaim significant lost ground during the years of privatisation, partly through the state's decision to form a duopoly. Ultimately, as the work of an

economic historian, it is obviously not the aim of the thesis to dismiss economic factors in the rationalising of historical fact, but rather to shed light on the fact that in the specific cases of the diffusion of these two ICTs in Argentina and Mexico, alternative mitigating factors (namely the role of the state) seem to provide greater understanding to the essential question posed by the thesis: what is the rationale behind the Paradox? Aided by a greater understanding of the political economy provided in chapter 1 and in greater appreciation of the actual diffusion processes of the two ICTs in each of the two countries presented in this chapter, it is possible in the next chapters to attempt to determine the main possible explanatory drivers of diffusion.

Chapter 4
A Quantitative and Qualitative Analysis of Diffusion

Chapters 1 and 3 placed the diffusion of the telegraph and the telephone in their historical, political and economic context. The aim of this chapter is to find the main drivers behind the relatively similar diffusion speeds in Argentina and Mexico, as per the analysis in chapter 2. The chapter re-visits some of the key potential drivers discussed in chapter 1. First a quantitative analysis is applied, using multiple regression analysis. It is imperative to note that although the regressions are useful in providing some numerical explanations or indications, the findings from the quantitative analysis need to be treated with care in light of the issues of data reliability (see the introduction to the appendices and appendix B for a detailed discussion). Second and most importantly for the purposes of this thesis, the second section of the chapter applied a more detailed qualitative analysis with particular focus on the role played by the state. Given the issues surrounding the data and the nature of the most important explanatory variables, there is a closer focus on the second half of the chapter. Overall, the chapter provides the basis from which to answer (in chapter 5), the three main research questions posed at the start of the thesis, namely: what were the main drivers behind the observed diffusion rates in Argentina and Mexico? What factors caused the 'Paradox'? And, to what extent can Mexico's experience with the diffusion of the two technologies be considered a 'Success Story'?

4.1 The Factors Behind the Rate of Telegraph and Telephone Diffusion

Chapter 1, section 1.5 Review of the Approaches to Different Rates of ICT Diffusion, demonstrated that there were many factors that can account for the relative speed of ICT diffusion for a given country over another. These were divided into four approaches (the economic, social, natural endowment and institutional approaches), and were subdivided further into those factors affecting consumer demand and those that affect the construction of the infrastructure. The same groupings are used here. There is a slight bias towards the economic factors, since the literature typically

focuses more heavily upon these.[1] However, these factors did not play their commonly overriding explanatory role in the two case studies under consideration, as will be shown.

The main economic factors that could drive telegraph and telephone diffusion and are accordingly included in the regression analysis are: the change in GDP per capita, population growth, urbanisation growth, investment and costs. GDP per capita (a proxy for income) is the most empirically tested economic variable, and theory predicts that a strong positive relationship between GDP per capita and the diffusion of the two ICTs should hold.[2] From a technology perspective, the effect of this should be stronger in the case of the telephone than the telegraph (given the greater individual cost of adoption). Having said this, it is expected that in the context of this thesis, the level of GDP per capita will not be the key explanatory variable, given that the diffusion of the two ICTs in Argentina and Mexico took place at similar rates despite different economic milieus (see chapter 1, section 1.1.1 The Economics of the Political Economy). This suggests that there may be other, more pertinent, factors that played a more prominent role in driving diffusion. Although one must acknowledge that over time it is likely that income plays a large role in understanding a given country's technological-economic history. Urbanisation and population growth are theoretically likely to play an important role in explaining ICT diffusion also, by affecting the development of the necessary infrastructure. A high degree of urbanisation provides the best environment for rapid telegraph/telephone diffusion in developing countries, as it is in these areas that infrastructure will develop first, as telecommunication companies give priority to the more profitable urban markets (vis-à-vis rural ones).[3] This is corroborated by Fischer and Carroll, who provide evidence that commercialisation in urban centres created an economic

[1] See for instance Rogers (1995), Griliches (1957), Mansfield (1961, 1963a, 1963b), Dekimpe et al. (1998), Antonelli (1993), Rouvinen (2006), Caselli and Coleman (2001), and Lücke (1993). Also see chapter 1, section 1.5.1 The Economic Approach.

[2] See Rogers (1995), Ahn H. and Lee M. H., 'An Econometric Analysis of the Demand for Access to Mobile Telephone Networks' *Information Economics and Policy* 11.3 (1999): 297-305, Gruber (2001), Gruber H. and Verboven F., 'The Evolution of Markets under Entry and Standards Regulation: The Case of Global Mobile Telecommunications' *International Journal of Industrial Organisation* 19.7 (2001): 1189-1212., - Madden G., Coble-Neal G. and Dalzell B., 'A Dynamic Model of Mobile Telephony Subscription Incorporating a Network Effect' *Telecommunications Policy* 28.2 (2004): 133-144, Milner (2006), Wallsten (2001a).

[3] Best and Maclay (2002). Indeed, this relationship is likely to be even stronger in developing countries and some studies acknowledge that there is rarely a negative relationship, thus providing further support for the hypothesis. Also see Canning (1998).

environment which served to incite faster telephone diffusion.[4] Argentina and Mexico are dominated by large cities.[5] This argument is closely linked to that of population growth, whereby more densely populated areas induce greater interaction, and again are often areas where infrastructure build-out is preferred. The changes in cost and in the level of investment directed towards the sector also are expected to explain the diffusion of the two technologies in part and are thus tested. The level of investment in particular is important as it dictates to a large extent the infrastructure build-out, hence a higher degree of investment should translate into faster diffusion.[7] A range of other economic factors which are deemed important within the literature were also tested in the regression analysis before ultimately being discounted.[8]

The main social factor tested for in the regression analysis was the historical living standard index (HLSI). HLSI is a common measurement of poverty and inequality.[9] Improved living standards should have a positive effect on the rate of diffusion of the two technologies. Social factors can play an important role in driving ICT diffusion from a consumer demand side perspective, by affecting the individual's ultimate decision on whether or not to adopt the new technology. This is an approach supported by many within the literature.[10] Although it was initially tested for, HLSI was not included in the final set of regressions, since there was apparently no correlation whatsoever in the year on year changes with the variation in the diffusion of the two technologies.

In terms of natural endowment factors, perhaps the most important for this thesis is country size. This is important because it affects the existing and future infrastructure

[4] Fischer and Carroll (1988). Also see Proenza et al. (2001), Morse (1974), and Wilkie (1984).
[5] However, if the rate of urbanisation growth is relatively constant the impact of this variable is likely to be less significant upon the regressions.
[7] See UNCTAD (1999), Dicken (2003), Soete (1985), Bell M. and Pavitt K., 'Technological Accumulation and Industrial Growth: Contrasts Between Developed and Developing Countries' in Archibugi D. and Michie J., *Technology, Globalisation and Economic Performance* Cambridge, Cambridge University Press (1997). Findlay (1978a), and Mayer J., 'Technology Diffusion, Human Capital and Economic Growth in Developing Countries' *United Nations Conference on Trade and Development Discussion Paper 154* (2001).
[8] This included the number of subscribers (network externality proxy), literacy rates, the length and density of lines and the number of telegraph offices.
[9] See Astorga et al (2004). This index accounts for both economic and social indicators by giving weights to GDP per capita, life expectancy, and the adult literacy rate, a methodology similar to the UN's Human Development Index, used by Crafts. See Crafts N., 'The Human Development Index, 1870-1999: Some Revised Estimates', *European Review of Economic History* 6.3 (2002): 395-405.
[10] For instance, Dekimpe et al. (1998, 2000a, 2000b), Gatignon and Robertson (1985), Gurevitch and Loevy (1972), Takada and Jain (1991), Gatignon et al. (1989), Bowden and Offer (1994), Hofstede G., *Culture's Consequences: International Differences in Work-Related Values* Beverly Hills, CA, Sage Publishers (1980), and Keida and Baghat (1988).

build-out. It is closely related to the population density argument. In theory smaller countries should experience faster ICT diffusion, as infrastructure build-out is easier and it is cheaper to provide service in a smaller, densely populated area, which is particularly important in developing countries.[11] Ultimately a country's size will affect the availability and accessibility of infrastructure and thus is expected to have an important impact. To evaluate country size, the regressions used population density, but ultimately this variable was left out of the final set of regressions.

As Milner and Duch's studies reveal, ICT diffusion was closely dependent upon political institutions.[12] Institutions are defined here in terms of formal rules, (e.g. statute, political system), and these rules in turn provide a governing framework within which individuals and organisations act.[13] Institutions therefore not only frame the incentives that can affect the actors' conduct, but also supply a relevant economic exchange framework.[14] Indeed, political players are believed to have an important role in explaining diffusion rates in Argentina and Mexico. As Brown reveals, it is the institutional factors that will influence the context in which a given technology is diffused, a view shared by Rosenberg, Henisz and Zelner, among others.[15] Arguably, institutions are particularly significant in developing and 'new' countries, such as the two under examination. Consequently, where possible, some measurement for certain institutional factors was included in the regression analysis.

Practically, institutions are 'the rules of the game in a society, or more formally, [the] humanly devised constraints that shape human interaction'.[16] There is much agreement on such a definition but no consensus on how to standardise measurement of institutional factors empirically.[17] Given that multiple regression analysis is able to

[11] Antonelli (1990), Canning (1998) and Fischer and Carroll (1988).
[12] Milner (2006), Duch (1991). Also see Andonova and Díaz-Serrano (2007), Bergara M., Henisz W. and Spiller P., 'Political Institutions and Electric Utility Investment: A Cross-Nation Analysis' *California Management Review* 40.2 (1998): 18-35, Esfahani and Ramirez (2003), Henisz and Zelner (2001), and Levy and Spiller (1996).
[13] World Bank, *Beyond the Washington Consensus: Institutions Matter* Washington D.C., The World Bank Latin American and Caribbean Studies (1998).
[14] North (1990), Meisel N. and Ould Aoudia J., 'A New Database for "Measuring" Institutions' *Trésor-Economics* 24 Paris, Treasury and Economic Policy General Directorate (2007).
[15] Brown (1981), Rosenberg (1970, 1972), Henisz and Zelner (2001). Also see Mokyr (2002), Wallsten (2001a, 2005), Bath C. R. and James D. D., 'The Extent of Technological Dependence in Latin America' in Street J. H. and James D. D., *Technological Progress in Latin America: The Prospects for Overcoming Dependency* Colorado, Westview Press (1979), Schuler and Brown (1999), and Milner (2006).
[16] North (1990), p.3.
[17] Woodruff C., 'Measuring Institutions' in Rose-Ackerman S., *International Handbook on the Economics of Corruption* Cheltenham, Edward Elgar Publishing (2006).

account only for quantitative explanatory variables, measuring qualitative variables, such as many institutional factors, is a common problem in the literature. The use of dummy variable regressors to measure institutions is a commonly accepted approach which allows the inclusion of qualitative explanatory variables in the model, thus increasing the range of application of the regression analysis. These proxies are crude measures, however, and thus the results must be examined with care. For instance, a dummy can account for the effect of privatisation (or nationalisation), by reducing the effect to a binary action, but this simply accounts for whether there was privatisation or not, and not for the extent or nature of it. This problem might become yet more complicated when measuring the degree of political stability, for instance. Nonetheless, despite these potential problems, some use of proxy indicators can provide the opportunity to examine the importance of some of these institutions empirically in the context of telegraph and telephone diffusion in the two countries. Although this is only done where it is reasonable to do so (whilst reducing statistical errors), greater accountability of the response variable can materially benefit the results of the study.[18] It is of no surprise that the measurement of political institutions is a perplexing pursuit for economists and requires the utmost care in assessment since they will typically aim to construct quantitative indicators, based on judgment. Even then the problem remains: unlike quantifiable measures of macroeconomics provided by national accounts, for instance, there is no such framework of consistency in examining institutions.[19]

Given the limitations of measuring institutional factors, only a few key ones were included in the regression analysis, where it was reasonably accurate to use dummy variables. Another typical danger to be aware of in the measurement of institutional factors is the fact that they can often be highly correlated, which thus increases the difficulty of the separating effect.[20] Such causes of concern were considered when carrying out the analysis. Government policies can exert a strong influence on subsequent technology diffusion. Consequently, key policies such the Mitre Law passed during the diffusion of the telegraph in Argentina were tested with the use of

[18] The institutional variables that were tested but excluded from the final regressions include the type of regime (e.g. democratic/military), the degree of legislative effectiveness and the effect of the line consolidation laws, for example.
[19] Meisel and Ould Aoudia (2007).
[20] Woodruff (2006).

a dummy variable. The rationale of its potentially significant role in explaining telegraph diffusion in Argentina can be found in chapter 3, section *Role of the State: The Impact of New Laws.* In developing countries in general, and certainly in the cases of Argentina and Mexico, successful diffusion depended on political activities.[21] These activities were a function of government perceptions, which is another issue that deserves further exploration since studies by Duch and Petrazzini show the significant effect they can have upon the diffusion process, as they will ultimately shape a country's system of property rights and regulation.[22] Moreover, they can determine to a large extent, both the capacity and ultimate success of a given administration's implemented reform.[23] The ramifications of these factors are further explored in the qualitative section of this chapter.

The market structure, the type of ownership and the degree of existing competition are amongst the most tested institutional variables since Mansfield's work.[24] As North and Williamson argue, investment in this type of infrastructure suffers from a number of market imperfections and consequently the government's role becomes even more important.[25] Government induced policies, such as the privatisation and nationalisation reforms (the former largely emphasised in the literature), are thought to play a leading role in the diffusion of the telephone in the two countries.[26] The impact of the privatisation reform was accounted for by a dummy variable, and is expected to be particularly important in the case of Argentina, where the rate of telephone adoption experienced a significant expansion during the years of privatisation (see chapter 3, section *The Period of Privatisation*). The impact of Mexico's unique telephone nationalisation reform also was tested with the use of a dummy variable but due to its gradual nature it is difficult to truly capture its effect in this way. The change in the number of telephone lines waiting to be installed was included also: one would expect that, as this number fell and telephone installation

[21] Henisz and Zelner (2001), Levy and Spiller (1996), Sidak and Spulber (1997), James (2000).
[22] Duch (1991), Petrazzini (1995).
[23] For instance see Kalathil and Boas (2003), Coe N. M., Helpman E. and Hoffmaister A. W., 'North-South R&D Spillovers' The Economic Journal 107.440 (1997): 134-149, Kedzie (1997).
[24] Mansfield (1961). Also see Wallsten (2001b, 2005), Ochoa-Morales (2004), Hollenstein (2004), Littlechild (1983), Foreman-Peck (1985), Milner (2006), Wilson (2004), and Coe et al. (1997).
[25] North (1990), Williamson (1988).
[26] As per the studies of Wallsten (2001a, 2005), Littlechild (1983), Cecchini S., 'Poverty, Inequality and New Technologies in Latin America' in Marshall S., Taylor W. and Yu X., *Encyclopaedia of Developing Regional Communities with Information and Communication Technology* Pennsylvania, Idea Group Reference (2006), and James (2000).

improved, faster diffusion followed, as individuals would be more prone to adopt the new technology if the whole process was easier and quicker, providing for a proxy for the quality of service.

After re-examining some of the primary drivers that can account for the rate of technology diffusion in a country, the focus now turns to the quantitative analysis.

4.2 Analysis of Diffusion – A Quantitative Approach

This section attempts to explain the factors behind the rates of telegraph and telephone diffusion in Argentina and Mexico, using multiple regression analysis. The factors outlined in the section above were tested to determine whether any of these were key drivers of the given diffusion rates in the two countries. It is imperative to reiterate that there are a number of limitations in relation to the data and hence the findings of the regression analysis must be read in conjunction with the qualitative findings that follow. As argued in the methodology in chapter 1 and in the introduction to the appendices, the data used is subject to various issues of reliability, particularly during the earlier period under coverage.[27] The main data sets were constructed from extensive field research, including substantial archive work and data collection from a number of institutions (e.g. standard sources such as statistical yearbooks from INEGI and INDEC, and national censuses). Nevertheless, this still does not guarantee the reliability of the data; with the accuracy of the censuses before the 1950s being the most questionable (see appendices B and C for the full sources and a critical review of the data). Moreover, the issues surrounding the data are also likely to reduce the likely '*r*' squared. Since the dependent variable is not biased, however, it is still reasonable to carry out the following analysis to test the significance of the right-hand variables and although the qualitative assessment will ultimately carry more analytical weight, a regression analysis in this instance is still useful in providing initial insights.

The regression analysis uses time series (or longitudinal) data, and relies on yearly data. This has clear advantages over cross-sectional data and is preferred for the purposes of this thesis since it is the process of diffusion that is measured, and time

[27] See chapter 1, section 1.7 Methodology. Also see the introduction in the appendices.

series data allows for the appropriate capture of this process, whereas cross-sectional data are purely one-dimensional (reflecting diffusion as a snapshot). A cross-sectional analysis had the potential to add detail to the country level findings (by treating each individual region within each country as an observation). However, this was not possible with any degree of accuracy, due to a lack of reliable data at the provincial level, particularly with respect to the years of the telegraph, making it impossible to provide meaningful generalisations. The regression analysis adopted the standard econometric technique of analysing the change in the dependent and explanatory variables (with the exception of the dummy variables), that is by looking at first differences. Additionally, a number of variables were lagged (by 3 years). It was necessary to do this to account for the impact of the time lags that some of the variables would have on the subsequent diffusion process. For instance, the impact of an increase in investment in the telecom sector should induce an increase in infrastructure, which should then increase diffusion, as consumers would benefit from a wider network. However, the infrastructure takes time to be constructed and therefore the positive effect upon diffusion will have an associated time delay. Additionally, the same set of regressions were run without the use of lags and the results remained unchanged (these are reported in footnotes). Further supplementary material to the telegraph regressions was provided by replicating the main set of regressions with alternative dependent variables to see if the results changed. Rather than the original left hand side variable of telegrams sent per 100 people, the growth of the network (in km) and the growth of telegram traffic on the network (calculated as telegram network size divided by the number of telegrams sent) were used. In both cases, no additional right-hand side variables proved to be statistically significant (the results are reported in footnotes). In the presentation of the findings, the figures shown below used rolling 3 year moving averages for each of the variables in order to smooth out the data and make the trends more easily observable.

The period examined in the regression analysis corresponds to the years of 10-90% diffusion (the period over which the characteristic rate of diffusion, CRD, was calculated), as determined by the FLOG model and linearisation techniques. The diffusion of the telegraph is examined first, followed by the telephone.

4.2.1 The Telegraph

For the regression analysis that follows, the potentially more important socio-economic and institutional explanatory factors over the relevant period of telegraph diffusion are identified and defined in table 4.1. The change in the numbers of telegrams sent per 100 people is the dependent variable used as a proxy for telegraph diffusion, and it is explained as a function of changes in income, urbanisation, etc. By taking the first differences of each of these socio-economic variables, the potential problem of partial correlations among the explanatory variables is avoided, hence providing a better regression analysis. For the change in GDP per capita, the change in urbanisation, the change in population and the change in budget, a 3 year lag was implemented, but this was not applied for the change in the cost of sending a telegram or for the dummy variables.[28] All of the factors in table 4.1 were tested in the regression analysis (see their descriptive statistics in table 4.2).

Table 4.1 Definitions of the Telegraph Diffusion's Main Explanatory and Dependent Variables

Type	Variable	Description	Notation	Unit
Dependent var. (LHS)	Telegrams per capita	Change in telegrams sent per 100	ΔTelegram	%
Institutional reform	Mitre Law	Impact of the Mitre Law	Mitre_law	(0,1)
Political institution	Porfiriato	Impact of the Porfirio Díaz regime	Porfiriato	(0,1)
Income wealth	Real GDP	Change in real GDP per capita	ΔGDP	%
Market potential	Urbanisation	Change in Urbanisation	ΔUrban	%
Market potential	Population	Change in Population	ΔPopulation	%
Cost	Telegram price	Change in cost of average telegram	ΔCost	%
Investment	Budget	Change in telegraph & postal budget	ΔBudget	%

Source: see appendix C for data sources.

[28] An increase in GDP per capita is a proxy for an increase in income, and the impact of this in further telegram diffusion is likely to take time since individuals will take time to save and use their disposable income in alternative ways such as through telegraph usage. Similarly, the impact of a change in urbanisation or population growth is likely to have a lagged effect, because it is in these areas that infrastructure tends to cluster; however, an increase in these variables will not see an instant impact on increased infrastructure. Moreover, the impact of a change in budget will take time to feed through the system before generating further infrastructure build-out. Alternatively, costs were not lagged, because a change in the cost of sending a telegram is likely to have an immediate effect upon consumption. Further, the dummy variables, which typically represent a period in time in regard to this analysis, were not lagged since they are accounting for a binary outcome.

Table 4.2 Telegraph Descriptive Statistics: Explanatory and Dependent Variables

	Argentina						Mexico					
	Date	N	Min	Max	Mean	S. Dev	Date	N	Min	Max	Mean	S. Dev
ΔTelegram	1891-16	26	-18.9	86.7	7.6	20.1	1881-07	27	-46.3	153.5	20.0	44.1
Porfiriato	n/a	n/a	n/a	n/a	n/a	n/a	1881-07	27	0	1	n/a	n/a
Mitre_law	1891-16	26	0	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
ΔGDP	1891-16	26	-21.2	15.8	2.4	9.0	1893-07	15	-8.1	10.0	2.7	3.8
ΔUrban	1891-16	26	-0.8	2.1	1.6	0.4	1881-07	27	-1.3	1.9	0.3	1.0
ΔPopulation	1891-16	26	0.2	4.8	3.4	0.8	1881-07	27	1.1	1.7	1.3	0.2
ΔCost	1896-16	21	-9.2	20.8	0.8	6.9	n/a	n/a	n/a	n/a	n/a	n/a
ΔBudget	1891-16	26	-51.9	67.6	10.1	19.7	1895-07	13	-12.5	19.1	7.0	8.7

Source: see appendix C for data sources. Note: data are presented as centred three year moving averages.

The descriptive statistics in table 4.2 show that, according to the differences in the means, Argentina's population grew on average at a faster rate than Mexico's. In terms of budget towards the sector, average growth rates over their respective 10-90% periods were also much higher in Argentina, but Argentina's rates also displayed greater volatility, indicated by a much higher standard deviation. The regression results look first at Argentina and then at Mexico.

Argentina: Telegraph Diffusion Regression Analysis

Argentina's initial telegraph regression results are presented in table 4.3. The explanatory variables in table 4.1 were all included. The final findings however showed that the Mitre Law was the only significant variable, and in line with the Mexican findings to come, provide little evidence in support of the socio-economic variables.

Table 4.3 Argentina's Telegraph Regressions with 3 Year Lags

Dependent variable: change in Argentina's telegrams sent per 100 people

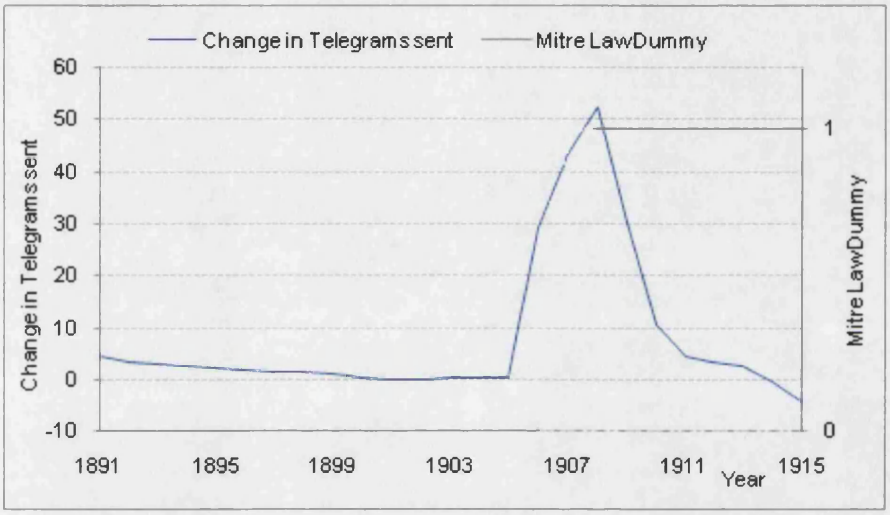
	(1)
Mitre_law	0.9 (8.8)
ΔGDP 3yLag	0.7 (0.6)
ΔUrban 3yLag	2.7 (10.6)
ΔPopulation 3y lag	13.0 (13.4)
ΔBudget 3y lag	0.5 (0.5)
ΔCost	0.6 (0.5)
Constant	-54.7 (49.1)
N	20
R^2 adjust	-0.01
D. W.	1.7

*Source: see appendix C for data. Note: standard errors in parentheses, *** sig. at 1%, ** sig. at 5% and * sig. at 10% level.*

Table 4.3 shows Argentina's telegraph regression, which tested for the main socio-economic factors and the most important institutional variable, that of the Mitre Law. It must be noted that all of the variables in the regressions that include the Mitre Law, have been run without a reading for 1907. Since the Mitre Law was introduced late in 1907 (in October), it is not clear whether this dummy variable should begin with an effect in 1907 or 1908. Econometrically having 1907 = 0 or 1907 = 1 is problematic and therefore the only safe solution is to delete it. The results of this initial regression showed all the variables; the change in GDP per capita, the change in urbanisation, the change in population, the change in the government's budget, the change in the average cost of sending a telegram, and the Mitre Law were all found to be insignificant factors in explaining Argentina's change in telegrams sent (i.e. telegraph diffusion). To some extent these findings are surprising, given the emphasis placed within the literature on some of these factors. Theoretically one would expect to have found a higher degree of correlation between some of these variables: for instance, an increase in urbanisation is likely to have a positive impact on diffusion due to a higher degree of infrastructure clustering (hence a more accessible network). Although some of these results may be a potential consequence of the inherent limitations of the collected data, especially in the latter part of the nineteenth century (see the introduction to the appendices and appendix C for an evaluation of the data, and details on the specific limitation of each of the sources

used). Given these findings, it is useful to look at the variables in more detail, factor by factor, to assess whether the regression findings hold. Note that the presentation of graphs throughout this section applies a rolling 3 year moving average in order to identify the main trends more easily.

Figure 4.1 Change in Argentina's Telegrams Sent (3 Year Moving Averages) and the Impact of the Mitre Law



Note: as explained, the year 1907 was omitted from the regressions.

Figure 4.1 shows reasonable correlation of the Mitre Law with the diffusion of telegrams in Argentina. The Mitre Law seems to have materially impacted diffusion, as there was no significant increase in the number of telegrams sent between 1892 and 1907, since the market was largely stagnant. After the law's introduction, the number of telegrams sent increased significantly, specifically by 167% from 1906 to 1908; although the graph obviously does not show the full extent of this, given the adoption of rolling 3 year moving averages, the increase in the number of telegrams sent is still appreciable.

Figure 4.2 Change in Argentina's Telegrams Sent and Change in GDP per capita (3 Year Moving Averages)

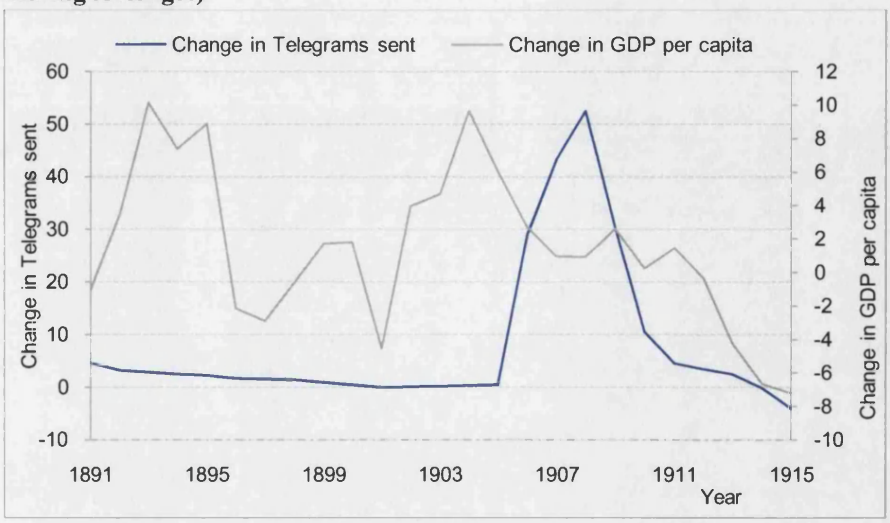


Figure 4.2 shows that the change in GDP per capita was not correlated with the change in the telegrams sent. Although there seems to be a modicum of correlation for the most latter period of diffusion, specifically from around 1909 onwards, this does not hold for the majority of period under examination. For instance, in the years between 1894 and 1905 there is almost no change in the number of telegrams sent compared to quite large variations in the rolling 3 year moving average for the change in GDP per capita. The rationale for the seeming lack of explanatory power in the change in GDP per capita is an argument that closely follows that of the cost of sending a telegram. Since it was relatively small, and given the absence of fixed costs for the user in consuming the technology, the impact of a change in income seemingly did not have a large effect upon the increased usage of the technology.

Figure 4.3 Change in Argentina's Telegrams sent and Change in Urbanisation (3 Year Moving Averages)

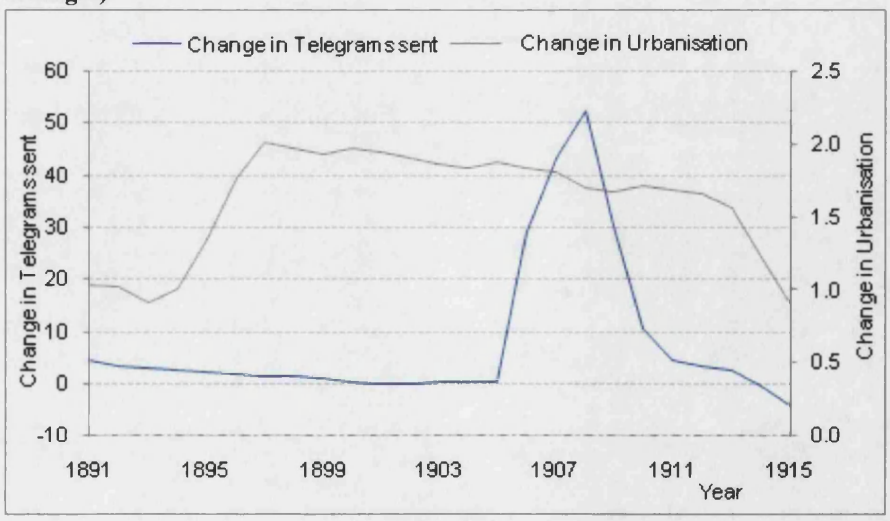


Figure 4.3 shows a clear lack of correlation between the change in urbanisation and the change in telegrams sent. It must be noted, however, that urbanisation is one of the variables that one must take particular care with, in terms of appreciating its reliability seemingly since there is a larger reliance on extrapolation techniques in the data collection methods of this earlier period of study (see appendix C, table C.1).

Figure 4.4 Change in Argentina's Telegrams Sent and Change in Population (3 Year Moving Averages)

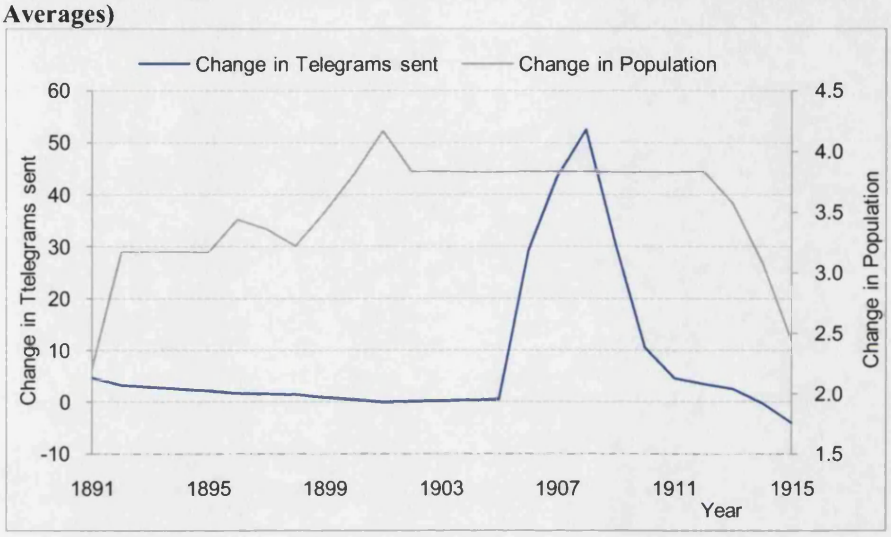


Figure 4.4 shows something similar to the depiction of urbanisation, there is clear lack of correlation between the change in population and the change in telegrams sent. Although the relationship again seems to hold better towards the latter part of the period, for the majority of years under consideration, there is little consistency. One should appreciate the fact, however, that the only 'rigorous' count of the population was done on the census years only, hence all estimates in between are typically estimates, which is potentially one reason why there is not a great deal of large changes in population data. Having said that, historically year on year population changes are rarely particularly volatile series' (again refer to appendix C for full data disclosure).

Figure 4.5 Change in Argentina's Telegrams Sent and Change in Budget (3 Year Moving Averages)

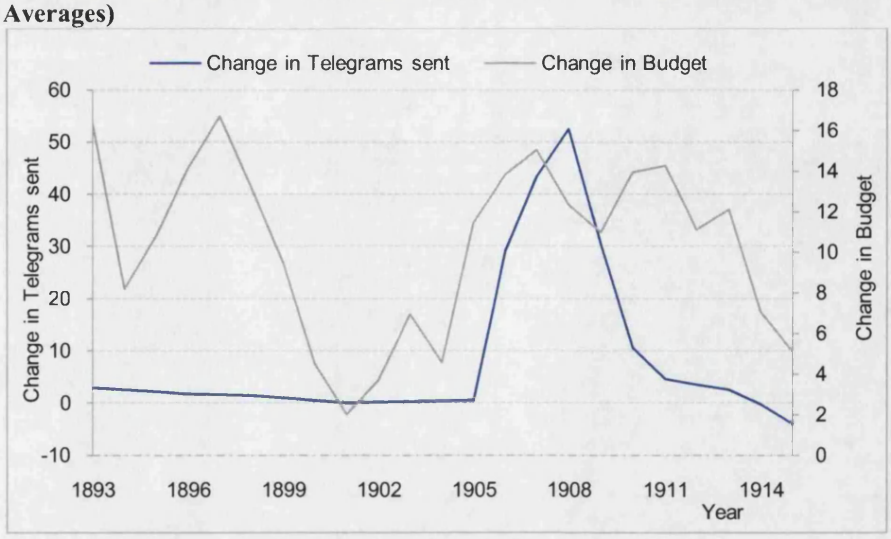


Figure 4.5 shows that, although there are some short periods of relatively strong correlation (namely 1904-1906 and 1912-1914), for the whole period there is a general lack of correlation between the changes in the number of telegrams sent and the government budget for the sector. Although one would expect a strong positive correlation throughout, there was seemingly no consistency in the trend, as a relatively unchanged number of telegrams sent for the first 12 years or so, sees large shifts in the change in budget.

Figure 4.6 Change in Argentina's Telegrams Sent and Change in the Average Real Cost of a Telegram (3 Year Moving Averages)

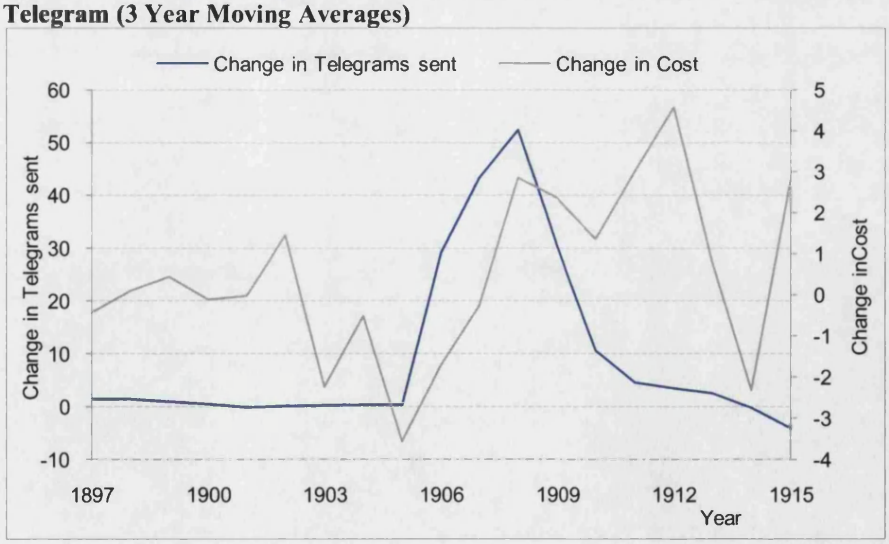


Figure 4.6 shows that, although, again there are some periods of relative correlation, this does not hold for the whole period. The seeming lack of correlation between the

change in the number of telegrams sent and the change in the cost of sending them suggests that individuals were partly price insensitive; high prices apparently did not act as a barrier to further diffusion.

Overall, figures 4.3 – 4.6 corroborate to some extent the finding in the regression of table 4.3, in that the socio-economic factors tested for, were not particularly closely correlated with the number of telegrams sent in Argentina throughout the period. The only variable for which the graphs potentially indicate relatively higher correlation is in regard to the dummy variable of the Mitre Law. This is therefore tested for in isolation in regression 1 of table 4.4. Some of the other socio-economic variables were also re-tested for completeness, but I did not expect these to be significant in light of the graphs presented above.

Table 4.4 Argentina's Telegraph Regressions with 3 Year Lags

Dependent Variable: Change in Argentina's Telegrams sent per 100 people

	(1)	(2)	(3)	(4)
Mitre_law	8.5* (4.9)	8.5 (5.3)	9.0 (5.5)	
ΔGDP 3yLag		0.2 (0.3)	0.2 (0.3)	
ΔUrban 3yLag		0.8 (6.3)		
ΔPopulation 3y lag			-0.6 (3.3)	
ΔBudget 3y lag				
ΔCost				
ΔGDP_Mitre 3y lag				-1.3 (2.5)
Constant	1.4 (2.9)	-0.3 (10.2)	2.9 (11.2)	7.8* (4.0)
N	25	25	25	26
R^2 adjust	0.08	0.08	0.01	-0.03
D. W.	1.6	1.7	1.7	1.4

*Source: see appendix C for data. Note: standard errors in parentheses, *** sig. at 1%, ** sig. at 5% and * sig. at 10% level.*

Regression 1 tested for the effect of the Mitre Law in isolation, and as expected, was significant. Regression 2 tested for the Mitre Law, the change in GDP per capita, and the change in urbanisation (given their significance within the literature). Regression 2 demonstrated that, none of the variables were significant. Regression 3 ran the same variables but substituted change in urbanisation for change in population growth, and again nothing was significant. The last regression, regression 4, tested

for an interaction variable (between the change in GDP per capita and the Mitre Law), given that figure 4.2 showed a relatively closer relationship between the change in GDP per capita and telegraph diffusion for the specific period after the introduction of the Mitre Law. The interaction variable was not significant, however.[29]

Regression 1 was found to be the 'best' regression: accounting for 8% of the variation in Argentina's telegraph diffusion during the years 1891-1916.[30] This regression suggests that Argentina's telegraph diffusion was statistically best explained by the introduction of the Mitre Law. This finding is aligned with my initial expectations and the graphical representation of the data given above.

The regression coefficient suggests that, on average, there was an increase of 8.5% in telegrams sent, following the implementation of the Mitre Law, compared to the previous years. The immediate impact of the Mitre Law can be best understood by referring to chapter 3, section *The Role of the State: The Impact of New Laws* within the years of telegraph expansion. Since the Mitre Law stipulated that the railways' telegraph lines had to be connected to the national telegraph network, there was an immediate improvement in network coverage, as more useful commercial hubs were connected despite limited immediate growth in the length of the telegraph network.[31] Meanwhile, the Mitre Law had a larger infrastructural impact over a longer period of time, as Argentina's national telegraph system expanded significantly, in line with the ongoing railway boom, especially during the first 4-5 years after the introduction of the law. Therefore, the law resulted in the direct physical expansion and interconnection of the telegraph network which had the knock-on effect of inducing an increase in the number of telegrams being sent; as it became easier and more advantageous to send telegrams due to the larger, wider reaching network.

[29] Additional regressions were run using no lags and in all cases the results were the same, with all variables (excluding the Mitre Law dummy variable) showing no statistical significance. Similarly, two new sets of regressions were run: one used capacity utilisation (total number of telegrams sent divided by the national telegraph network) as the dependent variable, and the second set used the total length of the national telegraph network (lines in km) as the dependent variable. Both of these supplementary sets of regressions were consistent with the findings in the main regression, as no other variables were found to be statistically significant.

[30] The regression is statistically robust and there is no cause for concern with regard to multicollinearity or autocorrelation, since the final regression only accounts for one variable. The normality of the distribution was verified visually.

[31] This was supported further by the tariff unification program which began in 1907.

Mexico: The Telegraph Diffusion Regression Analysis

The results of Mexico's telegraph regression are presented in table 4.5. All the explanatory variables of table 4.1 were included at some stage. Overall, the regression findings showed that none of the socio-economic factors (or the Porfiriato dummy variable) that were modelled in the regressions were significant in explaining the rate of telegraph diffusion in Mexico. This is an interesting finding, as it suggests that other factors were responsible, factors such as the role of political institutions, which is explored in the qualitative approach later in the chapter.

Table 4.5 Mexico's Telegraph Regressions with 3 Year Lags

Dependent variable: Change in Mexico's telegrams sent per 100 people		
	(1)	(2)
Porfiriato	-2.9 (82.9)	
ΔGDP 3yr lag		0.6 (1.6)
ΔUrban 3yr lag	-12.5 (11.3)	12.1 (9.7)
ΔPopulation 3yr lag	12.5 (61.5)	-21.0 (32.0)
ΔBudget 3yr lag		
Constant	-2.9 (82.9)	26.8 (40.5)
N	27	15
R^2 adjust	-0.06	-0.10
D. W.	2.0	2.7

*Source: see appendix C for data. Note: standard errors in parentheses, *** sig. at 1%, ** sig. at 5% and * sig. at 10% level .*

Table 4.5 shows Mexico's main telegraph regressions, testing for the primary socio-economic factors and the most important institutional variable. The variable accounting for the change in the government's budget was not included in these initial regressions since this would have reduced the initial sample size even further; consequently it was accounted for at a later stage. Regression 1 tested for the impact of the Porfiriato, the change in urbanisation and the change in population. A further second regression was included to test for the effect of a change in GDP per capita. Regression 2 carried over the variables from regression 1 but, due to the lack of a full sample for the GDP per capita variable, the Porfiriato dummy variable could not be included in this regression (since it would have been constant through the testable period). The results of these initial regressions found that all the variables were statistically insignificant. This was somewhat surprising because of the findings in

the wider literature, although part of this rationale may be due to the limitations of the data, as described above, given that this earlier period was more prone to potential data reliability issues (see appendix C). Given these findings, it is useful again to look at the variables in more detail, factor by factor, to see whether the regression findings held.

Figure 4.7 in Mexico's Telegrams Sent (3 Year Moving Averages) and the Impact of the Porfiriato

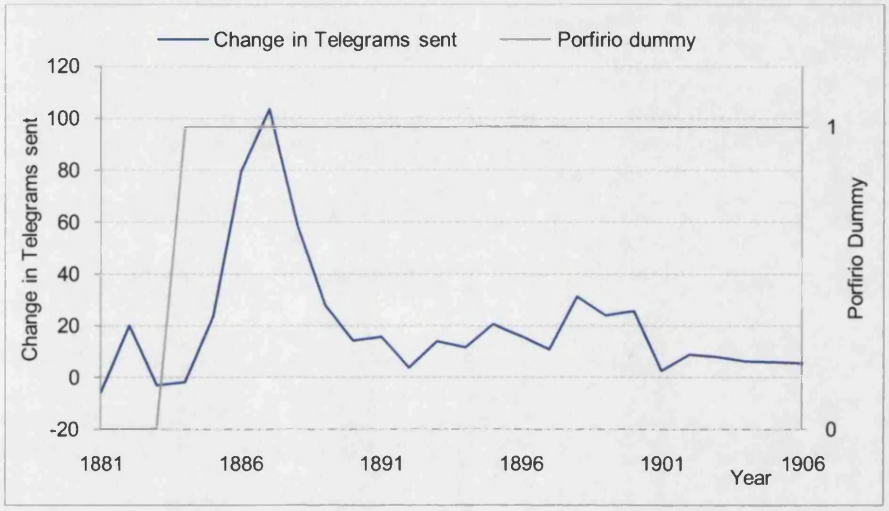


Figure 4.7 potentially shows that the Porfiriatio had a positive effect on the diffusion of the telegraph in Mexico, as this was accompanied by an increase in the number of telegrams sent. As will be argued in chapter 5 (see section 5.1 The Rates of Diffusion in Argentina and Mexico), Porfirio Díaz continually sought (once in power) to expand the telegraph network (and in turn promote diffusion), hence one would expect that his regime had a positive effect on further diffusion.

Figure 4.8 Change in Mexico's Telegrams and Change in GDP per capita (3 Year Moving Averages)

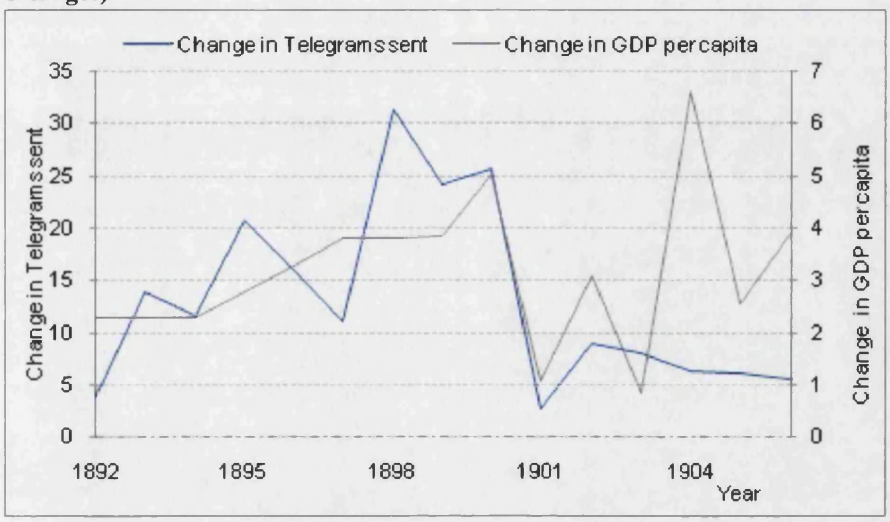


Figure 4.8 shows a lack of correlation between the change in GDP per capita and the change in telegrams sent, for the overall period under consideration. For a couple of years the change in GDP per capita and the change in the number of telegrams sent were relatively strongly positively correlated (especially immediately before 1901), but this was not true for most years under consideration, particularly toward the latter part of the period, where relatively large increases in GDP per capita were accompanied by very small changes in telegrams sent. The apparent lack of correlation between the two variables may be explained by the fact that telegraph use was relatively cheap, as explained earlier. Therefore, individuals did not have to be particularly wealthy to send a telegram once in a while. Similarly, perhaps they simply did not even want to send more telegrams, as a lot of people lived near their acquaintances and had a limited need to communicate frequently via this technology. Consequently it is not entirely surprising that an increase in GDP per capita did not translate into an increase in the number of telegrams sent.

Figure 4.9 Change in Mexico's Telegrams Sent and Change in Urbanisation (3 Year Moving Averages)

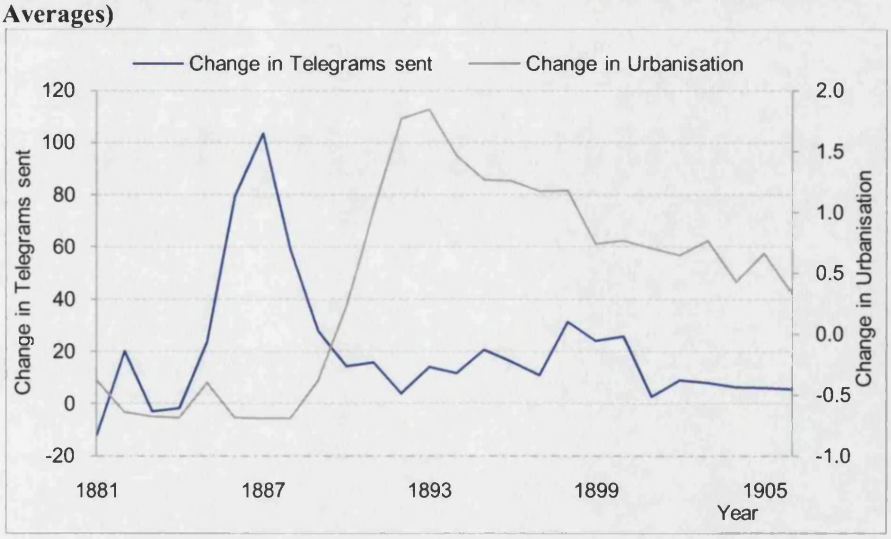


Figure 4.9 shows a lack of correlation between the changes in urbanisation and in telegrams sent for most of the period under consideration, with relatively little change in urbanisation occurring in any year. As in the Argentina section above, the reliability of the urbanisation data during this early period was slightly problematic, as even official bodies were forced into quite extensive use of interpolation in order to fill in reasonably substantial gaps in the official data collection (see appendix C). Despite this, it is clear that there is no correlation with the telegram data.

Figure 4.10 Change in Mexico's Telegrams Sent and Change in Population (3 Year Moving Average)

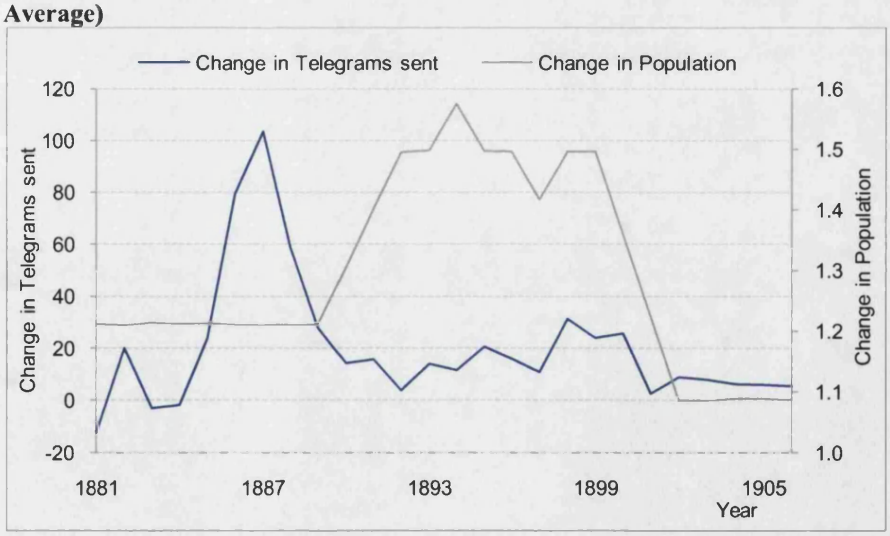


Figure 4.10 shows a lack of correlation between the change in population and the change in telegrams sent for the whole period. Again as in the case of Argentina, and

as with the urbanisation data, one needs to be particularly careful with the population data during this period, as there is extensive interpolation (see appendix C), but again the lack of correlation is apparent.

Figure 4.11 Change in Mexico's Telegrams Sent and Change in Budget (3 Years Moving Average)

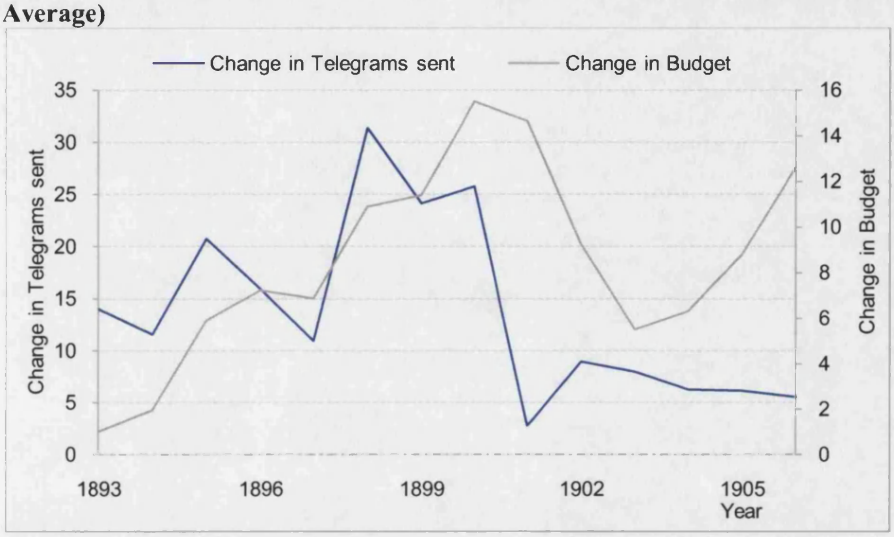


Figure 4.11 shows a seeming lack of correlation between the change in the government's budget towards the telegraph sector with the change in the telegrams sent in Mexico; and there is even a counter-intuitive negative correlation in parts. Indeed in some of the years in which there was a big increase in the budget, there were some of the smallest increases in diffusion; for instance in 1901 the budget increased by over 14%, while the change in the telegrams sent grew by under 3% on a year on year basis.

Figures 4.7 – 4.11 corroborate to some extent the findings in the regressions of table 4.5, in that the socio-economic factors tested for, were not particularly closely correlated with the number of telegrams sent in Mexico throughout the period. The only variable for which the graphs potentially indicate relatively higher correlation with telegraph diffusion is in regard to the dummy variable of the Porfiriato. This is therefore tested for in isolation in regression 1 of table 4.6. Some of the other socio-economic variables were also re-tested for completeness, but again I did not expect these to be significant in light of the graphs presented above.

Table 4.6 Mexico's Telegraph Regressions with 3 Year Lags

Dependent variable: Change in Mexico's telegrams sent per 100 people

	(1)	(2)	(3)
Porfiriato		-0.1 (27.5)	
ΔGDP 3yr lag	0.5 (1.5)		
ΔUrban 3yr lag			
ΔPopulation 3yr lag			
ΔBudget 3yr lag			-1.1 (0.7)
Constant	11.0 (7.1)	20.1 (21.0)	20.6** (7.5)
N	15	27	13
R^2 adjust	-0.07	-0.04	0.12
D. W.	2.6	1.9	2.6

*Source: see appendix C for data. Note: standard errors in parentheses, *** sig. at 1%, ** sig. at 5% and * sig. at 10% level .*

The results in the regressions in table 4.6 remained consistent with those of the earlier regressions in table 4.5, as no variables were found to be significant. Regression 1 tested for the impact of the Porfiriato in isolation. It is surprising that the Porfiriato dummy variable was insignificant, since Porfirio Díaz placed significant emphasis on the development of the new technology. However it is likely that this is a result of the difficulty in using a dummy variable over this period to capture the real effect. Porfirio Díaz was in power for two terms during telegraph diffusion and even when out of office he worked on building out the network.[32] When not president, Porfirio Díaz was the Minister of Public Works, which meant that he remained in charge of the telegraphs. Hence when he returned to office in 1884, his work with the telegraph network already had been under way for eight years. Therefore, the lack of statistical significance is partly due to the difficulty in accounting for such a variable, it does not mean that his role was not important, but rather highlights further the need for a complementary qualitative assessment. Regressions 2 and 3 tested for the effect of the change in GDP per capita, and the change in budget, respectively, each in isolation, given their perceived importance. As expected, these remained insignificant.

[32] This was rooted in his pursuit of national unification and state consolidation, as explored in chapter 3, section 3.1 The History and Development of the Electric Telegraph: The Argentinian and Mexican Experiences.

Mexico's regression analysis showed that none of the factors that were modelled in the regression framework were significant. [33] The seeming lack of statistical significance among these variables can be partly explained by the limitations of the data, as indicated earlier. It is necessary to bear in mind that there are some important issues regarding the validity and shortcomings of the data for Argentina and Mexico, particularly during the late nineteenth century (see the introduction to the appendices and appendix C for a detailed description). Despite this, econometrically, the regression results for both countries were unexpected, with no socio-economic variables proving to be significant, and the graphs supported this. These results serve to highlight further the importance of the political economy, which was anticipated to be the key driving theme of ICT diffusion, a theme which will take on increasing importance and focus of discussion, as the thesis progresses.

4.2.2 The Telephone

In quantitatively assessing the rates of telephone diffusion in Argentina and Mexico for the period of 10-90% diffusion, the potentially more important socio-economic and institutional explanatory factors were listed in table 4.7. The change in the number of telephones per household is to be explained as a function of changes in income, urbanisation, etc. By taking the first differences of each of the variables, the potential problem of partial correlations among the explanatory variables is avoided, hence allowing for better regressions. Once again, 3 year lags were used for: the change in GDP per capita, the change in urbanisation, the change in population growth and the change in investment, while the change in lines waiting to be installed and the dummy variables were not lagged.[34] All of the factors from the table

[33] Additional regressions were run using no lags and in all cases the results were the same: with no variables showing any statistical significance. Similarly, two new sets of regressions were run: one used capacity utilisation (total number of telegrams sent divided by the national telegraph network) as the dependent variable, and the second set used the total length of the national telegraph network (lines in km) as the dependent variable. Both of these supplementary set of regressions were consistent with the findings in the main regression, as no other variables were found to be statistically significant.

[34] An increase in GDP per capita is a proxy for an increase in income, and the impact of this in further telephone diffusion is likely to take time since individuals will take time to save and use their disposable income in alternative ways. Similarly, the impact of a change in urbanisation or population growth is likely to have a lagged effect, because it is in these areas that infrastructure tends to cluster; however, an increase in these variables will not see an instant impact on increased infrastructure. Moreover, the impact of a change in investment will take time to feed through the system before generating further infrastructure build-out. Alternatively, the change in lines waiting to be installed was not lagged, because it is likely to have a more immediate effect upon consumption. Further, the dummy variables, which typically represent a period in time in regard to this analysis, were not since they are accounting for a binary outcome.

below were subsequently tested in the regression analysis that follows (see their respective descriptive statistics in table 4.8).

Although the privatisation reforms were key drivers of telephone diffusion in both countries, I believe the impact was more decisive in Argentina. In Mexico, although the effect of privatisation was important, the impact of the nationalisation with 'private flavour' was more important. Telmex's particular form of nationalisation offered the telephone company government support but left it privately run in essence, thus it was run relatively more efficiently (vis-à-vis the fully nationalised ENTel). As a result, although the privatisation dummy was tested in Argentina's regression, the nationalisation reform was the tested dummy of choice in Mexico. Privatisation was clearly also important in the case of Mexico's telephone diffusion, but both reforms could not be tested for as dummy variables, as one dummy reflects the absence of the other, i.e. the whole period is split entirely between these two reforms.

Table 4.7 Definitions of the Telephone's Diffusion Main Explanatory and Dependent Variables

Type	Variable	Description	Notation	Unit
Dependent var. (LHS)	Telephone Handsets	Change in telephone handsets per 100 households	ΔTelephones	%
Institutional reform	Privatisation	Argentina's privatisation reform	Privatisation	(0,1)
Institutional reform	Nationalisation	Mexico's nationalisation reform	Nationalisation	(0,1)
Income wealth	Real GDP	Change in real GDP per capita	ΔGDP	%
Market potential	Urbanisation	Change in % of urban population	ΔUrban	%
Market potential	Population	Change in population growth	ΔPopulation	%
Quality service	Waiting lines	Change in waiting lines for installation	ΔWait_lines	%
Investment	Investment	Change in telecom investment, real terms	ΔInvestment	%

Source: see appendix C for data sources.

Table 4.8 Telephone Descriptive Statistics: Explanatory and Dependent Variables

	Argentina						Mexico					
	Date	N	Min	Max	Mean	S. Dev	Date	N	Min	Max	Mean	S. Dev
ΔTelephones	1943-97	55	-5.8	12.4	2.7	4.1	1945-97	53	-15.6	13.1	5.5	4.3
Privatisation	1990-97	55	0.0	1.0	n/a	n/a	1990-97	n/a	n/a	n/a	n/a	n/a
Nationalisation	1947-89	n/a	n/a	n/a	n/a	n/a	1947-89	53	0.0	1.0	n/a	n/a
ΔGDP	1943-97	55	-8.0	9.5	1.4	4.8	1945-97	53	-6.5	7.5	2.3	2.9
ΔUrban	1947-97	55	0.2	1.3	0.7	0.3	1945-97	53	0.7	1.9	1.4	0.4
ΔPopulation	1947-97	55	1.3	2.6	1.7	0.3	1945-97	53	1.8	7.1	2.8	0.8
ΔWait_lines	1976-97	22	-77.7	57.5	-6.7	31.8	1976-97	22	-64	74.5	4.7	34.3
ΔInvestment	1985-97	13	-11.2	235.3	23.9	67.4	1979-97	19	-36.5	76.4	16.6	34.5

Source: see appendix C for data sources. Note: data are presented as centred three year moving averages.

From table 4.8, according to the difference in the means, Mexico clearly had on average higher GDP per capita growth for the period under consideration (although lower absolute GDP per capita levels). Mexico was also ahead on several other fronts, with on average faster urbanisation and population growth. In terms of investment, although growth rates were high in both countries, the growth of investment directed towards the sector was on average higher in Argentina. The regression results look first at Argentina and then at Mexico.

Argentina: Telephone Diffusion Regression Analysis

Argentina's telephone regression results are presented in table 4.9. The explanatory variables from table 4.7 were all included at some stage. Theoretically Argentina's regression would include all of these explanatory variables. The findings highlight the specific importance of the privatisation reform, and as in Mexico's findings to come, again the socio-economic variables were insignificant.

A theme that emerged is that during the period of nationalisation which largely dominated the 10-90% diffusion period, ENTel's telephone provision was so poor that the usual socio-economic factors that would be expected to drive diffusion did not have a meaningful impact. Only once the privatisation reform was implemented does one observe any of the 'expected' results with regard to the economic drivers positively impacting diffusion, namely the change in GDP per capita. This highlights

the importance of institutions; since diffusion was seemingly, to a certain extent, constrained by the poor quality of service provided under government control.

Table 4.9 Argentina's Telephone Regressions with 3 Year Lags

Dependent Variable: Change in Argentina's Telephone Handsets per 100 households		
	(1)	(2)
Privatisation	5.6***(1.6)	7.3***(1.5)
ΔGDP 3ylag	-0.05 (0.1)	-0.02 (0.1)
ΔUrban 3ylag	-0.7 (1.7)	
ΔPopulation 3ylag		4.7**(2.0)
ΔWait_lines		
ΔInvest 3ylag		
ΔGDP_Priv 3ylag		
	2.5*(1.4)	-6.1 (3.5)
Constant	55	55
N	0.22	0.29
R2 adjust	1.4	1.7
D. W.	(1)	(2)

*Source: see appendix C for data. Note: Standard errors in parentheses, *** sig. at 1%, ** sig. at 5% and * sig. at 10% level.*

Table 4.9 displays Argentina's initial telephone regression (regression 1) which tested for the main socio-economic factors and the most important institutional variable, that of privatisation. The variables accounting for the change in investment, and the change in lines waiting to be installed were left out of this initial set of regressions since they reduced the initial sample size significantly (by over half), and are considered later (in table 4.10). Regression 2 ran the same variables as regression 1, but using population growth instead of urbanisation. The change in urbanisation and the change in population could not be simultaneously included in the same regression because they are too closely inter-correlated (see figure 4.11).

Figure 4.12 Correlation Between the Change in Urbanisation and the Change in Population (3 Year Moving Averages)

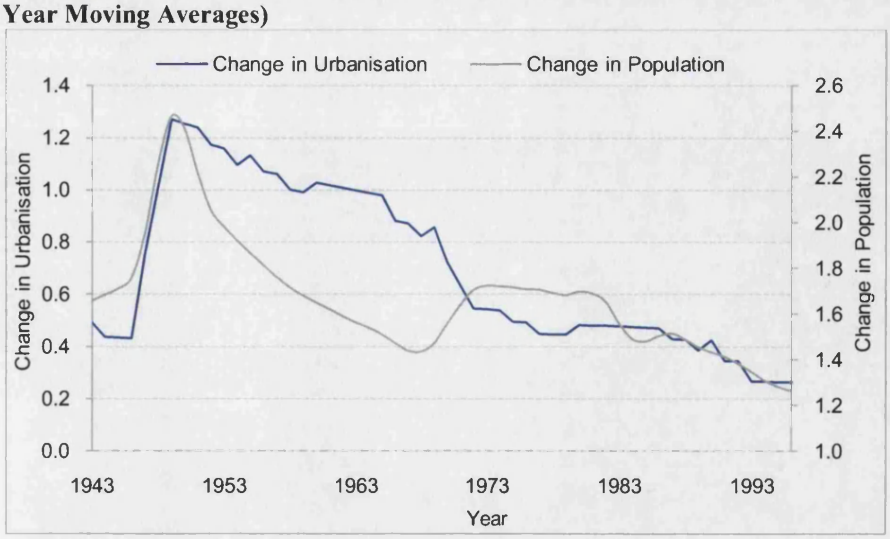


Figure 4.12 shows that there is a very close correlation between the change in urbanisation and the change in population (r = 0.6). This means that to avoid multicollinearity both variables cannot be included in the same regression.

The results of these initial set of regressions showed that the privatisation reform and the change in population were the only significant variables, while all the other factors were found to be insignificant. These findings are at some level surprising, given the emphasis in the literature on some of the other factors. Theoretically one would expect to have found an increase in GDP per capita for instance to have a positive impact on diffusion, as individuals can more easily afford to adopt the new technology. Similarly, an increase in urbanisation would be expected to have a positive impact on diffusion due to a higher degree of infrastructure clustering. The lack of significance among some of these variables may be in part a result of the inherent limitations with some of the data (see introduction to appendices and appendix C for a critical evaluation of the data). Given these findings, it is useful to look at the variables in more detail, factor by factor, to see whether the regression findings hold.

Figure 4.13 Change in Argentina's Telephones per Household (3 Year Moving Average) and the Impact of Privatisation

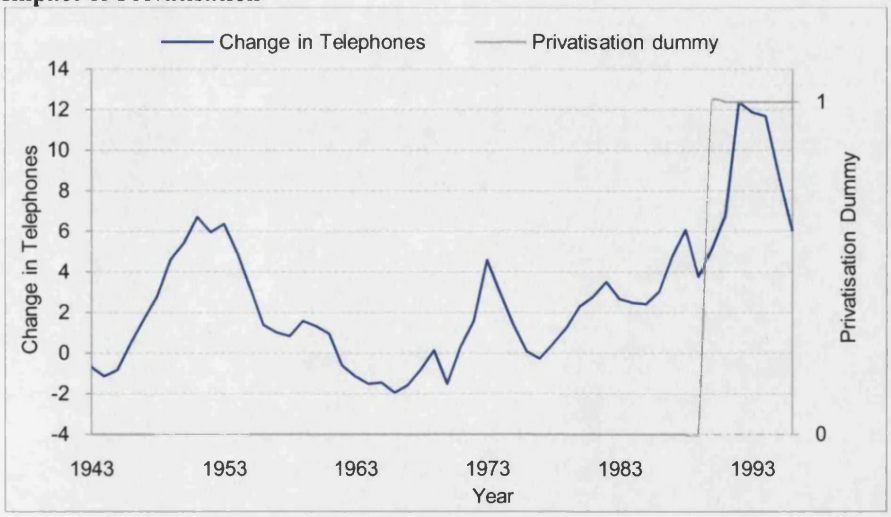


Figure 4.13 reveals a reasonably strong correlation between privatisation and telephone diffusion in Argentina. The figure shows that the largest increases in the change in the number of telephones per household happened after the implementation of privatisation. The positive impact of privatisation is largely in line with my initial expectations, as well as the research of Wallsten.[35] Further, the initial findings from the regressions in table 4.9 also support this.

Figure 4.14 Change in Argentina's Telephones per Household and Change in Real GDP per capita (3 Year Moving Averages)

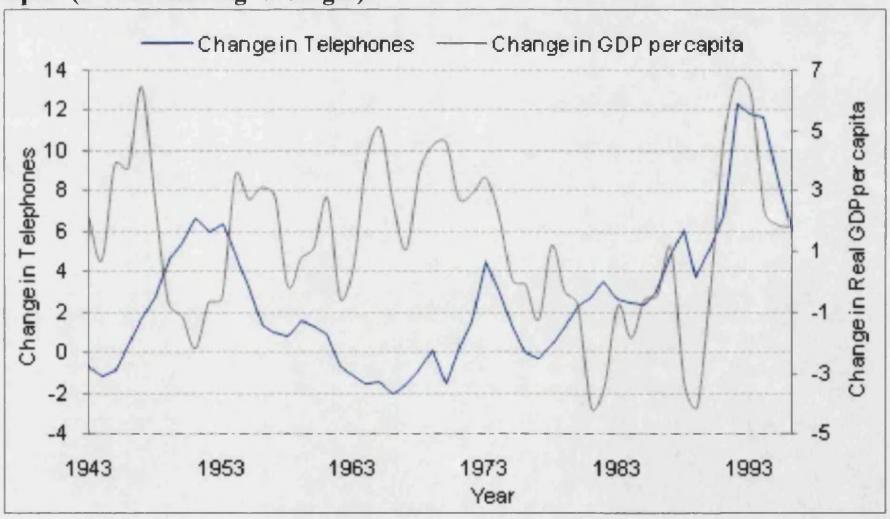


Figure 4.14 shows that although GDP per capita was seemingly closely correlated with the change in telephones from the early-1990s, this relationship does not hold for the previous decades. In fact, there almost seems to be evidence of suppressed

[35] Wallsten (2001a, 2005). Also see Littlechild (1983), Cecchini (2006).

demand during the 1960s and 1970s, so that by the 1980s, despite falls in GDP per capita, the number of telephones continued to increase and only in the 1990s can one see a straightforward economic story, by which time an increase (decrease) in GDP per capita was accompanied by an increase (decrease) of similar proportion in telephone diffusion, as the literature suggests. This suppression of diffusion may be explained in part by the fact that ENTel was under complete state control during 1946-1990, and was characterised by poor quality of service, due to the highly politicised environment in which it operated (see chapter 3, section *The Period of Nationalisation*).[36]

Figure 4.15 Change in Argentina's Telephones per Household and Change in Urbanisation (3 Year Moving Averages)

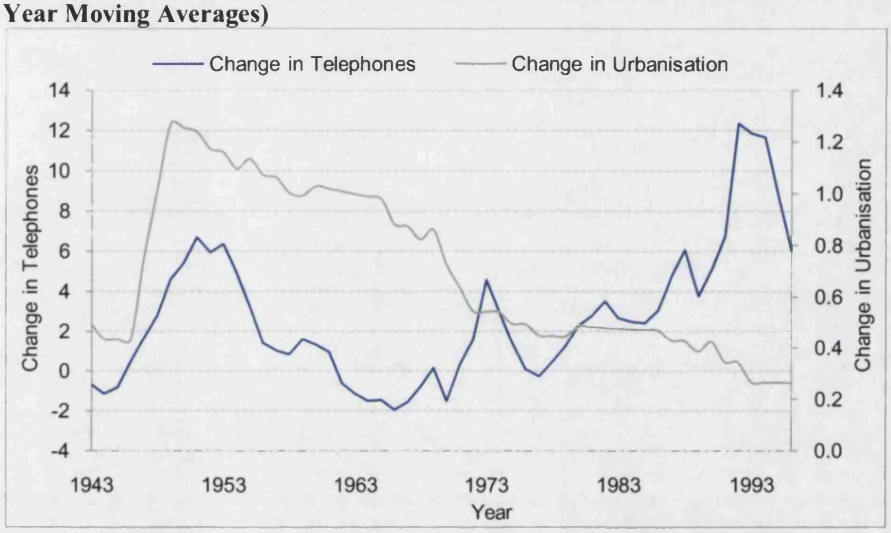


Figure 4.15 shows a lack of close correlation between the changes in urbanisation and telephone diffusion, which is in line with the findings of the regression in table 4.9. This may be explained partly by the fact that at the start of the period under consideration, Argentina was already heavily urbanised, with more than three in five people living in an urban area. Thus it is hard to imagine that further increases in urbanisation would be particularly powerful drivers of further telephone diffusion.

[36] This argument is supported by Cook (1999) and Petrazzini (1995).

Figure 4.16 Change in Argentina's Telephones per Household and Change in Population (3 Year Moving Average)

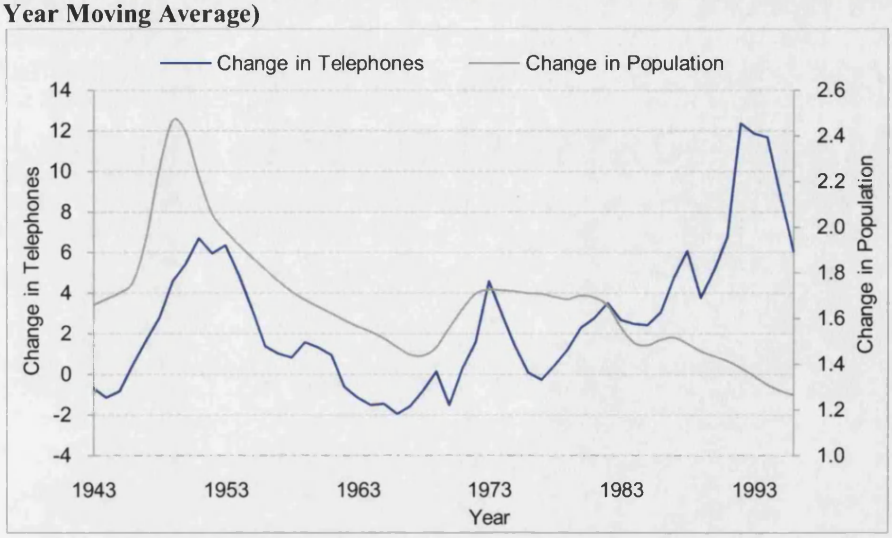
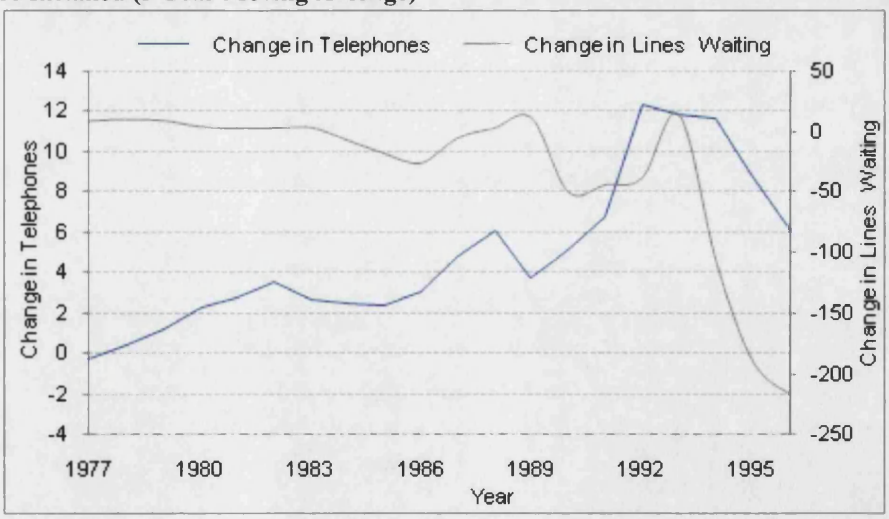


Figure 4.16 shows some correlation until the early 1970s, but no correlation thereafter. Hence, although regression 2 in table 4.9 showed that the change in population was significant, this relationship is likely to be spurious. Despite this, it is still tested in the supporting regressions below given its significance in the earlier regression. Note that the following two variables were not run in the original regressions.

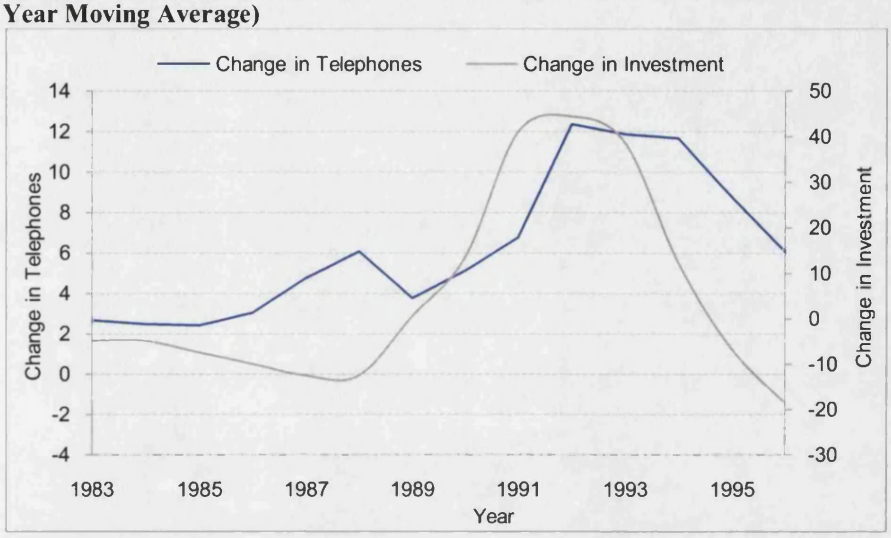
Figure 4.17 Change in Argentina's Telephones per Household and Change in Lines Waiting to be Installed (3 Year Moving Average)



Change in lines waiting to be installed and the change in telephones in figure 4.17 potentially looks more correlated than the relationship actually is. This is because of the use of rolling 3 year moving averages, over the period under consideration that is

already so short (due to data availability). Nevertheless, despite some potential correlation in the last 10 years, in the earliest years there is almost negative correlation, with a small negative change in telephones being accompanied by a 9% year on year shift in the change in the lines waiting to be installed in the late 1970s.

Figure 4.18 Change in Argentina's Telephones per Household and Change in Investment (3 Year Moving Average)



Again the relationship in figure 4.18 (change in telephones versus the change in investment) potentially reveals greater correlation than expected since rolling 3 year averages were used over a very short period (just 14 years). However, these charts will remain of this type, for consistency. Here, while there is relatively stronger correlation in the last few years, there is little correlation in the first half of the period.

Figures 4.12 – 4.18 provide some evidence that the socio-economic factors tested for do not seem to be closely correlated with the change in telephones per household in Argentina. The only variable tested so far that the graphs reveal there may be some potential correlation, is for privatisation, as indicated in regression table 4.9. This is tested for in isolation in regression 1 of table 4.10. Some of the other socio-economic variables, such as population growth are also re-tested, for completeness. Further, the change in lines waiting to be installed and the change in investment were accounted for. I do not expect any of these variables, with the exception of the privatisation dummy, to be significant.

Table 4.10 Argentina's Telephone Regressions with 3 Year Lags

Dependent Variable: Change in Argentina's Telephone Handsets per 100 households					
	(1)	(2)	(3)	(4)	(5)
Privatisation	5.9***(1.4)		5.5** (2.1)	1.8 (3.3)	
ΔGDP 3ylag					
ΔUrban 3ylag					
ΔPopul 3ylag		0.7 (2.2)			
ΔWait_lines			0.02 (0.0)		
ΔInvest 3ylag				0.02 (0.0)	
ΔGDP_Priv 3ylag					0.7** (0.3)
Constant	1.8*** (0.5)	1.6 (3.7)	2.7**(1.2)	5.0*(2.4)	2.3 (0.6)
N	55	55	22	13	55
R2 adjust	0.24	-0.02	0.19	-0.04	0.09
D. W.	1.4	0.9	2.0	1.8	1.0

*Source: see appendix C for data. Note: Standard errors in parentheses, *** sig. at 1%, ** sig. at 5% and * sig. at 10% level.*

Regression 1 tested for the effect of privatisation in isolation, which as expected, remained significant. Regression 2 tested for the effect of population growth in isolation, and it was insignificant, providing further support for the fact that the significance found in regression 2 in table 4.9 is spurious. Regressions 3 and 4 tested for a change in lines waiting to be installed and for the change in investment respectively (albeit at the expense of a smaller sample size), whilst also carrying forward the privatisation dummy, as the only consistently significant variable. The findings revealed that neither the changes in lines waiting to be installed, nor the changes in investment, were significant, thus confirming my expectations.[37] The reality was that, irrespective of the levels of investment being directed into telecommunications before privatisation, investments into ENTel were managed badly, as the state-operated company was run very inefficiently. For instance, it continually paid prices well above market rates to the same national providers in the equipment industry, regardless of how competitive prices were. Moreover, in observation of the regressions, it is clear that there is a very low '*r*' squared (essentially zero) for regressions without the privatisation dummy in it. Regression 5 tested for the impact of the privatisation reform while accounting for the change in GDP per capita, since figure 4.14 showed a plausible correlation during the latter period under consideration. This interaction variable was significant.

[37] The regression was also run replacing change in lines waiting to be installed with the actual waiting lines, but this was insignificant as well and made no difference to the overall regression results.

The first regression in table 4.10 provided the 'best' fitted regression in explaining Argentina's telephone diffusion and accounts for 24% of the variation during the years 1943-97.[38] The regression coefficient suggests that on average, there was an increase of 5.9% in telephones per household, following the implementation of the privatisation reform, compared to the previous years. Regression 5 shows that telephone diffusion was then next best explained by the impact of ENTel's privatisation reform, and once this reform was introduced, by the change in GDP per capita (however, this regression accounts for only 9% of the variation). It is interesting that the regression analysis showed that the change in GDP per capita did not play a key role in driving telephone diffusion in Argentina until privatisation was implemented, underlining the importance of the role of the state.

Mexico: Telephone Diffusion Regression Analysis

The results of Mexico's telephone regression are presented in table 4.11. The variables listed in table 4.7, were all included at some stage. Overall the final regression findings show that none of the tested socio-economic factors (or nationalisation dummy) were individually found to be significant.

Table 4.11 Mexico's Telephone Regressions with 3 Year Lags

Dependent Variable: Change in Mexico's Telephone Handsets per 100 households		
	(1)	(2)
Nationalisation	2.8* (1.6)	1.6 (1.7)
ΔGDP 3yr lag	0.4* (0.2)	0.3 (0.2)
ΔUrban 3yr lag	-2.2 (1.6)	
ΔPopulation 3yr lag		0.2 (0.9)
ΔWait_time		
ΔInvestment 3yr lag		
Constant	5.6*** (2.1)	2.9 (2.3)
N	53	53
R^2 adjust	0.06	0.02
D. W.	1.4	1.3

*Source: see appendix C for data. Note: standard errors in parentheses, *** sig. at 1%, ** sig. at 5% and * sig. at 10% level.*

[38] The regression is robust and, given that it has one single explanatory variable doing all the work, there is no danger of multicollinearity or autocorrelation, and the normality of the distribution was verified visually. Additional regressions were also run using no lags and in all cases the results were the same, with all variables (excluding privatisation) showing no statistical significance. The supplementary set of regressions were consistent with the findings in the main regression, as no other variables were found to be statistically significant.

As reported in table 4.11, Mexico's initial telephone regressions tested for the main socio-economic factors and the nationalisation dummy. Note that nationalisation in Mexico is taken between 1947 and 1989, which includes the whole period of gradual nationalisation. This reform was chosen as the most important institutional reform in Mexico in terms of telephone diffusion. The variables accounting for the change in waiting lines and investment were left out of this initial set of regressions since they reduced the sample size significantly; and they were accounted for at a later stage (in table 4.12). It is preferable to examine a fuller sample to begin with. As in the case of Argentina's telephone regression, the changes in urbanisation and in population were not run in the same regression to avoid multicollinearity. The regression results show that nationalisation and change in GDP per capita were significant when run alongside the change in urbanisation variable; however, when run with the change in population, nothing was significant. The seeming lack of consistent correlation between some of these socio-economic variables, the nationalisation dummy and the change in the number of telephones per Mexican household is somewhat surprising, although there is some possibility that these results are partly explained by the inherent limitations of the collected data (see appendix C). Given these findings, it is useful to look at the variables in more detail, factor by factor, to see whether the regression findings held.

Figure 4.19 Change in Mexico's Telephone per Household (3 Year Moving Average) and the Impact of the Nationalisation Reform

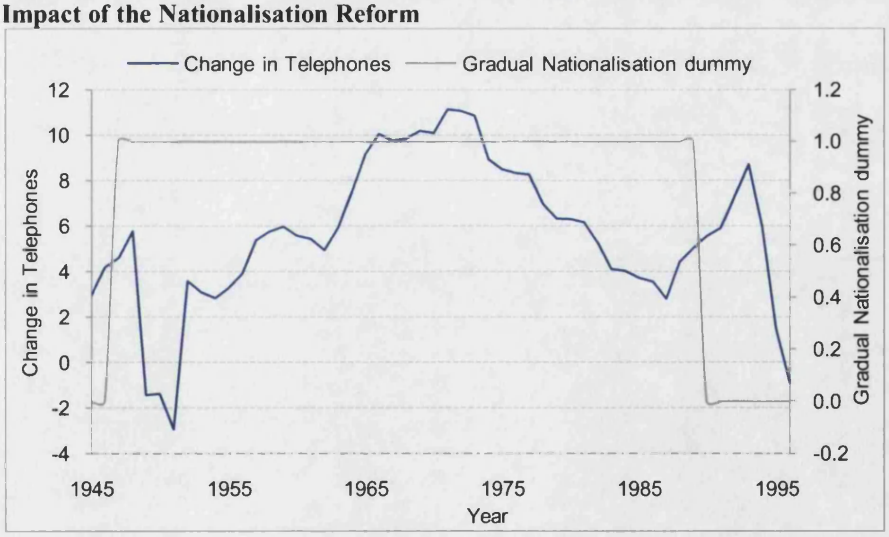


Figure 4.19 shows the impact of the gradual nationalisation reform on the diffusion of the telephone in Mexico. Although this reform is believed to have played a

significant role, it is difficult to account for its gradual nature with the use of a dummy variable, hence although I believe this had a strong positive effect on telephone diffusion (as argued in chapter 3, section *The Period of Nationalisation*) this seemingly failed to show itself in the regression analysis.

Figure 4.20 Change in Mexico's Telephone per Household and Change in Real GDP per capita (3 Year Moving Average)

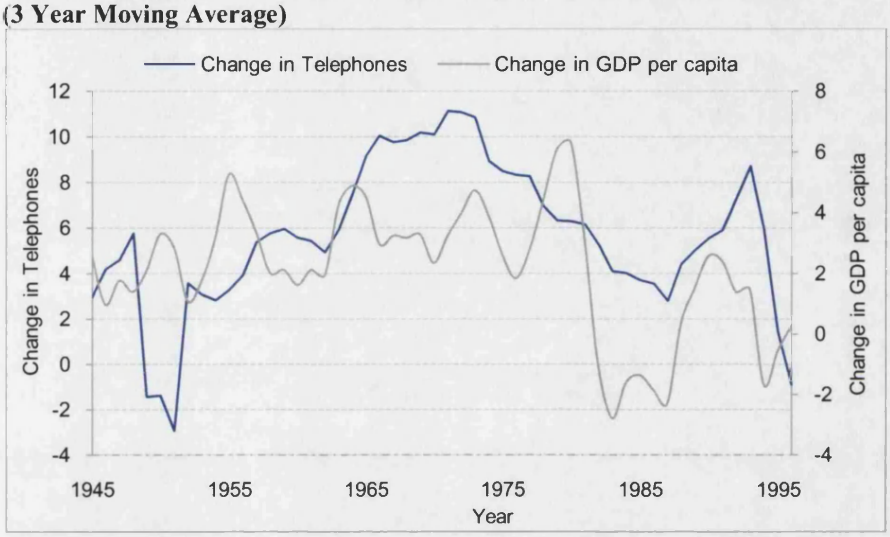
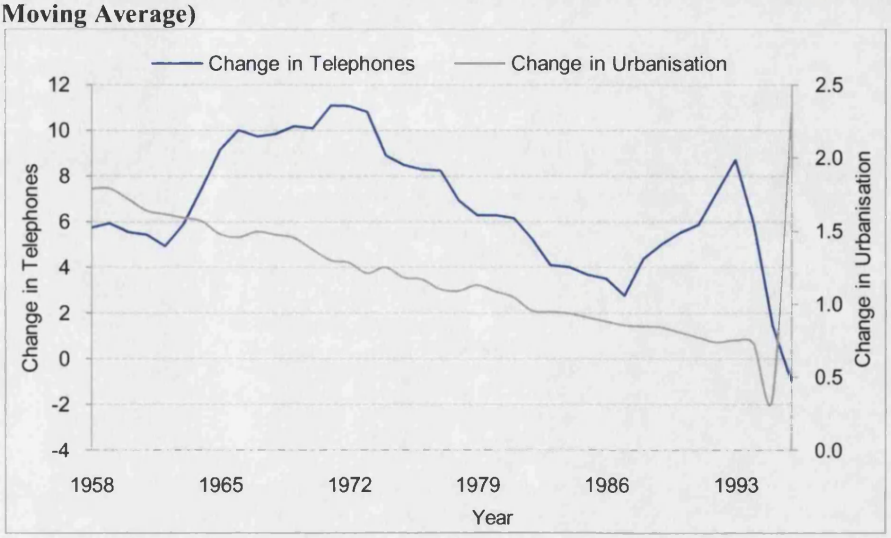


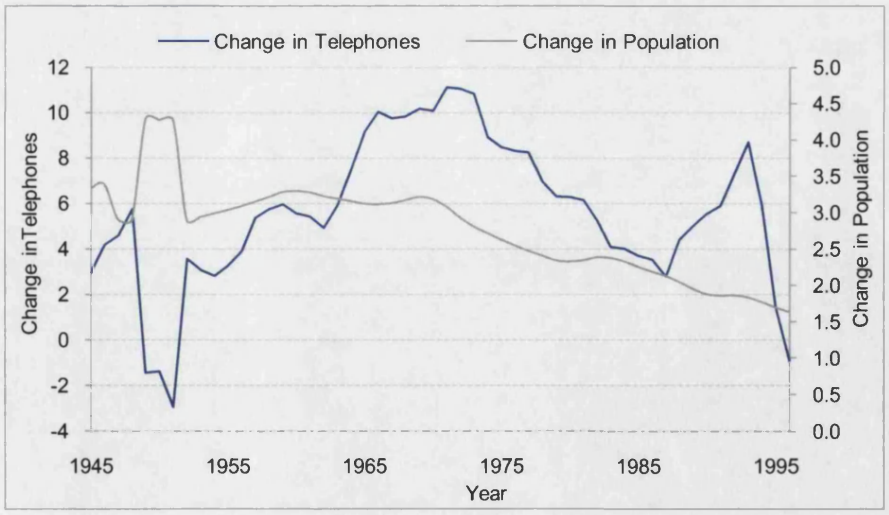
Figure 4.20 shows that, although there are periods of seeming correlation, there is no consistently close correlation between the changes in GDP per capita and the changes in telephone diffusion over the whole period, with pockets of inverse correlation in parts (e.g. the 1950s especially). This contrasts with the findings of the first regression in table 4.11, where there was a positive correlation between the changes in GDP per capita and telephone diffusion As a result, there is reason to believe that this finding may be spurious; hence the change in GDP per capita will be re-tested in isolation in table 4.12.

Figure 4.21 Change in Mexico's Telephone per Household and Change in Urbanisation (3 Year Moving Average)



Despite some pockets of correlation, figure 4.21 shows that there is not much correlation between the changes in urbanisation and the changes in telephones per household for the whole period.39 This can be explained in a similar way to the Argentinian argument above. By 1970 Mexico was largely urbanised, with 59% of the population living in urban areas (see appendix C, table C.4), this meant that increases in urbanisation typically grew at a declining rate, while the growth in telephones per household (although also declining from the 1970s) was more varied.

Figure 4.22 Change in Mexico's Telephone per Household and Change in Population (3 year Moving Average)



[39] Note that the geometrically linearised years from 1952 were excluded from the graph (see appendix C, table C.4).

Figure 4.22 shows a seemingly lack of correlation between the changes in population and telephones per household. The lack of variation in the change of population cannot explain the variation in the change in telephones for most of the period under consideration. Note that the following two variables were not run in the original regressions.

Figure 4.23 Change in Mexco's Telephone per Household and Change in the Lines Waiting to be Installed (3 Year Moving Average)

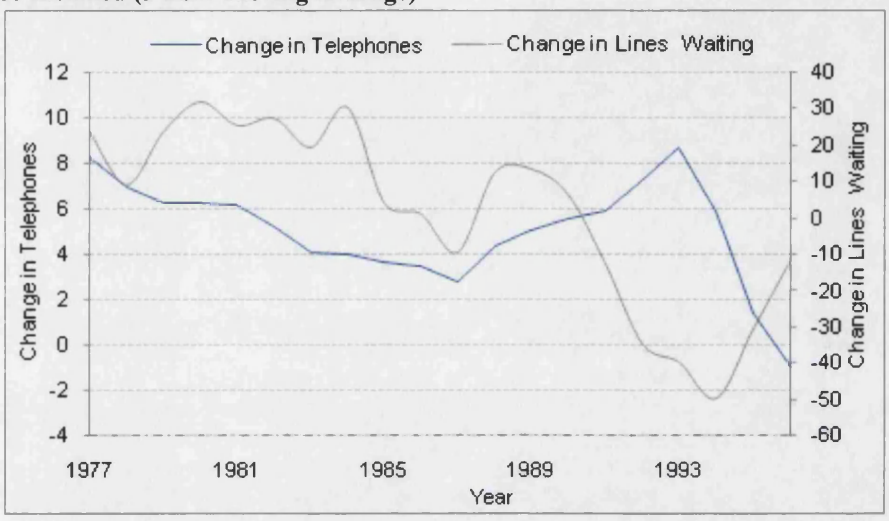


Figure 4.23 shows some periods of reasonably strong correlation between a fall in the number of lines waiting to be installed and the changes in telephones per household (1990s mainly). However, this relationship does not hold for the whole period, a period which again is already shortened (due to lack of data availability) and with data in rolling 3 year moving averages. Theoretically, a fall in the number of lines waiting to be installed should have a positive effect on further diffusion, as consumers are more willing to get a telephone line if they have less time to wait; however it did not appear to be the case (especially in the 1980s).

Figure 4.24 Change in Mexico's Telephone per Household and Change in Investment (3 Year Moving Average)

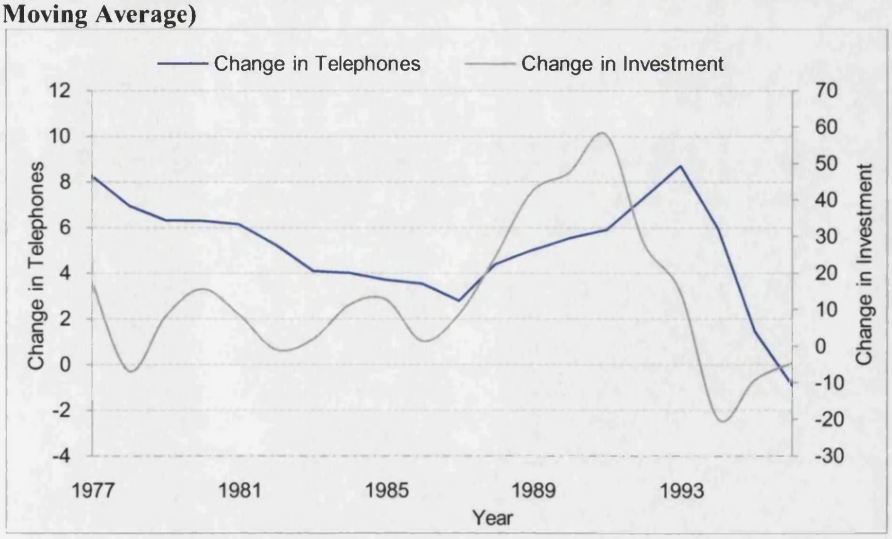


Figure 4.24 shows some limited correlation between the changes in investment and the changes in telephones per household (especially in the latter period), but for the entire first half of the period, continually large fluctuations in investment are accompanied by steadily declining growth in telephone diffusion.

Figures 4.19 – 4.24 provide some evidence that the socio-economic factors tested for, do not seem to be closely correlated with the change in telephones per household in Mexico. Given the great importance placed upon the unique nationalisation of Telmex, this dummy is run in isolation in table 4.12. However, given the problems of measuring this reform with a dummy variable, the regression may still yield an insignificant result. The results in regression table 4.11 show that the change in GDP per capita was the only significant variable and hence this variable is also re-tested in isolation in table 4.12 for completeness, although I do not expect it to be significant given the lack of consistent correlation in figure 4.20 above. Further, the change in lines waiting to be installed and the change in investment were also accounted for. I do not expect any of these variables to be significant either.

Table 4.12 Mexico's Telephone Regressions with 3 Year Lags

Dependent Variable: Change in Mexico's Telephone Handsets per 100 households			
	(1)	(2)	(3)
Nationalisation	2.0 (1.5)		
ΔGDP 3yr lag		0.3 (0.2)	
ΔUrban 3yr lag			
ΔPopulation 3yr lag			
ΔWait_time			0.01 (0.0)
ΔInvestment 3yr lag			0.02 (0.0)
Constant	3.9*** (1.4)	4.7*** (0.8)	4.1*** (0.9)
N	53	53	19
R^2 adjust	0.03	0.03	-0.09
D. W.	1.2	1.3	1.0

*Source: see appendix C for data. Note: Standard errors in parentheses, *** sig. at 1%, ** sig. at 5% and * sig. at 10% level.*

Regression 1 showed a lack of significance for the nationalisation dummy. To some extent this is due to the fact that its effect cannot accurately be captured by the use of a dummy variable, since it is actually the impact of the *gradual* nationalisation, rather than a full blown reform as in ENTel, that is trying to be measured. A dummy variable is not well suited to this, since it accounts for a binary outcome, whereas the effect of gradual nationalisation was not a binary occurrence, but rather a reinforcing and increasing effect. It would have been possible to account for the latter period of nationalisation (i.e. 1972-1989), when the government owned the majority stake in Telmex, but Mexico's success was built on the overall nationalisation strategy, including (if not more importantly) the gradual implementation from 1947 (and in some respects the shortness of the period of full government ownership).

Regression 2 re-tested for the impact of the change in GDP per capita in isolation, as this was the only significant variable from table 4.11. The result showed that GDP per capita was not significant, suggesting that the previous statistical significance was likely to be spurious. The last regression, regression 3, tested for the impact of the two remaining variables, the changes in the number of lines waiting to be installed and the changes in investment (albeit at the expense of reducing the sample

size significantly). The results in regression 3 show that, as expected, neither the changes in waiting lines or in investment were significant.[40]

Mexico's regression analysis shows that of the factors that were modelled in the regression, none were consistently significant.[41] As a result, there is no 'best' regression for the telephone diffusion in Mexico. It is interesting that the regression findings revealed that none of the conventional socio-economic drivers were significant in explaining Mexico's telephone diffusion during the 10-90% period, contrary to many of the findings within the more general literature on technology diffusion.[42]

4.2.3 Quantitative Analysis Summary

The regression analysis quantified the effect of a number of factors that potentially drove the diffusion of the two technologies in Argentina and Mexico. The regression findings interestingly showed that, despite the importance placed within the literature on these variables, telegraph diffusion was not driven by the conventional socio-economic factors in either of the two countries and only the introduction of the Mitre Law in Argentina was found to be consistently significant. The telephone regression analysis showed that in Argentina, the privatisation reform was particularly important, and only after its implementation was a change in GDP per capita also significant. Meanwhile in Mexico, none of the variables accounted for were found to be significant in explaining the country's rate of telephone diffusion. Once more the regression findings serve to bring attention to the integral role played by key state reforms. In Mexico, the lack of statistical significance of any variables suggest that perhaps its unique style of nationalisation was what distinguished its successful diffusion.[43] Meanwhile in Argentina it was the privatisation reform which finally spurred fast diffusion speed. It must be noted that, although the regressions were not biased and hence it was fair to assess the statistical significance of the independent

[40] The regression was also run replacing change in lines waiting to be installed with the actual waiting lines, but this was insignificant as well, and made no difference to the overall regression results.

[41] Additional regressions were run using no lags and in all cases the results were the same, with no variables showing any statistical significance. The supplementary set of regressions were consistent with the findings in the main regression, as no other variables were found to be statistically significant.

[42] For instance see Ahn and Lee (1999), Gruber (2001), Gruber and Verboven (2001), Madden et al. (2004), Milner (2006), Best and Maclay (2002), Fischer and Carroll (1988), Proenza et al. (2001), Morse (1974), Wilkie (1984), Canning (1998), Rogers (1995).

[43] However, Telmex's nationalisation was not proven to be statistically significant in the quantitative analysis due to problems in accounting for the 'gradual' nature of the process.

variables under consideration, as maintained throughout, the reader must accept these findings in light of the inherent limitations of the data, particularly the data collated from the earliest censuses. Despite this, the telegraph regressions serve to highlight the importance of other factors, such as the political economies of the two countries, a central theme of this thesis.

Notably Argentina not only had significantly higher levels of income per capita than Mexico during the years of telegraph diffusion and the early years of telephone diffusion but in fact was the richest country in Latin America for much of the period. According to the literature, diffusion of the new technology in Argentina should have been quicker than in Mexico; however, this was not the case. One may contend, therefore, that perhaps part of the reason for this result during the period of telegraph diffusion was a result of the 'belated' introduction of the Mitre Law. Had the Mitre Law been implemented earlier in Argentina, the telegraph diffusion rate might have been faster. In a similar way Argentina's telephone services were run relatively poorly during the nationalisation years and whether or not income was higher (compared to Mexico) seemingly had little relevance in impacting diffusion. It did not seem to be a matter of whether consumers could afford the telephone, but rather an issue of inefficiency in supply. Thus, one could potentially argue that if a more progressive nationalisation reform was introduced for ENTel (as at Telmex), perhaps telephone diffusion might have been faster in Argentina also. These arguments are, however, merely tentative, and beyond the scope of this thesis.

Focus now turns to the qualitative section of this chapter, which is very necessary in order to provide a better understanding of the explanatory variables at work in accounting for the observed diffusion rates in Mexico and Argentina.

4.3 Analysis of Diffusion – A Qualitative Approach

The rates of telegraph and telephone diffusion in Argentina and Mexico are now examined from a qualitative perspective. This is very necessary because of the limitations of the quantitative analysis, particularly during the period of telegraph diffusion, which was particularly prone to potential unreliability (see introduction to appendices and appendix B). Consequently, the qualitative account gains even greater weight in the analysis and therefore is given proportionally more attention.

Further, a qualitative account is the most appropriate way to assess the role of certain institutions since in reality many institutional factors cannot be accurately quantitatively accounted for. The role played by the government administrations in driving diffusion is given special focus because of its perceived importance in the context of this thesis.

Given the diverse evolution an institutional framework can take, there can be no unique singular formula for success, especially in economically less developed countries. Consequently, a given diffusion process may be successful under different institutions for different countries, depending upon their institutional heritage.[44] The process of diffusion is notionally an individual consumer's decision, but for certain technologies, such as the telegraph and the telephone, the adoption decision (and thus the subsequent diffusion process) is determined by the government, since it oversees the technology's entrance into the marketplace (see chapter 1, section 1.2 The State and the Role of ICT in Latin America).[45] In other words, for technologies such as those under consideration, it is not only the factors driving consumer demand that are relevant: at least as important are the drivers of the infrastructure expansion, as argued in chapter 1.[46] In Argentina and Mexico (as in most countries), the build-out of the necessary infrastructure, was very much dependent on the disposition of the government's attitude and their coordinating role, as patterns of diffusion were strongly driven by the political milieu.[47] In regard to the analysis that follows, particular focus was placed upon the respective government's attitude and perceptions towards the two technologies, as well as, the actual supply of the service. A positive attitude on the part of the state should theoretically (although not always practically) translate into state action which positively impacts the build-out of infrastructure and availability/accessibility of the technology to the consumer. The inherited environment was also important since this partly formed the state's attitude. Finally, the efficiency of the regulatory body and its power of enforcement are explored. The rest of the chapter is split up by technology, focussing on the telegraph first, and then the telephone.

---

[44] Aoki M., *Toward a Comparative Institutional Analysis* Cambridge, MA, MIT Press (2001), Dekimpe et al. (2000b).
[45] Mahajan and Muller (1994), Putsis (1997).
[46] See chapter 1, section 1.5 Review of the Approaches to Different Rates of ICT Diffusion.
[47] Robertson T. S. and Wind Y., 'Organisational Psychographics and Innovativeness' *Journal of Consumer Research* 7 (1980): 24-31. Dekimpe et al. (2000b).

4.3.1 The Telegraph

The quantitative analysis showed that the only factor that had any statistical significance across the diffusion of the telegraph in Argentina or Mexico was the introduction of the Mitre Law in Argentina. This section will shed more light on other potentially important variables such as the role of political actors in the diffusion process.

The Government's Attitude towards the Telegraph

To contemplate successful diffusion of the telegraph, the 'right' attitude and approval of the state was not so much an incremental positive as an absolute necessity, for they literally controlled the entire spectrum of the process. From the very beginning the government was in charge of providing the concessions necessary for the build-out of infrastructure. However, a positively inclined government attitude toward telegraph diffusion was insufficient, and had to be accompanied by state characteristics of a certain degree of autonomy and power in order to be able to force through diffusion enhancing reforms. As argued in chapter 1, the Argentinian and Mexican states quickly recognised how instrumental the telegraph could potentially be for their administrations and accordingly asserted control over it, primarily to protect their tenure, as well as to unify their countries (see chapter 1, section 1.1.3b. Argentina's and Mexico's Oligarchic Rule).[48] One could argue that out of the two countries, Mexico's administrations backed the development of the telegraph to a greater degree. The situation in each country is now examined separately.

Argentina

In Argentina one can observe a shift in the government's attitude over time as it revealed an increasing tendency to regulate and take responsibility for the provision of the telegraph. The Sarmiento administration played a particularly key role in the future diffusion of the telegraph, since he believed that government action could fundamentally affect the development of the telegraph.[49] He believed that the expansion of technological advances like the telegraph was of particular importance to Latin American countries characterised by sparse populations, with vast areas of land (like Argentina) due to the telegraph's capacity to unite the region. Sarmiento

[48] Oszlak (1981, 1990), Cárdenas de la Peña (1987a).
[49] Reggini (1997).

was all too aware of this fact, as his administration was the one that really kick-started telegraph diffusion. However, his operation lacked efficiency given his belief that it was better to do things badly, but get them done.[50] After his tenure and until the end of the diffusion of the telegraph there were a further 11 serving presidents (1874-1916) who shared a desire to expand the telegraph network and induce diffusion (see appendix H for a full list of the corresponding administrations during these years). Despite this unity of purpose and the 'monopoly' position of the PAN in Argentina's politics for much of the period in question (see chapter 1, section *The PAN's Political Machine and its Growing Opposition*), inducing speedy telegraph diffusion was not easy to bring about.

When Sarmiento came to power, the telegraph network was small in scale, partly because of wars, but also because historically the government had been excessively cautious. For instance, in 1857, the administration at the time rejected Jacinto Febrés de Rovira's proposal to expand the telegraph line, and a year it later rejected the Société Internationale de Télégraphie Electrique proposal. The administrations were suspicious of the proposer's intentions and perhaps felt that their restraint was well based. Nevertheless, the end result was that the telegraph network experienced minimal development during the early years. From the mid 1880s to the early 1890s, during Juárez Celmán's second term in charge and Carlos Pellegrini's tenure (1890-1892), they continually attempted to expand the Argentinian telegraph network. For instance, just before the 1890s depression, the federal government purchased Cordoba's provincial telegraph line (one of the poorest constructed lines in the Republic) in an effort to improve the telegraph network. The aim was to avoid duplication of construction across the disintegrated grid, but the telegraph network still did not expand significantly and the situation worsened during the 1890s depression.[51] Despite the seeming positive attitude of these presidents and the previous administrations, given the telegraph's perceived importance (see chapter 1, section *State Formation and the Telegraph and the Telephone in Argentina and Mexico*), efforts were frustrated consistently. Although the dominant PAN party stayed in power for much of the relevant period, and acquired some political stability (although relatively lower compared to the level the Porfiriato achieved for some of

[50] Ibid.
[51] The depression actually forced Juárez Celmán's administration to halt any work for several years.

these years), they lacked the necessary degree of autonomy from major interest groups to govern as freely. There were constant labour strikes, and the existing telegraph network was unable to handle increased usage. Furthermore, with the changes in administration, reforms were often inconsistent and/or delayed. Argentina's build-out of the telegraph network was simultaneously and independently carried out by various groups, without any coordination until 1892. Indeed some argue that the telegraph challenge in Argentina was as much about the build-out of the infrastructure, as it was about the fact that so much of the existing system did not work.[52]

This thesis argues that the Mitre Law played a very important role in allowing for the subsequent diffusion of the telegraph, in terms of increasing the number of telegrams sent by consumers. The Mitre Law was a government initiative that exploited the full benefits of the huge advancement in railway growth in Argentina. Chapter 3 showed that a huge shift in telegraph usage followed the introduction of this law (see chapter 3, section *The Role of the State: The Impact of New Laws*). The rationale for the overall effect was twofold: first, the requirement for railroad companies to give a line for free to the national government coincided with a huge explosion of growth in railway extensions and therefore positively impacted the course of the infrastructure build-out. Second, the further instruction to connect the railway network to nearby portions of the national network served to materially improve the network coverage and capacity for traffic, which in turn induced a sizeable growth in the number of telegrams sent. The regressions in the earlier part of this chapter add some sense of statistical validity to the argument as well. Indeed, by 1918 the federal government and the railway companies together controlled over 87% of the total telegraph network in Argentina. It is important to realise that although Argentina's government was in favour of telegraph network expansion, encouraging consumer use was not the main priority. Obviously, greater public use increased the profits for the private companies expanding the lines, providing them with an incentive to continue to promote the growth of the network, but the government cared most of all about using the telegraph to govern. As well as facilitating control, the telegraph also enabled the government to remain informed in a timely fashion about what was

[52] Hodge (1984).

going on in the whole country (see chapter 1, section 1.2 The State and the Role of ICT in Latin America). This perception not only gained credence in Argentina, but in Mexico, as well as in much of Latin America. The ability to impose control and induce further diffusion conducive reforms was quite different in the countries, as explored below. At first glance, it would appear that a more dictatorial inclined regime (such as the Porfiriato) may have afforded Mexico an opportunity to develop and implement longer term policies in regard to boosting telegraph diffusion, but success was not guaranteed.

Mexico

Regardless of which of Mexico's administrations was in charge, they all similarly endeavoured to play an active role in promoting fast telegraph diffusion, as they were well aware of its importance in protecting the country and their political supremacy (not surprising, given the continuous fighting and political chaos after independence). Mexico's main administrations during the period of telegraph diffusion were led by Maximilian, by Juárez and by Porfirio Díaz. These were three quite different regimes with varying levels of effectiveness in power, but no greater individual range of authority was observed outside of the lengthy tenure of the Porfiriato (see chapter 1, section *The Porfiriato: the Range in Authority Exercised*). It is important to analyse how far their influence extended in assessing the state's explanatory power, although it is not the focus here to assert which was the most successful administration in terms of promoting telegraph diffusion. The aggregated governmental influence is of more relevance given the fact that each ruler had to deal with his predecessors' successes and failures.

In Mexico, the state's influence over the telegraph was clear from the start, as they sought to develop and control what was, in their view, strategic infrastructure. It was immediately made state property under Maximilian's Empire in 1865 and then again in 1867 by the Juárez's administration.[53] The administrations of Maximilian and Juárez also made important institutional improvements with respect to the workings of the telegraph despite the very different contexts of the two regimes. Although both were dedicated to the potential uses of the telegraph to their regimes, for Juárez this

[53] Noyola (2004).

was based on a more domestically orientated perspective, while Maximilian was concerned with establishing grounds to cement his ruling empire and replicate successful strategies from his homeland. It is also important to appreciate that Juárez was a liberal while Maximilian was supported by the conservatives, so even after Maximilian's ousting, Juárez still faced the wrath of angry conservatives, which complicated his ability to control and expand the telegraph network. However, their combined efforts toward building out the network proved to be important in allowing for subsequent successful diffusion even if the actual line build-out was not very extensive under their tenures.[54] Juárez, for instance, created the *Líneas Telegráficas del Supremo Gobierno* in 1867, officially founding the public service of the telegraph from the very start of his administration. Indeed 1867 was the birth of 'modern' Mexico, and the development of 'modern' technologies like the telegraph, went in tandem with this. Juárez created the first telegraph regulation in 1869, which established fundamental legislation and the consolidation of the network, in an attempt to streamline and improve the service.[55] This government driven policy meant that, although the telegraph network was built simultaneously by private, provincial government and railway companies in tandem with the government (as in Argentina), steps were taken from the start to ensure the growing network was not simply being enlarged for enlargement's sake but rather that a more coordinated system was built. The early consolidation of the network, therefore, had an important effect on the further build-out of the telegraph network and aided faster diffusion as a more direct service encouraged more usage growth.

Once Maximilian and Juárez laid the foundations for the successful growth of the telegraph network, Porfirio Díaz carried on that good work and achieved real diffusion progress. Porfirio Díaz's administration was in power for most of the period of 10-90% telegraph diffusion in Mexico (with the exception of 1880-1884, when his nominee Manuel González ruled). The fact that Porfirio Díaz was president for most of this key period, however, does not necessarily mean it was any easier for him to implement longer term reforms. Not only have the very 'merits' of his dictatorship been challenged, but his power was not consistent across the nation, with

[54] Maximilian destroyed all of the lines (except the two main ones) on his way to ruling Mexico.
[55] Secretaría de Fomento, 'Reglamento para las Oficinas Telegráficas del Supremo Gobierno' Document 5, Memoria 1868-1869 México D.F. Note that network consolidation did not take place in Argentina until 1892, as mentioned

most of his authority centralised in Mexico City.[56] Although (much needed) foreign capital was available, this was not due to the positively recognised economic structures. Porfirio Díaz's tenure was built on a political economy of mutual 'back-scratching' through vertical political integration. The significant investment inflows were a key source behind Mexico's growth in the telegraph sector, as a large proportion of these funds were directed towards the expansion of the railways. Meanwhile Porfirio Díaz also ensured the parallel expansion of the telegraph network through legislation he imposed upon the railway developers. He controlled the fast process of the expansion of the telegraph network during the years of relative peace (1877-1910) by applying stringent policies and even using intimidation tactics with regard to 'telegraph crime'. For instance, if a telegraph line were cut, the perpetrator would face the death penalty. The Porfiriato retained notions of liberal democracy but these were typically subverted as it essentially ensured economic progress by largely imposing order. Although the means were arguably overly aggressive, Porfirio Díaz ensured that the telegraph network expanded by any means necessary, and in this respect he was largely successful: for instance by 1877 most of the lines destroyed during his accession to power only two years earlier, were operational again. [57] On a wider economic front, the sustained boom in investment/exports seemingly legitimised the regime, affording Porfirio Díaz time to consolidate his leadership even more, by protecting the *científicos* and by dividing the country into military zones that would be run by his loyal subordinates.[58] Having said this, it is important to note that the Porfirian state did change with time, as it looked considerably more secure in the late 1890s than a decade earlier, but it was subsequently weakened by the events of the 1905/1907 crisis in the U.S. However, through all of the varying stability and authority of his regime, even during the four year period that Porfirio Díaz removed himself from the presidency, as mentioned he continued to sponsor the telegraph sector's development

[56] Buffington and French in Meyer and Beezley (2000).
[57] Cárdenas de la Peña (1987a). Also see Pavía L., *Breve Bosquejo Biográfico de los Miembros Más Notables del Ramo Telegráfico, y Reseña Historia de la Existencia y Progreso de los Telégrafos de la República Mexicana* volume I, México D.F., Antigua Imprenta del Comercio (1893), Noyola (2004), Rodríguez J. A. O., *El Telégrafo en México: 150 Años, del Morse al Mouse* México D.F., Telecomunicaciones de México (2000), Secretaria de la Presidencia, *México a Través de los Informes Presidenciales* México D.F. (1976), Secretaría de Fomento, 'Reglamento para las Oficinas Telegráficas del Supremo Gobierno' Document 5, *Memoria 1868-1869,* México D.F. Secretaría de Fomento, *Memoria 1877-82* Secretaría de Fomento, México D.F.
[58] Lewis C. M. (2002).

by remaining as Minister of Public Works hence was still in charge of expanding the telegraph network, demonstrating his dedication to the cause.

Overall, perhaps two of the factors that most negatively impacted telegraph diffusion in Argentina and Mexico were political favouritism and the states commitment to property rights. Private capital was necessary to the build-out of the network and, coupled with the state's desire to consolidate their power, this brought about non-efficient progress as friends of the regime, rather than promoters of efficient telegraph diffusion, often were allocated the contracts. This problem was perhaps greater in Mexico, where this type of behaviour was particularly engrained.[59] With regards to the process of handing out private concessions, there was a lack of state commitment to property rights, as expropriation risk was rife. In the specific case of Mexico, although the government theoretically gave monthly payments to the private companies to build-out the network, even when they missed a payment the lines continued to be constructed and so the government had little incentive to pay.[60] Despite this, the telegraph was seen as a 'good' business and the government received numerous tenders for concessions.[61] Irrespective of the perceived degrees of success of the government administration in charge of promoting telegraph diffusion, it is, of course, important not to judge their individual effectiveness too harshly before analysing the situation they inherited, which often prevented them from fully implementing individual ideas and strategies. This brings us to the next variable: that of wars.

An Inherent Unstable Environment: The Role of Wars and Uprisings

The institution of war is an explanatory variable that had particular resonance in the diffusion of the telegraph in the two countries. Although much of this took place outside the actual period of telegraph diffusion (or during the very earliest years of diffusion), it is imperative to examine it since it had a meaningful effect upon the diffusion process that followed it. War is very much seen as having, in general, a

[59] Rodríguez (2000).
[60] Pacheco C. *Memoria presentada al Congreso* volume. I, México D.F. (1883-1885).
[61] As an example: around the early 1900s, a private company laying a line from Chihuahua to Paso del Norte in Mexico would need to employ only 10 unskilled labourers and a supervisor. For the 3 months it would take to install the line, the concession would be worth $3,457 and, given the relatively small daily cost of the employed workforce, the concession owner would receive a handsome profit. Further, firms did not build just a single line at a time, so it is no surprise that private investors found the market attractive – hence the demand for concessions and the reduced negative effect of weak property rights. See Noyola (2004).

negative effect on the physical pursuit of speedy telegraph diffusion, in the sense that during war time, telegraph networks were often attacked, or the use of the telegraph service by the public was restricted as instead it was used to coordinate the war effort. It can, however, have an indirect positive effect, in shaping the post-war government's attitude towards the importance of the telegraph. The situation in each country is now examined separately.

Argentina

Argentina was internally broken when the telegraph arrived, facing a period of confusion and anarchy almost since independence, suffering through civil and parochial wars during the 1850s and 1860s as it strove for constitutional order and political harmony. The 'highlights' of Argentina's predicament included Rosas' oppression, the proclamation of the Federal Constitution (1853), and finally its approval by Buenos Aires (1862). Argentina suffered badly during Rosas' tyranny and the army's ability to act had been crushed by the strains of the Paraguayan War (1865-1870). After independence, Argentina was terrorised by the powerful Ranqueles tribes and other sympathisers of Araucanians (of Chile). Argentina struggled for unity and therefore struggled to develop a national telegraph network that could induce strong telegraph diffusion (taking some 30 years after the telegraph's introduction to do so). The unrest was made worse by Argentina's sheer size and its underdeveloped transport infrastructure. In 1880 some genuine progress was made in the quest for national unity as the Federal District was formed and Buenos Aires was made the capital city, but although these were landmark events, Argentina still lacked constitutional order, given the deepening political and social unrest and the fact that the provinces had grown so segregated.[62]

By 1875 the telegraph was integral to the government's plight, as it facilitated territorial expansion across the Republic. In that year, Adolfo Alsina (Argentina's Minister of War under Nicolás Avellaneda [1874-1880]) came up with an elaborate plan for congress to create a military telegraph network connecting the major command hubs on the southern frontier. Congress acted accordingly, providing the relevant funds and authority. This provided the necessary military unification against

[62] Hodge (1984).

revolts and subsequently the network strategically expanded to Rio Limay (1881), to the Andean cordillera and from Lake Nahuel Huapi to Chos Malal (1882-1883), which ultimately aided entry to, and exploration of Patagonia. Thus Argentina found the telegraph to be of great value in times of crisis and a key tool in exercising control throughout its territories. The telegraph progressed military occupation and eased contact between operations. It also aided diplomacy in the lengthy negotiations held at the Chilean frontier for some 20 years.[63] Political stability strengthened and the telegraph was instrumental in delivering this by ensuring greater effectiveness of security at international borders. Indeed, the telegraph became symbolic of order and peace, while the pain that war and unrest had induced positively affected the authorities' strategic view regarding the necessity of speedy telegraph network build-out, which would then aid public usage through a larger existing network.

Mexico

When the first telegraph concession was handed out in Mexico in 1849, the country was already characterised by an unstable political and social climate, having only just signed a peace treaty with the U.S. in 1848. Mexico was severely fragmented, parts of the country wanted to become autonomous republics and in other areas there were continuous attacks from indigenous tribes who wanted to reclaim their land from the U.S. The country was divided both territorially and politically, and this was constrictive to Mexico's potential prosperity at the beginning of telegraph diffusion. Although the country gained independence in 1821, the period that followed saw a continual succession of presidents, and numerous coups d'états. From 1850, Mexico began a new era emphasising the integration and union of the population, striving for social and economic progress, and the telegraph was a way to achieve this, as well as providing much needed national security.[64]

Mexico faced further turbulent times during the Reform Wars (1857-1861) and the French Intervention (1862-1867) placing additional pressure on the expansion of the network given the telegraph's vital role during wartime, as it aided official communication to organise strategy and also as a media tool to deliver news flow quickly, hence the lines were continuously sabotaged by the enemy. This, coupled

[63] Ibid.
[64] Baur (1994), Hodge (1984).

with the delicate situation regarding the government's finances during these years, meant that telegraph lines were not repaired particularly fast and were often quickly destroyed again. This situation was made worse by the fact that the state always had priority of usage and during wartime there was no telegraph revenue as the government forbid public usage. It was widely accepted that the telegraph's main role was to serve the government's needs and although in theory the government offered 80 pesos per day per km of line when it took sole control of the network, it is not surprising that this was rarely paid.[65] In the period immediately before the 10-90% telegraph diffusion years, even when there were no major wars, Mexico was by no means at peace. For instance, during the Juárez administration, telegraph expansion was undermined by conflict and a barrage of line destruction. Proof of the detrimental effect of war in the context of telegraph diffusion can be found by looking at the relatively peaceful years of 1872-1875 (under Sebastian Lerdo de Tejada tenure) where the telegraph network expanded by a sizeable 2,600 km.[66] This was of little significance, however, given that, as mentioned, Porfirio Díaz destroyed many of the lines. However, when Porfirio Díaz came to power he instilled a level of relative political stability (compared to the period before him) and in turn, an opportunity for more successful telegraph expansion. Conversely, although the wars had a direct negative impact on the physical destruction of the telegraph network, it was arguably then, just as in Argentina that the telegraph's strategic significance was particularly highlighted. One could argue that a framework of fast telegraph diffusion in part was forced upon the government as a means to protect their power and people; if it had not been for the institutional coercion of war, the state could quite possibly have adopted a more laissez-faire attitude towards the telegraph.

Comparatively, an important difference between Argentina's and Mexico's respective struggles was the fact that Mexico had been under attack from a powerful threat (the U.S.), whereas Argentina's woes were predominantly internal conflicts. It is thus likely that the impact of wars, although a decisive factor in the two countries, was relatively more important in the case of Mexico, as it faced further difficulties

[65] Official figures suggest that between 1855 and 1863, according to this agreement the government and paid the telegraph a total of $58,540. See Rodríguez (2000).
[66] Ibid. Indeed, during the course of Juárez's and Lerdo de Tejada's tenures, the telegraph network expanded from 1,874km in 1867 to 8,000km in 1876, financed by public and private investment. See Mexico, Memoria de la Secretaria de Fomento de 1865 a 1891 *Archivo General de la Nación* Galera 5 (various years).

from developed foreign pressures and, having lost much of its territory already, it did not want to lose any more.

The Efficiency and Enforcement Power of the Regulatory Framework

The regulatory institutions were linked closely to, and influenced by, those in political power, as the state was the regulator and administrator of the telegraph services. Consequently, the regulatory institutions were not always able to act in a manner that was geared primarily toward the development and speedy diffusion of the telegraph system or the provision of universal service. The states' ability to create stable and effective regulation was dependent to a large degree upon the institutional setting, since the institutions already in place restricted the available options.[67] As a result the focus below is on the earlier period of telegraph diffusion since this period largely constrained what could be achieved in the remainder of the process.

During the relatively short period of telegraph diffusion, regulatory institutions tended to be vast organisations characterised by a high degree of bureaucracy and, although with varying degrees, insufficient autonomy. The telegraph system was run opportunistically, as the states excessive free use of the service not only reduced revenues but angered the public whose messages were frequently delayed. Theory suggests that, as a natural monopoly, telegraph provision is best provided under government control and this should protect the public from misuse, not cause it (see below for examples). Perhaps these institutions were less effective than theory would predict, but they still played an important role in the development of the telegraph. It was not just about the content of the regulatory framework and how that affected different private agents in the sector, but also the manner and freedom in which it was applied. The next section looks individually at the specific situation of the two countries.

Argentina

The evolution of telegraph regulation in Argentina began in 1862 with the creation of the *Dirección General de Correos Nacionales* which was to control the telegraph line build-out. Then in 1869 the *Inspector General de Telégrafos de la República* and

[67] Cárdenas de la Peña (1987a), Baur (1994), Hill and Abdala (1993).

in 1871 the *Administración Central de los Telégrafos Nacionales* were created to standardise practices, fix rates and set accounting procedures. However, until 1875 lines were constructed without much national order, and although some 29 laws regarding telegraph rates were passed between 1872 and 1919, only two charters had any meaningful impact in terms of increasing efficiency (and in turn diffusion speed), before the twentieth century: the Telegraph Law (1875) and the Telegraph Code (1892).[68] The 1875 Telegraph Law stated that the government had to give concessions for the construction of a telegraph line, and public service could not be provided until it was approved by congress.[69] This law placed the *Dirección General de Correos y Telégrafos* in charge of all aspects of the telegraph, granting them the power to ask private firms to provide statistics on their operations. Such was the widespread acceptance of the telegraph's importance in creating constitutional order that the regulatory bodies' penalties for related infractions were doubled during domestic unrest and tripled in times of foreign disputes. The law codified and clarified the rules on telegraph network construction, and hence improved efficiency which would potentially promote diffusion. Telegraph plans were scrutinised in depth before any work began; lines could not interfere with traffic, and individual stations had to be at least 25 miles apart. Municipal authorities were given jurisdiction to oversee some uncomplicated matters and in the event of a domestic or external conflict, the state had special powers to take over the telegraph network exclusively in the affected region.[70]

Eduardo Olivera was the first director of the *Dirección General de Correos y Telégrafos* in 1876, and in his four year tenure he reduced excessive state usage and standardised tariffs, improving overall operational efficiency.[71] By 1890 the fragility of the regulatory institution became apparent as President Juárez Celman's resignation marked the end of the incumbent Dr. Ramón Cárcano's tenure (because the directors were all handpicked by the president). Pellegrini became the new

[68] Ministerio del Interior, *Legislación Postal y Telegráfica. Convenciones, Reglamentos, Administración, 1858-1900* Buenos Aires (1901). The *Código Telégrafo* was approved by the Minister of Interior on August 29, 1892. See Carlés C., *Códigos Postales y Telegráficos Dictados durante la Administración del Dr. C. Carlés* Buenos Aires, Compañia Sud-americana de Billetes de Banco (1895).

[69] The railways were the only exception, as they could build lines for their closed system, i.e. for the exclusive use.

[70] See Berthold (1921a), Hodge (1984), Lynch A. B. and Krause M., 'Proyectos Para una Sociedad Abierta: Telecomunicaciones Para Comunicarse Eficientemente' *Revista Libertas 09* 7, *Instituto Universitario Escuela Superior de Economía y Administración de Empresas (ESEADE),* (1993), Reggini (1997).

[71] Castro Estevez (1952).

president and he oversaw a complete overhaul, making Manuel Bahía responsible for the telegraphs. Bahía inspected the entire network firsthand, submitting a report in 1891 that addressed a catalogue of infrastructural and administrative shortcomings, and the resultant 'Telegraph Code' put forward in 1892, which ultimately clarified and augmented the Telegraph Law of 1875. The new code defined relationships and offered detailed descriptions of some technical aspects: interpreting exactly the legal government powers during war times or periods of domestic unrest.[72] The charter emphasised to a greater degree the public importance of the telegraph, and the necessity of its diffusion, prescribing in greater depth how telegraphic conferences were to be organised. Bahía was not looking to improve the system marginally; his proposals were made after he analysed many other models around the world to ascertain what system could drive diffusion most appropriately and efficiently in Argentina. However, Bahía's original plans received little funding and even by 1918, his supporters were still demanding money from congress to repair the lines.[73] This seemingly demonstrated the 'free' voice that regulatory institutions enjoyed (in continually drawing up improvement plans), but it simultaneously conveys their lack of effectiveness as they ultimately carried little influence over the government's allocation of funds.

Argentina's regulatory framework was arguably not as effective as it could have been, and the relatively bureaucratic system did not help. For instance, in early 1873 comprehensive plans were made for the telegraph, which were formalised into a bill for the national chamber of deputies later that year, scrutinised in congress until August 1874, and only became law in October 1875.[74] This grimly demonstrates the slow workings of the institutional regulatory process, reducing its effectiveness to act quickly when necessary. In general, the largest problem regulators faced was the fact that, despite the poor condition of the telegraph network, its usage continued to increase, making matters worse.[75] This not only meant the quality of service

[72] For instance, if the government took control of a strategic line it was to compensate the private owner appropriately.
[73] Argentina, Fundación Standard Electric, *Historia de las Comunicaciones Argentinas* Buenos Aires, Fundación Standard Electric Argentina (1979).
[74] Argentina, Congreso Nacional *Diario de Sesiones de la Cámara de Diputados* República Argentina (1873) pp.1242-1245. Argentina, Congreso Nacional *Diario de Sesiones de la Cámara de Diputados* República Argentina (1874), p.639. Argentina, Congreso Nacional *Diario de Sesiones de la Cámara de Diputados* República Argentina (1875).
[75] Berthold (1921a).

continued to deteriorate but, moreover, it did little to encourage additional state funding.

Mexico

Mexico's telegraph regulatory landscape evolved from an ineffective *Secretaría de Fomento* in force until 1877 to an independently established *Dirección General de Telégrafos Federales* in 1878, which was a more streamlined, quasi-independent body, which the government hoped would speed up the expansion of the telegraph network.[76] In 1891 the *Secretaría de Comunicaciones y Obras Públicas* (SCOP) was established and took direct control of the telegraph.[77] During almost the entire period of 10-90% diffusion in Mexico, there were just three directors of SCOP (Manuel González Cosio, Francisco Mena and Leanaro Fernández). This compared to as many as four changes in directors in just the first 10 years of Argentina's equivalent period, potentially providing the regulatory body in Mexico with more continuity in its reforms and actions. Regardless of one's view of the Porfiriato, the stability in the regulatory framework was testament to the fact that Mexico was governed by just one president during this period. Similarly, as Bahía had questioned how Argentina's telegraph system had continued to operate, it was thought that the Mexican telegraph's '...biggest merit [was] to have survived despite everything it had endured'.[78]

During Mena's directorship, he tried to ensure some accountability for the provision of the telegraph by dividing the network up and appointing 20 zonal inspectors, thereby cutting administrative errors. [79] Mena sought to achieve sizeable efficiency gains and argued in his reports for 1896-99 that the Mexican people's belief that the country's telegraph provision was exemplary came about because they accepted that its primary function was to serve the state (and, as Mena argued, they had nothing to compare it against). Consequently the deficiencies went largely unnoticed.[80] This

[76] The five departments of the *Dirección General de Telégrafos Federales* covered those in charge of overseeing the build-out of the lines, those in charge of overseeing the service, the accounting, the correspondence and the administration. SCOP *Memoria 1892-1896* p. V., with regard to the effectiveness of the *Secretaria de Fomento.*

[77] Noyola (2004), Cárdenas de la Peña (1987), Secretaría de Fomento, *Memoria 1877-82* Secretaría de Fomento, Mexico, SCOP *Memoria 1896-1899,* pp.128-129, 167-169, 172-177.

[78] Rodríguez (2000), p.58.

[79] Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1899-1900* México D.F., p.129.

[80] For Mena's comment, see Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1904-1905* México D.F., pp.202-3. Mena's most notable improvement was to introduce wire transfers of payments in 1898 (a reform still used today), updating the tariffs system. Secretaría de Comunicaciones y Obras Públicas (SCOP),

was why Mena opened a registry in 1899 to record public complaints.[81] By 1902 when Mena left SCOP, he had overseen a doubling in investment (from 700,000 to 1,500,000 pesos), the national network had almost 35,000 km of installed lines and 33 offices (out of 379) provided 24-hour service.[82] It is likely that Mena was more successful than his predecessor not only as a result of the many changes he instigated but because of the greater diplomacy with which he went about his tasks, for example in not insisting that the government pay for their telegrams, which was a sensitive matter.[83] The issue of government payment and usage was a problem (although not just in Mexico), since making the government pay for their usage would only have improved profitability and in turn re-investment of the sector, therefore promoting its advancement and subsequent diffusion. Further it would have made the government use the service less, inducing more efficiency in public use.[84]

Fernández took over from Mena and also quickly implemented some innovations and took full advantage of the railway expansion to drive the telegraph network to increase by 1,293km (1902-1903), of which 676 were built on the railway's poles.[85] He also produced numerous reports demonstrating that the telegraph was a solvent business, which was imperative for further funding to drive diffusion. However, despite the great strides taken by Mena and Fernández, the government simply desired the regulatory institution to pander to the state's will and maximise its revenues.[86] For instance, in 1897 it was discovered that the railways were allowing public use of the telegraph service on their lines and, rather than encourage this or broker a mutually beneficial arrangement (as in Argentina), the Mexican government squandered additional monies in building parallel infrastructure to recoup the

Memoria 1905-1906 México D.F., pp.88, 175. See Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1907-1908* México D.F. pp.125-26.

[81] Rodríguez (2000), p.63.

[82] See appendix C for the size of the national network data.

[83] Mena did not include any estimates for government telegrams in his official reported figures, unlike his predecessors, believing that these should be free of charge. See Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1902-1910* México D.F.

[84] For instance, in 1882-1892 the net deficit for the telegraph was $303,425, while if one accounts for the revenue that would have come from the telegrams sent by the government, the surplus would have been around $235,567. See Newspaper:*Excelsior*, 12 February (1933), p.1 and p.8. Also Newspaper: *Excelsior*, 13 February (1933), p.5 and 8; 14 February (1933), p.5; 15 February (1933), p.5

[85] Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1896-99*, México D.F. Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1909-1910* Mexico. D.F. Noyola (2004).

[86] Dirección General de Telégrafos Nacionales, *Breves Apuntes sobre las Comunicaciones Telegráficas en el País* Mexico, Talleres Gráficos de la Nación (1924), Secretaría de Comunicaciones y Obras Públicas, SCOP *Memoria 1892-96*, Mexico.

revenue.[87] On reflection, although the government did not always complement the work of the regulatory framework (by building duplicate lines, for instance), Porfirio Díaz assigned some very effective individuals to the task of taking some important long-term steps, which proved successful in promoting Mexican telegraph diffusion.

The qualitative section of this chapter revealed that the diffusion of the telegraph in Argentina and Mexico was shaped to a large extent by certain key political institutions. Factors such as the attitude of the administration in power towards the telegraph, ultimately determined to a large extent the degree of government involvement and intervention in the sector. The inherited unstable environment characterised by wars and chaos was also important as it shaped to a certain extent an environment that indirectly placed further emphasis upon the perceived importance of the telegraph to the government. Finally, the efficiency and enforcement power of the regulatory body were also important in determining the speed of telegraph diffusion. One could argue that the regulatory body was more wide-reaching and forthcoming in Argentina; but perception and action are two very different beasts, with the latter obviously setting the tone for speedier telegraph diffusion. It is true that in Argentina much work was done on analysing the failings of the process, but it seems the regulatory institution in Mexico was more effective in maximising the efficiency of the telegraph network build-out and service, which in turn induced greater relative telegraph diffusion. Although the regression analysis provided some tentative indications of the significance of the role of the state, it is only with appropriate qualitative analysis that a true reflection of the significance they played in driving speedy telegraph diffusion comes fully to light.

4.3.2 The Telephone

With regard to the diffusion of the telephone, there were two critical institutional reforms, the nationalisation and privatisation reforms. The impact of these two reforms was accounted for in the regression analysis above, but given the limitations of the data and the approach itself in using dummy variables to evaluate the impact of such complex institutional reforms, one needs to assess the results of the regression analysis in corroboration with the qualitative assessment. Having said this,

[87] Note in 1901 the government already owned 47,828km the lines, provincial states had 6,917 km, private companies had 3,942 km, and the railroads had 12,036km. See Rodríguez (2000).

it is still worth noting that the regression revealed that the privatisation reform was particularly important in driving telephone diffusion in Argentina. Meanwhile in Mexico, the regressions failed to show a significant relationship between telephone diffusion and Telmex's nationalisation reform. By considering the institutional factors of the regression analysis in more depth and qualitatively interpreting a number of others, it is possible to create a sounder base from which to evaluate the argument regarding the key determinants of telephone diffusion. The main factors explored below include the degree of stability, the degree of autonomy and the characteristics of state power of the key different administrations, the state's shift in attitude towards the telephone, and the degree of effectiveness of the regulatory framework. By exploring these factors, some consistency of comparison across the two technologies in the two countries is possible.

Political Institutions: the Degree of Stability and Characteristics of State Power

The period of fastest telephone diffusion is characterised by both the nationalisation and privatisation reforms in Argentina and Mexico. Given the state's role in the implementation of these reforms, it is widely accepted that their degrees of success were largely dependent upon the inherent characteristics of the countries' executive branch.[88] Consequently, factors such as the degree of stability within the state, the degree of its autonomy, and the extent of the level of power concentration within the state are some important factors to consider (see chapter 1, section 1.5.4 The Institutional Approach: The Role of the State). Theoretically a setting with higher levels of these should allow for faster technology diffusion, as there are fewer difficulties in implementing necessary reforms and policies can remain relatively more consistent throughout time.[89] However, in practice there are many different forms (some overlapping) and degrees of these factors, which make them particularly difficult to define and assess. The task is made considerably more difficult by the sheer number of years under consideration here, in addition to the fact that the two countries not only had different political arenas, but the same administrations varied over time. Each country is explored individually below.

Argentina

[88] Petrazzini (1995).

[89] Evans P., *Embedded Autonomy: States and Industrial Transformation* Princeton, Princeton University Press (1995), Haggard (1990), Smith (1979).

As detailed in chapter 1, Argentina was characterised by a relatively higher degree of political flux than Mexico throughout much of the key telephone diffusion years (see section 1.1.3 The Politics of the Political Economy). Mexican politics were not without their problems, as explored below, but Argentina's politics over the period were dominated by conflict. There were short intervals of stability in the earlier period under consideration, but between 1930 and 1983 in particular, with few intervals of exception, Argentina was seemingly periodically plagued by military coups and generic conflict.[90] The volatile political system was evidenced not only by the 25 changes of presidency from the 1930s to 1989 (some of whom were literally in power for a matter of days), but by the fact that the actual regime types shifted (some military, some democratic, etc). A given administration could never be certain how long they would remain in power, and so rather than promoting policy making that would be most beneficial to society, they were more concerned with pushing through reforms that might extend their tenure and consolidate their power (or at the very least quell potential new opposition that came from interest groups).

The effect of this political turbulence from the perspective of this thesis often translated into the disorderly running of the telephone company as the different governments pursued different goals.[91] One must recall that during much of the period under consideration, the telephone company was a monopoly of the state (1946-1990). Consequently, the internal politics of the telephone provider were closely correlated with those of the state. As a result, it was common that with every new administration came the replacement of many of ENTel's employees whom the previous regime had appointed. Therefore, as governments came and went, so too did the top management of ENTel, along with their 'long-term' strategic plans.[92] It was not only the replacement of personnel, but also the cancellation and replacement of supplier contracts . Further, as the management was appointed by the president, those in the executive and top positions often had very little (if any) experience in the running of a telecom company, and consequently, the problems that arose from a lack of consistency were exacerbated by a lack of experience. One must note that for the period 1940-1980, secretaries of state, ministers and governors lasted in power an

[90] Noam (1998).
[91] Rock D., *Argentina 1516-1982: From Spanish Colonisation to the Falklands War* Berkeley, University of California Press (1985).
[92] Kalathil and Boas (2003).

average of 12, 13 and 14 months respectively. For state-owned companies and regulatory agencies during 1970-1990, the average tenure was even lower.[93]

During the period of telephone diffusion, Argentina did not establish a dominant coalition administration and thus the nation never enjoyed continuity of leadership of any high degree, which resulted in a distinct lack of clarity and hierarchical order. The situation was very different in Mexico, where the structure was much more vertically integrated. By the early 1980s the effects of this lack of relative governing stability in Argentina were taking their toll on the power base of the presidency and something needed to change. In 1983, the restoration of democracy seemed promising, but the legacies of previous administrations made it difficult for the incoming democratic governments to bring in reforms to bolster the telephone sector. As explained in chapter 1, it is not clear what type of regime was most beneficial to telephone diffusion and indeed some would argue that it was largely irrelevant in regard to effective policy.[94] The share of power in Argentina was relatively even across political parties and interest groups were generally quite strong. This was obviously of concern to the incumbent governing power since decisions could be blocked more easily.[95] Consequently, for much of the period of 10-90% telephone diffusion Argentina struggled to implement reforms, clear evidence of which was the failure of the first two attempts to privatise ENTel.

Argentina's first two attempts to privatise ENTel failed because the first administration lacked the necessary concentration of power, while the second did not have a sufficient degree of autonomy and was blocked by strong interest groups.[96] Indeed, it was not until Menem's administration that the situation was significantly reversed as ENTel was successfully privatised. Part of the reason why it was successful was that Menem (unlike in the two previous attempts) gave himself sufficient insulation by leaving little power outside his hands to implement the reform. His approach was to pass new temporary laws which centralised the policy-

[93] Petrazzini B., *Restructuring Telecommunications Policy in Argentina: Issue Beyond Domestic Concerns* Buenos Aires, mimeo presentado al XV Congreso de la International Political Science Association (1991).
[94] See chapter 1, section 1.1.3 The Politics of the Political Economy. Also see Haggard S. and Kaufman R., 'Democratic Transitions and Economic Reform' Paper presented at the Southern California Workshop on *Economic and Political Liberalisation*, University of Southern California, Los Angeles (1993).
[95] Oszlak (1990).
[96] See chapter 3, section *The Years of Privatisation.*

making process to his own inner circle, allowing the privatisation of ENTel to be achieved more smoothly and effectively as it was carried out almost entirely by presidential decrees.[97] In just two years Menem deployed over 100 'need and urgency' decrees, an extraordinary power that the previous presidents collectively adopted just 23 times in 136 years. He also brought in reinforcing organisational reforms including the introduction of fiscal and administrative institutions in an attempt to protect this new mode of governing.[98] The fact that he had to use more aggressive tactics and was finally successful goes some way toward illustrating the importance of the need for relative political stability and some sense of concentration of power in order to aid successful reform implementation.

Mexico

Mexico enjoyed, at least on the surface, a higher degree of political stability and institutional permanence over the relevant period of telephone diffusion. It is remarkable that for the whole of the critical period, (i.e. 10-90% telephone diffusion years) Mexico's political milieu was dominated primarily by one party (in great contrast to the experience of Argentina).[99] However, the fact that the same party was in power for so long did not mean that there was continuity of reforms nor did it ensure that a high level of autonomy was enjoyed seamlessly. In reality the power of the PRI varied significantly over time. The early years of telephone diffusion were characterised by the growing power of the political party, while the middle part saw the PRI create and sustain their stranglehold over power and finally the end of their uninterrupted tenure was characterised by a growing erosion of their authority (see chapter 1, sections *The Evolution of PRI control of Mexico [until 1960 and from 1960]*).

Despite the rise and fall of the PRI's power, the one party system in Mexico did bring about some significant advantages, in allowing for faster telephone diffusion (vis-à-vis Argentina). The Mexican state had a relatively higher degree of autonomy than its Argentinian counterpart and particularly by the second half of the century the

[97] The Economic Emergency Law and the Public Sector Reform Law. See Petrazzini (1995).
[98] Verbitsky H., *Robo para la Corona* Buenos Aires, Editorial Planeta (1991).
[99] Petrazzini (1995), Cavarozzi M., 'Political Cycles in Argentina since 1955' in O'Donnell G., Schmitter P.C. and Whitehead L., *Transitions from Authoritarian Rule: Latin America* Baltimore, Johns Hopkins University Press (1986), Hill and Abdala (1993), Cornelius and Craig (1991).

PRI effectively bought political stability. The degree of autonomy within the PRI was fostered by the weak and highly fragmented opposition parties, which were typically small and non-threatening. At times the PRI achieved political stability by virtue of their overall economic successes, especially during the economic miracle years (although marred by the increased levels of income inequality). The Mexican state was insulated more at important development stages of the telephone sector than Argentina was, because, as Noam points out, the PRI had materialised out of the Mexican Revolution. The Revolution united the Mexican people and nullified pre-existing arrangements – socially and institutionally, offering the new leader an unprecedented opportunity.[100] This is in line with Neher, who argues that political systems which form after a disruptive and radical social dislocation are typically more insulated from societal demands than states which emerge progressively, which in theory tend to be more vulnerable (such as Argentina).[101]

In the commentary on Argentina above, one point addressed the fact that the regime type is not necessarily the most important characteristic in determining effective policy, although many academics argue that authoritarian regimes do provide certain advantages over democracies.[102] For instance, authoritarian regimes offer greater capacity to introduce certain reforms from the planning, implementation and mobilisation of resources aspect. Moreover, Gerschenkron, Kuznets and Hewlett emphasise the potentially problematic nature of democracies with regard to the speed and timing of development since they do not provide the state with the necessary level of insulation from various interest groups.[103] Furthermore, it is argued that authoritarian regimes are equipped better to prepare and induce the masses to make sacrifices, as in regard to wage cuts, in order to achieve economic development.[104] Politically, plural regimes would be less able to instil such a national ideology of sacrifice in the pursuit of economic development.[105] The different structure of the

[100] Noam (1998).
[101] Neher C. D., *Southeast Asia: In the New International Era* Boulder, Westview (1991).
[102] See for instance Lipset S. M., 'Some Social Requisites of Democracy: Economic Development and Political Legitimacy' *American Political Science Review* 53 (1959): 69-105.
[103] Gerschenkron (1962), Kuznets S., 'Economic Growth and Income Inequality' *American Economic Review* 45 (1955): 1-28, Hewlett (1979).
[104] Johnson C., 'Political Institutions and Economic Performance: The Government-Business Relationship in Japan, South Korea, and Taiwan' in Deyo F., *The Political Economy of the New Asian Industrialism* U.S., Cornell University Press (1987).
[105] Johnson C., 'The Developmental State: Odyssey of a Concept' in Woo-Cumings M., *The Developmental State* Itacha and London, Cornell University Press (1999).

political systems was therefore a decisive factor. By global social standards perhaps Mexico's political institutions were not admired, but as far as telephone diffusion was concerned, the stronger presence of the characteristics described above, namely in Mexico's continuity of one political party and greater concentration of power seemingly afforded the regime, at least from a relative viewpoint, greater capacity to implement more effective diffusion enhancing reforms in the long-run.

The Government's Attitude and its Impact

Largely, both Argentina's and Mexico's governments were uninvolved in the earlier development of the telephone. This contrasts markedly with the situation under the early years of telegraph diffusion. As explained in chapter 3, this was in fact precisely due to the governments in the two countries having invested heavily in the telegraph, and the telephone being perceived as a threat.[106] Consequently, until the 1930s/1940s the expansion of the telephone network depended on private investment by mostly foreign firms, in a market almost entirely devoid of state intervention, and generally faced very limited control. For example, Argentina had no sector regulation until 1904, and Mexico did not pass a telephone law until 1932. Neither country adopted a truly interventionist stance until the 1940s.[107] At that point, the attitude of the two administrations toward the importance of the telephone changed and the two governments significantly increased their role and involvement within the sector, as they began to commit credibly towards the technology. A significant pick-up in diffusion followed. Indeed the government's attitude towards the telephone had swung full circle, from the very limited interest in the technology's early years to the realisation that the telephone deserved universal service given the resemblances to a public good. To this end, Argentina's and Mexico's government administrations not only increased their efforts in providing universal service, but generally placed further emphasis on redistributive policies, in alignment with accepted global standards. As a result, network provision improved, with the installation of new lines in non-urban areas which had until then been grossly underdeveloped due to the emphasis of the private providers on maximising profits. Both countries also implemented tariff policies, setting high long-distance taxes in order to subsidise

[106] See chapter 3, section 3.2.1 The Initial Years of Telephone Adoption.
[107] See Hill and Abdala (1993) and Petrazzini (1995).

local service, which as a result remained fairly cheap.[108] This shift in attitude coincided with a shift in the political economy, which resulted in a number of nationalisations for many enterprises including the telephone (see chapter 1, section *The Period of Import Substitution Industrialisation [1930s-1980s]*).[109]

Argentina

Argentina's government decided to take a majority stake in the incumbent telephone operator very early on, and by 1948 it was entirely state owned. Perón described the telephone in 1946 as '...essential for the economy and defence of the country... [and] the nervous system of the nation', thus, the new emphasis on the technology was already quite apparent.[110] Further, the state's strong commitment to the diffusion of the technology was indicative of an entire ideology shift and testament to much of the Argentinian population who no longer wanted their largest industries run by foreigners.[111] The only problem was that this commitment was undermined by the relative tumult in Argentinian politics following nationalisation, as violence seemingly escalated with each new administration from the end of Péron's constitutional period in office in 1955, until 1983.[112] This relative degree of political volatility over this period would see some 23 different administrators take control of the national telephone operator. In line with the stability of the given ruling government, the sector struggled to varying degrees to meet the needs of the public, often delaying infrastructure contracts and sometimes cancelling them all together.[113] Despite an outwardly positive stance from the government throughout, the broader economic volatility, political flux and many union issues during large portions of the critical period of telephone diffusion manifested themselves through waves of inconsistent telephone expansion.[114] Even when there was an official 'work plan',

[108] For instance ENTel's tariffs were kept artificially low, to the point that the profits did not even cover the funding requirements of normal operations or planned expansion. However, the state was successful in increasing coverage to previously neglected areas, as well as ensuring that the service was affordable to the masses at the expense of their foreign providers' profitability.

[109] For example, under Cárdenas' administration, the process of nationalisation began by nationalising enterprises, such as the railroads, which passed from foreign into Mexican hands. Cárdenas represents the promise of a 'Mexico for the Mexicans'. See Wright H. K., *Foreign Enterprise in Mexico: Laws and Policies* Chapel Hill, North Carolina University Press (1971), p.282.

[110] Cook (1999), p.556. Also see Tuman (2007).

[111] Donikian et al. (1990), Petrazzini (1995).

[112] Noam (1998).

[113] Argentina, Empresa Nacional de Telecomunicaciones, *Memoria Empresaria* 1985.

[114] In regard to unionism, note that the first union strikes during nationalisation came in August 1956, yet the dispute was not resolved for some three months. See Argentina, Empresa Nacional de Telecomunicaciones, *Memoria Empresaria* 1957.

execution of unplanned projects often totalled little more than half of the overall planned works.[115] There was a clear incompatibility between the fixed targets set for ENTel and what could actually be achieved.[116] For instance, just over 10 years into nationalisation, pending requests for telephone installations went from 145,258 in 1946 to 453,382 in 1958 and ENTel suitably made a financial loss for the first time under nationalisation in that final year.[117] The inconsistencies with regard to network build-out were dramatic and in one particular example, over 30 times more lines were delivered in 1979, than just four years earlier (for further details see chapter 3, section *The Progress Achieved during the Nationalised Era*).[118] Although the state clearly desired infrastructure expansion in order to increase the diffusion of telephone handsets among the population, the many directed efforts were hugely inefficient. Indeed, the hierarchical structure of ENTel became more and more convoluted right until privatisation, as each administration seemingly added to the complexity of its structure. As an example, there were some 15 primary roles/divisions listed in the 1965 official organisational chart of ENTel, compared to a sizeable 54 by 1983.[119]

Arguably, the privatisation of ENTel was a success in terms of significantly boosting telephone diffusion, which largely was because the nationalisation years had been so unfavourable. Although various Argentinian administrations had acknowledged the need for speedy diffusion, they were unable to follow through, often because of a difficult economic backdrop, relatively limited authority given the strength of opposition, and the shortness of their tenures. Despite the positive attitude of his predecessors, Menem demonstrated greater determination in his campaign in finally overseeing the successful completion of the privatisation reform, although it could be argued that his hand was slightly forced by material external pressures (see chapter 1, section *The Debt Crisis and the New Economic Model [1982-1990s]*). He was conscious of the need to complete a quick sale of ENTel, having recognised the threat of probable opposition to the reform. It is possible, therefore, that, despite the ultimate success of the structural shift of the national telephone provider into private

[115] Noam (1998).
[116] See Argentina, Empresa Nacional de Telecomunicaciones, *Memoria Empresaria* 1982-1984.
[117] Argentina, Empresa Nacional de Telecomunicaciones, *Memoria Empresaria* 1958.
[118] Also see Noam (1998).
[119] See Argentina, Empresa Nacional de Telecomunicaciones, *Memoria Empresaria* 1985, pp.81-84.

hands, the process could have been handled better if it were not for the need of a timely sale. For instance, a more appropriate regulatory framework could have been set up pre-privatisation (as discussed below). However, it was during privatisation (albeit in the relinquishing of direct state control) that a positive attitude of the state finally translated into meaningful telephone diffusion.

Mexico

As discussed in chapter 3, Mexico's administration did not initially fully nationalise Telmex (as in Argentina). Indeed Telmex would never become fully government owned (see chapter 3, section *Period of Nationalisation*). Instead, Mexico's government implemented a measured increase in its influence. The succession of administrations from the 1940s were able to shape and direct telephone evolution, and as a result one can observe the fast and incremental growth of the telephone service, particularly during the 1960s-1970s, as the involvement of the government in the sector grew. This period coincided with the 'Mexican economic miracle' years as well as some of the PRI's most authoritatively dominant years in power.[120] The government quickly acknowledged in the mid to late 1940s that the existing infrastructure was insufficient and implemented the Alemán Valdés Plan (1947-1952) as hopes of expansion grew.[121] The period of growth of telephone diffusion in Mexico arguably began to see some real improvement under Alemán Valdés whose views regarding nationalisation were at odds with those of Péron. The influence of state participation in the sector intensified as its importance continued to grow, advancing slowly but continually from the 1950s as the state sought to keep pace with Europe and the U.S. with regard to technology developments. During the Ruíz Cortines administration a significant increase in investment in the sector occurred, something which his successors would continue as nationalisation neared.

From the 1950s Mexico's government also made some real attempts to increase universal service; in 1952 a tax imposed a 10% charge on long-distance calls, to allow for local rates to remain discounted to the real market price.[122] Moreover in

[120] See chapter 1, sections *The Period of Import Substitution Industrialisation (1930s-1980s)* and *The Evolution of PRI control of Mexico (until 1960)*.

[121] The Miguel Alemán plan was a scheme under which SCT would engage in the building of new lines, and the result was a significant growth in the number of federal telephone lines. See Noam (1998).

[122] Indeed, until 1987, local rates in Mexico were some of the cheapest worldwide, although in contrast the long-distance charges were among the most expensive.

1954, a new government reform gave priority for line installation to those who had purchased Telmex shares, which helped to finance the telephone operator.[123] This ensured that investment found its way to the sector, even if at times this was via unpopular means, and these revenues were reinvested in the company. [124] The government also introduced a tariff freeze during 1954-1975 to make the telephone more accessible, although it reduced Telmex's revenue by a massive 94% in real terms. Thus the state, like in Argentina, improved the accessibility of the technology, even at the expense of profits. In 1958 the López Mateos administration implemented a number of populist gestures. Among them was the return of Telmex into Mexican hands, as he Mexicanised it, signifying the great importance that the state attached to the sector.[125] A significant expansion of telephone diffusion took place from then on and 'by 1967 Mexico was the third fastest growing telephone system in the world'.[126] Indeed, between 1960 and 1976 the number of telephone handsets per households increased fourfold.[127] During the 1960s the government remained heavily involved in Telmex and in 1972, under Echeverría, the government gained majority ownership of Telmex. It was from here onwards that the company's development really took off, and expansion followed at a very rapid pace, aided by foreign loans to build-out new infrastructure.

At the time of privatisation, although external pressures were present, there was an acceptance that Telmex would not be able to continue to grow fast enough; the government knew the company needed to enter world markets in order to meet infrastructure requirements and to diversify in a manner that needed the sourcing of additional technological expertise and capital. As in Argentina, privatisation of the telephone company was also political, but the case of Mexico was quite different. It was a gesture of intent, whereby the Mexican government was trying to demonstrate that they themselves had changed and were willing to privatise a sector that was so valuable and important to them. The Salinas de Gotari administration admitted that telecommunications was '...the cornerstone of the programme to modernise Mexico's

[123] Székely and Palacio (1995), Noam (1998).
[124] Cárdenas de la Peña E., 'Historia de las Comunicaciones y los Transportes en México: El Teléfono' México D.F., *Secretaría de Comunicaciones y Transportes* (1987b).
[125] Telmex was Mexicanised by coercing foreign investors to sell their shares.
[126] Petrazzini (1995), p.108.
[127] See data in appendix B.

economy'.[128] This reinforced their positive attitude towards the telephone since in part the privatisation signalled their willingness to give up the revenue streams of the second largest company in Mexico, in favour of improving the telephone sector's efficiency (and in turn the telephone's continued diffusion). The privatisation reform was successfully implemented as a result of two key factors; one, the government's attitude towards the importance of the reform's success, and two, the fact that, (even though the PRI's power was diminishing) the administration still retained greater capacity, through relatively higher concentration of power (in implementing the reform smoothly) and autonomy (to develop the right strategy), with less significant opposition in comparison to Argentina.

Although it can be argued that the various administrations in the two countries could have done more, such as placing more emphasis on objective setting with regard to the telephone providers' growth, in reality they achieved a great deal. [129] This was particularly true in Mexico, where telephone diffusion grew at a steadily fast pace throughout the 10-90% diffusion period, while the fastest telephone diffusion growth in Argentina was very much concentrated in the latter part of the period (the years of privatisation).

The Degree of Effectiveness of the Regulatory Framework

It is essential to examine the degree of efficiency within the institutional arrangements concerning the regulation of the telephone sector. An effective regulatory framework is important for the successful diffusion of the telephone, particularly when under private provision, while under nationalisation, regulation was linked closely to the administrative power hence had limited ability to act independently or induce meaningful change (as described below).

Argentina

Argentina's telecom regulator was the *Secretaría de Comunicaciones* (SECOM) since 1936. As per Mexico, the federal government controlled the sector. SECOM's mandate was clear: to develop service provision and communications plans. Given the continual impermanence of Argentina's political players, it was no wonder that

[128] Noam (1998), p.166. Also see Cook (1999) and Tuman (2007).
[129] Petrazzini (1995), Hill and Abdala (1993), Tuman (2007), Noam (1998).

similar shifts in the strategy and goals of the regulatory framework were just as aggressive. A further difficulty in regulating ENTel was the fact that the highest ranking officials were all directly selected by the presidential office, thereby closely integrating the managerial structure with politics, as explored earlier (see chapter 3, section *The Progress Achieved during the Nationalised Era*). To corroborate these issues, consider the following example of the second failed attempt to privatise ENTel in greater detail. In 1987, the new Minister of Public Works and Alfonsín decided to liberalise the telephone sector and partially privatise ENTel. Alfonsín first issued the necessary decrees that were inconsistent with the 1972 National Telecommunications Law (instigated by a previous Argentinian government), but then was unable to persuade congress to approve the privatisation reform. [130] Moreover, as Alfonsín's tenure was coming to an end, the whole process of designing and implementing a successful strategy for the telephone sector's growth (which would end up being privatised anyway) would be started all over again. This demonstrates how inadequate the system was in speeding up telephone diffusion. The implementation and assurance of adherence to regulation in Argentina was no simple task. On the one hand, dominant interest groups enjoyed much greater political clout than they did in Mexico and therefore potential resistance to reform was stronger. Further, the fact that ENTel was subjected to the policies of up to seven state agencies, all carrying their own agendas, resulted in typically opposing policies, which changed in tandem with every change of administration. For instance ENTel's budget was determined by the Ministry of the Economy, salaries were set by the Ministry of Labour, equipment was purchased by the Secretary of Industry, public service and provision policy was drafted by the Ministry of Services and Public Works, and SECOM created generic sectoral policies. It is no wonder that policies were inconsistent and inefficient.

Argentina created the *Pliego* in 1990 in anticipation of the privatisation reform. [131] The decree established the basis and conditions for the sale of ENTel, and granted the two future telephone providers a monopoly until 1997 on the condition that they

[130] Noam (1998).
[131] Argentina, Pliego de Bases y Condiciones para la Privatización del Servicio Público de Telecomunicaciones Executive Decree 62/1990 (5th January 1990). This document set out the terms and conditions for the Privatisation of the Telecommunications Services. Celani M., 'Determinantes de la Inversión en Telecomunicaciones en Argentina' *CEPAL Serie Reformas Económicas* 9 (1998): 1-45.

followed certain expansion goals. Although the *Pliego* provided general regulatory principles and the establishment of a regulator, in practice next to nothing was done. The task was executed with limited urgency since the regulatory authorities had thought from the beginning that the privatisation reform would fail, as past attempts had.[132] The policy making and regulatory functions were divided in the Argentinian system, in order to create a more autonomous framework. However, the *Comisión Nacional de Telecomunicaciones* (CNT), created in 1990, was in charge of almost all the regulatory functions.[133] Like most equivalent bodies, CNT was not free from bureaucratic struggles since its commissioners were appointed by the president.[134] Until 1991, CNT acted very infrequently, creating a backlog of decisions over the regulatory process. CNT was ineffectual in various areas, but most unfortunate was its ineptness in dealing with customer complaints.[135] CNT's decision-making process was so vague and non-standardised that it unnecessarily increased the risk of investing in the sector. In its defence, CNT's had no experienced staff to deal with its many responsibilities, and further, the commission had limited funding to source intellectual capital, nor did it have clearly defined reporting lines.[136]

Essentially, there was a general lack of clarity regarding the specific roles and range of authority of the regulatory framework, which made the task of standardising regulation difficult.[137] Pre-privatisation, the Argentinian government neglected to set up a regulatory framework and instead opted to wait until the entire process was well under way before designing anything suitable (in contrast with the Mexican experience where a regulatory framework was at least in existence). This was largely inefficient and meant that potential bidders were bidding blind in terms of knowledge of future regulatory requirements.[138] An unsurprising consensus formed by the end of 1991 that Argentina's telecom sector required more effective regulation, and

[132] Hill and Abdala (1993).
[133] CNT would become CNC from 1996.
[134] Petrazzini (1995), Noam (1998).
[135] For instance, there was a six-month delay in CNT's response to CAT's simple tariff increase requests, and they also ignored gross rate disparities between call types, which culminated in much distorted usage patterns. Additionally, it artificially incentivised new firms to 'cherry-pick' from the long distance and international markets; regulation was so lax that American firms managed to sell international calling cards illegally in Argentina. Moreover, CNT was ineffective in developing suitable standards and processes for issuing licences, verifying whether the licensee companies had actually met their performance targets, or in not creating a pricing policy that made most services economically viable. See Hill and Abdala (1993).
[136] Ibid.
[137] Luxner L., 'Dollars for Dialling' *Americas* (English Version) 44 (1992).
[138] This was a result of a speedy privatisation process forced upon Menem as indicated earlier.

accordingly (and in large part due to the fact that the World Bank forced its hand) the government intervened in 1992 and reformed CNT. CNT's mandate was reduced, and this induced a marked improvement in its efficiency.[139] All along, CNT had been largely dependent on SECOM (despite its theoretical autonomy), and now many of the important executive decisions (e.g. the control and operation of the licensing) were officially handed back to SECOM.[140] This transfer of regulatory power continued and by 1995/1996 SECOM had regained almost all of its initial regulatory power over the sector.[141] Although Argentina's regulatory framework seemed quite inefficient and unfavourable to the telephone sector's positive development, it is important to appreciate the explicit political implications surrounding the sector. Most importantly, it was not that there was no desire to appropriately regulate the telephone sector, but rather the sector was quite convoluted and subject to change.

Mexico

In Mexico, the telephone company was under the regulation of the *Secretaría de Comunicaciones y Obras Públicas* (SCOP). By 1936 a new law interconnected the telephone service providers, which resulted in a vast improvement in service provision and coverage, demonstrating early on how effective the regulatory function could be. In 1938 the Law of General Means of Communications was approved and this became central to the telecom industry in post-revolutionary Mexico. Indeed for 50 years, Mexico's telecom regulation would be based upon this very law, which granted the government extraordinary powers to interfere in corporate affairs. SCOP managed to significantly increase the development and access to the network. For instance, in 1947 SCOP arranged the merger of the two main telephone providers to avoid line duplication, improving the efficiency of the overall service, and promoting further diffusion.

Some argue that by the late 1950s, the politics of Mexico's telecommunications were based on three main agents, the constitution, the Law of General Means of

[139] Cook (1999), Noam (1998), Petrazzini (1996), Hill and Abdala (1993).
[140] Ronchietto A. and Rozenwurcel G., *Regulación de las Telecomunicaciones en Argentina: Marco Institucional, Interconexión y Servicio Universal* Universidad de Belgrano, Instituto Nacional de la Administración Pública (1999).
[141] Abdala (2000).

Communications and the *Secretaría de Comunicaciones y Transportes* (SCT).[142] The first two provided the governing and legal framework, while the task of the third was to stimulate the development of the technology efficiently.[143] SCT, which was part of the Ministry of Communications, became Mexico's new telecom regulatory body in 1959.[144] In the earlier part of the period, SCT proved to be relatively effective in advancing the formation of a modern telecom system through policy. SCT standardised technical aspects, controlled investment plans, and routinely re-set tariffs.[145] By the 1960s Mexico had acquired an enviable telephone system and SCT continued to improve in terms of effectiveness through the 1970s, as it targeted telephone development in rural areas, which was essential in maximising diffusion. In fact, by 1973 there were an extra 2,680km of lines benefiting almost 700,000 Mexicans in the rural areas, as the regulatory body was making a decisive effort to promote telephone access, increasing it from 770 to 1,500 towns in 1965-1970.[146] Soon afterwards, however, inefficient regulation by the state started to take its toll and Telmex's regulation became more of a painful reflection of the government's continual pursuit of self-interested goals over industry development. This meant profitability suffered and cross-subsidies of distance taxes worsened.[147] The Mexican government began using Telmex's profits to subsidise other sectors in the economy, and consequently re-investment to fuel growth and the quality of the service, deteriorated. This type of behaviour was testament to the economic backdrop, as this period also coincided with the end of the miracle years of growth and the growing erosion of PRI authority over Mexico.

---

[142] Note that the *Ley de Vías Generales de Comunicación* was replaced by the *Ley Federal de Telecomunicaciones* in 1995. See Artículo 28 de la Constitución Politica de los Estados Unidos Mexicano, the article that defined telecomunications as a strategic sector. Secretaría de Comunicaciones y Transportes, *Ley Federal de Telecomunicaciones* Diario Oficial de la Federación, Mexico, SCT, (8 June 1995). The critical difference between the two laws was that when a provision of a line expired after the 50 year tenure, the government no longer had the line free of charge but had to pay for it and if they refused to do so, third parties were allowed to step in. See Secretaría de Comunicaciones y Transportes, *Reglamento de Telecomunicaciones* Mexico, SCT (1995).

[143] For more details on the specific duties of SCT see Secretaría de Comunicaciones y Transportes, *Reglamento de Telecomunicaciones* Mexico, SCT (1995).

[144] The federal government, through SCT, were responsible for the distribution of the telecom services, installation, maintenance, operations and the development of the telecom network, with the aim of providing a satisfactory public service.

[145] Secretaría de Comunicaciones y Transportes, *Programa Nacional de Modernización de las Telecomunicaciones 1989-1994* Mexico, SCT (1994).

[146] Secretaría de Comunicaciones y Transportes, *Programa Nacional de Modernización de las Telecomunicaciones 1989-1994* Mexico, SCT (1994).

[147] Griffith K., 'Mexican Tele-connectivity' in Harms L. S. and Wedemeyer D. J., *PTC '89 Proceedings Pacific Telecommunications Connectivity: Users, Networks and Information Services: Proceedings* Honolulu, Pacific Telecommunications Council (1989), Hill and Abdala (1993), Noam (1998), Casaús (1994).

After privatisation and for the next five years, Telmex continued to be regulated solely by SCT. In 1995, the Federal Telecommunications Law (FTL) opened competition in the market and formalised the auction process for concessions to operate public communications. The law limited state involvement and allowed tariffs to adjust freely.[148] It also confirmed SCT as the telecoms regulator, which was to promote quality and efficient growth of the sector. However, given the nuances of the Mexican judicial system, the FTL actually achieved very little due to the existence of *amparos*.[149] Indeed, given the slow turnaround speed of the legal system, this proved to be a successful form of defence for Telmex.[150] In 1996 the Comisión Federal de Telecomunicaciones (Cofetel) was created by a presidential decree. Cofetel was to be a new and autonomous regulatory body, 'independent' of SCT. The idea was for Cofetel and SCT to co-regulate the telephone sector (and split the functions). In reality, Cofetel's power was limited, as its role was only to give recommendations to SCT, and it was not supposed to assert any authority, making the regulatory process supremely inefficient.[151] Thus, although in theory they were autonomous; in practice they were not independent at all. Further, under this framework, Telmex also had input regarding its own regulation, and under certain circumstances it could even opt out of rules (as long as SCT did not oppose).[152] Then, as supplementary firepower to the overall regulatory oversight, the *Comisión Federal de Competencia* (CFC) was created to prevent anti-competitive behaviour in the market. CFC caused further conflict for Cofetel as it challenged Telmex in 1997, claiming it was a practising monopoly. Telmex filed an *amparo* against this resolution, and the federal court highlighted CFC's limited influence and threw out its claims on grounds of insufficient evidence. It is interesting that Telmex faced no competition until 1998, and this highlights CFC's lack of power and efficiency.

Overall, in terms of the regulatory framework, one could argue that Argentina's regulatory framework did not thrive during nationalisation, and despite its lethargy in building a suitable framework before privatisation, during the post-privatisation

[148] Secretaría de Comunicaciones y Transportes, 'Ley Federal de Comunicaciones' *Diario Oficial de la Federación* Mexico, SCT (1995).
[149] An *amparo* allowed any firm to demand a temporary suspension of regulatory action under various circumstances.
[150] Mariscal and Rivera (2004).
[151] Ibid.
[152] Secretaría de Comunicaciones y Transportes, *Ley Federal de Comunicaciones* Diario Oficial de la Federación, Mexico, SCT (1995).

period the balance of effectiveness started to shift. Meanwhile, the effectiveness of Mexico's regulatory framework almost mirrored the strength of the country's economic successes and height of political authority, for instance from the latter part of the 1940s and most of the 1950s Mexico experienced relatively stronger regulatory success. Nevertheless, the regulatory frameworks in both countries largely failed to achieve the goals that were set: while the policy framework said one thing (competition and liberalisation) the reality said something entirely different as the advent of real competition was delayed until the end of the 1990s. Although haste and a lack of long-term organisation were some of the reasons for reduced effectiveness, the regulatory function was efficient to a certain extent, as telecoms was one of the economic sectors receiving the highest gross fixed investment between 1991 and 1997.[153] In reality the structures of the two regulatory agency structures, especially during privatisation, were undermined by state bureaucracy and institutional instability, and a lack of definitive governing criterion regarding the regulatory process.[154] In Argentina, the regulatory framework was perhaps more clearly defined (by regulatory decrees) but implementation proved more troublesome than in Mexico. However, it is clear that the regulatory function – whether the driver or perceived inhibiter of diffusion – played some role throughout the history of telephone diffusion in Argentina and Mexico.

The qualitative assessment of the diffusion of the telephone in Argentina and Mexico highlighted the important role played by the different governing administrations. Theory contends that a higher degree of stability within the political system, greater autonomy and concentration of power, should indirectly have a positive effect on faster diffusion, as reforms can be more easily implemented. The case studies of Argentina and Mexico for the period under consideration show that this is not straightforward to measure. One could argue that for key periods of telephone diffusion, particularly during the 1940s-1980s, Mexico seemingly had an advantage over Argentina, as Mexico's political arena was characterised by a one party system. Moreover, despite the fact that the administrations in the two countries were keen to diffuse the telephone, this willingness seemingly translated into the more efficient implementation of reforms in Mexico rather than in Argentina. Lastly, the regulatory

[153] Celani (1998).
[154] Baur (1994).

framework that governed the process of diffusion suggests that although in theory and in planning, Argentina had a superior regulatory body, it was in Mexico that it proved to be slightly more effective (especially in the years just before privatisation) in governing and decisively acting to promote speedy diffusion.

4.3.3 Qualitative Analysis Summary

The qualitative section drew attention back to the central role played by the different governments during the periods of telegraph and telephone diffusion. This section is important since it allows for more meaningful interpretations to be made in the next chapter, in regard to the arguments concerning the importance of the political economy in explaining the given patterns of ICT diffusion under consideration. The qualitative analysis showed that the continuous influence of the government, whether directly in reform implementation or indirectly via its influence on the regulatory function, was present throughout the diffusion process. Although the lingering effects of war (during telegraph diffusion) and the (in)effectiveness of the regulatory framework (during telephone diffusion) played their part in explaining diffusion growth (or lack thereof) to some degree, the primary explanatory driver was arguably state action. The state's positive attitude toward the diffusion of the technologies was reflected most clearly in their ever evolving structural views on the sector: for instance, in telephone diffusion it governed nationalisation and then implemented privatisation. Institutionally, despite the often more structured and methodical regulators in Argentina (admittedly in the face of greater political uncertainty), Mexico's regulatory framework was seemingly more effective in governing the diffusion process (although not in all periods). Overall, despite the willingness on the part of Argentinian and Mexican leaders, the relatively greater political stability (during important periods for diffusion) and continuity of control in Mexico (especially during the PRI's uninterrupted tenure) seemingly afforded their heads of state more opportunity to advance the diffusion of the telegraph and telephone technologies.

4.4 Conclusion

This chapter applied a quantitative and qualitative analysis to assess the explanatory factors behind the observed rates of telegraph and telephone diffusion in Argentina and Mexico. An even balance between the quantitative and the qualitative analysis is

generally preferred, but in light of the limitations of the underlying data and the indications offered by the regressions, the qualitative analysis took on even greater importance within this study. Given that the two countries diffused the two technologies at similar rates despite their different economic make-ups, it is interesting to analyse the unique set of variables behind this phenomenon. Guided by the literature review of chapter 1, a number of quantitative and qualitative factors were assessed, providing the basis for a better understanding of the Paradox. In this assessment, the Paradox is explained by the apparent underperformance of the Argentinian administrations, and the outperformance of the Mexican ones, which seemingly made the most of key state reforms (an argument further expanded upon in chapter 5, section 5.2 Explaining the 'Double Paradox').

Chapter 5

A Comparative Discussion of the Empirical Findings

This chapter examines and consolidates the findings of the previous chapters, to answer the main questions raised in the introduction of the thesis. Firstly, given the relative disparity in Argentina's and Mexico's respective economic settings, what were the main drivers behind the observed diffusion rates? This provides the basis for the primary focus of the chapter, that is, to address the second question of the thesis: what factors caused the Paradox? The answer to this lies largely in the role played by the government. Given Mexico's relatively greater barriers to economic and social development in comparison to Argentina (especially at the beginning of the period under examination), this should in theory have hindered diffusion. To substitute for these economic shortcomings, the Mexican state exploited alternative factors to speed up successful technology diffusion. Ultimately at particular stages and in varying levels, the Mexican state's relatively more positive attitude toward the need for diffusion, and perhaps more importantly, its greater strength of action (especially in the latter part of telegraph diffusion and first part of telephone diffusion), provided a diffusion-conducive setting for the two technologies. This success was fostered by the demonstration of particular traits, in addition to the relative benefits of a stronger sense of timing and the seeming underperformance of the Argentinian state function. The chapter finishes by assessing the third question: to what extent can the Mexican case study be considered a 'Success Story'? In providing an answer to this, some lessons are highlighted.

Chapter 2 measured the rates of diffusion via the FLOG and linearisation techniques (see chapter 2, section 2.6 Applying the Flog Model), to demonstrate that the relative diffusion rates in Argentina and Mexico were similar for the telegraph (CRD = 25 and 26 years) and for the telephone (CRD = 54 and 52 years), despite the presence of their significantly differing economic milieus (see chapter 1, section 1.1.1 The Economics of the Political Economy). Chapter 3 placed the development of the two technologies within the historiography of the two countries set up in chapter 1. After which, chapter 4 quantitatively and qualitatively assessed the main factors which could potentially explain the diffusion rates in the two countries, with the guidance

offered by chapter 1 (see section 1.5 Review of the Approaches to Different Rates of ICT Diffusion). In consolidation of the contributions of chapters 1 – 4, this chapter will determine more holistic findings.

5.1 The Rates of Diffusion in Argentina and Mexico

There are naturally some common themes present in the diffusion of the telegraph and the telephone in Argentina and Mexico, but there are also some idiosyncratic explanatory factors, which combine to underpin the entire analysis. Since the diffusion of the two technologies took place over two very different time periods, a given relevant factor in one setting may not affect the diffusion of the other. For instance, the post-independence chaos of the nineteenth century had a decisive impact upon the evolution of telegraph diffusion but clearly did not have anything like the same effect upon telephone diffusion. On the other hand, since the two technologies are in practice quite similar (and are substitutes for one another) they have a number of commonalities (e.g. characteristics of natural monopolies), which means that there are certain generic factors that commonly explained the diffusion patterns observed across the two technologies. The next section pinpoints these explanatory factors, in regard to diffusion speed, first in examination of the telegraph and then the telephone.

5.1.1 The Telegraph

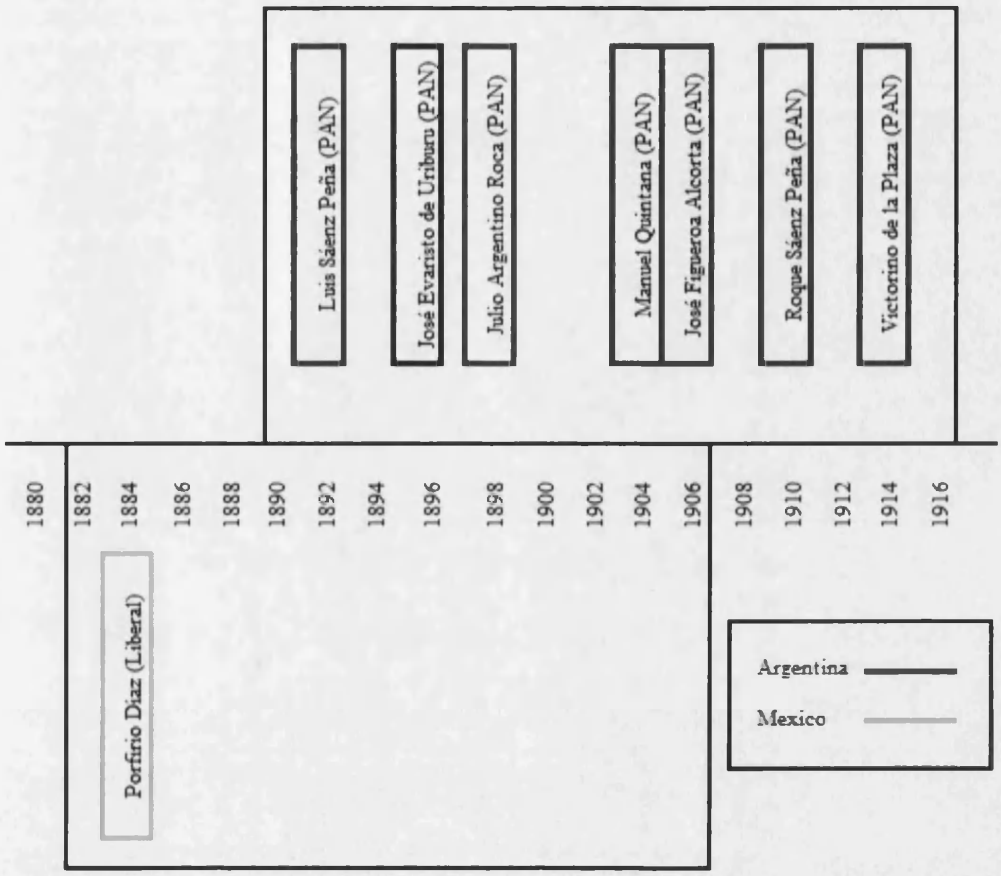
Telegraph diffusion speed in Argentina can be explained partly by the somewhat inhibiting role played by the delayed implementation of some important reforms. Meanwhile, the telegraph diffusion rate in Mexico can be explained partly by the relatively more effective implementation of key government reforms. The findings therefore suggest that state action can have both a positive and a negative effect upon the diffusion process.

Chapter 4 highlighted the importance of the presiding government's role and attitude in the two countries during telegraph diffusion. Argentina and Mexico suffered from a period of significant chaos and political instability when the technology first emerged; the opportunity provided by it to establish order and consolidation of power was very attractive at a time when the two regimes were obsessed with state-building. The telegraph also allowed for national integration and the advancement of

economic development by facilitating trade and commerce. Given the political implications, it is evident why both governments were happy to drive the technology's expansion. Proof of this is found in the fact that they quickly made the telegraph a monopoly of the state, and were keen to expand the network quickly, granting concessions to various groups, which also kept direct costs to a minimum (see chapter 1, section *State Formation and the Telegraph and the Telephone in Argentina and Mexico* and chapter 3, section 3.1.1 The Adoption and Early Years of Telegraph Diffusion).

Without the 'right' attitude, telegraph diffusion arguably would not have began when it did in either of the two countries and quite possibly might have followed an entirely different diffusion path (e.g. in terms of structural evolution), given the government's vital role in the initial infrastructural development of such goods. This attitude also largely framed and pre-determined sector policy and the regulatory framework (as argued in the qualitative section of chapter 4, section 4.3.1 The Telegraph). Intuitively, if the respective administrations had not supported the diffusion of the technology or even 'allowed' (never mind facilitated) its initial adoption, all other explanatory factors would be largely inconsequential. Specifically, in the case of Mexico, the impact of the Porfiriato is believed to hold particular importance, as his regime dominated the vast majority of the key telegraph diffusion years (as highlighted in figure 5.1 below). In Argentina, the state's passing of the Mitre Law is believed to hold particular importance (see chapter 3, section *The Role of the State: the Impact of New Laws*). It is also necessary to distinguish the specific effect that such factors had on diffusion, since the Porfiriato in reality expanded the telegraph network in all directions and an increase in usage followed largely in line. The Mitre Law, however not only generated an eventual large scale build-out of the network but also induced an immediate increase in usage of the system, by means of dramatically improving accessibility through the more efficient inter-connection of the existing telegraph network.

Figure 5.1 Presidential Changes in Argentina and Mexico (10-90% Telegraph Diffusion)



Source: Own elaboration. See appendix H. Note: PAN: Partido Autonomista Nacional, and Liberal: Partido Liberal. Note: The figure only displays the presidencies where the full term occurred in this period.

Figure 5.1 charts a timeline of the changes in presidents in Argentina and Mexico during this key period of telegraph diffusion, with each box representing a new administration (and the thick black box representing the 10-90% diffusion period). During this period, Porfirio Díaz controlled the Mexican presidency, while Argentina was governed by seven different PAN-affiliated presidents. It is not intended to over homogenise Mexican politics or over 'democratise' Argentinian politics (since this was not the case), or to simplify what was a very complex political system (see chapter 1, section 1.1.3a. The Structure of Argentina's and Mexico's Political System), but it simply illustrates the seemingly higher degree of consistency in Mexico's political arena, as the period was dominated by just one regime. In contrast, although Argentinian politics were now more stable (in comparison to the previous period) and indeed were governed by just one party, the continuous changes in the head of state naturally afforded them less continuity of strategy and action.

The fact that Mexico was characterised by one administration during this period did not necessarily mean that Porfirio Díaz automatically possessed a higher degree of autonomy and centralism of power. Further, even with a higher degree of these political characteristics, the success of strategies or actions towards telegraph diffusion is not guaranteed, but it merely provides greater capacity to do so. Diffusion in Mexico was somewhat 'luckily' aided by the fact that Porfirio Díaz saw the telegraph as a strategic tool and was thus keen to emphasise its development. Moreover, since Porfirio Díaz took on a government role that directly oversaw the telegraph build-out even in the four years he was out of office (in between tenures), this served to accentuate the consistency of policy-making and execution. Then when he regained the presidency in 1884, Mexico was in an even more favourable position from which to induce further telegraph network expansion (and in turn diffusion) since the country was at relative peace.

In Argentina, although the political regime was relatively stable (indicated by the single political party), the regular changes in government administrations, at least in the telecom sector partly translated into a lack of consistency in the general running of the main telegraph operator. For instance in 1905, Quintana's administration passed a statute that would allow for new mass construction of the network, connecting Buenos Aires to all the key commercial hubs. However, less than half of the projected build-out was completed in the first six years, as Alcorta became Argentina's new president in 1906 and since this was not *his* project, it was not given the relevant priority. Again under Sáenz Peña in 1912, a huge reconstruction and consolidation plan was proposed, but by 1916 little was achieved as yet another president assumed power half way through.[1] Despite the good intentions of the different government administrations, their capacity to act meaningfully was weakened by the shortness of their tenures. Moreover, the political system in Argentina was relatively more open to different political actors and was perhaps a more socially inclined system than that of Mexico, which made the opposition stronger. In Mexico, although the ability to implement reforms varied through time and across regions (see chapter 1, section *The Porfiriato: the Range in Authority Exercised*), the regime of Porfirio Díaz continually sought to ensure that the

[1] See Berthold (1921a).

telegraph network would expand, even if at times, tactics were somewhat overly aggressive (e.g. 'telegraph crime', see chapter 4, section *The Government's Attitude towards the Telegraph*). Indeed, as indicated in the Porfiriato section in chapter 1, there has been significant debate surrounding the extent of its achievements and whether it was a 'dictatorship' in the true sense, but a widely held view in regard to the telegraph is that one of Porfirio Díaz's regime's largest success was the significant telegraph network expansion achieved.

In Argentina, the importance of the role of the governing administration is particularly highlighted with the implementation of the Mitre Law in 1907. This law ensured a sizeable expansion in network infrastructure especially in the first few years after its implementation, but it also had a more immediate effect (aided by the tariff unification scheme) by opening up network coverage by connecting more useful commercial hubs. This combined to generate a sizeable increase in the number of telegrams sent (i.e. diffusion growth) as it became easier to send telegrams due to the larger, wider reaching network (see table 5.1).

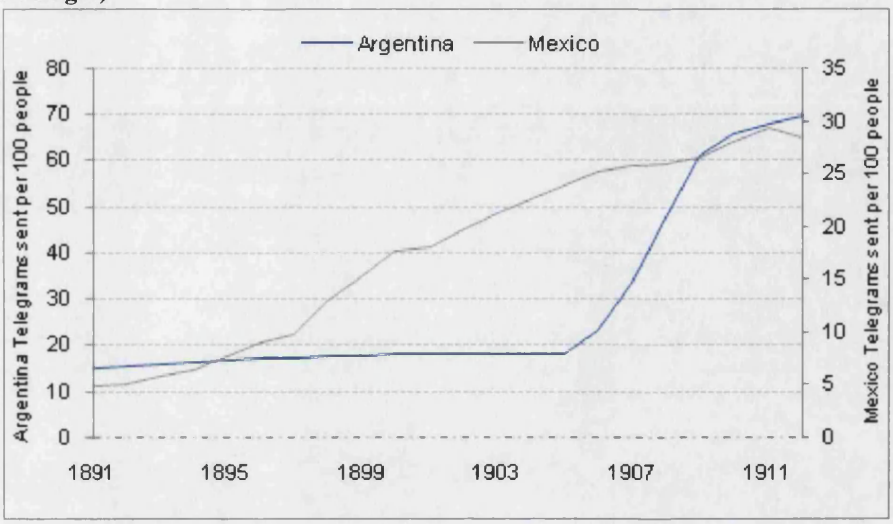
Table 5.1 Telegraph Diffusion (Telegrams sent per 100 people)

	1880	1884	1888	1892	1896	1900	1904	1906	1908	1910	1912
Argentina	9.0	12.3	13.0	15.6	17.1	17.8	17.9	18.0	48.1	73.8	68.0
Mexico	0.9	0.6	3.1	5.6	9.1	16.7	22.2	25.7	25.4	27.4	30.8

Source: see appendix B.

As table 5.1 reveals, telegraph diffusion in Argentina significantly increased from 1906 to 1908, around the Mitre Law's introduction. It was at this point that the absolute level of telegrams sent in Argentina caught up with (and overtook) the levels in Mexico. As shown in appendix C, table C.1, in the three years before the introduction of the Mitre Law, year on year average network traffic usage was 0.4%, while in the three years immediately after this, the average rose to 52.5%. This seeming constriction of network build-out may well have restricted to some extent the usage of the telegraph, and hence its diffusion among consumers, as indicated in figure 5.2, which shows the partial telegraph diffusion s-curves of Argentina and Mexico.

Figure 5.2 Argentina's and Mexico's Partial Telegraph Diffusion S-curve (3 Year Moving Averages)



Source: see appendix B.

Figure 5.2 neatly demonstrates the minimal growth in telegraph diffusion in Argentina before the introduction of the Mitre Law, and also shows that under Porfirio Díaz's guidance, telegraph diffusion growth in Mexico was very continuous.

Overall, telegraph diffusion in Argentina and Mexico was driven seemingly, to a large extent, by various actions of the administrations in power, actions, which were shaped by the government's perception of the importance of the technology. The success of the diffusion-conducive reforms was also dependent on the administration's ability to implement reforms effectively and at the appropriate time, which arguably was aided by the relative degrees of the administration's autonomy and capacity.

5.1.2 The Telephone

Some of the factors that explained the diffusion of the telegraph also apply to the telephone diffusion speed in Argentina and Mexico. Once again the notion that the state mattered is a prevalent theme, but this does not necessarily mean that it always acted in the best way: the state was sometimes a promoter and sometimes an inhibitor to diffusion, but either way its impact was pivotal. The same broad state reforms at times seemingly served to constrain further telephone diffusion in one country (e.g. ENTel's nationalisation), and boosted it in the other (e.g. Telmex's

nationalisation).[2] As with the telegraph findings, the attitude of the administration in power, as well as their relative degrees of stability, of autonomy and the extent of the concentration of their power, were seen as having an important role.[3] This was because these characteristics, to a relatively large extent, determined the ability to implement and sustain diffusion-conducive reforms and policies efficiently over time.

It is unquestionable that a large part of the success in the diffusion of the telephone in the two countries was due to the increased role of the government within the telephone sector. This was a result of the shift in the states' attitude towards the importance of this technology (around the 1940s), and consequently from this point onwards one observes a significant growth in telephone diffusion. This is aligned with the study of Milner, where ICT diffusion was closely driven by the role of political institutions.[4] Indeed, the important nationalisation and privatisation reforms, as well as the regulatory bodies, were driven directly, shaped and controlled by, the administrations in power, and thus it is logical that their attitudes and relative degrees of power to implement change would be of significance. The prominent role of the government administrations in Mexico within the sector especially began to intensify during the 1970s, at which point (having lagged Argentina for almost 80 years) the diffusion rate in Mexico actually surpassed that in Argentina (see table 5.2).

Table 5.2 Telephone Diffusion (Handsets per 100 households)

	1900	1910	1920	1930	1940	1950	1960	1970	1976	1980	1990	1997
Argentina	1.7	6.4	15.1	18.1	18.7	21.4	29.4	27.2	29.3	30.4	41.2	77.0
Mexico	0.7	2.2	2.1	2.7	4.6	5.4	8.3	18.3	32.0	41.6	64.4	83.6

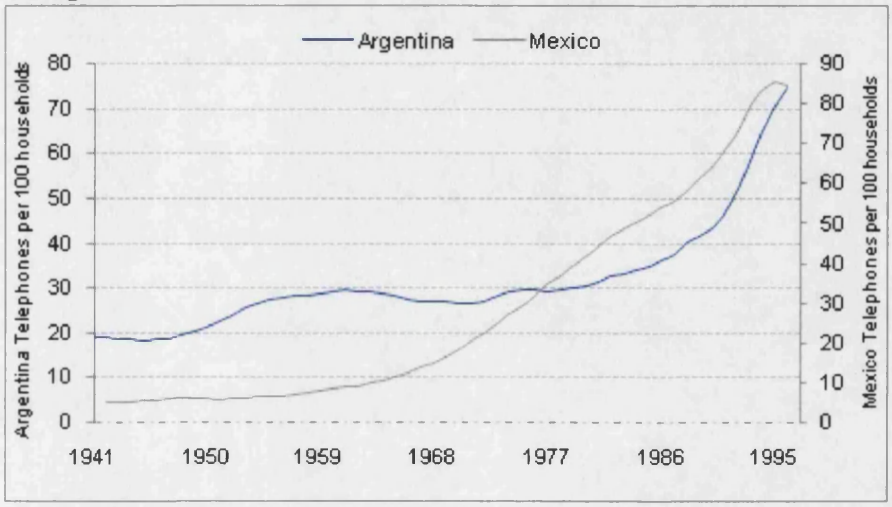
Source: see appendix B.

Table 5.2 shows how diffusion started to gather pace as the years progressed and the attitude of the government administrations shifted; placing greater emphasis on the expansion of the network and the provision of the service. One must note that Telmex was not supremely efficient once the government took majority ownership; but rather what was important was that majority government ownership was in place for a relatively shorter period. Arguably, diffusion in Argentina during the

[2] See for example, chapter 3, section *The Period of Nationalisation.*
[3] See chapter 4, sections *Political Institutions: The Degree of Stability and Characteristics of State Power* and *The Government's Attitude and its Impact.*
[4] Milner (2006). Also see Andonova and Díaz-Serrano (2007), Bergara et al. (1998), Esfahani and Ramirez (2003), Henisz and Zelner (2001) and Levy and Spiller (1996).

nationalisation years could have been potentially faster in relative terms, when compared to the diffusion experienced in Mexico (see figure 5.3).

Figure 5.3 Argentina's and Mexico's Partial Telephone Diffusion S-curves (3 Year Moving Averages)



Source: see appendix B.

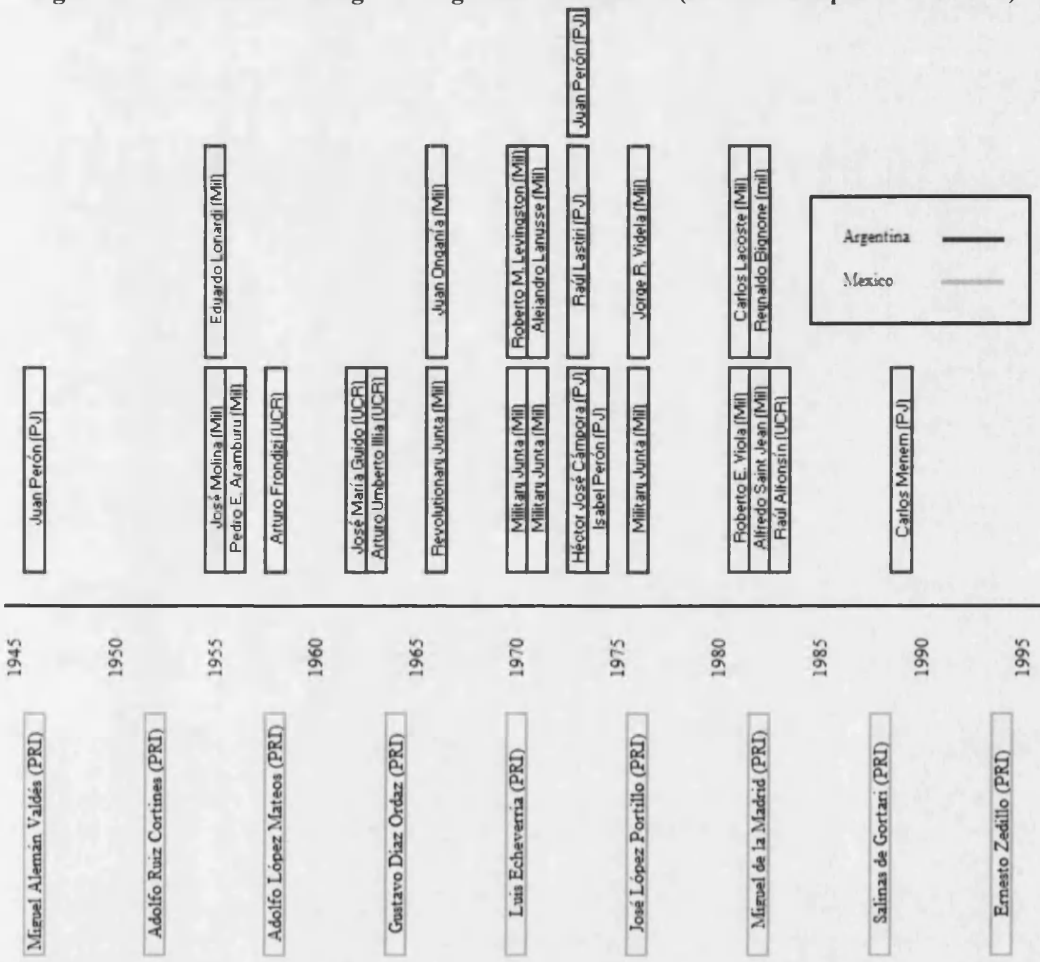
Figure 5.3 shows the telephone diffusion s-curves in Argentina and Mexico for the period when the government administrations in the two countries began to increase their control over the sector. Seemingly in Argentina, the increase in the influence of the government over ENTel during the nationalisation years had a relatively negative effect (this was not unique to Argentina, however – nationalisation was often opposed precisely because state telecom monopolies in many other developing regions typically failed to meet even the basic service requirements).[5] This contrasts to the situation in Mexico, where telephone diffusion increased relatively more slowly until the 1960s, before accelerating. In both countries, the important role played by the administration in power was fairly clear. Arguably, if the administrations from the start of Alemán Valdés (1946) to the end of Díaz Ordaz (1970) in Mexico had not recognised the importance of the telephone, and had maintained its pre-1940s laissez-faire attitude throughout the rest of the diffusion period, the rate of telephone diffusion would have likely suffered. Meanwhile in Argentina, it is interesting that a positive attitude by the administration in power toward the need to diffuse the telephone was not the only pre-requisite to allow for fast telephone diffusion; it was merely the starting point.

[5] See Petrazzini (1995).

The Mexican administrations not only shared the relevant wish to promote telephone network expansion (and in turn diffusion) but also had the relative capacity and ability to implement the change necessary to do so. During the key period of telephone diffusion, and in particular during the years of Telmex's progressive nationalisation, the Mexican administrations were characterised by a relatively higher degree of autonomy and continuity in their strategies and actions, since these years were characterised by the PRI's relatively strongest grip on political control. As privatisation neared, however, this advantage would fade (see chapter 1, sections *The Evolution of PRI Control of Mexico [until and from 1960]*). The political situation in Argentina was rather different; for much of the telephone diffusion period, politics were relatively more unstable; which meant that despite the positive attitude of the government, it was often more difficult to implement changes and sustain diffusion enhancing policies. Indeed, from 1930 to 1983 Argentina was 'characterized by numerous military coups, [the] legacies of 25 presidents, 22 years of military rule, and 13 years of Peronism' (see chapter 1, section 1.1.3d. The Politics in the Second Half of the Twentieth Century, and figure 5.4).[6]

[6] Sullivan M. P., 'Argentina: Political and Economic Conditions and U.S. Relations' *Congressional Research Service (CRS) Report for Congress* (2006): 1-6, p.2. Also see Waisman C. H. 'Argentina: Autarkic Industrialization and Illegitimacy' in Diamond L., Linz J.L., and Lipset S.M., *Democracy in Developing Countries* Volume Four: Latin America, Boulder, Lynne Rienner Publishers (1989), p.63.

Figure 5.4 Presidential Changes in Argentina and Mexico (10-90% Telephone Diffusion)



Source: Own elaboration. See appendix H. Note: PJ: Partido Justicialista, Mil: Military; UCR: Unión Cívica Radical, and PRI: Partido Revolucionario Institucional.

Figure 5.4 shows a timeline with the changes in presidents in each country during the 10-90% period of telephone diffusion; each box represents a new administration (it also details the party they belonged to). Figure 5.4 visually shows that Mexico's government administrations were more consistent and the whole system was relatively more stable compared to Argentina. In Mexico there was an orderly change in president (but not political party) every six years (the *sexenio*). Meanwhile in Argentina, these years were characterised by a rapid succession of military coups, and the subsequent military or civilian regimes (and as mentioned some presidents remained in power for literally a matter of days). Given that ENTel was a state monopoly from 1946 to 1990, a relatively higher degree of political instability translated into the relatively more disorderly running of ENTel, as its top management were appointed by the president (see examples in chapter 3, section *The*

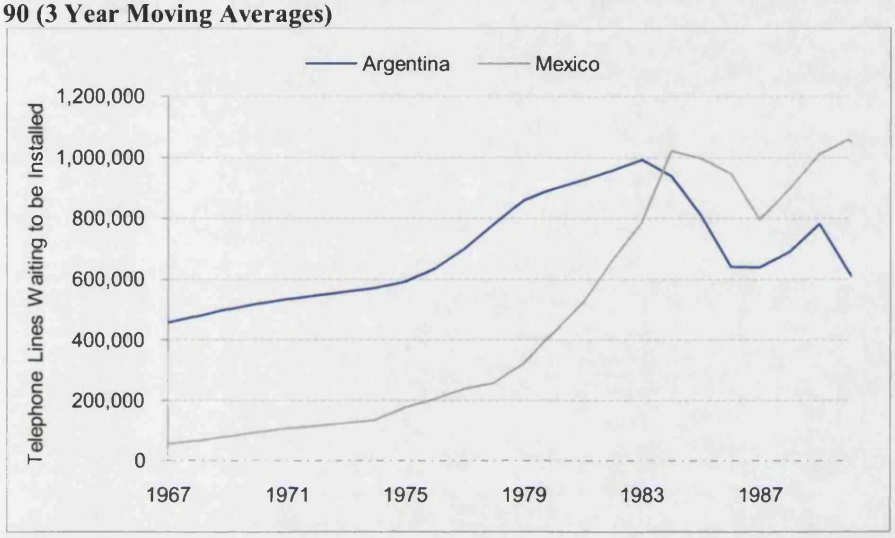
Progress Achieved during the Nationalised Era and in chapter 4, section *The Degree of Effectiveness of the Regulatory Framework*). Alternatively in Mexico, the PRI ruled for the whole period (although with differing levels of effectiveness and strength of governance), offered the telephone operator relative political stability through uninterrupted rule. This in part could be seen as providing a relative advantage over Argentina, since one could argue that it meant that Telmex enjoyed a more stable setting, where longer-term goals could be set and achieved more easily, which naturally facilitated faster diffusion. It could also be argued that just because there was seemingly greater capacity to enact reforms quicker and more efficiently in Mexico, this did not guarantee that the policy choices were good. For example, the introduction of the very unpopular 1960 long-distance tax initially priced many customers out of the market.[7] Since the government decided to exploit these revenues, Telmex faced political pressure of a different nature.[8] Some observers argue that at times, it seemed as if Telmex had become almost a private financing vehicle for the Mexican government.[9] However, once government involvement increased in the sector, evidenced for example by an increased emphasis on universal service provision, one could argue that this promoted diffusion, as new lines were installed in non-urban areas, which had been mostly ignored under private provision (as occurred in Argentina too).[10]

One of the key facilitators for fast telephone diffusion in Mexico, as indicated earlier, was its unique nationalisation reform, due to the effect this had upon service.[11] Diffusion in Mexico benefited from the private sector's running of Telmex, alongside increasing government involvement, which meant that government employees in Telmex were in a relatively better position to run the company than those in ENTel, and could provide relatively more efficient services. Even under majority government ownership, Telmex retained some private flavour (e.g. through its retention of staff and board members), offering further potential to learn and

[7] The government raised the long-distance tax so aggressively that at one point more than 50% of Telmex's revenues were coming from this tax. See Mote D. and Mancini C., Teléfonos de Mexico S.A. de C.V *International Directory of Company Histories* 63 (1992).
[8] Casaús (1994).
[9] Mote and Mancini (1992).
[10] For Argentina see Empresa Nacional de Telecomunicaciones, Memoria Empresaria, 1985, p.10. For Mexico, see Secretaría de Comunicaciones y Transportes (SCT), *Programa Nacional de Modernización de las Telecomunicaciones 1989-1994* SCT (1994).
[11] Note that the regression analysis failed to show statistical significance for this relationship due to the difficulties in measuring this factor.

progress with the guidance and experience of the existing staff, which generated an all round more experienced and more cohesively run state entity. Meanwhile, the Argentinian officials placed in charge of ENTel had never run a telephone operator before. Relatively worse provision of service naturally followed as the emblematic inefficiencies characteristic of a state monopoly provider were more pronounced and this proved to restrict diffusion by inadequately dealing with the public's requirements, especially when demand continued to increase (see figure 5.5).[12]

Figure 5.5 Comparing Argentina's and Mexico's Telephone Line Waiting to be Installed: 1967-90 (3 Year Moving Averages)



Source: see appendix C.

Figure 5.5 compares the telephone lines waiting to be installed during the years of nationalisation (for which data are available) in Argentina and Mexico. It shows that prior to the mid to late-1980s when there was a substantial problem across the two countries, the number of people waiting to get a new line in Mexico was significantly lower than in Argentina (obviously this is a function of demand, but consider that the population of Mexico was at no point less than twice as large as Argentina's from 1967-1990). In 1989 waiting times for line installation in Argentina were between 12 and 14 years compared to 3 years in Mexico.[13] Unfortunately, slow installation was just one of a long list of inefficiencies, with first time connectivity rates on local and long-distance calls all below 50% in Argentina, versus equivalent rates above 90% in

[12] For example, for details on the continuing increase in both the number of people waiting to have their line repaired, and in the durations of the waiting periods, in addition to continual increases in demand for new lines, see Empresa Nacional de Telecomunicaciones, Memoria Empresaria, 1979, p.12. Also see Empresa Nacional de Telecomunicaciones, Memoria Empresaria, 1981, pp.8-9.
[13] Mairal (1994), Cook (1999), Ramamurti (1996).

Mexico (see chapter 3, section *The Progress Achieved during the Nationalised Era* for more information on the quality of service).[14]

As a result of the poor service provided by ENTel during the nationalisation years, once the company was privatised in 1990 one observes a significant spurt in diffusion (figure 5.3). Clearly, one of the most important drivers of telephone diffusion in Argentina was its privatisation reform and, although it was also important for Telmex, one can argue that the impact of this reform was relatively more significant for ENTel. This was largely because telephone diffusion in Argentina had underperformed considerably in the years prior to privatisation. In Mexico, Telmex had performed relatively well (in the sense that telephone diffusion growth was already on a reasonably strong trajectory, as depicted in figure 5.3); hence there was relatively less room for improvement. Moreover, despite the success of two telephone providers in Argentina during the privatisation period, it proved no easy task. As described earlier, the privatisation reform was successfully implemented the first time around under the Salinas de Gotari's administration in Mexico, while Menem's success was the third attempt at ENTel's privatisation in Argentina (see chapter 3, section *The Period of Privatisation*).[15] This particular example highlights an instance where it was not necessarily that the given reform was superior in Mexico, but that the relative ease with which the Mexican administration (in comparison to their Argentinian counterparts and even at the point where PRI power had eroded substantially) were still able to force the reform through.

The importance of the privatisation reform in aiding further telephone diffusion is consistent with studies such as Wallsten's.[16] As argued, this was particularly important in the case of ENTel; for instance, the number of lines waiting to be installed fell from a peak of over 1 million to fewer than 20,000 in just 12 years.[17] Also, the cost of connection decreased significantly in Argentina from a massive US$2,165 in 1990, to US$250 in 1997, compared to a drop from US$494 to US$123

[14] See Abdala (2000).
[15] See Petrazzini (1995).
[16] Wallsten (2001a, 2005).
[17] Source: International Telecommunication Union (ITU), *ICT Statistics Database* ICT Eye (http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx). Also see chapter 3, section *The Progress Achieved during the Privatisation Era.*

in Mexico for the same period.[18] The percentage of recorded telephone faults in Argentina fell from 42% to only 17% (1991-1997), compared to a drop from 9% to 3% in Mexico for the same period.[19] Hence, although the privatisation reform was important for Telmex, as it boosted capital investment, improved productivity and cut inefficiencies, in relative terms the reform was more impactful and allowed for greater telephone diffusion (via improved provision) in Argentina. Significant strides were made in telephone service provision in Argentina, not only because it was no longer controlled by the government, but because it became a private duopoly providing for some element of competition, which translated into further improvements on installation of infrastructure and the overall quality of the service, therefore boosting diffusion. In fact, telephone diffusion in Argentina experienced an aggressive increase during the privatisation period; having lagged telephone diffusion in Mexico for 20 years, it finally caught up.

Argentina's telephone diffusion was dictated to a large extent by the role of the state, both positively during the privatisation reform and negatively during the nationalisation reform. Meanwhile in Mexico, the government's attitude and relatively higher degree of stability in allowing for the successful implementation of Telmex's unique nationalisation and privatisation reforms exerted a positive effect on telephone diffusion.

As explained in chapter 2, diffusion is a two-step process, with initial speed of adoption (dictated by the government's willingness to promote it) followed by the actual speed of diffusion (which becomes a question of the government generating consumer accessibility and demand). The power of the governing administrations was determined largely by their respective ability to implement key reforms. The relatively greater degree of autonomy and concentration of power in the executive branch of the Mexican government during much of the critical period of telegraph diffusion enabled Porfirio Díaz to bring in various diffusion-conducive reforms. As a result of the *sexenio's* introduction, the subsequent governments were not afforded the same luxury of such long individual tenures but they had sufficient continuity via their one party political system, which in comparison to Argentina offered them

[18] Ibid.
[19] Ibid.

greater relative capacity to execute successful telephone nationalisation and privatisation reforms. Meanwhile in Argentina, it was the Alcorta administration that finally implemented the Mitre Law during the years of telegraph diffusion, and the much needed privatisation reform under Menem, during the years of telephone diffusion. These two events in Argentina, were so overriding that previous to their implementation, one can argue that further diffusion of the two technologies was somewhat restricted. In summary, throughout the fastest period of telegraph and telephone diffusion the role of the state was clearly the most important factor driving (or inhibiting) diffusion. Also of note was the tentative finding, which suggested that socio-economic variables played a limited role in explaining diffusion, which neatly brings us back to the Paradox.

5.2 Explaining the 'Double Paradox'

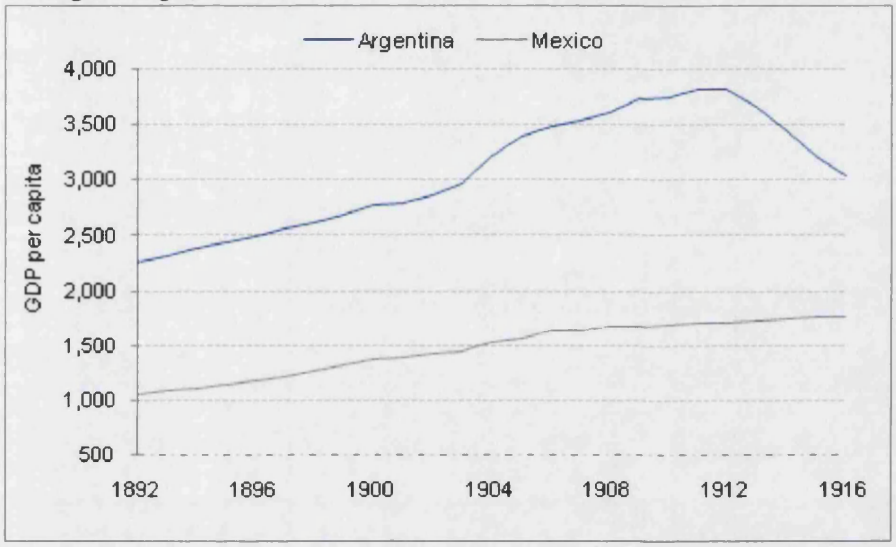
Recall that the 'Double Paradox' refers to the fact that, given the relative socio-economic disparity between Argentina and Mexico during the period under consideration, the diffusion of the telegraph and the telephone should have been relatively faster in Argentina than in Mexico. This circumstance was pronounced most of all during the fastest period of telegraph diffusion (see chapter 1, section *The Period of Export-led Growth [1870-1930]*). Whilst the literature presents a range of potential factors that can explain the difference in diffusion rates across countries, it is the relative level of economic development in one country compared with another that is cited most frequently. In light of this – in terms of telegraph and telephone diffusion – Argentina relatively underperformed, while Mexico outperformed.

5.2.1 The Economic Disparity

The extent of the economic divide for the period under discussion was addressed at various stages of chapter 1 (see section 1.1.1 The Economics of the Political Economy). To remind the reader, with regard to social development during the years of telegraph diffusion; before the First World War for instance, life expectancy in Mexico was 28 years compared to 46 years in Argentina. Similarly, Argentina's literacy rates were double Mexico's (see appendix A, table A.3 and A.4). It is also important to recall that, although the economic discrepancies were vast during telegraph diffusion they continued well into early telephone diffusion. For example, at a mid-point in telegraph diffusion, in 1900, Argentina had achieved a GDP per

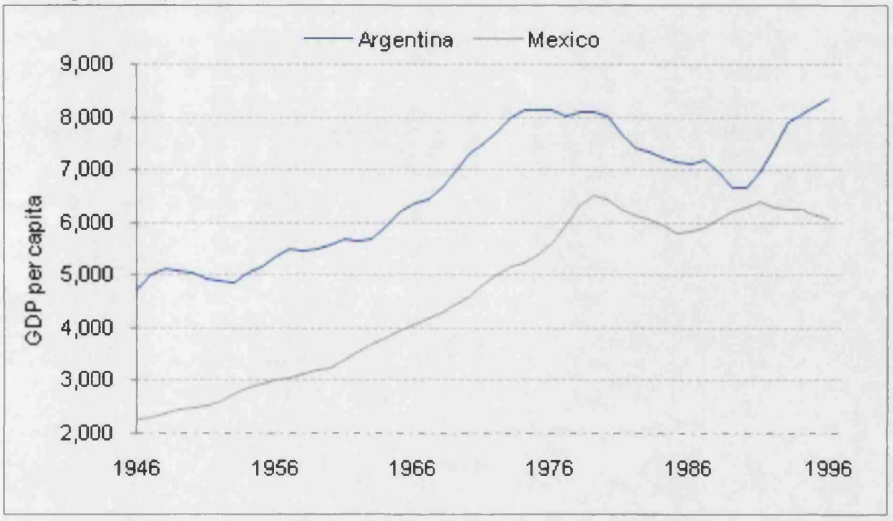
capita level of US$2,756, versus US$1,366 in Mexico. At a similar mid-point in telephone diffusion, in 1960, Argentina had a GDP per capita of US$5,559 while Mexico still lagged notably, at only US$3,155 (see appendix A, table A.1). Furthermore, from 1900 to 1960, Mexico's HLSI grew from 0.13 to 0.50 compared to Argentina's which grew from 0.34 to 0.65 in the same period, thus revealing a distinct lack of comparative social advancement (see appendix A, table A.7). Figures 5.6 and 5.7 show the differences in GDP per capita levels in Argentina and Mexico over the key diffusion periods to help to frame the scale of the economic divide.

Figure 5.6 Argentina's and Mexico's GDP per capita for 10-90% Telegraph Diffusion (3 Year Moving Averages)



Source: For consistency, all the data are sourced from Maddison (2006). Maddison used 1990 International Geary-Khamis dollars as the base for GDP per capita (see appendix A, table A.1 for data from 1900). Note: Although the start of Mexico's 10% of telegraph diffusion occurred in 1881, the figure above begins from Argentina's 10% level of diffusion due to data availability.

Figure 5.7 Argentina's and Mexico's GDP per capita for 10-90% Telephone Diffusion (3 Year Moving Averages)



Source: For consistency, all the data are sourced from Maddison (2006), Maddison used 1990 International Geary-Khamis dollars as the base for GDP per capita (see appendix A, table A.1 for data).

Figures 5.6 and 5.7 show that Argentina's GDP per capita was consistently higher than that Mexico's and although the gap narrowed during the years of telephone diffusion (figure 5.7), it widened again through the 1990s. It is interesting that, despite this, the diffusion speed of the telegraph and the telephone in the two countries was relatively similar - given that the literature places a lot of importance on income as a key driver of diffusion.[20] The logical argument follows that a certain level of income is necessary in order to diffuse the technology, but once a threshold is reached, further income growth does not necessarily translate into an increase in diffusion. Littlechild (in analysing telephone diffusion rates) provides further rationale: he argues that to some extent GDP per capita will play a relatively more responsive role in telephone diffusion when provision is private, as opposed to under a government-owned system.[21] Indeed, in the case of Argentina, income growth was significant but only during the privatisation years, in line with Littlechild's findings.[22]

To substantiate the revelations of the Paradox, one must consider the following: arguably telegraph diffusion was relatively more successful in Mexico than in

[20] For instance, see Rogers (1995), Antonelli (1993), Helsen K., Jedidi K. and DeSarbo W. S., 'A New Approach to Country Segmentation Utilizing Multinational Diffusion Patterns' *Journal of Marketing 57* (1993): 60-71. Gatignon and Robertson (1985), Dekimpe et al. (1998, 2000a, 2000b), Ahn and Lee (1999), Gruber (2001), Gruber and Verboven (2001), Madden et al. (2004), Milner (2006), Wallsten (2001a), Griliches (1957) and Mansfield (1961, 1963a, 1963b). Also see chapter 1, section 1.5.1 The Economic Approach.

[21] Littlechild (1983).

[22] See the regression analysis in chapter 4, section 4.2.2 The Telephone.

Argentina, to the extent that Mexico was first to build a telegraph line, and had a larger network in terms of density. For instance, in 1899 Argentina had 20,330 km of lines (spanning 2,700,000 sq km), while Mexico had 32,394 km across a much smaller area (over 1,900,000 sq km) - see appendix C, tables C.1 and C.2. In absolute levels, telegraph diffusion in Mexico surpassed Argentina's briefly in 1888, despite Argentina having the highest GDP per capita in all of Latin America. With regard to telephone diffusion, in absolute levels diffusion was higher initially in Argentina, but during Telmex's gradual nationalisation process, telephone diffusion in Mexico actually took over the levels seen in Argentina. One could argue that, because Argentina was relatively wealthier than Mexico, telephone diffusion should have been faster, diffusion in Argentina therefore underperformed. Even if the Argentinian administrations had delayed nationalisation (or implemented it gradually as Telmex did), or privatised earlier (or been successful at the first attempt), perhaps diffusion would have been faster. An indication of this can be found in the fact that the change in GDP per capita was only a significant factor driving diffusion after ENTel was privatised. This suggests that ENTel's nationalisation potentially acted as an inhibiting factor toward further diffusion.

As explained below, there are two sides to the Paradox, with the diffusion of the two technologies in Argentina having partly underperformed, coupled with the relative outperformance in the diffusion of the two technologies in Mexico.

5.2.2 The Theoretical Underperformance of Diffusion in Argentina

This side of the Paradox refers to the inability in Argentina to diffuse the two technologies faster than it did (given its consistently superior economic setting), an underperformance, which ultimately made it 'easier' for diffusion in Mexico to catch up. The rationale for this was potentially due to the characteristics of some of the Argentinian administrations as well as the environment in which they operated. Within this context, telegraph and telephone diffusion was less successful because the Argentinian administrations did not make the most of key reforms; whether it was in part due to late implementation, or a result of the relative ineffectiveness of the reforms themselves. With regard to telegraph diffusion, one could argue that the delayed implementation of the Mitre Law seemingly acted as a barrier to further diffusion, irrespective of the country's economic and social advantage. In other

words, previous to the implementation of this law, diffusion was constrained to the extent, that network usage almost tripled between 1906 and 1908, while the length of the telegraph network increased 55% between 1907 and 1914 (see chapter 3, table 3.2 Argentina's National Telegraph Network Size and Traffic [during 10-90% Diffusion]). One could therefore contend that if the Mitre Law was implemented earlier, perhaps telegraph diffusion in Argentina would have been faster than in Mexico.

With regard to telephone diffusion, during the majority of the years of ENTel's nationalisation, the government administrations in Argentina drifted between those supporting deregulation, foreign capital, and free enterprise, and those who sought greater state regulation, the suppression of foreign capital and an expanded state economy. Unlike Mexico, where one political party largely dominated the nationalisation years, in Argentina, there were not only many more administrations over the period, but many regime types and many political parties, which served to disrupt consistency at ENTel. The years of ENTel's nationalisation were particularly stagnant in terms of diffusion growth, as complete nationalisation turned ENTel into an inefficient monopoly, with deteriorating service, which arguably served to restrain further diffusion (for details see chapter 3, section *The Progress Achieved during the Nationalised Era*). As in telegraph diffusion, the socio-economic advantage that Argentina may have had, seemingly had little impact in driving faster telephone diffusion, due to the relatively negative impact of ENTel's government ownership. Perhaps, if ENTel had imitated Telmex's nationalisation process, telephone diffusion would have been faster. Whether this would actually have been the case is difficult to judge with any degree of accuracy and would demand some sort of rigorous counterfactual analysis, which is beyond the scope of the thesis, but it is important to intuitively highlight the possibility. In reality, the various government administrations in Argentina did not introduce reforms particularly different to those in Mexico (e.g. the consolidation of the telegraph network, or the nationalisation of the telephone), but rather the Mexican administrations were seemingly more effective in positively impacting the subsequent diffusion rate.

The Paradox is built upon the economic disparity between the two countries, and it is interesting that while the economic backdrop during the 10-90% telephone diffusion

period in Argentina and Mexico ranged in stability and success, both faced painful debt crises that in many respects dictated their all important privatisation reforms, which were especially important to the success of telephone diffusion in Argentina. Without such diffusion success during this period, it is likely that the diffusion of the telephone in Argentina would have been potentially far worse. To rationalise this, one may argue in line with the view of Evans and Amsden, citing the importance of a degree of 'state capacity' as a means to facilitate (rather than inhibit) economic development.[24] One could argue that at various stages, the relatively lower degree of state capacity of the Argentinian administrations (versus Mexico), particularly during the rapid succession of presidents during ENTel's nationalisation, meant that the administrations were less able to govern effectively. Moreover it affected their ability to deal appropriately with opposition from interest groups, which were already more powerful in Argentina and were often a hindrance to reform implementation. Therefore one side of the Paradox can partly be understood in terms of the seeming underperformance in the diffusion of the two technologies in Argentina, despite Argentina's overall socio-economic advantages.

5.2.3 The Traits of the Government Administrations in Mexico

The government's role in allowing for successful technology diffusion in general tends to be more pronounced in developing countries (see chapter 1, section 1.5.4 The Institutional Approach: the Role of the State). This thesis suggests that this was the case in Argentina and Mexico. Successful diffusion of the telegraph and the telephone in the two countries initially was dependent upon the incumbent government administrations, as opposed to consumer behaviour directly, since it was the government that provided the initial access to the new technology and that was responsible for shaping an environment that was conducive to the development of infrastructure and in turn diffusion growth. The political and social environment in which the telegraph, in particular, diffused in these 'new' countries was characterised by the need for national unification and state consolidation (as argued in chapter 1, section 1.2 The State and the Role of ICT in Latin America).[25] This was true in both Argentina and Mexico, but perhaps was more pronounced in the case of the latter.

[24] Amsden A., 'The State and Taiwan's Economic Development' in Evans et al. (1985). Also see Skocpol T., 'Bringing the State Back in: Strategies of Analysis in Current Research' in Evans et al. (1985), Haggard (1990) and Evans (1995).
[25] Oszlak (1981, 1982).

Mexico feared for the very borders of its national territory and indeed for its national integrity. Chapter 4 argued that this reinforced further the strategic need for the diffusion of the telegraph in Mexico, compared to Argentina. The Mexican administrations of Juárez and Porfirio Díaz (particularly the latter), were accordingly highly supportive of fast telegraph diffusion, and took a relatively prominent role to ensure this. Furthermore, Mexico (with 75 presidents in the 55 years prior to the Porfiriato) arguably had experienced a relatively acute period of political flux after independence, this is not to say that Argentina was politically stable either, but rather that in relative terms, the situation was more volatile in Mexico.[26] Consequently, one can argue that although the two countries had administrations that were disposed positively toward diffusing the telegraph from early on, a partial differentiating factor that must have played an important role was that the Mexican administrations inherited an even higher degree of urgency in utilising tools, such as the telegraph, that could consolidate and unify the region.

As argued in chapter 1, the government controlled the entire diffusion process: through the provision of concessions, its commitment to property rights, and the implementation of reforms and regulations (see chapter 1, section 1.5.4 The Institutional Approach: the Role of the State). Consequently the extent of intervention and ability to implement reforms was important. Two factors that are particularly important within this context were: the government's attitude toward the perceived benefits offered by the new technology, and the intrinsic characteristics of the government administration during important periods of telegraph and telephone diffusion. The findings of this thesis suggest that perhaps more critical rationale than the attitude, was the nature of the intrinsic characteristics of some of the ruling administrations. Such distinguishing traits (as explored below) provided for a certain comparative advantage in terms of strategising and implementing diffusion conducing actions. This draws somewhat on the developmental authoritarianism literature, which argues that such types of regimes were more prone to facilitate development in late industrialising countries.[27] Gerschenkronian style catch up of

[26] Haber et al. (2003).

[27] See Johnson C., *MITI and the Japanese Miracle: The Growth of Industrial Policy, 1925-1975* Stanford, Stanford University Press (1982). Amsden (1989), Zysman J., *Governments, Markets, and Growth: Financial Systems and the Politics of Industrial Change* Oxford, Martin Robertson (1983), White G., *Developmental States in East Asia* New York, St. Martin's Press (1988).

sorts seemingly ensued as the state became more important than the previously accepted pre-requisites, such as income or credible commitment to property rights in Mexico's case in promoting diffusion growth.[28]

The argument follows that from a relative perspective, Mexico's governments had more centralised power structures, coupled with a seemingly more positive, or determined, attitude at critical junctures of the diffusion of the two ICTs (see chapter 1, section 1.1.3 a. The Structure of Argentina's and Mexico's Political System). This created and shaped a setting in which the diffusion of the telegraph and the telephone was relatively more incentivised to develop. One could argue that the keenness of the Mexican government to diffuse the two technologies originated for the 'wrong' reasons – as the two were perceived as tools for the benefit of the state rather than consumer goods in need of universal supply – but it nevertheless ensured that the necessary infrastructure was built, providing the fundamental basis for subsequent diffusion. In regard to the situation in Mexico (particularly during the period of telegraph diffusion), one could argue to some extent in line with Deyo; in that more authoritarian regimes can typically build-out the necessary infrastructure more efficiently in the initial stages of development, because of policy consistency and the like.[29] However, there were obviously instances (such as the middle period of telephone diffusion) where Argentina's administrations also revealed more authoritarian tendencies. Indeed, the decisive argument rests on the fact that identifying the need to develop and diffuse the two technologies (as Argentina and Mexico both did) was insufficient; the relative degree of ability to act was more important. And on the face of it, some of the administrations in Mexico were better equipped to do this. For instance, during the Porfiriato, telegraph diffusion was prioritised to such a high degree that even during the peaceful years of Porfirio Díaz's tenure, he deployed stringent policies and intimidation tactics (e.g. 'telegraph crime') in order to promote the diffusion of the telegraph (see chapter 4, section *The Government's Attitude towards the Telegraph*). Similarly, during the diffusion of the telephone, the López Mateos administration coerced foreign investors to surrender their shares in an effort to 'Mexicanise' Telmex in 1958. By no means is this trying to condone or even contemplate assessing the appropriateness of such courses of

[28] Gerschenkron (1962).
[29] Deyo F., *The Political Economy of the New Asian Industrialism* U.S., Cornell University Press (1987).

action. The point is simply that the relatively higher degree of capacity which some of the key Mexican administrations enjoyed, coupled with a largely positive attitude towards the need to drive the diffusion of the two technologies, translated into a 'get the job done' mentality. This was a mentality that the relatively economically superior Argentinian administrations did not have the appropriate characteristics to allow it to subscribe to, during the critical development years.

During the key periods of fastest diffusion the attitudes and government characteristics were not static. This line of thought was perhaps most imperative at the turn of the twentieth century when telegraph diffusion was in full swing and telephone diffusion was just starting. One observes that in Mexico, during the Porfiriato, the administration was characterised by relatively greater autonomy, which resulted from a greater notion of a 'dictatorship' that Porfirio Díaz had. This higher degree of autonomy was partly a result of Porfirio Díaz having hand-picked all the members of congress, yet this did not guarantee authority over a nation, he still relied upon the distrustful relationships that were arranged between himself and the local *jefes politicos* as argued in chapter 1. This situation, when at its strongest (in the middle of telegraph diffusion), allowed Porfirio Díaz to implement diffusion conducive reforms more effectively and in the face of much less resistance, in vast contrast to the Argentinian rulers of the equivalent period. During this period, Argentina also fostered a greater notion of political stability, as one political party, the PAN (and especially those associated with the 'Generation of 1880') retained control of politics for some time, but this stability was of a different nature. As described in further detail in chapter 4, the Argentinian administrations of this period (on the way toward quasi-democracy) were unable to free themselves from powerful interest groups, as efficient handling of increasing telegraph demand was blighted by labour strikes.

The evolution of the state's attitude and characteristics continued into the years of expansion of telephone diffusion, with the one administration regime in Mexico giving way to the one political party system. Just like the Porfiriato, the PRI's control of Mexico had a strong beginning, a cementing of power in the middle and a dwindling of power into some sort of crisis (the Revolution for Porfirio Díaz, and the debt crisis for the PRI). An important difference was that the combined PRI

presidencies spanned a much longer period in Mexican politics. As a result political continuity in Mexico was sustained (especially during the 1940s and 1950s), which paved the way, to some extent, for successful diffusion, as policies could be sustained over the longer run. Meanwhile the case study of Argentina provides a stark contrast, since there was relatively more uncertainty over government rule, which had a stronger negative effect upon telephone diffusion during nationalisation, as almost 30 different presidents from various political dispositions governed. Moreover Argentinian administrative executive powers were relatively weaker, at least in constitutional terms, as they constantly had to confront congress (harshly evidenced in Alfonsín's failed privatisation attempt, for instance), making policy making a comparatively more difficult task. It was only when Menem adopted a very different tack during ENTel's privatisation that the desired reform was finally achieved (see chapter 1, section *Peronism and Post-Peronism in Argentina*).

Overall, while the period cannot be generalised for Argentina or Mexico, the observations are that the Mexican administrations (during critical diffusion periods) typically retained relatively greater notions of autonomy and capacity to act, which were, more often than not, fostered by the one administration regime or the one political party system. Further, the positive attitude of the state towards the need for promoting the telegraph and telephone infrastructure build-out (and therefore diffusion) was perhaps greater in Mexico at the very beginning, but it is unfair to conclude which nation's administrations had the stronger desire in the latter part. These distinguishing characteristics of the given administrations at critical periods provide the rationale to the Paradox. The differences in rule between Argentina and Mexico throughout telegraph and telephone diffusion were not constant, and there is some support for the view that the periods where elements of democracy were more a notion than a practicality (PRI rule and the inability of an opposition party to win an election in the 1950s and 1960s), and where the relative degree of the concentration of power was particularly centralised (demonstrated in Menem's use of urgency and necessity decrees during privatisation), stronger diffusion was invoked. For instance between 1950 and 1970, teledensity increased 3.4 times in Mexico, and in Argentina it almost doubled during the very short period of privatisation (see appendix B for data). Finally, although the economic divide between the two nations narrowed by the time of ENTel and Telmex's privatisations, it was still material, and

as the role of the state was still a central explanatory factor, the Paradox was therefore just as important as it was during the diffusion of the telegraph.

5.2.4 The Mexican Timing Effect

Indeed, while the government's positive attitude and capacity to implement effective policies was important as explored above, their relative success to act in a timely fashion was just as key. Timing was another important factor that can partly explain the Paradox. As explored below, the administrations in Mexico were at times, relatively faster in implementing some necessary reforms, reforms which were also implemented in Argentina, but at a later date. Further, some administrations in Mexico also proved to have relatively greater acumen for timing, in terms of favourability and opportunism vis-à-vis some of the regimes in Argentina. Moreover, one can argue that throughout the diffusion of the two technologies the various administrations in Mexico seemingly made earlier efforts to promote diffusion. For example, in taking advantage of the railway companies' 'right of way' before Argentina, or in the earlier consolidation of the telegraph network. Lastly, during the diffusion of the telephone, Telmex seemingly benefited from the Alemán Valdés government's timely decision to implement a gradual movement toward nationalisation, which paved the way for greater relative success (see chapter 3, The period of Nationalisation).

As argued, the first telegraph line was introduced six years earlier in Mexico than in Argentina, as Mexican regimes became obsessed with state-building and establishing order. Administrations in Argentina could almost be described as having been too cautious in the early years of telegraph diffusion, refusing a number of early opportunities to expand the network (see chapter 4, section *The Government's Attitude towards the Telegraph*).[30] The telegraph became property of the state in Mexico 10 years earlier than in Argentina (in 1865 compared to 1875), and this provided a theoretical advantage in Mexico because it meant that the government was overseeing the construction of the network from earlier on.[31] In Argentina, lines

[30] For instance, as mentioned the Argentinian government rejected the proposal of Febrés de Rovira and of Société Internationale de Télégraphie Electrique in the 1850s.

[31] Although the government made the telegraph state property in 1865 in Mexico compared to 1875 in Argentina, in reality this would prove to be less important given the fact that many of the lines would be destroyed on Porfirio Díaz's ascent to power, however it still serves to highlight the timing effect.

were built without much definitive governmental policy for longer and as a result these 'were not infrequently a menace to public service' (see chapter 3, section 3.1.2 The Years of Telegraph Expansion).[32]

The administrations in Mexico emphasised the expansion of the telegraph infrastructure from very early on, and the Juárez administration consolidated all the telegraph lines into a national network in 1869 (when telegraph diffusion had not reached even 1% diffusion). This was important because it made the network relatively more useful (to the consumer) and hence positively impacted diffusion, as it was easier and faster (in theory at least) to send a telegram given the interconnection of the provincial, state, private and federal telegraph lines. Without the consolidation of the network, its further build-out would have been less useful, as in Argentina.[33] The consolidation of the telegraph network in Argentina did not occur until 1892 (by which time telegraph diffusion had reached 19%), which meant that the administrations in Argentina consolidated the network 23 years after Mexico. As a result of this delay, the network was interlinked poorly and lines that were supposedly complementary to each other were competing for business. The earlier consolidation of the network in Mexico provided a relative advantage seemingly vis-à-vis diffusion in Argentina. Arguably it was not just the earlier timing of the reform in Mexico, but the opportunism of timing, whereby the lines were constructed and connected into one network, while in Argentina, by the time consolidation of the lines was carried out, the country had amassed a large and messy network by then, thus consolidation was relatively more difficult.

The Mexican administrations also implemented a regulatory framework ahead of Argentina as argued in chapter 3. Mexico's telecom policy began in 1855, and by 1869 it developed the set of rules for the Telegraph Offices.[34] Meanwhile, in Argentina, by 1862 little had been done to organise matters, and the first telegraph law was only passed in 1875. As mentioned the government in Mexico also took advantage of the railways' right-of-way relatively earlier than in Argentina despite Argentina's telegraph network having developed in tandem with the railway network

[32] Berthold (1921a), p.8.
[33] See chapter 3, section *The Progress Achieved during 10-90% Diffusion*, where it is argued that it was not so much about the expansion of the lines, but rather the fact that half of the system was unusable.
[34] Griffith in Noam (1998).

much earlier than in Mexico. The government in Mexico realised (through statute) the potential mutual benefits of this relationship much sooner (in 1881) compared to Argentina (1907).[35] Despite the fact that the railways and the telegraph grew together in Argentina since 1857, the country waited 50 years to exploit this relationship fully, Mexico waited just six, as argued in chapter 3, section *The Role of the State: The Impact of New Laws*. This example was perhaps the clearest testament to the Argentinian-Mexican divide in terms of government effectiveness. Since this law was introduced significantly earlier in Mexico, one perhaps could argue that there was no such restricting effect (as in Argentina). In other words, telegraph expansion in Mexico was relatively uninterrupted. One could argue that the administrations in Mexico were relatively more effective in coordinating efforts to implement critical reforms earlier than in Argentina.

With regard to the telephone, the governments in the two countries promoted diffusion and the move toward nationalisation at a similar time. In Mexico, the timing effect was about the favourability and the optimisation of timing, and less about haste and swiftness of action (although this was still a factor). The Mexican administrations' opportunism of timing was particularly apparent in its progressive nationalisation reform of Telmex, which arguably was a better type of nationalisation than ENTel's full nationalisation. The government's gradual increased influence over Telmex and ultimate attainment of majority ownership, alongside the retention of much of its successful private structure (employees, board members, etc.) resulted in greater market knowledge (experienced learning), an opportunity that was arguably largely bypassed at ENTel. Moreover, the benefit of the 'Mexican way' resulted in a relatively more continuous diffusion process during the overall period, as well as a relatively higher quality of service in comparison to ENTel. Figure 5.3, earlier in the chapter, illustrated the diffusion of the telephone in the two countries. If one focuses on the years of nationalisation and the progressive movement toward nationalisation in Mexico (i.e. 1947-1989), it is clear that once ENTel was nationalised fully (in 1948) diffusion increased at a relatively slower rate, as the period was characterised by a more inefficient system and at times by administrative chaos.[36] Meanwhile,

[35] Bare in mind that that by 1881, railroad telegraph lines in Argentina already accounted for over 20% of the total telegraph network also. See Berthold (1921a).
[36] For a more detailed overview, see chapter 3, section *The Progress Achieved during the Nationalised Era.*

during the period of gradual movement toward nationalisation, telephone diffusion in Mexico grew at a relatively fast rate.

Telephone diffusion in Mexico also benefited from better timing with regard to the events prior to Telmex's privatisation, as well as the reform itself. Immediately before privatisation, Telmex was re-arranged and restructured, making the regulatory framework clear by setting out how it intended to govern the newly privatised sector. This avoided the confusion, which to some extent took place in Argentina, where limited restructuring took place prior to the reform and no clear regulatory body was set up until the bidding process began. Arguably this provided a potential advantage for telephone diffusion in Mexico compared to Argentina, since in the latter, the lack of clarity over the regulatory aspect at the time of bidding reduced the number of potential bidders for ENTel. Moreover, the new telecom regulatory agency created in Argentina in 1990, did almost nothing until 1992, partly due to its lower degree of autonomy and to some extent limited finances, further highlighting the problems caused by poor timing.

Ultimately, one can argue that this seeming advantage in speed and relative sense of better timing can partly explain the side of the Paradox that explains why Mexico outperformed. The Mexican timing effect can be summarised as a twofold argument: first, in terms of the relatively more proactive and relatively faster speed of action (e.g. introduction of Mexico's Mitre Law equivalent many years before Argentina) and second, in terms of the favourability of timing (e.g. Telmex's gradual nationalisation). By implementing key reforms before Argentina's administrations, the telecom sector in Mexico was able to reap the benefits from these reforms relatively sooner (as well as avoid wasting time travelling down a less efficient diffusion path) and, through the gradual timing of other reforms, it arguably benefited from a relatively better reform.

5.3 Mexico's Success Story

As explored, there are two sides to the Paradox. From a learning perspective, one could claim that the examination of the Mexican side of the story is likely to be relatively more useful for developing countries, as it provides some examples of how

to potentially outperform in ICT diffusion relative to their economic means. It seems logical therefore, to ask at this instance whether the diffusion of the telegraph and the telephone in Mexico can be considered a 'Success Story', or was it merely a quirk of circumstance? In appreciation of the factors that explained the rate of diffusion of the two technologies, it is believed that Mexico can be labelled as a relative success story, and this section explains to what extent this was the case.

The relatively similar speed with which the two technologies diffused in Mexico compared to Argentina does not necessarily mean the experience in Mexico was a success story. However, the various administrations in Mexico did achieve some sense of success in introducing timely reforms and in dealing more efficiently than Argentina with additional customer demand. Perhaps Argentina's governments did not set their diffusion rate targets as high as they could have been, given the country's relative advantage with regard to income wealth, but one cannot take credit away from the Mexican administrations. Mexico's telegraph diffusion was particularly fast, since during the period of export-led growth from a socio-economic standpoint, the country significantly lagged not just Argentina, but the Latin American average (see chapter 1, section *The Period of Export-led Growth [1870-1930]*, and appendix A).[37] Indeed, the diffusion experience in Mexico can be considered a relative success story on two fronts. One, the positive attitude and overall capacity of the Mexican administrations at critical periods of telegraph and telephone diffusion, translated into reasonably effective implementation of diffusion-inducing reforms (as assessed earlier in section 5.2.3 The Traits of the Government Administrations in Mexico). Two, it was not only the decisions to implement these policies that were impressive, but the swift and timely manner in which plans were executed, in relative terms when compared to the situation in Argentina (as analysed earlier in section 5.2.4 The Mexican timing Effect).

Through analysis of specific examples from the Mexican experience it is possible to present some potential learning implications. For instance, the gradual approach to Telmex's nationalisation (in retaining private flavour) adopted by the Mexican administrations after the Second World War in preference to ENTel's full blown

[37] Note that the most significant part of telegraph diffusion took place during export-led growth and this was when the economic divide with Argentina was at its largest.

nationalisation, enabled a relatively higher quality of service provision by Telmex. The opportunity to learn from the expertise of the previous private provider, instead of simply appointing (perhaps capable but) inexperienced government officials to run the company (as with ENTel), incentivised relatively greater diffusion among the population. Therefore one lesson for other countries is to decisively and thoughtfully implement structural changes at critical stages of technology diffusion. Next, it would be wrong to consider the diffusion of the two technologies in Mexico an absolute success. Indeed, much of Porfirio Díaz's ability to implement reforms and encourage the expansion of the telegraph network was at times carried out by overly aggressive means. The fact that if someone was caught breaking a telegraph cable they could face the death penalty, says a lot. This 'got the job done', as it were, but it cannot be deemed as 'successful policy' to be copied by other countries. Moreover, Porfirio Díaz's positive attitude was not founded on the fact that the telegraph had characteristics of a public good in need of universal supply, but rather was driven by the fact that it was conceived as a primary tool for state consolidation. Despite the fact that it was an innovative technological breakthrough, a similar mindset was observed in Argentina, so by no means can one say that the Mexican administrations had a particularly distorted perspective. Hence, one could argue that, moral issues and motives aside, another lesson is that one must appreciate that an outwardly positive attitude toward the diffusion process is particularly important.

Further, without overly generalising, given the significant variation in rule even within the same tenure of a given administration (over the period under consideration), the generally higher degree of political stability fostered in Mexico during the height of the Porfiriato and the height of the PRI's dominance over politics in particular (which coincided with the fastest portions of telegraph and telephone diffusion speed), allowed for a relatively higher degree of continuity in diffusion conducive reforms (see specifically chapter 4, sections *Political Institutions: the Degree of Stability and Characteristics of State Power*). Clearly, political stability is not necessarily a trait that every administration in power can necessarily influence greatly, but rather the message is to act in the interests of the long-term, for strong diffusion speed. A final lesson that can be drawn from Mexico's experience is that an economic advantage is not seemingly a pre-requisite for successful diffusion of the telegraph and the telephone. Despite the theoretical advantage of Argentina's

socio-economic lead over Mexico throughout much of the period in question, which the conventional literature argues is key in explaining differences in diffusion rates, in this study this advantage did not necessarily ensure faster diffusion.[38] Arguably, despite Argentina's relatively higher income levels, the two technologies managed to diffuse at a relatively similar speed in Mexico. The thesis provides some support toward the argument that, rather, it was political players and institutional reforms that were relatively more meaningful drivers of the diffusion of the telegraph and the telephone. This in some ways alludes to Gerschenkronian concepts as the state to some extent was more important than the typical pre-requisite factors (e.g. higher income) in promoting diffusion.[39]

In evaluation of the whole telegraph and telephone diffusion complex, it is reasonable to argue that to some degree, and certainly in comparison to the experience in Argentina, the diffusion of the telegraph and the telephone in Mexico constitutes a relative 'Success Story'. Moreover, the analysis delivered a number of potential learning implications, particularly for developing countries that may face similar uncertainty regarding the future diffusion of a given technology. One: certain Mexican administrations were successful in taking relatively decisive action in the implementation of reforms in a timely manner. Two: although the primary rationale for the state's positive attitude toward diffusing the two technologies was primarily self-interested, the end-result was a success. The lesson here is that the government should aim to adopt a visibly supporting stance in promoting access to such technologies in order to drive diffusion. Three: a greater notion of political stability is favourable in implementing diffusion-conducive reforms. Since this is not always attainable, more importantly, where such technologies are concerned, the governing party must ideally put the public's needs first and seek to implement long-term policies that can be maintained by future leaders, and not simply pander to short-sighted populist choices. Indeed, the fourth lesson does not come in appreciation of the Mexican success story but rather indirectly in acknowledgement of the relative 'failings' of Argentina. The fourth lesson is that the state should never restrict diffusion, which the Mexican administrations managed to avoid to a relatively higher

[38] Chapter 4, section 4.2 Analysis of Diffusion – A Quantitative Approach, provides some evidence for this. However the regression analysis must be read in conjunction with the qualitative assessment, given the issues surrounding the data.
[39] Gerschenkron (1962).

degree than in Argentina. In a process that is so uniquely shaped by the intrinsic traits of a country's setting, it is important to be self-aware and ready to shift policy where necessary, at the very least so as not to inhibit diffusion. The final lesson is that an economic advantage is not essential to ensure successful diffusion.

5.4 Conclusion

From the platform set up by chapters 1-4, this chapter addressed the three questions posed at the start of the thesis, namely, what were the main drivers behind the diffusion rates of the telegraph and the telephone in Argentina and Mexico? Secondly, since both countries experienced very similar diffusion rates, despite significant income level differentials, how can the Paradox be explained? Third and finally, can the Mexican case study be considered a 'Success Story'?

In response to the first question, the thesis found that the role of the government was crucial across the diffusion of both technologies in Argentina and Mexico. Telegraph diffusion in Argentina was ultimately most affected by the government's introduction of the Mitre Law, while the implementation of privatisation drove telephone diffusion most of all. In Mexico, the relatively stronger desire and degree of autonomy, as well as the capacity of the main administrations in the early part of the diffusion period enabled the successful development of the telegraph, while the government's gradual nationalisation approach of Telmex was the determining factor during telephone diffusion.

In answering the second question, the Paradox is best explained by both Argentina's relative underperformance and Mexico's outperformance in terms of diffusion speed. The diffusion of the two technologies in Argentina was not as fast as it theoretically could have been in regard to its economic advantage, ultimately making it easier for the diffusion of the two technologies in Mexico to catch up. In Argentina, the underperformance in diffusion speed seemingly was driven by the constraining impact of various factors that the state somewhat controlled (namely the delayed introduction of the Mitre Law and the inability of the nationalisation reform in meeting increased demand), since diffusion speed was rapid after the given situations were rectified. Meanwhile, in Mexico, the outperformance can be best understood

through close examination of the various governments in power. This revealed that the particular traits of the most important government administrations in Mexico, as well as the timing of the implementation of reforms particularly conducive to diffusion, were the two comparatively key broad explanatory factors.

In appreciation of the Mexican side of the Paradox, the final question can thus be suitably answered. This chapter demonstrated that the Mexican experience can certainly be viewed as a relative 'Success Story' and moreover it provided five learning implications for developing countries looking to optimise ICT diffusion speed. These implications point to the need to: act decisively and carefully in implementing reforms, adopt a visible supportive stance in promoting access to such technologies, achieve a relatively higher level of state stability (or at least implement long-term policies), avoid acting in a manner that restricts the diffusion process and, lastly, understand that an economic advantage does not automatically pertain to successful diffusion. In conclusion, this chapter has served its purpose in providing reasonably sound answers to the three important questions raised at the beginning of the thesis.

Conclusion

This thesis has set out to document and explain the diffusion of the telegraph and the telephone in two major Latin American countries, Argentina and Mexico. Since Argentina was considerably richer than Mexico in the eras in which the telegraph and telephone could become available, the expectation was for both technologies to have diffused more quickly in Argentina than in Mexico. This was not the case, and explaining this 'paradox' became the intellectual core of my thesis.

Overall, the thesis contributes to the surprisingly limited literature of comparative historical studies (of Argentina and Mexico) on the diffusion of traditional ICTs. The telegraph and telephone were revolutionary technologies that affected not only economic advancement, but also social behaviour.[1] By examining the whole period of diffusion, the strength of the findings are improved and their scope enlarged. This approach contrasts with a great deal of the literature since most studies look at the diffusion process as a snapshot.[2] Similarly, the work that has been done on ICT diffusion in Latin America has concentrated on the most recent period, after privatisation, and on the most modern ICTs, such as the internet. This thesis contributes to the literature not only by examining an earlier period of diffusion, but by focusing on ICTs which largely impacted the setting and arrival of future ones (e.g. the relationship between fixed-line telephones and the internet). Given the growing recognition that past technological achievements influence future ones, this thesis allows insights to be drawn for future ICT diffusion. It aids our understanding of a country's given experience with modern ICT diffusion, and the thesis shows that 'history counts'. The results of the thesis serve to redirect the focus toward the overwhelming influence of the state in determining the speed of technology diffusion.

[1] Although some studies have focused on the history of the development of these technologies, particularly with regard to Argentina, they are largely historical accounts of the evolution of facts.
[2] This is problematic because as a process, diffusion cannot simply be viewed at a moment in time, if one hopes to draw meaningful generalisations about the whole period of diffusion, or provide much insight regarding the primary drivers of a given diffusion rate over time.

The first stage of the thesis was to document the increasing use of the two technologies in each country. Wherever possible I used standard, well respected sources, including the national censuses, data from INDEC and INEGI, or from official industry publications. The official data was also checked against parallel series and always subject to critical, sceptical scrutiny. Where primary sources were not available, it was necessary to merge various time series and cross-reference their consistency to complete the construction of consolidated telegraph and telephone diffusion series. Examination showed that telegraph and telephone diffusion were just as rapid in Mexico as in Argentina, as summarised in table 6.1 (for full details see chapter 2, section 2.6.2 Linearisation of the S-curves):

Table 6.1 Summary Findings of the Diffusion Analysis

Data set	Diffusion Speed (as measured by the CRD)	Saturation Point (years)	Inflection Point (years)
Argentina Telegraph	25yrs	83.5	35.6
Mexico Telegraph	26yrs	30.8	15.4
Argentina Telephone	54yrs	86.2	28.1
Mexico Telephone	52yrs	86.3	37.6

Source: See appendix B for data sources. Note: CRD = Characteristic Rate of Duration (see chapter 2).

Table 6.1 confirms the statistical closeness of the diffusion speeds as measured by the characteristic rates of diffusion.[3] Throughout the research process, various challenges presented themselves. One of the most difficult proved to be plotting real diffusion against a theoretical model. The methodology required sufficient complexity to map the diffusion process, without overshadowing the simplicity of the conclusions. The Flexible Logistic Growth model and subsequent linearisation methods provided the necessary base from which to form the analyses. This gave rise to an interesting historical episode, which I called the 'Double Paradox' ('the Paradox' for short). Notably, relatively similar diffusion strategies were implemented in Argentina and Mexico, yet the degrees of

[3] Note that the saturation and inflection points in Mexico are much lower for the telegraph.

success were quite different.[4] Although the period cannot be generalised in entirety, the distinguishing factors were seemingly the relative underperformance of the Argentinian administrations and the apparent outperformance of the Mexican administrations, at critical junctures of ICT diffusion. It is in the combination of these experiences that the dual nature of the Paradox is revealed.

Aside from conceptual issues, the most difficult obstacle to the research was the physical collection of historical records from Buenos Aires and Mexico City. There were often incomplete data sets or missing volumes and, although alternative data sets could sometimes be sourced from the archives, at times it had to be accepted that the data did not exist. For instance, as a result of a lack of data in the earliest periods under consideration, it was not possible to carry out a cross-sectional data analysis as initially planned in order to account for the intra-regional and spatial diffusion patterns. These challenges were mitigated as far as possible in the production of the consolidated data series (see appendix B). Indeed, the greatest challenge was arguably the fact that as the research evolved, the focus of the thesis shifted, and more emphasis was placed on the qualitative aspects, particularly the political economy and state capacity.

The implications of the Paradox are significant in providing some evidence that those in power hold the key, with the state having the power to both drive and constrain diffusion. Although these findings are somewhat contrasting to the conclusions of various academic contributions, this should not be taken as support for an argument that economic factors are not important. Rather, the findings suggest that an economic advantage was not a pre-requisite for successful ICT diffusion. In analysing these two developing countries and finding that the level of income had, at best, a weak impact on the rate of diffusion of these two technologies, this work is most closely aligned with Rouvinen's hypotheses.[5] On the other hand, the finding in the regression analysis that GDP per capita was a significant variable in explaining the telephone diffusion rate in

[4] Chapter 3 demonstrated that the governments in Argentina and Mexico assumed similar positions regarding the diffusion of the telegraph (e.g. both made it a monopoly of the state, implemented the Mitre Law and its equivalent and consolidated the network) and in the diffusion of the telephone, (e.g. the nationalisation and privatisation reforms).
[5] Rouvinen (2006).

Argentina, but only after privatisation, is directly supportive of Littlechild's work.[6] Moreover, the results of the thesis show that some of Mexico's administrations acted as substitutes (Gerschenkronian style) for economic shortcomings in allowing for successful diffusion.[7]

The fact that the state played a crucial role in ICT diffusion is not surprising given a state's capacity to affect the entire diffusion environment (and these findings are aligned with the work of Petrazzini, Milner, Rosenberg, Henisz and Zelner, among others).[8] The extent of the state's impact, however, is surprising. Indeed, initiatives for sector reform were often exogenous and associated with an economic crisis, making the state the key player in pushing the necessary reforms onto the political agenda. At the extreme, Argentina's reform strategies actually served to constrain diffusion. Indeed, various Argentinian governments proved to be relatively inefficient at important moments in the implementation (e.g. nationalisation) or timing (e.g. the Mitre Law) of diffusion-enhancing reforms, and this was testament to the relative slow pace of diffusion. Clearly this was not the aim of government policy, but rather an unintentional consequence. In a comparison of some of the most important administrations during telegraph and telephone diffusion, the thesis provided evidence that a relatively more closed political system was seemingly more effective than a more open, decentralised and quasi-democratic one, in the implementation of telecom reforms. This is very much aligned with the conclusions reached by Petrazzini, but at odds with the work of Duch.[9] Moreover, it draws some parallels to the developmental authoritarianism literature, although this is not to say that a country that has an authoritarian regime is necessarily predisposed to faster diffusion.[10]

[6] Littlechild (1983).
[7] Gerschenkron (1962).
[8] Petrazzini (1995), Milner (2006), Rosenberg (1970, 1972), Henisz and Zelner (2001). Also see Bergara et al. (1998), Andonova and Díaz-Serrano (2007), Esfahani and Ramirez (2003), Levy and Spiller (1996), Brown (1981), Mokyr (2002), Wallsten (2001a, 2005), Bath and James (1979), Schuler and Brown (1999).
[9] Petrazzini (1991), Duch (1991).
[10] The advocates include Haggard and Kaufman (1993). Those opposing this include O'Donnell et al. (1986). Also see Johnson (1982, 1999), Johnson in Deyo (1987), Amsden (1989), Zysman (1983), White (1988), Deyo (1987).

The introduction to the thesis argued that a greater understanding of the factors driving the diffusion of traditional ICTs was necessary for an understanding of what can drive future ICT diffusion (and thus economic development), particularly in developing countries. The thesis is well placed to adjudicate on this matter and in turn supplied some learning implications for developing economies in the future. The examination of the Mexican 'Success Story' highlighted five specific lessons: first, the importance of swiftness and optimal timing. Second, the need for a government to adopt a visible supportive stance in promoting access to such technologies. Third, ensuring the implementation of diffusion-conducive reforms with longevity beyond the government's term in office. Fourth, in a process that is shaped by the unique traits of a given country, it is important to be self-aware and shift policy and strategy where necessary, at the very least to avoid hindering diffusion. Finally, understanding that an economic advantage does not necessarily ensure successful diffusion provided the given administration functions as an appropriate substitute. The wider implications of these lessons highlighted the fact that it is not only the choosing of the reforms that is imperative in inducing faster diffusion but it is down to the smallest of details that can make the decisive difference between outperformance and underperformance. Indeed, in light of a growing appreciation of the importance of ICTs in accelerating economic growth, it is increasingly more important to learn about their diffusion processes, especially for developing countries. In diffusing a technology after others have done so, there is an opportunity to learn from the mistakes of the innovators and to try to replicate their successes. Accordingly, the value of this thesis in comparing Argentina (the leading Latin American economy for much of the period) and Mexico is both fascinating and has proved useful.

In terms of further research, readdressing the key findings gives rise to a number of interesting questions about the balance between institutional factors and economic factors regarding the ICT diffusion process in developing economies. For example, we could ask under what circumstances do institutional players have a more significant role than economic factors in explaining ICT diffusion? Econometrically, it would be interesting to find the point at which additional income does not further diffusion.

Indeed, more specifically we could ask whether governments often fail to perform as expected, or was this unique to Argentina? Lastly, is an authoritarian-inclined regime, a pre-requisite, or are there other ways to achieve a diffusion-conducive setting? Although beyond the scope of this thesis, these are potentially intriguing new directions the research could take.

The literature on technology diffusion recognises the importance of a plethora of factors in explaining differences in diffusion rates across countries, but economic factors are commonly asserted to play *the* crucial differentiating role. Historically, ICT diffusion often is explained as a function of wealth, urbanisation, etc. Theory would therefore predict that the telegraph and the telephone diffusion in Argentina should have been relatively faster than in Mexico given its (varying but material) inherent economic advantage throughout the period studied. One of the main contributions of the thesis is to demonstrate that this was not the case. These variables do not explain diffusion in either country independently, nor can they explain the differences in diffusion between the countries.[11] This result alone is a contribution to the literature since the unexpected finding not only questions a purely economic rationalising but broadened the accepted complex of primary explanatory outcomes with regard to technology diffusion speed.

This thesis achieved its central aims of documenting and explaining the diffusion of the telegraph and the telephone in Argentina and Mexico. Both the summary statistics and the application of a more formal diffusion model show that, contrary to initial expectations, neither of the two technologies diffused faster in Argentina, despite Argentina's greater wealth throughout the period under consideration. This thesis also demonstrates that the diffusion rates in each country cannot be explained using the sort of conventional economic modelling that have proven so successful for both contemporary, and historical diffusion processes. Instead, what explains the relatively rapid rate of diffusion in Mexico, relative to Argentina is essentially a matter of political economy. Through a range of interventions, ranging from the early implementation of a complementary railway statute in the case of the telegraph, to a gradual approach to

[11] One must only accept these results, however, with due consideration of the issues raised with regard to the data.

nationalisation in the case of the telephone, the Mexican governments arranged things in such a way as to be much more supportive of technological diffusion. This result is interesting for historians of technology, for those interested in the role of government in the development process in general, and above all for historians of Latin America. The primacy of politics in economics is embedded in the history of the region and is a recurring theme in the history of Latin America, and it is a theme that again proves to be extremely powerful in this case.

Bibliography

Official Data Sources

- American Telephone and Telegraph Company, *The World's Telephones* New York, AT&T (1957), various years between 1957 to 1992.

- Arriaga E., *New Life Tables for Latin American Populations in the Nineteenth and Twentieth Centuries* Berkeley, Institute of International Studies, University of California (1968).

- Aubrey H. G., *The National Income of Mexico* Washington D.C., Instituto Interamericano de Estadística (1950).

- Bairoch P. and Etemad B., *Commodity Structure of Third World Exports, 1830-1937* Geneva, Librairie Droz (1985).

- Banco de México, *Informe Sobre la Revisión Preliminar de las Estimaciones del Producto Nacional de México para los años de 1950 a 1962* México D.F., Comercio Exterior (1963).

- Banco de la República, *Principales Indicadores Económicos: 1923-1992* Bogota, Banco de la República (1993).

- Banks A. S., 'Cross National Time Series, 1815-1973' *ICPSR* Ann Arbor, University of Michigan, Inter-University Consortium for Political and Social Research: Producer and Distributor (1976).

- Baptista A., *Bases Cuantitativas de la Economía Venezolana 1830-1989* Caracas, Comunicaciones Corporativas (1991).

- Baptista A., *Bases Cuantitativas de la Economía Venezolana, 1830-1995* Caracas, Ediciones Fundación Polar (1997).

- Bertola L., 'El PBI Uruguayo 1870-1936 y otras Estimaciones' *documento de trabajo no. 43*, Montevideo, Universidad de la República Montevideo (1998).

- Bose, Walter B. L., 'Los Orígenes del Telégrafo en la Argentina' *Revista de Correos y Telégrafos* no.81 Buenos Aires, Dirección General de Correos y Telégrafos (15 Mayo 1944).

- Castro Esteves R., *Historia de Correos y Telégrafos de la República Argentina* volumen V, Buenos Aires, Ediciones de la Dirección General de Correos y Telégrafos (1952).

- Centro Latinoamericano y Caribeño de Demografía (CELADE), *Boletín Demográfico* 29.58 (1996): 55.

- Coatsworth J. H., 'The Decline of the Mexican Economy, 1800-1860' in Liehr R., *La Formación de las Economías Latinoamericanos en la época de Simón Bolívar* Berlin, Colloquium Verlag (1989).

- Comisión Económica para América Latina (CEPAL), *Cuadros del Producto Interno Bruto en Dólares de 1950* Santiago, United Nations (1962).

- Comisión Económica para América Latina (CEPAL), *Series Históricas del Crecimiento de América Latina* Santiago, United Nations (1978),

- El Colegio de México, *Estadísticas Económicas del Porfiriato: Comercio Exterior de México, 1877-1911* México D.F., El Colegio de México (1960).

- Empresa Nacional de Telecomunicaciones (ENTEL), *Anuario Estadístico 1974* Buenos Aires (1974).

- Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Anual* Buenos Aires (various years).

- Ferreres O. J., *Dos Siglos de Economía Argentina 1810-2004* Buenos Aires, Fundación Norte y Sur (2005).

- González Garza J. R. H. and Sidaoui J. J., *Cuentas Nacionales y Análisis Macroeconómico* Document 38, México D.F., Banco de México (1981).

- Greer R. G., *The Demographic Impact of the Mexican Revolution 1910-21* Master's thesis, University of Texas (1966).

- Hofman A., 'International Estimates of Capital: A 1950-1989 Comparison of Latin America and the USA' *Research Memorandum 509* University of Groningen, Institute of Economic Research (1992).

- Hofman A., *Economic Performance in Latin America - A Comparative Quantitative Perspective* Consultancy paper done in 1997 for R. Thorp (1998).

- Hunt S., *The Human Condition in Latin America, 1900 - 1995* Consultancy paper done in 1997 for R. Thorp (1998).

- Instituto Brasilero de Geografía y Estadística (IBGE), *O Brasil em Numeros* Rio de Janeiro (1960).

- Instituto de Estudios Económicos sobre la Realidad Argentina y Latinoamericana (IEERAL), *Estadísticas de la Evolución Económica de la Argentina, 1913-1984* Buenos Aires, Argentina (1986).

- Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 1957* Buenos Aires (1958).

- Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 1973* Buenos Aires (1974).

- Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 1979-1980* Buenos Aires (1981).

- Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 1981-1982* Buenos Aires (1984).

- Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 1983-1986* Buenos Aires (1989).

- Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 1990* Buenos Aires (1990).

- Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 1995* Buenos Aires (1995).

- Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 2000* Buenos Aires (2000).

- Instituto Nacional de Estadística y Censos (INDEC), *Censo Nacional de Población, Hogares y Viviendas 2001* Buenos Aires (2001).

- Instituto Nacional de Estadística y Censos (INDEC), *Estadísticas de Servicios Públicos* Buenos Aires (various years between 1995-2004).

- Instituto Nacional de Estadística y Censos (INDEC), *Estadísticas Telefónicas 1970* Buenos Aires (1970).

- Instituto Nacional de Estadística y Censos (INDEC), *La Población de Argentina* Buenos Aires, Series Investigaciones Demográficas (1973).

- Instituto Nacional de Estadística y Censos (INDEC), *La Población de Argentina* Buenos Aires, Serie Investigaciones Demográficas (1975).

- Instituto Nacional de Estadística y Censos (INDEC), *Situación y Evolución Social* Sintesis no.4, Buenos Aires (1994).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1940* México D.F. (1942).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1951-1952* México D.F. (1954).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1960-1961* México D.F. (1963).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1970-1971* México D.F. (1973).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1979* México D.F. (1981).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1980* México D.F. (1982).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1990* México D.F. (1992).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1995* México D.F. (1996).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 2006* México D.F. (2007).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Estadísticas Históricas de México* volume I, México D. F (1985).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Sistema de Cuentas Nacionales de México: Cuentas Consolidadas de la Nación, Oferta y Utilización, Producto Interno Bruto, 1980-86* México D.F. (1987).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Estadísticas Históricas de México* México D.F. (1990).

- Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Estadísticas Históricas de México* México D.F. (1994).

- International Monetary Fund (IMF), (http://www.imf.org/external/pubind.htm).

- International Telecommunication Union (ITU), (http://www.itu.int).

- International Telecommunication Union (ITU), *ICT Statistics Database* ICT Eye (http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx).

- Maddison A. and Associates, *The Political Economy of Economic Growth. Brazil and Mexico* New York, Oxford University Press (1992).

- Maddison A., *Monitoring the World Economy 1820-1992* Paris, OECD Development Centre (1995).

- Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003).

- Maddison A., 'Historical Statistics of the World Economy: 1-2003 AD' *Historical Statistics* Copyright Angus Maddison (2006).

- México, Departamento de la Estadística Nacional, *Anuario de 1930* Tacubaya D.F., Secretaría de Agricultura y Fomento (1932).

- México, Peñafiel A. *Anuario Estadístico de 1893* México D.F., Dirección General de Estadística (1894).

- Mitchell B. R., *International Historical Statistics: Australasia and Americas* London, Palgrave Macmillan (1983).

- Mitchell B. R., *International Historical Statistics: The Americas, 1750-1988* Basingstoke, Palgrave Macmillan (1993).

- Mitchell B. R., *International Historical Statistics: The Americas, 1750-1993* New York, Palgrave Macmillan (1998).

- Mitchell B. R., *International Historical Statistics: Europe, 1750-2000* 5th ed., New York, Palgrave Macmillan (2003a).

- Mitchell B. R., *International Historical Statistics: The Americas 1750-2000* 5th ed., New York, Palgrave Macmillan (2003b).

- Mitchell B. R., *International Historical Statistics: Africa, Asia and Oceania 1750-2000* 4th ed., New York, Palgrave Macmillan (2003c).

- Organisation for Co-operation and Development (OECD), *Historical Statistics and National Accounts* (various years) (http://www.oecd.org)

- Oxlad, *Población Censada y Tasas de Crecimiento Medio Anual, Según Cuidades, 1950-1990 Boletín Demográfico*, Edición Especial: Urbanización y Evolución de la Población Urbana de América Latina (1950 -1990), Centro Latinoamericano de Demografía (2002).

- Palma J. G., *Growth and Structure of the Chilean Manufacturing Industry from 1830 to 1935* Doctoral thesis, Oxford University (1979).

- Pan-American Union (PAU), *The Foreign Trade of Latin America since 1913* Washington D.C., Pan American Union (1952).

- Peña S. and Wilkie J. W., *La Estadística Económica en México: los Orígenes* México D.F., Siglo Veintiuno Editores (1994).

- Pérez Brignoli H., 'América Latina en la Transición Demográfica 1800-1980' *La Transición Demográfica en América Latina y el Caribe* volume 1, México D.F., INEGI (1993).

- Pérez López E., *Mexico's Recent Economic Growth* Austin, University of Texas Press (1967).

- Province de Buenos Ayres, Ministère de Gouvernement, Bureau de Statistique Generale, *Annuaire Statistique de la Province de Buenos Ayres, 1882* Buenos Aires (1883).

- Province de Buenos Ayres, Ministère de Gouvernement, Bureau de Statistique Generale, *Annuaire Statistique de la Province de Buenos Ayres, 1896* Buenos Aires (1897).

- República Argentina, Comisión Nacional del Censo, *Primer Censo Nacional, 1869* Buenos Aires, Imprenta del Porvenir (1872).

- República Argentina, Comisión Nacional del Censo, *Segundo Censo de la República Argentina, 1895* Buenos Aires (1898).

- República Argentina, Comisión Nacional del Censo, *Tercer Censo Nacional, 1914* Buenos Aires, Talleres Gráficos de L. J. Rosso y Cía. (1915-1917).

- República Argentina, Comisión Nacional del Censo, *Cuarto Censo General de la Nación 1947,* Buenos Aires (1947).

- República Argentina, Dirección General de Estadística, *Extracto Estadístico de la República Argentina,* Buenos Aires (1916).

- Republica Argentina, Cámara Argentina de Comercio, *Revista Oficial de la Cámara Argentina de Comercio* Buenos Aires (various years from 1925).

- República Mexicana, Dirección General de Estadística, *Censo General de la República Mexicana, 1895* México D.F., Oficina Tipográfica de la Secretaría de Fomento (1897).

- República Mexicana, Dirección General de Estadística, *Censo General de la República Mexicana, 1900* México D.F., Oficina Tipográfica de la Secretaría de Fomento (1902).

- República Mexicana, Dirección General de Estadística, *Tercer Censo de Población de los Estados Unidos Mexicanos, 1910* México D.F. (1920).

- República Mexicana, Dirección General de Estadística, *Censo General de Habitantes, 1921* México D.F., Talleres Gráficos de la Nación (1928).

- Reynolds C. W., *The Mexican Economy. Twentieth-Century Structure and Growth* New Haven, Yale University Press (1970).

- Rosenblat A., *La Población Indígena de la América desde 1492 hasta la Actualidad* Buenos Aires, Institución Cultural Española (1945).

- Rosenzweig F., *Fuerza de Trabajo y Actividad Económica por Sectores, Estadísticas Económicas del Porfiriato* México D.F., Colegio de México (1960).

- Scott Keltie J., *The Statesman's Yearbook* Fourteenth annual publication, London, Macmillan and Co. (1900). Various publications from 1900 onwards.

- Secretaría de la Economía Nacional. Dirección General de Estadística, *México en Cifras* México D.F., Talleres Gráficos de la Nación (1938).

- Seminario B. and Beltrán A., *Crecimiento Económico en el Perú 1896-1995* Lima, Universidad del Pacifico (1998).

- The World Bank, *World Bank Tables* Washington D.C. (1993).

- The World Bank, *World Development Report 1994* Washington D.C. (1994).

- The World Bank, *World Development Indicators* (www.data.worldbank.org)

- Thorp R. and Bertram I. G., *Peru 1890-1977: Growth and Policy in an Open Economy* London, Macmillan (1978).

- United Nations, *Statistical Yearbook* New York, United Nations (1951).

- United Nations, *Demographic Yearbook* New York, United Nations (1960).

- United Nations, *World Economic Trends* New York, United Nations (1995).

- United Nations Conference on Trade and Development (UNCTAD), *World Investment Report 1999: Foreign Direct Investment and the Challenge of Development* Geneva: United Nations (1999).

- United Nations Development Programme (UNDP), *Human Development Report* New York, Oxford University Press (1997).

- U.S. Bureau of the Census, (http://www.census.gov./ipc)

- Vargas Torres E., 'Estimaciones del Ingreso Nacional de México' in *El Trimestre Económico* volume 27.4, México D.F., Fondo de Cultura Económica (1960).

- Vázquez Presedo V., *Estadísticas Históricas Argentinas (Comparadas), Primera Parte, 1875-1914* Buenos Aires, Ediciones Macchi (1971).

- Vázquez Presedo V., *Estadísticas Históricas Argentinas (Compendio 1873-1973)* Buenos Aires, Instituto de Economía Aplicada (1988).

- Vázquez Presedo V., *Estadísticas Históricas Argentinas (Suplemento 1970-1990)* Buenos Aires, Ediciones Macchi (1994).

- Webb R., *The Political Economy of Poverty, Equity and Growth in Peru 1948-85* Washington D.F., The World Bank (1988).

- Wilkie J. W. and Ruddle K., *Quantitative Latin American Studies: Methods and Findings* Statistical Abstract of Latin America (SALA) Supplement Series 6, Los Angeles, UCLA (1977).

- Zimmerman L. J., *Arme en rijke landen: Een Economische Analyse (Poor and Rich Countries: An Economic Analysis)* The Hague, Uitgerij Albany (1964).

Government and Official Documents

- Antonelli C., *The Diffusion of Advanced Telecommunications in Developing Countries* Paris, OECD (1991).

- Argentina, Banco Central de la Republica Argentina *Estimaciones Anuales de la Oferta y Demanda Globales: Periodo 1980-1990* República Argentina (1993).

- Argentina, Congreso Nacional, *Diario de Sesiones de la Cámara de Diputados* República Argentina (1873).

- Argentina, Congreso Nacional, *Diario de Sesiones de la Cámara de Diputados* República Argentina (1874).

- Argentina, Congreso Nacional, *Diario de Sesiones de la Cámara de Diputados* República Argentina (1875).

- Argentina, Congreso Nacional, *Diario de Sesiones de la Cámara de Diputados* República Argentina (1929).

- Argentina, *Leyes Nacionales 1907-1908* (Law no. 5315) Publicación Oficial de la Secretaria del Honorable Senado de la Nación, Buenos Aires (1912).

- Argentina, 'Ley Sobre Ferrocarriles Agrícolas y Económicos' *Decreto Reglamentario de 21 Septiembre de 1904* Publicación Oficial, La Plata, Taller de Impresiones Oficiales (1907).

- Argentina, *Memoria* of the Director General of Posts and Telegraphs, submitted to the Minister of Interior for 1878.

- Argentina, *Memoria* of the Director General of Posts and Telegraphs, Dr. Estanislao Zeballos, submitted to the Minister of Interior in 1891.

- Argentina, *Memoria* of the Director General of Posts and Telegraphs, submitted to the Minister of Interior in 1892.

- Argentina, *Memoria* of the Director General of Posts and Telegraphs, submitted to the Minister of Interior in 1919.

- Argentina, *Pliego de Bases y Condiciones para la Privatización del Servicio Público de Telecomunicaciones* Executive Decree 62/1990 (5th January 1990).

- Argentina, Telephone Census, *Boletín Mensual de Correos y Telégrafos* Buenos Aires, No. 16, Teléfonos (1912).

- Benavides García R., *Hitos de las Comunicaciones y los Transportes en la Historia de México* México D.F., Secretaría de Comunicaciones y Transportes (1987).

- Calderón C. and Servén L., 'Trends in Infrastructure in Latin America, 1980-2001' Policy Research Working Paper 3401, The World Bank (2004).

- Cárdenas de la Peña E., *Historia de las Comunicaciones y los Transportes en México: El Telégrafo* México D.F., Secretaría de Comunicaciones y Transportes (1987a).

- Cárdenas de la Peña E., *Historia de las Comunicaciones y los Transportes en México: El Teléfono* México D.F., Secretaría de Comunicaciones y Transportes (1987b).

- Carlés C., *Códigos Postales y Telegráficos Dictados durante la Administración del Dr. C. Carlés* Buenos Aires, Compañia Sud-americana de Billetes de Banco (1895).

- Casaús C., 'Privatisation of Telecommunications: The Case of Mexico' in Wellenius B. and Stern P.A., *Implementing Reforms in the Telecommunications Sector: Lessons from Experience* Washington D.C., The World Bank (1994).

- Consultative Committee for International Telephony and Telegraphy (CCITT), *Economic Studies at the National Level in the Field of Telecommunications (1964-68)* Geneva, United Nations (1968).

- D'Estrabau G., *Historia de las Comunicaciones y los Transportes en México: El Ferrocarril* México D.F., Secretaria de Comunicaciones y Transportes (1988).

- Dirección General de Telégrafos Nacionales, *Breves Apuntes sobre las Comunicaciones Telegráficas en el País* México D.F., Talleres Gráficos de la Nación (1924).

- Economic Commission for Latin America (ECLA), *Economic Survey of Latin America* New York, United Nations (1950a), various years.

- Economic Commission for Latin America (ECLA), *The Economic Development of Latin America and Its Principal Problems* New York, United Nations (1950b).

- Economic Commission for Latin America (ECLA), *Foreign Capital in Latin America* New York, United Nations (1955).

- Economic Commission for Latin America (ECLA), *El Desarrollo Económico de la Argentina* Santiago, United Nations (1959).

- Economic Commission for Latin America (ECLA), *External Financing in Latin America* New York, United Nations (1965).

- Economic Commission for Latin America (ECLA), *The Process of Industrialisation in Latin America* New York, United Nations (1966).

- Economic Commission for Latin America (ECLA), *Developmental Problems in Latin America: An Analysis by the UN ECLA* Austin, United Nations (1970).

- Economic Commission for Latin America (ECLA), *Dirección y Estructura del Comercio Latinoamericano* Santiago, United Nations (1984).

- Economic Commission for Latin America (ECLA), *Serie Distribución del Ingreso*, Santiago, United Nations (various years).

- Economic Commission for Latin America and the Caribbean (ECLAC), *Statistical Yearbook for Latin America and the Caribbean* Santiago, United Nations (1996).

- Economic Commission for Latin America and the Caribbean (ECLAC), *Economic Survey of Latin America and the Caribbean 1998-1999* Santiago, United Nations (1999).

- Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1957).

- Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1958).

- Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1975).

- Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1979).

- Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1981).

- Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1984).

- Empresa Nacional de Telecomunicaciones (ENTel), *Memoria Empresaria* Buenos Aires (1985).

- Fuentes G., *Historia de las Comunicaciones y los Transportes en México: La Radiodifusión* México D.F., Secretaría de Comunicaciones y Transportes (1987).

- García Benavides R., *Historia de las Comunicaciones y los Transportes en México : Hitos de las Comunicaciones y los Transportes en la Historia de México hasta 1911* México D.F., Secretaría de Comunicaciones y Transportes (1987).

- Hanna N., Guy K. and Arnold E., 'The Diffusion of Information Technologies' *The World Bank Discussion Paper* 281, Washington D.C., The World Bank (1985).

- Harteneck G. and McMahon B., 'Privatisation in Argentina' in OECD, *Privatisation in Asia, Europe and Latin America* Paris, OECD (1996).

- Hilbert M. R., 'From Industrial Economics to Digital Economics: An Introduction to the Transition' *Cepal Review* 100, United Nations Publication (2001): 1-133.

- Hill A. and Abdala M. A., 'Regulation, Institutions, and Commitment: Privatisation and Regulation in the Argentine Telecommunications Sector' *Policy Research Working Paper 1216,* Washington D.C., The World Bank (1993): 1-41.

- Hollenstein H., 'The Decision to Adopt Information and Communication Technologies (ICT): Firm-Level Evidence for Switzerland' *The Economic Impact of ICT, Measurement, Evidence and Implications* Paris, OECD Publications (2004).

- *Ley Sobre Ferrocarriles Agrícolas y Económicos* Decreto Reglamentario de 21 Septiembre de 1904, Publicación Oficial, La Plata, Taller de Impresiones Oficiales, República Argentina (1907).

- Mairal H. A., 'The Argentine Telephone Privatisation' in Wellenius B. and Stern P. A., *Implementing Reforms in the Telecommunications Sector: Lessons from Experience* Washington D.C., The World Bank (1994).

- Menezes C., 'Development of the Information Society in Latin America and the Caribbean' *UNESCO Report* 1-7 (2000): 1-7.

- Merchán Escalante C. A., *Historia de las Comunicaciones y los Transportes en México: Telecomunicaciones* México D.F., Secretaría de Comunicaciones y Transportes (1988).

- México, 'Reglamento de Ferrocarriles' *Diario Oficial del Gobierno Supremo de la República* volumen I, no. 120 (17th December 1867).

- México, 'Reglamento de Ferrocarriles, Telégrafos y Teléfonos' *en Sabas y Munguía,* Recopilación, 1870-ss, t. XXXVIII, (16th December 1881), pp. 346-347.

- México, 'Ley sobre Ferrocarriles' *Diario Oficial del Supremo Gobierno de los Estados Unidos Mexicanos* México D.F. (13th May 1899).

- México, Cámara de Diputados del H. Congreso de la Unión, *Ley de Vías Generales de Comunicación, 1938 (General Means of Communication Law)* México D.F., Diario Oficial de la Federación (30th December 1939).

- México, Memoria de la Secretaria de Fomento de 1865 a 1891 *Archivo General de la Nación* Galera 5 (various years).

- Ministerio del Interior, *Legislación Postal y Telegráfica. Convenciones, Reglamentos, Administración, 1858-1900* Buenos Aires (1901).

- Newspaper: *El Monitor Republicano*, (11 October 1855).

- Newspaper: *El País*, (14th June 1990).

- Newspaper: *Excelsior*, 12 February (1933), 13 February (1933), 14 February (1933), and 15 February (1933).

- Newspaper: *International Herald Tribune*, (7th September, 1992).

- Newspaper: *The New York Times*, 'The Mexico Railroad Law: New Statute Increases Governmental Powers of Supervision' (29th July 1899).

- Organisation for Economic Co-operation and Development (OECD), *Technology and the Economy: The Key Relationships* Technology, Economy Program (TEP) Paris, OECD Publications (1992).

- Organisation for Economic Co-operation and Development (OECD), *Open Markets Matter: The Benefits of Trade and Investment Liberalisation* Paris, OECD Publications (1998)

- Organisation for Economic Co-operation and Development (OECD), *The Economic Impact of ICT: Measurement, Evidence and Implications* Paris, OECD Publications (2004).

- Pacheco C., *Memoria presentada al Congreso* volume I, México D.F. (1883-1885).

- Parliamentary Office of Science and Technology, 'ICT in Developing Countries' *Postnote* 261 (2006): 1- 4.

- Pietrobelli C. and Rabellotti R., *Upgrading in Clusters and Value Chains in Latin America: The Role of Policies* Washington D.C., Inter-American Development Bank (2004): 1-106.

- Pilat D. and Devlin A., 'The Diffusion of ICT in OECD Economies' in *The Economic Impact of ICT, Measurement, Evidence and Implications* Paris, OECD Publications (2004).

- Proenza F. J., Bastidas-Buch R. and Montero G., *Tele-centres for Socioeconomic and Rural Development in Latin America and the Caribbean* Washington D.C., Inter-American Development Bank (2001).

- Sachs J., 'A Tale of Asian Winners and Latin Losers' *The Economist* (22nd February 1986): 63-4.

- Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1892-96* México D.F.

- Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1896-99* México D.F.

- Secretaría de Comunicaciones y Obras Públicas (SCOP), Memoria *1899-1900* México D.F.

- Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1904-1905* México D.F.

- Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1905-1906* México D.F.

- Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1907-1908* México D.F.

- Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1909-1910* Mexico. D.F.

- Secretaría de Comunicaciones y Obras Públicas (SCOP), *Memoria 1902-1910* México D.F.

- Secretaría de Comunicaciones y Transportes (SCT), *Programa Nacional de Modernización de las Telecomunicaciones 1989-1994* México D.F. (1994).

- Secretaría de Comunicaciones y Transportes (SCT), *Ley Federal de Telecomunicaciones* México D.F., Diario Oficial de la Federación (1995).

- Secretaría de Comunicaciones y Transportes (SCT), *Reglamento de Telecomunicaciones* México D.F. (1995).

- Secretaría de Comunicaciones (SECOM) (http://www.secom.gov.ar).

- Secretaría de Fomento, 'Reglamento para las Oficinas Telegráficas del Supremo Gobierno' document 5, *Memoria 1868-1869* México D.F.

- Secretaría de Fomento, *Memoria 1877-1882* México D.F.

- Secretaria de la Presidencia, *México a Través de los Informes Presidenciales* México D.F. (1976).

- SET (Consultores en Sociología y Economía del Trabajo, Secretaría de Asuntos Profesionales de FOETRA), *Análisis de la Productividad en las Empresas*

Telefónicas según Balances Contable. Matriz Básica de Datos Buenos Aires, Argentina, FOETRA (1996).

- Tandon P. and Abdala M., 'Mexico: Teléfonos de Mexico' in Galal A., Jones L., Tandon P. and Vogelsang I., *Welfare Consequences of Selling Public Enterprises: Case Studies from Chile, Malaysia, Mexico and the UK* Washington D.C., The World Bank (1992).

- Telmex, *Informe* México D.F., Telmex (1995).

- The World Bank *Beyond the Washington Consensus: Institutions Matter* Washington D.C., The World Bank Latin American and Caribbean Studies (1998).

- Tornquist E. and Cía., *Memoria del Telégrafo de la Provincia de Buenos Aires, 1895-96* La Plata, Talleres de Publicaciones del Museo (1896).

- Tornquist E. and Cía., *The Economic Development of the Argentine Republic in the Last Fifty Years* Buenos Aires, United Nations (1919).

- United Nations Conference on Trade and Development (UNCATD), *World Investment Report 1999: Foreign Direct Investment and The Challenge of Development* Geneva, United Nations (1999).

- United Nations, *Growth of the World's Urban and Rural Population 1920-2000* New York, United Nations (1966).

- United Nations, *Patterns of Rural and Urban Population Growth* New York, United Nations (1980).

- Wallsten S., 'Ringing the Twentieth Century: The Effects of State Monopolies, Private Ownership, and Operating Licenses on Telecommunications in Europe, 1892-1914' *Regulation and Competition Policy, Development Research Group* Washington D.C., The World Bank (2001b): 1-38.

- Wellenius B. and Stern P. A., *Implementing Reforms in the Telecommunications Sector: Lessons from Experience* Washington D.C., The World Bank (1994).

- Wheeler D. and Martin P., 'Prices, Policies and the International Diffusion of Clean Technology: The Case of Wood Pulp Production' in Low P., *International Trade and the Environment* Discussion paper 159, Washington D.C., The World Bank (1992).

- World Summit of the Information Society, *The Report of the Task Force on Financial Mechanisms for ICT for Development* ITU (2004): 1-121.

Articles and Journals

- Abdala M. A., 'Institutional Roots of Post-privatisation Regulatory Outcomes' *Telecommunications Policy* 24.8-9 (2000): 645-668.

- Abramovitz M., 'Catching-up, Forging Ahead and Falling Behind' *Journal of Economic History* 46. 2 (1986): 385-406.

- Ahn H. and Lee M. H., 'An Econometric Analysis of the Demand for Access to Mobile Telephone Networks' *Information Economics and Policy* 11.3 (1999): 297-305.

- Aitken B. J. and Harrison A. E., 'Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela' *American Economic Review* 89 (1999): 605-618.

- Alderman N. and Davies S., 'Modelling Regional Patterns of Innovation in the UK Metal-working Industries' *Regional Studies* 24.6 (1990): 1451-1461.

- Altimir O., Santamaria H. and Sourrouille J. V., 'Los Instrumentos de la Promoción Industrial en la Post-guerra' *Desarrollo Económico* 6.24 (1967): 709-734.

- Altimir O., 'Income Distribution Statistics in Latin America and Their Reliability' *Review of Income and Wealth* 33.2 (1987): 111-55.

- Ames E. and Rosenberg N., 'Changing Technological Leadership and Industrial Growth' *Economic Journal* 73. 289 (1963): 13-31.

- Amsden A., 'Taiwan's Economic History: A Case of Etatisme and Challenge to Dependency Theory' *Modern China* 5.3 (1979): 341-80.

- Anderson D., 'Energy and the Environment: Technical and Economic Possibilities' *Finance and Development* 33.2 (1996): 10-13.

- Anderson T. W. and Darling D. A., 'Asymptotic Theory of Certain "Goodness-of-fit" Criteria Based on Stochastic Processes' *Annals of Mathematical Statistics* 23 (1952): 193–212.

- Andonova V., 'Mobile Phones, the Internet and the Institutional Environment' *Telecommunications Policy* 30 (2006): 29-45.

- Andonova V. and Díaz-Serrano L., 'Political Institutions and the Development of Telecommunications' *Institute for the Study of Labour, Discussion Paper 2569* (2007): 1-28.

- Antonelli C., 'The International Diffusion of New Information Technologies' *Research Policy* 15 (1986): 136-47.

- Antonelli C., 'Profitability and Imitation in the Diffusion of Process Innovations' *Rivista Internazionale di Scienze Economiche e Commerciali* (1990): 109-136.

- Antonelli C., 'Investment and Adoption in Advanced Telecommunications' *Journal of Economic Behaviour and Organisation* 20 (1993): 227-45.

- Antonelli C., Petit P. and Tahar G., 'Technological Diffusion and Investment Behaviour: The Case of the Textile Industry' *Weltwirtshaftliches Archiv* 4 (1989): 782-803.

- Astero T., Colombo M. G. and Seri R., 'The Diffusion of Complementary Technologies: An Empirical Test' *SSRN Paper* (2005): 1-35.

- Astorga P., Bergés A. R. and Fitzgerald E. V. K., 'The Standard of Living in Latin America during the Twentieth Century' *Discussion Papers in Economic and Social History* 54, Oxford University (2004).

- Audretsch D. B. and Feldman M. P., 'R&D Spillovers and the Geography of Innovation and Production' *American Economic Review* 86 (1996): 630-640.

- Bagchi K. K., Solis A. O. and Gemoets A. L., 'An Empirical Study on Telecommunication Product Adoption in Latin America and Caribbean' *Electronic Journal on Information Systems in Developing Countries* 15.3 (2003): 1-17.

- Baker E., 'Institutional Barriers to Technology Diffusion in Rural Africa' *American Agricultural Economics Association General Meeting* (2005): 1-30.

- Barnett T., 'Why are Bureaucrats Slow Adapters? The Case of Water Management in the Gezira Scheme' *Sociologia Ruralis* 19 (1979): 60-70.

- Barreto L., 'Gaps and Needs in Technology Diffusion Models: The Perspective of an Energy-systems Modeler' Paper presented to the *Workshop on Clean Technologies Diffusion Modelling* (2003): 1-11.

- Bass M. F., 'A New Product Growth Model for Consumer Durables' *Management Science* 15 (1969): 215-227.

- Baur C., 'The Foundations of Telegraphy and Telephony in Latin America' *Journal of Communication* 44.4 (1994): 9-25.

- Beise M., 'Lead Markets: Country-specific Drivers of the Global Diffusion of Innovations' *Research Policy* 33.6-7 (2004): 997-1018.

- Bergara M., Henisz W. and Spiller P., 'Political Institutions and Electric Utility Investment: A Cross-Nation Analysis' *California Management Review* 40.2 (1998): 18-35.

- Bewley R. and Fiebig D. G., 'A Flexible Logistic Growth Model with Applications in Telecommunications' *International Journal of Forecasting* 4 (1988): 177-192.

- Blackman A. W., 'The Rate of Innovation in the Commercial Aircraft Jet Engine Market' *Technological Forecasting and Social Change* 2 (1971): 269-276.

- Blackman A. W., 'A Mathematical Model for Trend Forecasts' *Technological Forecasting and Social Change* 3 (1972): 441-452.

- Blackman A. W., 'The Market Dynamics of Technological Substitutions' *Technological Forecasting and Social Change* 6 (1974): 41-63.

- Blomstrom M., 'Foreign Investment and Productive Efficiency: The Case of Mexico' *Journal of Industrial Economics* 35 (1986): 97-110.

- Bonaccorsi A., Piscitello L. and Rossi C., 'The ICT Diffusion: A Spatial Econometric Approach' *Social Science Research Network* 120 (2005): 1-18.

- Bowden S. and Offer A., 'Household Appliances and the Use of Time: the United States and Britain since the 1920s' *Economic History Review* 47 (1994): 725-748.

- Brown L. A., Malecki E. J. and Spector A. N., 'Adopter Categories in a Spatial Context: Alternative Explanations for an Empirical Regularity' *Rural Sociology* 41 (1976): 99-118.

- Bundgaard-Nielsen M., 'The International Diffusion of New Technology' *Technological Forecasting and Social Change* 9 (1976): 365-370.

- Calvert P., 'Privatisation in Argentina' *Bulletin of Latin American Research* 15.2 (1996): 145-156.

- Cameron R., 'The Diffusion of Technology as a Problem in Economic History' *Economic Geography* 51.3 (1975): 217-230.

- Canitrot A. 'La Experiencia Populista de Redistribución de Ingresos' *Desarrollo Económico* 15.59 (1975): 331-351.

- Canning D., 'A Database of World Stocks of Infrastructure, 1950-95' *The World Bank Economic Review* 12.3 (1998): 529-547.

- Carey J. and Moss M. L., 'The Diffusion of New Telecommunication Technologies' *Telecommunications Policy* 9.2 (1985): 145-58.

- Carr B., 'The Creation of the Mexican Socialist Party' *Journal of Communist Studies* 4.3 (1988): 339-341.

- Caselli F. and Coleman W. J., 'Cross-country Technology Diffusion: The Case of Computers' *American Economic Review* 91.2 (2001): 328-335.

- Cavallo D.F. and Cottani J. A., 'Argentina's Convertibility Plan and the IMF' *The American Economic Review* 87.2 (1997): 17-22.

- Celani M., 'Determinantes de la Inversión en Telecomunicaciones en Argentina' *CEPAL Serie Reformas Económicas* 9 (1998): 1-45.

- Chow G. C., 'Technological Change and the Demand for Computers' *The American Economic Review* 57 (1967): 1117-1130.

- Chua A. L., 'The Privatisation-Nationalisation Cycle: The Link Between Markets and Ethnicity in Developing Countries' *Columbia Law Review* 95.2 (1995): 223-303.

- Cipolla C. M., 'The Diffusion of Innovations in Early Modern Europe' *Comparative Studies in Society and History* 14.1 (1972): 56-52.

- Clark G. L. and Wrigley N., 'The Spatial Configuration of the Firm and the Management of Sunk Costs' *Economic Geography* 73 (1997): 285-304.

- Clayton D., 'The Consumption of Radio Broadcast Technologies in Hong Kong, c.1930–19601' *The Economic History Review* 57.4 (2004): 691-726.

- Coatsworth J. H., 'Obstacles to Economic Growth in Nineteenth Century Mexico' *American History Review* 83.1 (1978): 80-100.

- Coe N. M., Helpman E. and Hoffmaister A. W., 'North-South R&D Spillovers' *The Economic Journal* 107.440 (1997): 134-149.

- Colombo M. and Mosconi R., 'Complementarity and Cumulative Learning Effects in the Early Diffusion of Multiple Technologies' *Journal of Industrial Economics* 43 (1995): 13-48.

- Cook P., 'Privatisation and Utility Regulation in Developing Countries: The Lessons So Far' *Annals of Public and Cooperative Economics* 70.4 (1999): 549-587.

- Crafts N., 'The Human Development Index, 1870-1999: Some Revised Estimates' *European Review of Economic History* 6.3 (2002): 395-405.

- Cuéllar A. B., 'Railroad Problems of Mexico' *Annals of the American Academy of Political and Social Science* 187 (1936): 193-206.

- Dahlman C. J. And Westphal L. E., 'The Transfer of Technology: Issues in the Acquisition of Technological Capability by Developing Countries' *Finance and Development* 20.4 (1983): 6-9.

- Davis K. and Golden H. H., 'Urbanization and the Development of Pre-industrial Areas' *Economic Development and Cultural Change* 3 (1954): 6-26.

- Davidson W. H. and McFetridge D. G., 'Key Characteristics in Choice of International Technology Transfer Mode' *Journal of International Business Studies* 6.2 (1985): 5-21.

- Dekimpe M. G., Parker P. M. and Sarvary M., 'Staged Estimation of International Diffusion Models: An Application to Global Cellular Telephone Adoption' *Technological Forecasting and Social Change* 57 (1998): 105-132.

- Dekimpe M. G., Parker P. M. and Sarvary M., 'Global Diffusion of Technological Innovations: A Coupled-hazard Approach' *Journal of Marketing Research* 37.1 (2000a): 47-59.

- Dekimpe M. G., Parker P. M. and Sarvary M., 'Globalisation: Modelling Technology Adoption Timing across Countries' *Technological Forecasting and Social Change* 63 (2000b): 25-42.

- Deutschmann P. J., 'The Mass Media in an Underdeveloped Village' *Journalism Quarterly* 40.1 (1963): 27-35.

- Deutschmann P. J. and Fals Borda O., 'Communication and Adoption Patterns in an Andean Village' *Programa Interamericano de Informacion Popular* 33 (1962).

- Dix R. H., 'Populism: Authoritarian and Democratic' *Latin American Research Review* 20.2 (1985): 29-52.

- Dixit A., 'A Model of Duopoly Suggesting a Theory of Entry Barriers' *Bell Journal of Economics* 10 (1979): 20-32.

- Dixon R., 'Hybrid Corn Revisited' *Econometrica* 48.6 (1980): 1451–61.

- Dodson J. A. and Muller E., 'Models for New Product Diffusion Through Advertising and Word-of-Mouth' *Management Science* 24 (1978): 1568-78.

- Duncan J. S., 'British Railways in Argentina' *Political Science Quarterly* 52.4(1937): 559-82.

- Easingwood C. J., 'Early Product Life Cycle Forms for Infrequently Purchased Major Products' *International Journal of Research in Marketing* 4 (1987): 3-9.

- Easingwood C. J., 'Product Life Cycle Patterns for New Industrial Products' *R & D Management* 18 (1988): 23-32.

- Easingwood C. J., 'An Analogical Approach to the Long-term Forecasting of Major New Product Sales' *International Journal of Forecasting* 5 (1989): 69-82.

- Easingwood C. J., Mahajan V. and Muller E., 'A Nonsymmetric Responding Logistic Model for Technological Substitution' *Technological Forecasting and Social Change* 20 (1981): 199-213.

- Easingwood C. J., Mahajan V. and Muller E., 'A Non-uniform Influence Innovation Diffusion Model of New Product Acceptance' *Marketing Science* 2 (1983): 273-296.

- Eaton B. C. and Lipsey R. G., 'The Theory of Market Pre-emption: The Persistence of Excess Capacity and Monopoly in Growing Spatial Markets' *Económica* 46 (1979): 149-158.

- Efendioglu U., Soete L. and Freeman C., 'Diffusion and the Employment Effects of Information and Communication Technology' *International Labour Review* 134.4-5 (1995): 587-603.

- Eliashberg J., Tapiero C. S. and Wind Y., 'Diffusion of New Products in Heterogeneous Populations: Incorporating Stochastic Coefficients' *Working Paper, University of Pennsylvania* (1983).

- Engerman S. L. and Sokoloff K. L., 'Factor Endowments, Institutions, and Differential Paths of Growth among New World Economies: A View from Economic Historians of the United States' *NBER Working Paper 9259* (2002): 1-55.

- Esfahani H. and Ramirez M., 'Institutions, Infrastructure, and Economic Growth: An Empirical Investigation' *Journal of Development Economics* 70 (2003): 443-477.

- Espada V. C., 'Corporate Policy in Mexico during the Porfirian Age. The Telephone Companies, 1881-1905' *Munich Personal RePEc Archive* 1740 (2005): 1-29.

- Faye M., 'Developing National Information and Communication Infrastructure (NICI) Policies and Plans in Africa' *Paper presented during the Nigeria NICI Workshop* Abuja, Nigeria (2000).

- Feder G. and Omara G. T., 'On Information and Innovation Diffusion: A Bayesian Approach' *American Journal of Agricultural Economics* 64 (1982): 145-7.

- Felix D., 'Income Distribution and the Quality of Life in Latin America: Patterns, Trends, and Policy Implications' *Latin American Research Review* 18.2 (1983): 3-33.

- Fernández-Maldonedo A. M., 'Telecommunications in Lima: Networks for the Networks?' *Paper for the Conference Cities in the Global information Society.* Newcastle-upon-Tyne (1999).

- Findlay R., 'Relative Backwardness, Direct Foreign Investment, and the Transfer of Technology: A Simple Dynamic Model' *American Economic Review* 92.1 (1978a): 1-16.

- Findlay R., 'Some Aspects of Technology Transfer and Direct Foreign Investment' *American Economic Review* 68.2 (1978b): 275-279.

- Fischer S. C. and Carroll G. R., 'Telephone and Automobile Diffusion in the United States, 1902-1937' *The American Journal of Sociology* 93.5 (1988): 1153-1178.

- Fisher J. C. and Pry, R. H. 'A Simple Substitution Model of Technological Change' *Technological Forecasting and Social Change* 3 (1971): 75-88.

- Foreman-Peck J., 'Competition and Performance in the U.K. Telecommunications Industry' *Telecommunication Policy* 9.3 (1985): 215-228.

- Fudenberg D. and Tirole J., 'Pre-emption and Rent Equalization in the Adoption of New Technology' *Review of Economic Studies* 52 (1985): 383-401.

- Gabel D., 'Competition in a Network Industry: The Telephone Industry 1894-1010' *European Telecommunications* 54.3 (1994): 543-72.

- Gabel R., 'The Early Competitive Era in Telephone Communication, 1893-1920' *Law and Contemporary Problems* 34.2 (1969): 340-59.

- García Merodio G. G., 'Technological Innovation and the Expansion of México D.F., 1870-1920' *Journal of Latin American Geography* 5.2 (2006): 109-126.

- Gatignon H. and Robertson T. S. 'A Propositional Inventory for New Diffusion Research.' *Journal of Consumer Research* 11 (1985): 849-867.

- Gatignon H., Eliashberg J. and Robertson S., 'Modelling Multinational Diffusion Patterns: An Efficient Methodology' *Marketing Science* 8.3 (1989): 231-247.

- Geroski P. A., 'Models of Technology Diffusion' *Research Policy* 29 (2000): 603-625.

- Gerschenkron A., 'Notes on the Rate of Industrial Growth in Italy, 1881-1913' *Journal of Economic History* 15.4 (1955): 360-75.

- Gerschenkron A., 'The Discipline and I' *Journal of Economic History* 27.4 (1967): 443-59.

- Gil-Díaz F. and Carstens A., 'One Year of Solitude: Some Pilgrim Tales about Mexico's 1994-1995 Crisis' *American Economic Review* 86.2 (1996): 164-169.

- Glazer A., 'The Advantages of Being First' *The American Economic Review* 75.3 (1985): 473-80.

- Globerman S., Kokko A. and Sjoholm F., 'International Technology Diffusion: Evidence from Swedish Patent Data' *Kyklos* 53 (2000): 17-38.

- Gompertz B., 'On the Nature of the Function Expressive of the Law of Human Mortality, and a New Mode of Determining the Value of Life Contingencies' *Philosophical Transactions of the Royal Society of London* 115 (1825): 513-85.

- Goodwin P. B., 'The Central Argentine Railway and the Economic Development of Argentina, 1854-1881' *The Hispanic American Historical Review* 57.4 (1977): 613-632.

- Goolsbee A. and Klenow P., 'Evidence of Learning and Networking Externalities in the Diffusion of Home Computers' *National Bureau of Economic Research, Working Paper 7329* (1999): 176-199.

- Gouldner A. W., 'Cosmopolitans and Locals: Toward an Analysis of Latent Social Roles' *Administrative Science Quarterly* 2 (1957): 281-306.

- Goyer D. S. and Domschke E., *The Handbook of National Population Censuses. Latin America and the Caribbean, North America and Oceania* Connecticut, Greenwood Press (1983).

- Graham S., 'Class and Conservatism in the Adoption of Innovations' *Human Relations* 9.1 (1956): 91-100.

- Griliches Z., 'Hybrid Corn: An Exploration in the Economics of Technological Change' *Econometrica* 48 (1957): 501-522.

- Gruber H., 'Competition and Innovation: The Diffusion of Mobile Telecommunications in Central and Eastern Europe' *Information Economics and Policy* 13.1 (2001): 19-34.

- Gruber H. and Verboven F., 'The Evolution of Markets under Entry and Standards Regulation: The Case of Global Mobile Telecommunications' *International Journal of Industrial Organisation* 19.7 (2001): 1189-1212.

- Grynspan D., 'Technology Transfer Patterns and Industrialisation in LDC's: A Study of Licensing in Costa Rica' *International Organisation* 36.4 (1982): 795-806.

- Gurevitch M. and Loevy Z., 'The Diffusion of Television as an Innovation: The Case of the Kibbutz' *Human Relations* 25.3 (1972): 181-197.

- Guy D. J., 'Carlos Pellegrini and the politics of early industrialization, 1873-1906' *Journal of Latina American Studies* 11.1 (1979): 123-144.

- Hägerstrand T., 'A Monte Carlo Approach to Diffusion' *Archives Europeennes de Sociologie* 6.1 (1965) : 43-67.

- Hage J. and Dewar R., 'Elite Values versus Organisational Structure in Predicting Innovation' *Administrative Science Quarterly* 18 (1973): 279-290.

- Hanson G. H., 'Should Countries promote Foreign Direct Investment?' *G-24 Discussion Paper Series Geneva, United Nations Conference on Environment and Development* (2001).

- Hargattai E., 'Weaving the Western Web: Explaining Differences in Internet Connectivity among the OECD Countries' *Telecommunications Policy* 23.10-11 (1999): 701-718.

- Heeler R. M. and Hustad T. P., 'Problems in Predicting New Product Growth for Consumer Durables' *Management Science* 26 (1980): 1007-1020.

- Helsen K., Jedidi K. and DeSarbo W. S., 'A New Approach to Country Segmentation Utilizing Multinational Diffusion Patterns' *Journal of Marketing* 57 (1993): 60-71.

- Henisz W., 'The Institutional Environment for Infrastructure Investment' *Industrial and Corporate Change* 11.2 (2000): 355-89.

- Henisz W. and Zelner B., 'The Institutional Environment for Telecommunications Investment' *Journal of Economics and Management Strategy* 10.1 (2001): 123-147.

- Hernes G., 'Diffusion and Growth: The Non-Homogeneous Case' *Scandinavian Journal of Economics* 78 (1976): 427-436.

- Herrera A., 'The Privatisation of Telecommunication Services: The Case of Argentina' *Columbia Journal of World Business* 28.1 (1993): 47-61.

- Hewlett S. A., 'Human Right and Economic Realities, Tradeoffs in Historical Perspective' *Political Science Quarterly* 94.3 (1979): 453-473.

- Hiebert L. D., 'Risk, Learning and the Adoption of Fertilizer Responsive Seed Varieties' *American Journal of Agricultural Economics* 56 (1974): 764-8.

- Hodge J. E., 'The Role of the Telegraph in the Consolidation and Expansion of the Argentine Republic' *The Americas* 41.1 (1984): 59-80.

- Hunt P., 'True Stories: Tele-centres in Latin America & the Caribbean' *The Electronic Journal on Information Systems in Developing Countries* 4.5 (2001): 1-17.

- Hurter A. P. and Rubenstein A. H., 'Market Penetration by New Innovations: The Technological Literature' *Technological Forecasting and Social Change* 3 (1978): 197-221.

- Ireland N. and Stoneman P. L., 'Order Effects, Perfect Foresight and Inter-temporal Price Discrimination' *Recherches Economiques de Louvain* 51 (1985): 7-20.

- Jaffe A. B., Trajtenberg M. and Henderson R., 'Geographical Localisation of Knowledge Spillovers as Evidenced by Patent Citations' *Quarterly Journal of Economics* 108 (1993): 577-98.

- James D., 'The Peronist Left' *Journal of Latin American Studies* 8.2 (1976): 273-396.

- James J., 'Pro-Poor Modes of Technical Integration into the Global Economy' *Development and Change* 31 (2000): 765-783.

- Javala J. and Pohjola M., 'Economic Growth in the New Economy: Evidence from Advanced Economies' *World Institute for Development Economics Research (WIDER) Discussion Paper No. 2001/5* (2001).

- Jensen R., 'Adoption and Diffusion of an Innovation of Uncertain Profitability' *Journal of Economic Theory* 27 (1982): 182-93.

- Jeuland A. P., 'Parsimonious Models of Diffusion of Innovation Parts A and B: Derivations and Comparisons' *Working Paper* 8 (1981).

- Jones G. E., 'The Adoption and Diffusion of Agricultural Practices' *World Agricultural Economics and Rural Sociology Abstracts* 9 (1967): 1-34.

- Johnson C., 'The industrial policy debate re-examined' *California Management Review* 27.1 (1982).

- Johnson J. J., *The Military and Society in Latin America* Stanford, Stanford University Press (1964).

- Karshenas M., and Stoneman P. L., 'Rank, Stock, Order, and Epidemic Effects in the Diffusion of New Process Technologies: An Empirical Model' *Research And Development (RAND) Journal of Economics* 24.4 (1993): 503-528.

- Katz M. and Shapiro C., 'Network Externalities, Competition, and Compatibility' *American Economic Review* 75.3 (1985): 424-440.

- Katz M. and Shapiro C., 'Technology Adoption in the Presence of Network Externalities' *Journal of Political Economy* 94.4 (1986): 822-841.

- Keida B. L. and Baghat R. S., 'Cultural Constraints on Transfer of Technology Across Nations: Implications for Research in International and Comparative Management' *Academy of Management Review* 13.4 (1988): 559-571.

- Kiiski S. and Pohjola M., 'Cross-Country Diffusion of the Internet' *Information Economics and Policy* 14 (2000): 297-310.

- Kimberly J. R., 'Hospital Adoption of Innovation: The Role of Integration into External Information Environments' *Journal of Health and Social Behaviour* 19 (1978): 361-73.

- Kimberly J. R. and Evanisko M. J., 'Organisational Innovation: The Influence of Individual, Organisational and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations' *Academy of Management Journal* 24 (1981): 689-712.

- Kirkman G., 'It is More than Just Being Connected: A Discussion of Some Issues of Information Technology and International Development' *Working Paper presented at the Development E-Commerce Workshop, The Media Laboratory* Massachusetts Institute of Technology (1999).

- Korol J. C. and Sabato H., 'Incomplete Industrialisation: An Argentine Obsession' *Latin American Research Review* 25.1 (1990): 7-30.

- Kuntz S., 'Economic Backwardness and Firm Strategy: An American Railroad Corporation in the Nineteenth-Century Mexico' *Hispanic American Historical Review* 8.2 (2000): 267-268.

- Kuznets S., 'Economic Growth and Income Inequality' *American Economic Review* 45 (1955): 1-28.

- Lado A. A. and Vozikis G. S., 'Transfer of Technology to Promote Entrepreneurship in Developing Countries: An Integration and Proposed Framework' *Entrepreneurship: Theory and Practice* 21.2 (1996): 55.

- Lee C., 'Determinants of National Innovativeness and International Market Segmentation' *International Marketing Review* 7 (1990): 39-49.

- Lehr W. and Lichtenberg F., 'Computer Use and Productivity Growth in US Federal Government Agencies, 1987-1992' *Journal of Industrial Economics* 21.1 (1990): 27-44.

- Lenz R. C. and Lanfrod H. W., 'The Substitution Phenomenon' *Business Horizons* 15.1 (1972): 63-8.

- Lewis C. M., 'Problems of Railway Development in Argentina, 1857-1890' *Inter-American Economic Affairs* 22.2 (1968): 55-75.

- Lewis C. M., 'Immigrant Entrepreneurs, Manufacturing and Industrial Policy in the Argentine, 1922-28' *Journal of Imperial and Commonwealth History* 16.1 (1987): 77-108.

- Lewis C. M. and Suzigan W., 'Industry and Industrialisation in Latin America: In Pursuit of Development' *Cuadernos de Historia Latinoamericana* 8 (2000): 227-316.

- Liikanen J., Stoneman P. and Toivanen O., 'Intergenerational Effects in the Diffusion of New Technology: The Case of Mobile Phones' *Swedish School of Economics and Business Administration, Working Paper* 3 (2001).

- Lipset S. M., 'Some Social Requisites of Democracy: Economic Development and Political Legitimacy' *American Political Science Review* 53 (1959): 69-105.

- Littlechild S. C., 'The Effect of Ownership on Telephone Penetration' *Telecommunications Policy* 7.3 (1983): 246-247.

- Loboda J., 'The Diffusion of Television in Poland' *Economic Geography* 50.1 (1974): 70-82.

- Londoño J. L. and Szekely M., 'Persistent Poverty and Excess Inequality: Latin America, 1970-1995' *Journal of Applied Economics* 3.1 (2000): 93-134.

- Lücke M., 'Diffusion of Innovations in the World Textile Industry' *Journal of Economic Development* 21.2 (1996): 121-143.

- Lücke M., 'The Diffusion of Process Innovations in Industrialized and Developing Countries: A case Study of the World Textile and Steel Industries' *World Development* 21.7 (1993): 1225-1238.

- Luxner L., 'Argentine Telco Sale Causes Uproar' *Telephony* 218.7 (1990): 9-10.

- Luxner L., 'Dollars for Dialling' *Americas (English Version)* 44 (1992).

- Lynch A. B. and Krause M., 'Proyectos Para una Sociedad Abierta: Telecomunicaciones Para Comunicarse Eficientemente' *Revista Libertas 97, Instituto Universitario Escuela Superior de Economía y Administración de Empresas (ESEADE)* (1993).

- MacLeod C., 'Strategies for Innovation: The Diffusion of New Technology in Nineteenth-Century British Industry' *The Economic History Review* 45.2 (1992): 285-307.

- Maddala G. S. and Knight P. T., 'International Diffusion of Technical Change: A Case Study in the Oxygen Steel-Making Process' *Economic Journal* 77.307(1967): 531-58.

- Madden G., Coble-Neal G. and Dalzell B., 'A Dynamic Model of Mobile Telephony Subscription Incorporating a Network Effect' *Telecommunications Policy* 28.2 (2004): 133-144.

- Mahajan V. and Muller E., 'Innovation Diffusion in a Borderless Global Market: Will the 1992 Unification of the European Community Accelerate Diffusion of New Ideas, Products and Technologies?' *Technological Forecasting and Social Change* 45 (1994): 221-237.

- Mahajan V. and Muller E., 'Innovation Diffusion and New Product Growth Models in Marketing *Journal of Marketing* 43.4 (1979): 55-68.

- Mahajan V., Muller E. and Bass F. M., 'New Product Diffusion Models in Marketing: A Review and Directions for Research' *Journal of Marketing* 54 (1990): 1-26.

- Mamer J. W. and McCardle K. F., 'Uncertainty, Competition, and the Adoption of New Technology' *Management Science* 33.2 (1987): 161-77.

- Mansfield E., 'Technical Change and the Rate of Imitation' *Econometrica* 29.4 (1961): 741-766.

- Mansfield E., 'The Speed of Response of Firms to New Techniques' *Quarterly Journal of Economics* 77.2 (1963a): 290-311.

- Mansfield E., 'Intra-firm Rates of Diffusion of an Innovation' *Review of Economics and Statistics* 45.4 (1963b): 348-359.

- Mansfield E., 'Size of Firm, Market Structure, and Innovation' *Journal of Political Economy* 71.6 (1963c): 556-576.

- Mansfield E., 'Technological Change and the Rate of Imitation' *Econometrica* 29 (1981): 741-765.

- Mansfield E., 'Industrial Robots in Japan and the USA' *Research Policy* 18 (1989): 183-192.

- Marchetti C., 'Primary Energy Substitution Models: On the Interaction Between Energy and Society' *Technological Forecasting and Social Change* 10 (1977): 345-356.

- Mariscal J. and Rivera E., 'New Trends in the Latin American Telecommunications Market: Telefónica & Telmex' *Paper at the 32nd Annual Telecommunications Policy Research Conference (TPRC)* October (2004): 1-35.

- Mariscal J. and Rivera E., 'New Trends in the Latin American Telecommunications Market: Telefónica & Telmex' *Telecommunications Policy* 29.9 (2005): 757-777.

- Marshall A., 'La Composición del Consumo de los Obreros Industriales de Buenos Aires, 1930-1980' *Desarrollo Económico* 21.83 (1981): 351-374.

- Mayer J., 'Technology Diffusion, Human Capital and Economic Growth in Developing Countries' *United Nations Conference on Trade and Development Discussion Paper 154* (2001).

- McCulloch R., 'Technology Transfer to Developing Countries: Implications of International Regulation' *Annals of the American Academy of Political and Social Science* 458 (1981): 110-122.

- McGowan I., 'The Use of Growth Curves in Forecasting Market Development' *Journal of Forecasting* 5 (1986): 69-71.

- Meade N. and Islam T., 'Forecasting with Growth Curves: An Empirical Comparison' *International Journal of Forecasting* 11 (1995): 199-215.

- Mehta S. K., 'Some Demographic and Economic Correlates of Primate Cities: a Case for Revaluation' *Demography* 1.1 (1964): 136-147.

- Meisel N. and Ould Aoudia J., 'A New Database for "Measuring" Institutions' *Trésor-Economics* 24 Paris, Treasury and Economic Policy General Directorate (2007).

- Mencinger J., 'Does Foreign Direct Investment Always Enhance Economic Growth?' *Kyklos* 56 (2003): 491-508.

- Miller R., 'Latin American Manufacturing and the First World War: An exploratory essay' *World Development* 9.8 (1981): 717-34.

- Milner H. V., 'The Global Spread of the Internet: the Role of International Diffusion Pressures in Technology Adoption' *Paper presented at the second conference on Interdependence, Diffusion and Sovereignty* UCLA (2003): 1-44.

- Milner H. V., 'The Digital Divide: The Role of Political Institutions in Technology Diffusion' *Comparative Political Studies* 39.2 (2006): 176-199.

- Mokyr J., 'Technological Inertia in Economic History' *The Journal of Economic History* 52.2 (1992): 325-338.

- Mokyr J., 'Thinking About Technology and Institutions' presented at *Macalester International College Roundtable Prometheus's Bequest, Technology and Change* (2002): 1-31.

- Morse R. M., 'Trends and Patterns of Latin American Urbanisation 1750-1920' *Comparative Studies in Society and History* l 16.4 (1974): 416-447.

- Most B. A., 'Authoritarianism and the G rowth of the State in Latin America: An assessment of their impact on Argentine public policy 1930-1970' *Comparative Political Studies* 13.2 (1980): 173-203.

- Mote D. and Mancini C., Teléfonos de Mexico S.A. de C.V *International Directory of Company Histories* 63 (1992).

- Munck R., 'The "modern" Military Dictatorship in Latin America: The Case of Argentina (1976-1982)' *Latin American Perspectives* 12.4 (1985): 41-47.

- Nelson R. and Phelps E., 'Investment in Humans, Technological Diffusion, and Economic Growth' *American Economic Review* 56 (1966): 69-75.

- Nelson R., 'A Diffusion Model of International Productivity Differences in the Manufacturing Industry' *American Economic Review* 58 (1968): 1218-48

- Noriega C., 'The Present State of National Accounts in Latin America' *Review of Income and Wealth* 22.2 (1976): 133-49.

- Norris P., 'The Global Divide: Information Poverty and Internet Access Worldwide' *Paper for the Internet Conference at the International Political Science World Congress Quebec* (2000): 1-33.

- North D. C., 'A Framework for Analysis the State in Economic History' *Explorations in Economic History* 16 (1979): 249-259.

- Norton J. A. and Bass F. M., 'A Diffusion Theory Model of Adoption and Substitution for Successive Generations of High-Technology Products' *Management Science* 33.9 (1987): 1069-86.

- Noyola J., 'El Desarrollo Económico y la Inflación en Mexico y otros Países Latinoamericanos' *Investigación Económica* 16.4 (1956): 603-48.

- Ochoa-Morales H. J., 'The Dynamic Changes in the Telecommunication Sector in Latin America and its Effects on the Knowledgeable Society' *Communications of the IIMA* 2.1 (2002): 84-93.

- Ochoa-Morales H. J., 'The Effect of Information and Communication Technology (ICT) on the Globalization Paradigm' *Issues in Information Systems* 5.2 (2004): 647-653.

- O'Donnell G., 'Reflections on the pattern of Change in the Bureaucratic-Authoritarian State' *Latin American Research Review* 13 (1978): 3-38.

- Oren, S. S. and Schwartz R. G., 'Diffusion of New Products in Risk-Sensitive Markets' *Journal of Forecasting* 7 (1988) 273-87.

- Oszlak O., 'The Historical Formation of the State in Latin America: Some Theoretical and Methodological Guidelines for its Study' *Latin American Research Review* 16.2 (1981): 3-32.

- Oszlak O., *La Reforma del Estado en la Argentina* Buenos Aires, volume 36, Documentos CEDES (1990).

- Oviatt B. M., and McDougall P. P., 'Toward a Theory of International New Ventures' *Journal of International Business Studies* 25.1 (1994): 45-64.

- Paus E., 'Direct Foreign Investment and Economic Development in Latin America: Perspectives for the Future' *Journal of Latin American Studies* 21.2 (1989): 221-239.

- Pedersen P. O., 'Innovation Diffusion between and within National Urban Systems' *Geographical Analysis* 3 (1970): 203-54.

- Perkins R. and Neumayer E., 'The International Diffusion of New Technologies: A Multi-technology Analysis of Latecomer Advantage and Global Economic Integration' *Annals of the Association of American Geographers* 95.4 (2005): 789-808.

- Pletcher D. M., 'The Building of the Mexican Railway' *The Hispanic American Historical Review* 30.1 (1950): 26-62.

- Pozanski K. Z., 'International Diffusion of Steel Technologies: Time-lag and the Speed of Diffusion' *Technological Forecasting and Social Change* 23 (1983): 305-23.

- Pugel T., 'International Technology Transfer and Neo-classical Trade Theory: A Survey' *Working Paper, New York University* (1978).

- Pulley R. H., 'The Railroad and Argentine National Development, 1852-1914' *The Americas* 23.1 (1966): 63-75.

- Putsis W. P., Balasubramanian S., Kapkan E. H. and Sen S. K., 'Mixing Behaviour in Cross-Country Diffusion' *Marketing Science* 16 (1997): 354-369.

- Quirmbach H., 'The Diffusion of New Technology and the Market for an Innovation' *Research And Development (RAND) Journal of Economics* 17 (1986): 618-624.

- Quiroz A. W., 'Financial Leadership and the Formation of Peruvian Elite Groups, 1884-1930' *Journal of Latin American Studies* 20.1 (1988): 49-81.

- Rai L. P. and Kumar N., 'Development and Application of Mathematical Models for Technology Substitution' *PRANJANA* 6.2 (2003): 49-60.

- Rai L. P., 'Appropriate Models for Technology Substitution' *Journal of Scientific and Industrial Research* 58 (1999): 14-18.

- Randall R. W., 'Mexico's Pre-Revolutionary Reckoning with Railroads' *The Americas* 42.1 (1985): 1-28.

- Rao A. G. and Yamada M., 'Forecasting With a Repeat Purchase Diffusion Model' *Management Science* 34 (1988): 734-52.

- Ravn H. F. and Valqui Vidal R. V., 'Operational Research for Developing Countries-A Case of Transfer of Technology' *The Journal of the Operational Research Society* 37.2 (1986): 205-210.

- Ray G. F., 'The Diffusion of New Technology: A Study of Ten Processes in Nine Industries' *National Institute Economic Review* 48 (1969): 40-83.

- Reilly K. and Gómez R., 'Comparing Approaches: Tele-centre Evaluation Experiences in Asia and Latin America' *Electronic Journal on Information Systems in Developing Countries* 4.3 (2001): 1-17.

- Reinganum J., 'Market Structure and the Diffusion of New Technology' *The Bell Journal of Economics* 12 (1981): 618-624.

- Reyes Heroles González Garza J. and Sidaoui J. J., *Cuentas Nacionales y Análisis Macroeconómico* document 38, México D.F., Banco de México (1981).

- Robertson T. S. and Wind Y., 'Organisational Psychographics and Innovativeness' *Journal of Consumer Research* 7 (1980): 24-31.

- Romer P. M., 'Endogenous Technological Change' *Journal of Political Economy* 98.5 (1990): 71- 102.

- Rosenberg N., 'Economic Development and the Transfer of Technology: Some Historical Perspectives' *Technology and Culture* 11.4 (1970): 550-576.

- Rosenberg N., 'Factors Affecting the Diffusion of Technology' *Explorations in Economic History* 10.1 (1972): 3-33.

- Rosenberg N., 'On Technological Expectations' *Economic Journal* 86 (1976): 523-535.

- Rouvinen P., 'Diffusion of Digital Mobile Telephony: Are Developing Countries Different?' *Telecommunications Policy* 30 (2006): 46-63.

- Ruttan V.W., 'What Happened to Political Development?' *Economic Development and Cultural Change* 39 (1991): 265–291.

- Ryan B. and Gross N. C., 'The Diffusion of Hybrid Seed Corn in Iowa Communities' *Rural Sociology* 8 (1943): 15-24.

- Schmalensee R., 'Product Differentiation Advantages of Pioneering Brands' *American Economic Review* 72 (1982): 349-365.

- Schuler D. A. and Brown D. S., 'Democracy, Regional Integration and Foreign Direct Investment' *Business and Society* 38.4 (1999): 450-473.

- Sharif M. N., 'Technological leapfrogging: Implications for Developing Countries' *Technological Forecasting and Social Change* 36 (1998): 201-208.

- Sharif M. N. and Islam M. N., 'The Weibull Distribution as a General Model for Forecasting Technological Change' *Technological Forecasting and Social Change* 18 (1980): 247-256.

- Sharif M. N. and Kabir C. A., 'A Generalised Model for Forecasting Technological Substitution' *Technology Forecasting and Social Change* 8 (1976): 353-364.

- Shuster M. S., 'Diffusion of Network Innovation: Implications for Adoption of Internet Services' *Paper presented at MIT Internet Telephony Consortium* (1998): 1-29.

- Silverberg G., Dosi G. and Luigi O., 'Innovation, Diversity and Diffusion: A Self-Organisation Model' *The Economic Journal* 98 (1988): 1032-1054.

- Singh J., 'Measurement Issues in Cross-National Research' *Journal of International Business Studies* 26 (1995): 597-618.

- Soete L., 'International Diffusion of Technology: Industrial Development and Technological Leapfrogging' *World Development* (1985): 409-422.

- Solow R. M., 'A Contribution to the Theory of Economic Growth' *Quarterly Journal of Economics* 70.1 (1956): 65-94.

- Spence A. M., 'The Learning Curve and Competition' *Bell Journal of Economics* 12 (1981): 49-70.

- Srivastava R. K., Mahajan V., Sridhar N. R. and Cherian J., 'A Multi-Attribute Diffusion Model for Forecasting the Adoption of Investment Alternatives for Consumers' *Technological Forecasting and Social Change* 28 (1985): 325-33.

- Stoneman P., 'Intra-Firm Diffusion, Bayesian Learning and Profitability' *Economic Journal* 91 (1988): 375-388.

- Stoneman P. and Battisti G., 'Intra Firm Diffusion of New Technologies: The Neglected Part of Technology Transfer' *International Journal of Industrial Engineering* 4.4 (1997): 270-282.

- Stoneman P. and Ireland N. J., 'The Role of Supply Factors in the Diffusion of New Process Technology' *Economic Journal RES/AITE Conference Supplement* (1983): 66-78.

- Stoneman P. and Kwon M. J., 'The Diffusion of Multiple Process Technologies' *Economic Journal* 104 (1994): 420-31.

- Stoneman P. and Toivanen O., 'The Diffusion of Multiple Technologies: An Empirical Study' *Economics of Innovation and New Technology* 5 (1997): 1-17.

- Succar P., 'International Technology Transfer: A Model of Endogenous Technological Assimilation' *Journal of Development Economics* 26 (1987): 375-395.

- Sullivan M.P., 'Argentina: Political and Economic Conditions and U.S. Relations' *Congressional Research Service (CRS) Report for Congress* (2006): 1-6.

- Sunkel O., 'Underdevelopment, the Transfer of Science and Technology, and the Latin American University' *Human Relations* 24.1 (1971): 1-18.

- Swann G. M. P., 'Sales practice and Market Evolution: the Case of Virtual Reality' *International Journal of Industrial Organization* 19 (2001): 1119–1139.

- Takada H. and Jain D., 'Cross-national Analysis of Diffusion of Consumer Durable Goods in Pacific Rim Countries' *Journal of Marketing* 55.2 (1991): 48-54.

- Teotia A. P. S. and Raju P. S., 'Forecasting the Market Penetration of New Technologies Using a Combination of Economic Cost and Diffusion Models' *The Journal of Product Innovation Management* 3.4 (1986): 225-237.

- Tuman J. P., 'Comparing Modes of Privatisation: A Study of the Telecommunications Sectors in Argentina and Mexico, 1990–2000' *Industrial Relations Journal* 38.2 (2007): 155-177.

- Twiss B. C., 'Forecasting Market Size and Market Growth Rates for New Products' *The Journal of Product Innovation Management* 1 (1984): 19-29.

- Udell G. G. and O'Neill M. F., 'Technology Transfer: Encouraging the Non-corporate Inventor' *Business Horizons* 20.4 (1977): 40-45.

- Van Pottelsberghe de la Potterie B. and Lichtenberg F., 'Does Foreign Direct Investment Transfer Technology across Borders?' *The Review of Economics and Statistics* 83.3 (2001): 490-497.

- Von Bertalanffy L., 'Quantitative Laws in Metabolism and Growth' *Quarterly Review of Biology* 32 (1957): 217-231.

- Vernon R., 'International Investment and International Trade in the Product Cycle' *Quarterly Journal of Economics* 80.2 (1966): 198-207.

- Villanueva J., 'En origen de la industrialización Argentina' *Desarrollo Económico* 12.47 (1972): 451-476.

- Walker D., 'Porfirian Labour Politics: Working class organizations in México D.F. and Porfirio Díaz, 1876-1902' *The Americas 37.3* (1981): 257-287.

- Wallsten S., 'An Econometric Analysis of Telecom Competition, Privatisation and Regulation in Telecommunication Markets in Africa and Latin America' *Journal of Industrial Economics* 49.1 (2001a): 1-19.

- Wallsten S., 'Returning to Victorian Competition, Ownership, and Regulation: An Empirical Study of European Telecommunications at the Turn of the Twentieth Century' *Journal of Economic History* 65.3 (2005): 693-722.

- Williamson O., 'The Logic of Economic Organisation' *Journal of Law, Economics and Organisation* 4 (1988): 65-93.

- Womack J. Jr., 'The Mexican Economy during the Revolution 1910-1920: Historiography and Analysis' *Marxist Perspectives 1.4* (1978): 80-123.

- Wong P., 'ICT Production and Diffusion in Asia, Digital Dividends or Digital Divide' *Journal of Information, Economics and Policy* 14.2 (2002): 167-87.

- Wozniak G., 'Human Capital, Information and the Early Adoption of New Technology' *Journal of Human Resources* 22 (1987): 101-1 12.

- Yamada M. and Rao A. G., 'Forecasting with a Repeat Purchase Diffusion Model' *Management Science* 34.6 (1988): 734-52.

- Yeon S., Park T. S. and Kim S., 'A Dynamic Diffusion Model for Managing Customer's Expectation and Satisfaction' *Technological Forecasting & Social Change* 73 (2006): 648–665.

Books

- Abel C. and Lewis C. M., *Welfare, Poverty and Development in Latin America* Oxford, Macmillan Press (1993).

- Academia Nacional de la Historia, *Historia Argentina Contemporánea 1862-1930* volumes 1 & 2 Buenos Aires, El Ateno (1964, 1966).

- Acuña M., *De Frondizi a Alfonsín: La Tradición del Radicalismo* 2 volumes, Buenos Aires, Centro Editor de América Latina (1984).

- Acuña C. H., 'Business Interests, Dictatorship and Democracy in Argentina' in Payne L. A., *Business and Democracy in Latin America* Pittsburgh, University of Pittsburgh Press (1995).

- Albert B., *South America and the First World War: The Impact of the First World War on Brazil, Argentina, Peru and Chile* Cambridge, Cambridge University Press (1988).

- Alonso P., *Between Revolution and the Ballot Box: The Origins of the Argentine Radical Party in the 1980s* Cambridge, Cambridge University Press (2000).

- Álvarez C. L., *Historia de las Telecomunicaciones en México* México D.F., Revista del Doctorado en Derecho (2007).

- Amsden A., 'The State and Taiwan's Economic Development' in Evans P. B., Rueschemeyer D. and Skocpol T., *Bringing the State Back in* New York, Cambridge University Press (1985).

- Amsden A., *Asia's Next Giant: South Korea and Late Industrialisation* New York, Oxford University Press (1989).

- Anderson R., *Outcasts in their Own Land: Mexican Industrial Workers, 1906-191* Illinois, Deklab (1976).

- Anguiano A., *El Estado y la Política Obrera del Cardenismo* México D.F., Ediciones Era (1975).

- Aoki M., *Toward a Comparative Institutional Analysis* Cambridge, MA, MIT Press (2001).

- Apter D., *The Politics of Modernisation* Chicago, University of Chicago Press (1965).

- Argentina, Fundación Standard Electric, *Historia de las Comunicaciones Argentinas* Buenos Aires, Fundación Standard Electric Argentina (1979).

- Arias P., *Industria y Estado en la Vida de México* Zamora, El Colegio de Michoacán (1990).

- Ashby J. C., *Organized Labor and the Mexican Revolution under Lázaro Cárdenas* Chapel Hill, University of North Carolina Press (1967).

- Bahía M. B., *Los Telégrafos de la República Argentina* Estudio Técnico presentado al Director General, Buenos Aires, Imprenta La Universidad de J. N. Klingelfuss y Cía (1891).

- Baily S. L., *Labor, Nationalism, and Politics in Argentina* New Brunswick, Rutgers University Press (1967).

- Bairoch P., *The Economic Development of the Third World since 1900* London, Methuen & Co. (1977).

- Bartra A., *Los Movimientos campesinos posrevolucionarios en México, 1920-80* México D.F., Ediciones Era (1985).

- Bath C. R. and James D. D., 'The Extent of Technological Dependence in Latin America' in Street J. H. and James D. D., *Technological Progress in Latin America: The Prospects for Overcoming Dependency* Colorado, Westview Press (1979).

- Bazdresch, C. and Levy S., 'Populism and Economic Policy in Mexico, 1970-1982' in Dornbusch R. and Edwards S., *The Macroeconomics of Populism in Latin America* Chicago, U.S., University of Chicago Press (1991).

- Beals C., *Porfirio Díaz, Dictator of Mexico* New York, J. B. Lippincott & Company (1932).

- Bell M. and Pavitt K., 'Technological Accumulation and Industrial Growth: Contrasts Between Developed and Developing Countries' in Archibugi D. and Michie J., *Technology, Globalisation and Economic Performance* Cambridge, Cambridge University Press (1997).

- Benjamin A., *A Rich Land of Poor People: Politics and Society in Modern Chiapas* Albuquerque, University of New Mexico Press (1989).

- Benjamin T., 'Rebuilding the Nation' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).

- Bennett A. R., *The Telephone Systems of the Continent of Europe* London, Longmans, Green and Co. (1985).

- Berthold V. M., *History of the Telephone and Telegraph in the Argentine Republic, 1857-1921* New York, AT&T (1921a).

- Berthold V. M., *History of the Telephone and Telegraph in Colombia, 1865-1921* New York, AT&T (1921b).

- Berthold V. M., *History of the Telephone and Telegraph in Uruguay, 1886-1925* New York, AT&T (1925).

- Best M. L. and Maclay C. M., 'Community Internet Access in Rural Area: Solving the Economic Sustainability Puzzle' in *The Global Information Technology Report 2001-2002: Readiness for the Networked World* Oxford, Oxford University Press (2002).

- Bethell L., *The Cambridge History of Latin America, 1970-1930* volume IV, Cambridge, Cambridge University Press (1986a).

- Bethell L., The Cambridge History of Latin America, *1970-1930* volume V, Cambridge, Cambridge University Press (1986b).

- Bhagwati J., Economics *of Underdeveloped Countries* London, Littlehampton Book Services (1966).

- Bieber L., *Las Relaciones Económicas de Bolivia con Alemania 1880-1920* Berlín, Colloquium (1982).

- Bizberg I., *Estado y Sindicalismo en México* México D.F., El Colegio de México (1990).

- Black S. W., *A Levite among the Priests: Edward M. Bernstein and the Origins of the Bretton Woods System* Boulder, Westview Press (1991).

- Bortz J. L. and Haber S., *The Mexican Economy, 1870-1930* California, Stanford University Press (2002).

- Brock G. W., *The Telecommunications Industry, the Dynamics of Market Structure* Cambridge, Harvard University Press (1981).

- Brown L. A., *Innovation Diffusion, A New Perspective* London, Methuen & Co. (1981).

- Brown L. C., 'Cárdenas: Creating a campesino power base for presidential policy' in Wolfskill G. and Richmond D.W., *Essays on the Mexican Revolution: Revisionist Views of the Leaders* Austin, University of Texas Press (1979).

- Buffington R. M. and French W. E., 'The Culture of Modernity' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).

- Bulmer-Thomas V., *The Economic History of Latin America Since Independence* Cambridge, Cambridge University Press (1994).

- Bulmer-Thomas V., *The New Economic Model in Latin America and Its Impact on Income Distribution and Poverty* England, Palgrave Macmillan (1996).

- Bulnes F., *El verdadero Díaz y la Revolución* México D.F., Ediciones Coma (1920).

- Bunge A., *Riqueza y Rentas en la Argentina* Buenos Aires, Agencia General de Librería y Publicaciones (1917).

- Bunge A., *Los Problemas Económicos del Presente* Buenos Aires, Ediciones A. E. Bunge (1920).

- Camp R. A., *Entrepreneurs and Politics in Twentieth Century Mexico* New York, Oxford University Press (1989).

- Camp R. A. *Generals in the Palacio: The Military in Modern Mexico* New York, Oxford University Press (1992).

- Cárdenas E., 'The Great Depression and Industrialisation: the Case of Mexico' in Thorp R., *Latin America in the 1930s: The Role of the Periphery in the World Crisis* New York, Macmillan (1984).

- Cárdenas E., *La Industrialización Mexicana durante la Gran Depresión* México D.F., El Colegio de Mexico (1987).

- Cárdenas E., *Historia Económica de México* 4 volumes, México D.F., Editorial Fondo de Cultura Económica (1990).

- Cárdenas E., *La Hacienda Pública y la Política Económica, 1929-1958* México D.F., El Colegio de México (1994).

- Cárdenas E., 'A Macroeconomic Interpretation of nineteenth century Mexico' in Haber S., *How Latin America Fell Behind, Essays on the Economic Histories of Brazil and Mexico, 1800-1914* California, Stanford University Press (1997).

- Cárdenas E., 'The Process of Accelerated Industrialisation in Mexico, 1929-82' in Cárdenas E., Ocampo J. A. and Thorp R., *An Economic History of Twentieth Century Latin America,* Volume 3: *Industrialisation and the State in Latin America The Post-war Years* New York, Palgrave Macmillan (2000).

- Cárdenas E., Ocampo J. A. and Thorp R., 'The Export Age: The Latin American Economies in the Late Nineteenth and Early Twentieth Centuries' in Cárdenas E., Ocampo J. A. and Thorp R., *An Economic History of Twentieth-Century Latin America* Basingtoke, Palgrave Publishers (2000).

- Cardoso C., *Mexico en el Siglo XIX: Historia Económica y de la Estructura Social* México D.F., Nueva Imagen (1980).

- Cardoso F. H. and Faletto E., *Dependencia y Desarrollo en América Latina* México D.F., Siglo Veintiuno Editores (1971).

- Carr B., *El Movimiento Obrero y la Politica en México, 1910-1929* México D.F., Ediciones Era (1981).

- Carr B. and Montoya A., *The Mexican Left, the popular Movements, and the Politics of Austerity* San Diego, Center for US–Mexican Studies, University of California (1986).

- Carr B., *Marxism and Communism in Twentieth-Century Mexico* Lincoln, University of Nebraska Press (1992).

- Casson N. H., *The History of the Telephone* Chicago, A.C. McClurg & Co. (1910).

- Castañeda J. G., *Utopia Unarmed: The Latin American Left after the Cold War* New York, Alfred A. Knopf (1993).

- Cavallo D. and Mundlak Y., 'Agriculture and Economic Growth: The Case of Argentina' *Research Report 36* Washington D.C., International Food Policy Research Institute (1982).

- Cavarozzi M., 'Political Cycles in Argentina since 1955' in O'Donnell G., Schmitter P.C. and Whitehead L., *Transitions from Authoritarian Rule: Latin America* Baltimore, Johns Hopkins University Press (1986).

- Cecchini S., 'Poverty, Inequality and New Technologies in Latin America' in Marshall S., Taylor W. and Yu X., *Encyclopaedia of Developing Regional Communities with Information and Communication Technology* Pennsylvania, Idea Group Reference (2006).

- Centeno M. A., *Democracy within Reason: Technocratic Revolution in Mexico* Pennsylvania, U.S., Penn State University Press (1997).

- Chakravarti I. M., Laha R. G. and Roy J., *Handbook of Methods of Applied Statistics*, Volume I, New York, John Wiley and Sons (1967).

- Chávez Hernández A. V., 'La Mecánica Cardenista' volume 16, in Cosío Villegas D., *Historia de la Revolución Mexicana* 23 volumes, México D.F., El Colegio de México (1979).

- Cho S., *The Dynamics of Institutional Reform in Telecommunications: Globalization, Liberalisation, and Regulatory Change* New York, Garland Publishing Inc. (1998).

- Coatsworth D., *Growth Against Development: The Economic Impact of Railroads in Porfirian Mexico* Dekalb, Northern Illinois Press (1981).

- Cockcroft J., *Intellectual Precursors of the Mexican Revolution, 1900-1913* Austin, University of Texas Press (1968).

- Coleman J., Katz E. and Menzel H., *Medical Innovation: A Diffusion Study* Indianapolis, Bobbs-Merrill (1966).

- Collier D., *New Authoritarianism in Latin America* Princeton, Princeton University Press (1980).

- Collier R. B., *The Contradictory Alliance: State-Labour Relations and Regime Change in Mexico* Berkeley, University of California at Berkeley (1992).

- Collier R. B. and Collier D., *Shaping the Political Arena* Princeton, Princeton University Press (1991).

- Cornelius W. A., Gentleman J. and Smith P. H., *Mexico's Alternative Political Futures* La Jolla, for U.S.-Mexican Studies, University of California Press (1989).

- Cornelius W. A. and Craig A. L., *The Mexican Political System in Transition* California, University of California Press (1991).

- Corradi J. E., *The Fitful Republic: Economy, Society and Politics in Argentina* Colorado, Westview Press (1985).

- Cortés Conde R., *El Progreso Argentino, 1880-1914* Buenos Aires, Editorial Sudamericana (1979).

- Cortés Conde R., *Estimaciones del Producto Bruto Interno de Argentina, 1875-1935* documento de trabajo no. 3 (1994).

- Cortés Conde R., 'The Vicissitudes of an Exporting Economy: Argentina (1875-1930) in Cárdenas E., Ocampo J. A. and Thorp R., *An Economic History of Twentieth-Century Latin America* Basingtoke, Palgrave Publisher (2000).

- Cortés Conde R., *The Political Economy of Argentina the Twentieth Century* Cambridge, Cambridge University Press (2009).

- Cortés Conde R. and Gallo E., *La Formación de la Argentina Moderna* Buenos Aires, Editorial Paidós (1967).

- Cortés Conde R. and Stein S. J., *Latin America: A Guide to Economic History, 1830-1930* Berkeley, University of California Press (1977).

- Cosío Villegas D., 'El Porfiriato: Su Historiografía o Arte Histórico' *Extremos de América* México D.F., Fondo de Cultura Económica (1949).

- Cuccorese H. J., *Historia de los Ferrocarriles en la Argentina* Buenos Aires, Ediciones Macchi (1969).

- Dahl R. A., *Polyarchy: Participation and Opposition* New Haven, Yale University Press (1971).

- David P., *A Contribution to the Theory of Diffusion* Stanford, Centre for Research in Economic Growth Research Memorandum 71, Stanford University (1969).

- David P., *Technical Choice, Innovation and Economic Growth* Cambridge, Cambridge University Press (1975).

- Davies S., *The Diffusion of Process Innovations* Cambridge, Cambridge University Press (1979).

- Davies L. E. and Gallam R. E., *Evolving Financial Markets and International Capital Flows: Britain, the Americas and Australia, 1865-1914* Cambridge, Cambridge University Press (2001).

- De la Garza Toledo E., 'Reconversión Industrial y Cambio en el Patrón de Relaciones Laborales en México' in Angiano A., *La Modernizacion de México* México D.F., Universidad Autónoma Metropolitana (1990).

- De la Peña J., *Historia de las Telecomunicaciones* Barcelona, Editorial Ariel (2003).

- Della Paolera G. and Taylor A. M., *A New Economic History of Argentina* Cambridge, Cambridge University Press (2003).

- Del Mazo G., *El Radicalismo: Ensayo sobre su Historia y Doctrina* Buenos Aires, Ediciones Gure (1957).

- De Soto H., *The Other Path: The Invisible Revolution in the Third World* London, Harper Collins (1989).

- Deyo F., *The Political Economy of the New Asian Industrialism* U.S., Cornell University Press (1987).

- Diamond L., Harttlyn J., Linz J., Lipset J. J. and Seymore M., *Democracy in Developing Countries: Latin America* Boulder, Lynne Rienner (1999).

- Di Tella G., 'Criterios para una Política de Desarrollo Industrial' in Brodersohn M., *Estrategias de Industrialización para la Argentina* Buenos Aires, Editorial del Instituto (1970).

- Di Tella G., *Argentina under Perón, 1973-1976* London, Macmillan Press (1983).

- Di Tella G. and Zymelman M., *Las Etapas del Desarrollo Económico Argentino* Buenos Aires, Editorial Paidós (1967).

- Di Tella G. and Platt D.C.M., *The Political Economy of Argentina 1880-1946* New York, St Martin's Press (1985).

- Di Tella G. and Dornbusch R., *The Political Economy of Argentina, 1946-1983* London, The University of Pittsburgh Press (1989).

- Di Tella T., 'Populism and reform in Latin America' in Veliz C., *Obstacles to Change in Latin America* New York, Oxford University Press (1965).

- Di Tella T., 'An Introduction to the Argentine System' in Fagen R. R. and Cornelius W. A., *Political Power in Latin America: Seven Confrontations* Englewood Cliffs, Prentice Hall (1970).

- Díaz Alejandro C. F., *Essays on the Economic History of the Argentine Republic* New Haven, Yale University Press (1970).

- Díaz Alejandro C. F., 'The Argentine State and Economic Growth: A Historical Review' in Ranis G., *Government and Economic Development* New Haven, Yale University Press (1971).

- Díaz Alejandro C. F., 'Economía Argentina, 1880-1913' in Ferrari G. and Gallo E., *La Argentina del Ochenta al Centenario* Buenos Aires, Editorial Sudamericana (1980).

- Díaz Alejandro C. F., 'Stories of the 1930s for the 1980s' in Armella P. A., Dornbusch R. and Obstfeld M., *Financial Policies and the World Capital Market: The Problem of Latin American Countries* Chicago, University of Chicago (1983).

- Díaz Alejandro C. F., 'Latin America in the 1930s' in Velasco A., *Trade, Development and the World Economy* Oxford, Basil Blackwell (1984).

- Díaz Alejandro C. F., 'No Less than One Hundred Years of Argentine Economic History, Plus Some Comparison' in Velasco A., *Trade, Development and the World Economy* Oxford, Basil Blackwell (1988).

- Dicken P., *Global Shift: Reshaping the Global Economic Map in the 21st Century* London, Sage Publications (2003).

- Dominguez J. I. and Shifter M., *Constructing Democratic Governance in Latin America* Baltimore, Johns Hopkins University Press (2003).

- Dominguez L. M., *National Income Estimates of Latin American Countries* volume X, New York, National Bureau of Economic Research (1947).

- Donikian L., Raúl V. A., Vito D. L. and Roberto V., *Teléfonos: de la Política Nacional al Saqueo Privatista* Buenos Aires, Foetra (1990).

- Dorfman A., *Cincuenta años de industrialización argentina, 1930-1980* Buenos Aires, Ediciones Solar (1983).

- Dornbusch R. and Edwards S., *Reform, Recovery, and Growth: Latin America and the Middle East* Chicago, University of Chicago Press (1995).

- Dornbusch R. and Helmers F. L., *The Open Economy, Tools for Policymakers in Developing Countries* Oxford, Oxford University Press (1988).

- Duch R. M., *Privatising the Economy: Telecommunications Policy in Comparative Perspective* Ann Arbor, University of Michigan Press (1991).

- Durkheim E., *On the Division of Labour in Society* (Translated by George Simpson), New York, The Free Press (1981).

- Dye A., 'The Institutional Framework' in Bulmer-Thomas V., Coatsworth J. H. and Cortés Conde R., *The Cambridge Economic History of Latin America: Volume II, The Long Twentieth Century* New York, Cambridge University Press (2006).

- Eliashberg J., Tapiero C.S. and Wind Y., *Diffusion of New Products in Heterogeneous Populations: Incorporating Stochastic Coefficients* Working Paper, University of Pennsylvania (1983).

- Evans P. B., *Embedded Autonomy: States and Industrial Transformation* Princeton, Princeton University Press (1995).

- Evans P. B., Rueschemeyer D. and Skocpol T., *Bringing the State Back in* New York, Cambridge University Press (1985).

- Ezegbobelu E. E., *Developmental Impact of Technology Transfer Theory and Practice a Case of Nigeria* Frankfurt, Peter Lang (1986).

- Ferrari G. and Gallo E., *La Argentina del Ochenta al Centenario* Buenos Aires, Editorial Sudamericana (1980).

- Ferrer A., *Los Planes de Estabilización en Argentina* Buenos Aires, Editorial Paidós (1967a).

- Ferrer A., *La Economía Argentina: Las etapas de su Desarrollo y Problemas Actuales* Buenos Aires, Editorial Fondo de Cultura Económica (1967b).

- Ferrer A., *The Argentine Economy* Berkeley, University of California Press (1967c).

- Ffrench-Davies R., Muñoz O. and Palma J. G., 'The Latin American Economies, 1950-1990' in Bethell L., *The Cambridge History of Latin America* volume VI, Cambridge, Cambridge University Press (1994).

- Ffrench-Davies R. and Muñoz O., 'The Latin American Economic Development and the International Environment' in Meller P., *The Latin American Development Debate* Oxford, Westview Press (1991).

- Ficker S. K., and Riguzzi P., *Ferrocarriles y Vida Económica en México (1850-1950): Del Surgimiento Tardío al Decaimiento Precoz* México City, Universidad Autónoma Metropolitana Xochimilco (1996).

- Field A., *Discovering Statistics using SPSS for Windows* London, Sage Publications (2000).

- Fitzgerald E. V. K., 'Restructuring through the Depression: the State and Capital Accumulation in Mexico, 1925-1940' in Thorp R., *Latin America in the 1930s: The Role of the Periphery in the World Crisis* New York, Macmillan (1984).

- Fitzgerald E. V. K., 'Financial Constraints Upon Relative Autonomy: the State and Capital Accumulation in Mexico, 1940-1982' in Anglade C. and Fortin C., *The State and Capital Accumulation in Latin America: Brazil, Chile, Mexico* Pittsburgh, University of Pittsburgh Press (1985).

- Floyd A., 'A Methodology for Trend Forecasting of Figures of Merit' in Bright J., *Technological Forecasting for Industry and Government: Methods and Applications* NJ, Englewood Cliffs, Prentice Hall (1968).

- Fogel R. and Engerman S., *The Reinterpretation of American Economic History* New York, Harper and Row (1971).

- Frank A. G., *Capitalism and Underdevelopment in Latin America: Historical Studies of Chile and Brazil* New York, Monthly Review Press (1969).

- Franko P. M., *The Puzzle of Latin American Economic Development* New York, Rowman and Littlefield Publishers Inc. (1999).

- Frenkel R. and O'Donnell G., 'The "Stabilization Programs" of the International Monetary Fund and their Internal Impacts' in Drake P. W., *Money Doctors, Foreign*

Debts and Economic Reforms in Latin America from the 1890s to the Present Wilmington, Scholarly Resources (1994).

- Frieden J. A., 'Winners and Losers in the Latin American Debt Crisis: The Political Implications' in Kaufman R. and Stallings B., *Debt and Democracy in Latin America* San Francisco, Westview Press (1989).

- Friedrich P., *Agrarian Revolt in a Mexican Village* Englewood Cliffs, Prentice Hall (1970).

- Fuentes M. M. and Araujo O. R., *El Partido de la Internacional Comunista, 1919-1943* México D.F., Ediciones 'El caballito' (1973).

- Furtado C., *The Economic Development of Latin America: Historical Background and Contemporary Problems* Cambridge, Cambridge University Press (1977).

- Gallitelli B. and Thompson A., *Sindicalismo y Regímenes Militares en Argentina y Chile* Amsterdam CEDLA Publications (1982).

- Gallo E., 'Agrarian Expansion and Industrial Development in Argentina, 1880-1930' in Carr R., *Latin American Affairs (St. Antony's Papers* No.22) Oxford, Oxford University Press (1970).

- Garnet R. W., *The Telephone Enterprise* Baltimore, The Johns Hopkins University Press (1985).

- Garrido L. J., *El Partido de la Revolución Institucionalizada: La Formación del Nuevo estado en México (1928-1945)* México D.F., Siglo Ventiuno Editores (1986).

- Gerassi M. N., *Los nacionalistas* Buenos Aires, Editorial Jorge Álvarez (1969).

- Gerschenkron A., *Economic Backwardness in Historical Perspective* Cambridge, MA, Harvard University Press (1962).

- Gerschunoff P. and Llach L., *El Ciclo de la Ilusión y el Desencanto: un Siglo de Políticas Económicas Argentinas* Buenos Aires, Editorial Ariel (2003).

- Gilbert F., *The Historical Essays of Otto Hintze* New York, Oxford University Press (1975).

- Glade W. P., *The Latin American Economies* New York, American Book (1969).

- Glade W. P., 'Latin America and the International Economy, 1870-1914' in Bethell L., *The Cambridge History of Latin America* volume IV, Cambridge, Cambridge University Press (1986).

- Glade W. P. and Anderson C.W., *The Political Economy of Mexico* Madison, University of Wisconsin Press (1963).

- Glenn E. S. and Glenn C. G., *Man and Mankind: Conflict and Communication Between Cultures* Norwood, NJ, Ablex (1981).

- Gómez-Galvarriato A., 'Measuring the Impact of Institutional Change in Capital-Labor Relations in the Mexican Textile Industry, 1900-1930' in Bortz J. L. and Haber S., *The Mexican Economy, 1870-1930* California, Stanford University Press (2002).

- Gonzalez Fraga J. A., 'Argentine Privatisation in Retrospect' in Glade W., *Privatisation of Public Enterprises in Latin America* San Francisco, ICS Press (1991).

- González González L., *Pueblo en vilo: Microhistoria de San José de Gracia* México D.F., El Colegio de México (1972).

- Goodman L. W., Mendelson J. S. R. and Rial J., *The Military and Democracy: The Future of Civil-Military Relations in Latin America* Lexington, Lexington Books (1990).

- Griffith K., 'Mexican Tele-connectivity' in Harms L. S. and Wedemeyer D. J., *PTC '89 Proceedings Pacific Telecommunications Connectivity: Users, Networks and Information Services: Proceedings* Honolulu, Pacific Telecommunications Council (1989).

- Griffith K. A., 'Mexico' in Noam E. M., *Telecommunications in Latin America* New York, Oxford University Press (1998).

- Grubler A., 'Time for a Change: On the Pattern of Diffusion of Innovation' in Ausubel J. H. and Lagford D. H., *Technological Trajectories and the Human Environment* Washington D.C., National Academy Press (1997).

- Habakkuk H. J., *American and British Technology in the 19th Century* Cambridge, Cambridge University Press (1962).

- Haber C. S., Razo A. and Maurer N., *The Politics of Property Rights, Political Instability, Credible Commitments, and Economic Growth in Mexico, 1876-1929* Cambridge, Cambridge University Press (2003).

- Haber S., 'Regulatory Regimes, Capital Markets and Industrial Development: A comparative study of Brazil, Mexico and the United States, 1840-1930' in Harris J., Hunter J. and Lewis C. M., *The New Institutional Economics and Third World Development* New York, Francis Routledge (1995).

- Haber S. *Industry and Underdevelopment: The Industrialisation of Mexico, 1890-1940* Stanford, Stanford University Press (2000).

- Hägerstrand T., *Innovation of Spatial Process* Chicago, University of Chicago Press (1953).

- Haggard S. *Pathways from the Periphery: The Politics of Growth in the Newly Industrialising Countries* Ithaca, Cornell University Press (1990).

- Haggard S. and Kaufman R., 'Democratic Transitions and Economic Reform' *Paper presented at the Southern California Workshop on Economic and Political Liberalisation* University of Southern California, Los Angeles (1993).

- Hall J. A., *States in History* Oxford, University of North Carolina Press (1988).

- Halperín Donghi T., 'Argentina' in Cortés Conde R. C. and Stein S. J., *Latin America: A Guide to Economic History 1830-1930* Berkeley, University of California Press (1977).

- Halperín Donghi T., *Argentina, la democracia de masas* Buenos Aires, Editorial Paidós (1983).

- Halperín Donghi T., *The Contemporary History of Latin America* Durham, Duke University Press (1993).

- Hamilton N., 'Limits of State Autonomy: Post-Revolutionary Mexico' in Hamilton N. and Harding T. F., *Modern Mexico: State, Economy and Social Conflict* Princeton, Princeton University Press (1982).

- Hamilton N. and Harding T. F., *Modern Mexico: State, Economy and Social Conflict* London, Sage Publications (1986).

- Hart J., 'The Mexican Revolution, 1910-1920' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).

- Hayes J. E., 'Radio as Medium' in Smelser N. J. and Baltes P. B., *International Encyclopaedia of the Social and Behaviour Sciences* Amsterdam, Elsevier (2001).

- Herzog J. S., *El Agrarismo Mexicano y la Reforma Agraria* México D.F., Fondo de Cultura Economica (1964).

- Hirsch S., *Location of Industry and International Competitiveness* London, Oxford University Press (1967).

- Hofman A. and Mulder N., 'The Comparative Productivity Performance of Brazil and Mexico, 1950-1994' in Coatsworth J. H. and Taylor A. M., *Latin America and the World Economy since 1800* Cambridge, Harvard University Press (1998).

- Hofstede G., *Culture's Consequences: International Differences in Work-Related Values* Beverly Hills, CA, Sage Publishers (1980).

- Holcombe A. N., *Public Ownership of Telephones on the Continent of Europe* Boston, The Riverside Press (1911).

- Hora R., *Landowners of the Argentine Pampas: A Social and Political History, 1860*-1945 New York, Oxford University Press (2001).

- Huntington S. P., *Political Order in Changing Societies* New York, Yale University Press (1968).

- Huntington S. P. and Nelson J., *No Easy Choice: Political Participation in Developing Countries* Cambridge, MA, Harvard University Press (1976).

- Islas Rivera V., *Estructura y Desarrollo del Sector Transporte en México* México D.F., El Colegio de México (1992).

- James D., *Resistance and Integration: Peronism and the Argentine Working Class, 1946-1976* Cambridge, Cambridge University Press (1969).

- Jeremy D. J., *International Technology Transfer: Europe, Japan and the USA, 1700-1914* England, Elgar Publishing Limited (1991).

- Johnson C., *MITI and the Japanese Miracle: The Growth of Industrial Policy, 1925-1975* Stanford, Stanford University Press (1982).

- Johnson C., 'Political Institutions and Economic Performance: The Government-Business Relationship in Japan, South Korea, and Taiwan' in Deyo F., *The Political Economy of the New Asian Industrialism* U.S., Cornell University Press (1987).

- Johnson C., 'The Developmental State: Odyssey of a Concept' in Woo-Cumings M., *The Developmental State* Itacha and London, Cornell University Press (1999).

- Joseph G. M., *Revolution from Without: Yucatán, Mexico and the United States, 1880-1924* Cambridge, Cambridge University Press (1982).

- Kalathil S. and Boas T. C., *Open Networks, Closed Regimes: The Impact of the Internet on Authoritarian Rule* Washington D.C., Carnegie Endowment for International Peace (2003).

- Kaufman R., 'Economic Orthodoxy and Political Change in Mexico: The Stabilisation and Adjustment Policies of de la Madrid Administration' in Kaufman R. and Stallings B., *Debt and Democracy in Latin America* San Francisco, Westview Press (1989).

- Kaufman R. and Stallings B., *Debt and Democracy in Latin America* San Francisco, Westview Press (1989).

- Kedzie C. R., *Communication and Democracy: Coincident Revolutions and the Emergent Dictator's Dilemma* Santa Monica, Research And Development (RAND) (1997).

- Kemp R., *Environmental Policy and Technical Change: A Comparison of the Technological Impact of Policy Instruments* U.K., Edward Elgar (1997).

- Keremitsis D., *La Industria Textil en el Siglo XIX* México D.F., Sep-Setentas (1973).

- Knight A., 'The Political Economy of Revolutionary Mexico, 1900-1940' in Abel C. and Lewis C. M., *Latin America Economic Imperialism and the State: The political Economy of the External Connection from Independence to the Present* London, Athlone Press (1985).

- Knight A., 'State Power and Political Stability in Mexico' in Harvey N., *Mexico Dilemmas of Transition* London, British Academic Press (1993).

- Knight A., 'Export-led Growth in Mexico, c. 1900-30' in Cárdenas E., Ocampo J. A. and Thorp R., *An Economic History of Twentieth-Century Latin America* England, Palgrave Publisher (2000).

- Koch K., *International Trade Policy and the GATT, 1947-1967* Stockholm, Almquist and Wiksell (1969).

- Koizumi T., 'Absorption and Adaptation: Japanese Inventiveness in Technological Development' in Lundstedt S. B. and Colglazier E. W., *Managing Innovation: The Social Dimensions of Creativity, Invention and Technology* New York, Pergamon Press (1982).

- Kosacoff B., 'La Industria Argentina: un Proceso de Reestructuración Desarticulada' in Kosacoff B., *El Desafío de la Competitividad: la Industria Argentina en Transformación* Buenos Aires, Alianza Editorial (1993).

- Kotler P., *Marketing Decision Making: A Model Building Approach* New York, Holt, Rinehart and Winston (1971).

- Kuuse J., Olsson U. and Jacobaus C., *L. M. Ericsson, 100 Years* Orebro, Interbook Publishers (1977).

- León S. and Marvan I., *La clase obrera en la historia de Mexico: En el Cardenismo 1934-1940* México D.F., Siglo Veintiuno Editores (1985).

- Levin J. V., *The Export Economies: Their Pattern of Development in Historical Perspectives* Cambridge, Harvard University Press (1960).

- Levy B. and Spiller P., *Regulations, Institutions and Commitment* Cambridge, Cambridge University Press (1996).

- Lewis C. M., *British Railways in Argentina 1857-1914: A Case of Foreign Investment* London, The Athlone Press (1983).

- Lewis C. M., 'Industry in Latin America before 1930s' in Bethell L., *The Cambridge History of Latin America* volume IV, Cambridge, Cambridge University Press (1986).

- Lewis C. M., 'Industry in Latin America' in Bernecker W. L. and Tobler H. W., *Development and Underdevelopment in America* New York, Walter de Gruyter (1993).

- Lewis C. M., *Argentina: A Short History* Oxford, Oneworld Publications (2002).

- Lewis C. M., 'Britain, the Argentine and Informal Empire: Rethinking the Role of Railway Companies' in Brown M., *Informal Empire in Latin America: Culture, Commitment and Capital* Oxford, Wiley-Blackwell (2008).

- Lewis C. M. and Torrents N., *Argentina in the Crisis Years (1983-1990): from Alfonsín to Menem* London, Institute of Latin American Studies (1993).

- Lewis P. H., *The Crisis of Argentine Capitalism* Chapel Hill, University of North Carolina Press (1990).

- Lewis P. H., *Authoritarian Regimes in Latin America: Dictators, Despots, and Tyrants* Lanham, Rowman & Littlefield Publishers (2006).

- Liewen E., *Mexican Militarism: The Political Rise and Fall of the Revolution Army, 1910-40* Westport, Greenwood Press (1968).

- Linstone H. A. and Sahal D., *Technological Substitution* New York, American Elsevier (1976).

- Linz J. J. and Stepan A., *Problems of Democratic Transition and Consolidation: Southern Europe, South America, and Post-Communist Europe* Baltimore, Johns Hopkins University Press (1996).

- Llach J. J., *Reconstrucción o Estancamiento* Buenos Aires, Editorial Tesis (1987).

- Luna F., *Perón y su Tiempo,* 3 volumes, Buenos Aires, Editorial Sudamericana (1984-1986).

- Lustig N., *Distribución del Ingreso y Crecimiento en México. Un Análisis de las Ideas Estructuralistas* México D.F., El Colegio de México (1981).

- Lustig N., 'Equity and Growth in Mexico' in Teitel S., *Towards a New Development Strategy for Latin America: Pathways from Hirschman's Thought* Washington, Johns Hopkins University Press (1992).

- Lynn F., 'An Investigation of the Rate of Development and Diffusion of Technology in our Modern Society' in *Studies Prepared for the National Commission on Technology, Automation and Economic Progress* 2 Washington (1966).

- Machinea J. L., 'Stabilisation under Alfonsín' in Lewis C. M. and Torrents N., *Argentine in the Crisis Years, 1983-1990: from Alfonsín to Menem* London, Institute of Latin American Studies (1993).

- Maddison A., *Phases of Capitalist Development* Oxford, Oxford University Press (1982).

- Maddison A., *Growth and Slowdown* in Advanced Capitalist Economies: Techniques of Quantitative Assessment' *Journal of Economic Literature* 25.2 (1987): 649-698.

- Maddison A., 'Economic and Social Conditions in Latin America, 1913-1950' in Urrutia M., *Long-Term Trends in Latin American Economic Development* Washington D.C., Inter-American Development Bank (1991).

- Mahajan V. and Peterson R. A., *Models for Innovation Diffusion* Newbury Park, California, Sage Publications (1985).

- Mallon F. E., *Peasant and Nation: The Making of Postcolonial Mexico and Peru* Berkeley, University of California Press (1995).

- Malloy J. M., *Authoritarianism and Corporatism in Latin America* London, University of Pittsburgh Press (1977).

- Mansfield E., *Industrial Research and Technological Innovation: An Econometric Analysis* New York, Norton (1968).

- Manzetti L., *Privatisations South American Style* Oxford, Oxford University Press (1999).

- Marchical C., *A Century of Debt Crisis in Latin America: From Independence to the Great Depression 1820-1930* Princeton, Princeton University Press (1989).

- Marton K., *Multinationals, Technology and Industrialisation* Lexington, MA, Heath (1986).

- McGuire J. M., *Peronism Without Perón: Unions, Parties, and Democracy in Argentina* Stanford, Stanford University Press (1997).

- Medina L., *Del Cardenismo al Avilacamachismo* México D.F., El Colegio de Mexico (1978).

- Meyer L., *El Conflicto Social y los Gobiernos del Maximato* volume 13, México D.F., El Colegio de México (1978).

- Meyer L., 'Democratisation of the PRI: Mission Impossible?' in Cornelius W. A., Gentleman J. and Smith P. H., *Mexico's Alternative Political Futures* La Jolla, for U.S.-Mexican Studies, University of California Press (1989).

- Meyer M. C. and Sherman W. L., *The Course of Mexican History* New York, Oxford University Press (1999).

- Midgley D.F., *Innovation and New Product Marketing* New York, John Wiley (1977).

- Milner H. V., *The Global Spread of the Internet: the Role of International Diffusion Pressures in Technology Adoption* New York, Columbia University (2003).

- Moses B., *The Railway Revolution in Mexico* San Francisco, The Berkley Press (1895).

- Mukherjee S. and Mukherjee I., *International Transfer of Technology* India, Mittal Publications (1989).

- Mulleady R. T., *Breve Historia de la Telefonia Argentina (1886-1956)* Buenos Aires, Kraft (1956).

- Munck R., *Argentina from Anarchism to Peronism* London, Zed Books (1987).

- Murmis M. and Portantiero J .C., *Estudios sobre los Orígenes del Peronismo* Buenos Aires, Siglo Veintiuno Editores (1971).

- Nabseth L. and Ray G. F., *The Diffusion of New Industrial Processes: An International Study* Cambridge, Cambridge University Press (1974).

- Nader N., *Economic Policy and Stabilization in Latin America* New York, M. E. Sharpe (1996).

- Nava C., *Ideología del Partido de la Revolución Mexicana* México D.F., Centros de Estudios de la Revolución Mexicana 'Lázaro Cárdenas' A.C. (1984).

- Neher C.D., *Southeast Asia: In the New International Era* Boulder, Westview (1991).

- Nelson R. and Winter S., *An Evolutionary Theory of Economic Change* Cambridge, MA, Harvard University Press (1982).

- Noam E., *Telecommunications in Europe* New York, Oxford University Press (1992).

- Noam E. M., *Telecommunications in Latin America* New York, Oxford University Press (1998).

- Norris P., *Digital Divide: Civic Engagement, Information Poverty and the Internet Worldwide* Cambridge, Cambridge University Press (2001).

- North D. C., *Structure and Change in Economic History* New York, Norton Press (1981).

- North D. C, *Institutions, Institutional Change and Economic Performance* Cambridge, Cambridge University Press (1990).

- Noyola L., *La Raza de la Hebra: Historia del Telégrafo Morse en México* Puebla, Universidad Autónoma de Puebla (2004).

- O'Connell A., 'Argentina into the Depression: Problems of an Open Economy' in the 1930s' in Thorp R., *Latin America in the 1930s, The Role of the Periphery in World Crisis* New York, Macmillan (1984).

- O'Donnell G. A., *Modernization and Bureaucratic-Authoritarianism: Studies in South American Politics* Berkeley, University of California Press (1973).

- O'Donnell G. A., Schmitter P. C. and Whitehead L., *Transitions from Authoritarian Rule* Baltimore, Johns Hopkins University Press (1986).

- Ortiz Mena A. L., *El desarrollo estabilizador: reflexiones sobre una época* México D.F., El Colegio de México, Fondo de Cultura Económica (1998).

- Oszlak O., *La Formación del Estado Argentino* Buenos Aires, Editorial de Belgrano (1982).

- Palma J. G., *Growth and Structure of the Chilean Manufacturing Industry from 1830 to 1935* Doctoral thesis, Oxford University (1979).

- Pavía L., *Breve Bosquejo Biográfico de los Miembros Más Notables del Ramo Telegráfico, y Reseña Historia de la Existencia y Progreso de los Telégrafos de la República Mexicana* vol. 1, México D.F., Antigua Imprenta del Comercio (1893).

- Pérez R. M., *Los Telefonistas Frente a la Crisis y la Reconversión* México D.F., Editorial Nuestro Tiempo (1989).

- Pesaran B. and Pesaran M. H., *Working with Microfit 4.0 Interactive Econometric Analysis* New York, Oxford University Press (2003).

- Petrazzini B. A., *Restructuring Telecommunications Policy in Argentina: Issue Beyond Domestic Concerns* Buenos Aires, mimeo presentado al XV Congreso de la International Political Science Association (1991).

- Petrazzini B. A., *The Political Economy of Telecommunications Reform in Developing Countries: Privatisation and Liberalisation in Comparative Perspectives* London, Praeger Publishers (1995).

- Petrazzini B. A., 'Telephone Privatisation in a Hurry: Argentina' in Ramamurti R., *Privatising Monopolies: Lessons from the Telecommunications and Transport Sectors in Latin America* Baltimore, Johns Hopkins University Press (1996).

- Porter M. E., *The Competitive Advantage of Nations* London, Macmillan (1990).

- Potash R. A., *The Army and Politics in Argentina: Yrigoyen to Perón* Stanford, Stanford University Press (1969).

- Potash R. A., *The Army and Politics in Argentina: Perón to Frondizi* Stanford, Stanford University Press (1980).

- Prados de la Escosura L., 'The Economic Consequences of Independence' in Bulmer-Thomas V., Coatsworth J. H. and Cortés Conde R., *The Cambridge Economic History of Latin America, Volume I: The Colonial Era and the Short Nineteenth Century* Cambridge, Cambridge University Press (2006).

- Pred A. R., *Urban Growth and the Circulation of Information: The United States System of Cities, 1790-1840* Cambridge, Harvard University Press (1973).

- Proenza F. J., Bastidas-Buch R. and Montero G., *Tele-centres for Socioeconomic and Rural Development in Latin America and the Caribbean* Washington D.C., Inter-American Development Bank (2001).

- Ramamurti R., *Privatising Monopolies: Lessons from the Telecommunications and Transport Sectors in Latin America* Baltimore, Johns Hopkins University Press (1996).

- Ramirez R., *El movimiento estudiantil de Mexico: Julio-diciembre de 1968* 2 vols, México D.F., Ediciones Era (1969).

- Ranis G., *Government and Economic Development* New Haven, Yale University Press (1971).

- Rapoport M., *Historia Económica, Política y Social de la Argentina (1880-2000)* Buenos Aires, Ediciones Macchi (2000).

- Raventos P., *Privatización y Regulación en Telecomunicaciones: Conceptos y Casos* INCAE (1997).

- Reggini H. C., *Los Caminos de la Palabra: Las Telecomunicaciones de Morse al Internet* Buenos Aires, Ediciones Galápago (1996).

- Reggini H. C., *Sarmiento y las Telecomunicaciones: La Obsesión del Hilo* Buenos Aires, Ediciones Galápago (1997).

- Reynolds C. W., *The Mexican Economy: Twentieth-Century Structure and Growth* New Haven, Yale University Press (1970).

- Ridings E., *Business Interest Groups in Nineteenth-century Brazil* Cambridge, Cambridge University Press (1994).

- Rippy J. F., *British Investments in Latin America, 1822-1949* Minneapolis, University of Minnesota Press (1959).

- Robertson T. S., *Innovative Behaviour and Communication* New York, Holt, Rinehart and Winston (1971).

- Robson B., *Urban Growth: An Approach* London, Methuen (1973).

- Rock D., *Politics in Argentina, 1890-1930: The Rise and Fall of Radicalism* Cambridge, Cambridge University Press (1975).

- Rock D., *Argentina 1516-1982: From Spanish Colonisation to the Falklands War* Berkeley, University of California Press (1985).

- Rock D., *Argentina 1516-1987: From Spanish Colonisation to Alfonsín* Berkeley, University of California Press (1987).

- Rock D., *Authoritarian Argentina: The Nationalist Movement, its History and its Impact* Berkeley, University of California Press (1993).

- Rodríguez J. A. O., *El Telégrafo en México: 150 Años, del Morse al Mouse* México D.F., Telecomunicaciones de México (2000).

- Rogers E. M. and Shoemaker F. F., *Communication of Innovations: A Cross Cultural Approach* New York, Free Press (1971).

- Rogers E. M., *Diffusion of Innovations* 4th edition, New York, The Free Press (1995).

- Romero L. A., *A History of Argentina in the Twentieth Century* University Park, Pennsylvania State University Press (2002).

- Ronchietto A. and Rozenwurcel G., *Regulación de las Telecomunicaciones en Argentina: Marco Institucional, Interconexión y Servicio Universal* Universidad de Belgrano, Instituto Nacional de la Administración Pública (1999).

- Ronfeldt D., *The Modern Mexican Military: A Reassessment* La Jolla, Center for U.S.-Mexican Studies, Cambridge University Press (1984).

- Ronfeldt D., 'Prospects for Elite Cohesion' in Cornelius W. A., Gentleman J. and Smith P. H., *Mexico's Alternative Political Futures* La Jolla, Centre for US-Mexican studies (1989).

- Ros J., 'Mexico from the Oil Boom to the Debt Crisis: An Analyses of Policy Reponses to External Shocks, 1978-85' in Thorp R. and Whitehead L., *Latin American Debt and the Adjustment Crisis* Pittsburgh, University of Pittsburgh Press (1987).

- Rosenzweig Hernandez F., *El Desarrollo Económico de México* México D.F., Colegio Mexiquense, ITAM (1989).

- Rouquie A., *Poder Militar y Sociedad Política en la Argentina* 2 volumes, Buenos Aires, Emece Editores (1981/1982).

- Ruelas A. L., *La Reconversión Regulatoria de las Telecomunicaciones* México D.F., Juan Pablos S. A. (2005).

- Sábato H. and Lettieri A., *La Vida Política en la Argentina del Siglo XIX: Armas, Votos y Voces* Buenos Aires, Fondo de Cultura Económica (2003).

- Saborio S., *The Premise and the Promise: Free Trade in the Americas* Oxford, Transaction Publishers (1992).

- Saragoza A. M., *The Monterrey Elite and the Mexican State, 1880-1940* Austin, University of Texas Press (1988).

- Schaeffer R. K., *Understanding Globalization: The Social Consequences of Political, Economic and Environmental Change* Lanham, M.D., Rowman and Littlefield Publishers (1997).

- Schoultz L., *The Populist Challenge: Argentine Electoral Behaviour in the Post War Era* Chapel Hill, University of North Carolina Press (1983).

- Schumpeter J., *The Theory of Economic Development* Cambridge, MA, Harvard University Press (1984).

- Schvarzer J., *Empresarios del Pasado: la Unión Industrial Argentina* Buenos Aires, CISEA/Imago Mundi (1991).

- Scobie J. R., *Argentina a City and a Nation* New York, Oxford University Press (1964).

- Shannon C. E. and Weaver W., *The Mathematical Theory of Communication* Urbana, University of Illinois Press (1949).

- Sherman J. W., 'The Mexican Miracle and its Collapse' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).

- Shugart M. S. and Carey J. M., *Presidents and Assemblies: Constitutional Design and Electoral Dynamics* Cambridge, Cambridge University Press (1992).

- Shumway N., *The Invention of Argentina* Berkley, University of California Press (1991).

- Skocpol T., 'Bringing the State Back in: Strategies of Analysis in Current Research' in Evans P. B., Rueschemeyer D. and Skocpol T., *Bringing the State Back in* New York, Cambridge University Press (1985).

- Sidak J. G. and Spulber D.F., *Deregulatory Takings and the Regulatory Contract: The Competitive Transformation of Network Industries in the United States* New York, Cambridge University Press (1997).

- Sierra J., *México y su Evolución Social* México D.F., J. Ballescá y Compañía (1901).

- Skidmore T. E. and Smith P.H., *Modern Latin America* New York, Oxford University Press (2005).

- Smith P. H., *Argentina and the Failure of Democracy: Conflict among Political Elites, 1904-1955* Madison, University of Wisconsin Press (1974).

- Smith P. H., *Labyrinths of Power: Political Recruitment in Twentieth-Century Mexico* Princeton, Princeton University Press (1979).

- Smith P. H., 'Mexico Since 1946: Dynamics of an Authoritarian Regime' in Bethell L., *Mexico Since Independence* Cambridge, Cambridge University Press (1991).

- Smith P. H., *Democracy in Latin America: Political Change in Comparative Perspective* New York, Oxford University Press (2005).

- Solís L., *La Realidad Económica Mexicana: Retrovisión y Perspectivas* México D.F., Siglo Veintiuno Editores (1970).

- Sterling C. H., Bernt P. W. and Weiss M. B. H., *Shaping American Telecommunications, A History of Technology, Policy and Economics* U.S., Lawrence Erlbaum Associates (2006).

- Stevens E. P., 'Mexico's PRI: The Institutionalisation of Corporatism?' in Malloy J. M., *Authoritarianism and Corporatism in Latin America* London, University of Pittsburgh Press (1977).

- Stoneman P., *Technological Diffusion and the Computer Revolution* Cambridge, Cambridge University Press (1976).

- Stoneman P., *The Economics of Technological Diffusion* Oxford, Blackwell Publishers Ltd. (2002).

- Sunkel O., *Development from Within: Toward a Neostructuralist Approach for Latin America* London, Lynne Rienner Publishers (1993).

- Sussman G., *Communication, Technology, and Politics in the Information Age* London, Sage Publications (1997).

- Suzigan W., *Indústria Brasileira: Origems e Desenvolvimento* São Paulo, Editora Brasiliense (1986).

- Székely G. and de Palacio J., *Teléfonos de México: Una Empresa Privada* México D.F., Grupo Editorial Planeta Mexicana (1995).

- Székely M. and Montes A., 'Poverty and Inequality' in Bulmer-Thomas V., Coatsworth J. H. and Cortés Conde R., *The Cambridge Economic History of Latin America: Volume II, The Long Twentieth Century* New York, Cambridge University Press (2006).

- Tamarin D. *The Argentine Labor Movement, 1930-1945: A Study in the Origins of Peronism* Albuquerque, University of New Mexico Press (1985).

- Tarde G., *The Laws of Imitation* New York, University of Chicago Press (1969).

- Taylor A. M., 'Foreign Capital Flows' in Bulmer-Thomas V., Coatsworth J. H. and Cortés Conde R., *The Cambridge Economic History of Latin America: Volume II, The Long Twentieth Century* New York, Cambridge University Press (2006).

- Taylor D., *Disappearing Acts: Spectacles of Gender and Nationalism in Argentina's 'Dirty War'* Durham, Duke University Press (1997).

- Telecom, *Historia de las Telecomunicaciones en Colombia* Bogotá, Telecom (1970).

- Teléfonos de México, S.A. de C.V. *Datos Internos* México D.F., Telmex (1994).

- Tesler M., *La Telefonía Argentina, Su Otra Historia* Buenos Aires, Editorial Rescate (1990).

- Thorp R., *Latin America in the 1930s* New York, Macmillan (1984).

- Thorp R., 'Latin America and the International Economy from the First World War to the World Depression' in Bethell L., *The Cambridge History of Latin America* 4 Cambridge, Cambridge University Press (1986).

- Thorp R., *Progress, Poverty and Exclusion: An Economic History of Latin America in the Twentieth Century* Washington D.C., Inter-American Development Bank (1998).

- Thorp R. and Bertram G., *Peru, 1890-1977: Growth and Policy in an Open Economy* London, Macmillan Press (1978).

- Tilton J. E., *International Diffusion of Technology: The Case of Semiconductors* Washington D.C., The Brookings Institution (1971).

- Todaro M. P., *Economic Development* Reading, MA, Addison Wesley Longman (2000).

- Topik S., 'The Economic Role of the State in Liberal Regimes - Brazil and Mexico Compared, 1880-1910' in Love J. L. and Jacobsen N., *Guiding the Invisible Hand:*

Economic Liberalism and the State in Latin American History New York, Praeger Publishers (1988).

- Topik S. C. and Well A., *The Second Conquest of Latin America: Coffee, Henequen, and Oil during the Export Boom, 1850-1930* Austin, University of Texas Press (1998).

- Tornell A., 'Economic Crises and Reform in Mexico' in Haber S., *Crony Capitalism and Economic Growth in Latin America: Theory and Evidence* Stanford C. A., Hoover Institution Press (2002).

- Tornquist E. and Cía., *The Economic Development of the Argentine Republic in the Last Fifty Years* Buenos Aires (1919)

- Torre J. C., *Los Sindicatos en el Gobierno, 1973-76* Buenos Aires, Centro Editor de América Latina (CEAL) (1983).

- Turner J. K., *Barbarous Mexico* Austin, University of Texas Press (1910).

- Urdinola, A. and Carizzosa M. *Povery, Equity and Growth in Colombia* Bogota, The World Bank (1985).

- Vanderwood P., 'Betterment for Whom? The Reform Period: 1855-1875' in Meyer M. C. and Beezley W. H., *The Oxford History of Mexico* New York, Oxford University Press (2000).

- Vázquez Castillo M. T., *Land Privatisation in Mexico, Urbanization, Formation of Regions and Globalization in Ejidos* London, Routledge (2004).

- Velasco A., *Trade, Development and the World Economy: Selected Essays of Carlos F. Díaz Alejandro* Oxford, Basil Blackwell (1988).

- Velasco C., 'El Desarrollo Industrial de México en la Década 1930-40: las Bases del Proceso de Industrialización' in Cordera R., *Desarrollo y Crisis de la Económica Mexicana: Ensayos de Interpretación Histórica* México City, Fondo de Cultura Económica (1981).

- Veliz C., *Obstacles to Change in Latin America* New York, Oxford University Press (1965).

- Verbitsky H., *Robo para la Corona* Buenos Aires, Editorial Planeta (1991).

- Vernon R., *The Dilemma of Mexico's Development: The Roles of the Private and Public Sector* Cambridge, Harvard University Press (1963).

- Wade R., *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialisation* Princeton, Princeton University Press (1990).

- Waisman C. H., *Reversal of Development in Argentina: Post-war Counterrevolutionary Policies and rheir Structural Consequences* Princeton, Princeton University Press (1987).

- Waisman C. H. 'Argentina: Autarkic Industrialization and Illegitimacy' in Diamond L., Linz J.L., and Lipset S.M., *Democracy in Developing Countries* Volume Four: Latin America, Boulder, Lynne Rienner Publishers (1989).

- Waisman C. H., 'Argentina's Revolution from Above' in Epstein E. C., *The New Democracy in Argentina* New York, Praeger Publishers (1992).

- Walter J. and González C. S., *La Privatización de las Telecomunicaciones en América Latina* Argentina, Editorial Universitaria de Buenos Aires (1998).

- Walter R. J., *The Socialist Party of Argentina, 1890-1930* Institute of Latin American Studies, monograph no. 42, Austin, University of Texas Press (1977).

- Weaver F. S., *Class, State and Industrial Structure: The Historical Process of South American Industrial Growth* Westport, Greenwood Press (1980).

- Weid E. and Rodrigues Bastos A. M., *O filo da Meada: Estratégia de Expansão de uma Indústria Têxtil: Companhia América Fabril* Rio de Janeiro, Fundação Casa de Rui Barbosa, Confederação Nacional da Indústria (1986).

- Weiner R., *Race, Nation, and Markets: Economic Culture in Porfirian Mexico* Tucson, University of Arizona Press (2004).

- Wells J., *Latin America at the Cross-Roads* Santiago, CEPAL (1988).

- Weyland K., *The Politics of Market Reform in Fragile Democracies: Argentine, Brazil, Peru, and Venezuela* Princeton, Princeton University Press (2002).

- White G., *Developmental States in East Asia* New York, St. Martin's Press (1988).

- Wilkie J. W., *Statistics and National Policy (supplement 3)* Los Angeles, University of California (1974).

- Wilkie J. W., *Latin American Population and Urbanisation Analysis: Maps and Statistics, 1950-82* California, Latin American Centre Publications (1984).

- Wilson E., *The Information Revolution and Developing Countries* Cambridge, MA, MIT Press (2004).

- Winston B., *Media, Technology and Society A History: From the Telegraph to the Internet* London, Routledge (1998).

- Woodruff C., 'Measuring Institutions' in Rose-Ackerman S., *International Handbook on the Economics of Corruption* U.K., Edward Elgar Publishing (2006).

- Wright H. K., *Foreign Enterprise in Mexico: Laws and Policies* Chapel Hill, North Carolina University Press (1971).

- Wright W. R., *British-owned Railways in Argentina: Their Effect on Economic Nationalism 1854-1948* Austin, University of Texas Press (1972).

- Wynia G. W., *Argentina in the Postwar Era: Politics and Economic Policy Making in a Divided Society* Albuquerque, University of New Mexico Press (1978).

- Wythe G., *Industry in Latin America,* New York, Columbia University Press (1945).

- Xelhuantzi-López M., *El Sindicato de Telefonistas de la República Mexicana: Doce años (1976–1988)* México D.F., Sindicato de Telefonistas de la República Mexicana (1990).

- Zalduendo E. A., *Libras y Rieles* Buenos Aires, Editorial El Coloquio (1975).

- Zysman J., *Governments, Markets, and Growth: Financial Systems and the Politics of Industrial Change* Oxford, Martin Robertson (1983).

APPENDICES

The appendices presented below provide a more comprehensive overview of the statistical data referred to in the thesis. The appendices elaborate further upon the data sets used and identify the sources and procedures employed. First of all, it is important to appreciate the evolution and nature of the data collection process in Latin America as a whole. Indeed, detailed widespread recording of national accounts did not really begin across Latin America until after the Second World War. Even then, the information gathered was relatively limited, typically including only GDP estimates by industrial origin and its structure by expenditure type. In the late 1940s, national income estimates for Latin American economies based on official publications were presented collectively by Dominguez.[1] Further progress was made in the 1960s, by which point every Latin American country produced their own GDP estimates. Moreover, under the recommendations of the United Nations, some countries (with varying restrictions) also drew up a simplified system of accounts. However, as Noriega warns, due to the distinct absence of rigorous independent estimates of domestic product and income, a huge limiting factor was the inability to check the reliability of these official estimates.[2]

In light of the known inherent limitations of the official data, the appendices attempt to justify the decisions made with regards to the chosen data sources for Argentina and Mexico. Given the length of the period under concern and the fact that data are presented for more than one country, inevitably various methodological challenges with regard to consistency presented themselves and it must be accepted that the chosen approach will never be to every reader's complete satisfaction. Despite this, and provided that the associated issues are made transparent, the extensive use of data sets are useful. In using data sets collected by various institutions and academics and in constructing four of my own, it is important to try to adhere to certain criteria. This includes striking the right balance between adopting databases with the longest data

[1] Note that Dominguez produced this under the technical guidance of Simon Kuznets. Dominguez L. M., *National Income Estimates of Latin American Countries* volume X, New York, National Bureau of Economic Research (1947).
[2] Noriega C., 'The Present State of National Accounts in Latin America' *Review of Income and Wealth* 22.2 (1976): 133-149.

series available without overly forfeiting on reliability. Further, standardisation of definitions (or as proximate as possible) is important to aid comparability between countries. Taking all of this into consideration, occasionally, it is still necessary to make some generalisations about the raw data in order to ensure its accessibility and value. A full set of data are shown for appendices B and C, however due to a lack of space, the socio-economic data in appendix A is presented at regular intervals only over the period. When analysing Latin American averages for various data, the LA6 [or 8] grouping (Argentina, Brazil, Chile, Columbia, Mexico and Venezuela [plus Peru and Uruguay]) is frequently used, since together these economies typically accounted for at least three quarters of economic activity of Latin America during this period and represent as much as 80% of the region's entire population and territory. Therefore LA6 [or 8] data can be seen as a good proxy for overall Latin American development, at least in regard to socio-economic indicators.

For Argentina and Mexico the appendix considers generic data issues, before detailing various problems associated with specific data. In sourcing the historical data sets, the official sources were primarily used where readily available and consistent, however due to various gaps in the data sets, complementary sources were used as well. An excellent institutional source for both Argentina and Mexico from the second half of the period in question is the Economic Commission for Latin America (ECLA). From 1950, ECLA estimated socio-economic variables such as real gross product (in constant prices) in a standardised fashion.[3] It is interesting that policy makers (especially in the early part of the period in question) typically ignored aggregated economic indicators because of the wide range in data availability on important areas such as the nominal value of GDP. National income statistics in the first half of the century were used primarily to reflect the successes, or failure, of political administrations instead of as a basis for policy formulation.[4] Consequently overestimation of these values in the official accounts seems unavoidable.

[3] ECLA (1950a), and subsequent years.
[4] Reynolds (1970).

The Evolution of Argentinian Statistical Data

In the second half of the nineteenth century Argentina underwent unprecedented demographic and economic changes whose appraisal and measurement were of particular interest to the ruling classes. Statistical research was aimed at increasing knowledge in regard to population growth, learning more about the consequences of immigration, as well as obtaining information on the conditions of economic production. This information became so central to the diagnosing and designing of government strategy and policy that in 1869, the first National Population Census was ordered.[5] There is a genuine lack of data on Argentina during the nineteenth century, and the existing data are sporadic and isolated. Even at the turn of the twentieth century, the data improved minimally and there are difficulties in connecting the data, as successive governments failed to use consistent methods.

Strong demand for national statistics came in the late 1920s, as a consequence of the new international economic landscape, as well as mass European immigration and domestic developments in Argentina's social and productive structure. It is useful therefore to list the various governmental agencies (and their insertion in the state structure) that oversaw the production of public statistics over the relevant period. From 1894: *Dirección General de Estadística* (General Direction of Statistics), an agency of the *Ministerio de Hacienda* (Ministry of Public Finances). From 1944: *Consejo Nacional de Estadística y Censos* (National Council of Statistics and Censuses), an agency of the *Consejo de Defensa Nacional, Ministerio del Interior* (Council of National Defense in the Ministry of Interior), and of the *Secretaría Técnica de la Presidencia de la Nación* (Technical Secretariat of the Argentine Presidency). From 1950: *Dirección General del Sistema Estadístico Nacional* (General Direction of the National Statistical System), an agency of the *Dirección Nacional de Servicios Técnicos del Estado, Ministerio de Asuntos Técnicos* (National Direction of the Technical Services of the State, in the Ministry of Technical Affairs). From 1952: *Dirección Nacional de Servicio Estadístico* (National Direction of Statistical Service), an agency of both the Ministry of

[5] República Argentina, Comisión Nacional del Censo, *Primer Censo Nacional, 1869* Buenos Aires, Imprenta del Porvenir (1872).

Technical Affairs and the Ministry of Public Finances. From 1956: *Dirección Nacional de Estadística y Censos* (National Direction of Statistics and Censuses), an agency of the *Ministerio de Economía* (Ministry of Economy).

The *Instituto Nacional de Estadística y Censos* (INDEC) was created in 1968, under the provisions of its founding act (the national Law No. 17622), which sought to align Argentina's statistical economic data-keeping, with international standards. From INDEC's inception, it was subordinated successively to various agencies and departments of the executive branch, preserving in all cases its independence regarding the production of public statistics. At present it is an agency of the *Secretaría de Programación Económica y Regional, Ministerio de Economía y Obras y Servicios Públicos de la Nación* (Secretariat of Economic and Regional Planning in the National Ministry of Economy and Public Works and Services). As well as drawing up the Annual Program of Statistics and Censuses, INDEC continuously develops the methods and standards that will ensure the comparability of statistical information across various sources. Through the 1990s, as Argentina progressed economically and was integrated further into global markets, there was an increased requirement for timely and reliable public statistical data to aid the decision making process and assess policy choices. Further, there was a greater need to update previous information gaps with regard to education and the impact of technological and economic changes. As a result INDEC diversified its production, accelerated its publication turnaround and ensured widespread information dissemination, however the reader must acknowledge that these changes did not take place until the very end of the century.

The Evolution of Mexican Statistical Data

In Mexico, the official sources are often readily available, however there are so few independent estimates to cross-check against, that it is difficult to assess the reliability of much of the data. As a result, it becomes necessary to evaluate the official data on its own merits and attempt to determine the quality of the data and the potential biases from the known information. In appreciation of this task, a very brief review of the actors

involved in the data collection process during the relevant period is also useful as presented above for Argentina.

One must note that statistical economic recording during the Porfiriato was relatively advanced for the period however, the Revolution abruptly ended this. Statistical data collection did not really get back on track until the late 1930s, and in 1938 the first estimate on national income appeared in the *Dirección General de Estadística.*[6] Scholars from *El Colegio de México* made attempts to fill in various gaps in this data.[7] It was not until 1939, that *Banco de México* began the arduous task of collecting real systematic data of economic indicators in Mexico. *Banco de México* made a concerted attempt in the following years to prepare more reliable benchmark estimates for national estimates. In 1950, Enrique Pérez López compiled detailed estimates of gross national product (in constant pesos) from 1895 to 1964 (excluding the revolution years).[8] These were revised further by Mario Gutierrez Requenes (as directed by Solís, Chief of Economic studies at the *Banco de México*) and extended to 1967.[9] Note that only the estimates for 1921-1939 were entirely re-estimated.[10]

The *Instituto Nacional de Estadística, Geografía e Informática* (INEGI) was formed toward the end of the 1970s, from the merger of the statistics and geography bureaus of Mexico. INEGI assumed the role as Mexico's primary provider of statistical economic estimates. The institute was (and is) integrated by a governing council, which is

[6] Secretaría de la Economía Nacional. Dirección General de Estadística, *México en Cifras* México D.F., Talleres Gráficos de la Nación (1938). For an excellent account of national statistics pre-1930, refer to México, Departamento de la Estadística Nacional, *Anuario de 1930* Tacubaya D.F., Secretaría de Agricultura y Fomento (1932). For specialised references to historical estimates of national income pre-1950, see - Vargas Torres E., 'Estimaciones del Ingreso Nacional de México' in *El Trimestre Económico* volume 27.4, México D.F., Fondo de Cultura Económica (1960) and Aubrey H. G., *The National Income of Mexico* Washington D.C., Instituto Interamericano de Estadística (1950). For a more recent study on the historical statistics of Mexico, see Peña S. and Wilkie J. W., *La Estadística Económica en México: los Orígenes* México D.F., Siglo Veintiuno Editores (1994). Although it must be noted that most of this relies on Reynolds C. W., *The Mexican Economy. Twentieth-Century Structure and Growth* New Haven, Yale University Press (1970).

[7] El Colegio de México, *Estadísticas Económicas del Porfiriato: Comercio Exterior de México, 1877-1911* México D.F., El Colegio de México (1960).

[8] Pérez López E., 'The National Product of Mexico 1895 to 1964' in Pérez López E., *Mexico's Recent Economic Growth* Austin, University of Texas Press (1967).

[9] Note that all the numbers were revised up to 1939 and the weightings were changed between 1950 and 1960. Banco de México, *Informe Sobre la Revisión Preliminar de las Estimaciones del Producto Nacional de México para los Años de 1950 a 1962* México D.F., Comercio Exterior (1963).

[10] This comment can be located in Maddison A. and Associates, *The Political Economy of Poverty, Equity and Growth. Brazil and Mexico* New York, Oxford University Press (1992).

controlled by a governing director, the President of the INEGI, a commissioner of the Secretary of Economy and three representatives from the Secretary of Tax and Public Credit (Hacienda).[11] INEGI is a public agency with technical and management autonomy, and retains its own legal entity. INEGI's tasks include the coordination and promotion of development of the National Statistical and Geographic Information System, the drawing up and completion of the national census, integration of the national accounts system as well as the national summary of Industrial and Consumer Prices. Upon creation, one of INEGI's first major contributions was the creation of the new official economic series from 1960 onwards.[12] Also, INEGI since has built a historical GDP series from 1895 to the present.[13]

Although INDEC and INEGI are standard primary sources at the country level, I used Maddison for consistency across my country sample for various variables, like GDP per capita. Maddison naturally references INDEC and INEGI in various series but also importantly draws much of his data from independent bodies like ECLA and the World Bank, which means they are free from potential bias as explained. According to the evidence to be presented, Maddison is one of the more consistent and impartial sources available.

Appendix A examines the main socio-economic variables referenced throughout the thesis and most specifically in chapter 1. Appendix A focuses on providing the relevant data that makes comparisons across Latin American economies over a range of factors possible. For this reason, consistency of periodicity and definition across the data were favoured, whereas for the purposes of a single country study, the reader may have a preference for alternative sources in some instances. Appendix A most importantly allows the reader to observe the relative performance of Argentina and Mexico within the wider socio-economic landscape. Appendix B focuses on the telegraph and telephone data in Argentina and Mexico. This data provided the basis for the analysis in

[11] Hacienda is Mexico's equivalent to an internal revenue agency.
[12] Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Sistema de Cuentas Nacionales de México: Cuentas Consolidadas de la Nación, Oferta y Utilización, Producto Interno Bruto, 1980-86* México D.F. (1987).
[13] Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Estadísticas Históricas de México* México D.F. (1994).

chapter 2 and allowed for the construction of the diffusion s-curves. Given the requirements of the data series in appendix B, sources with the fullest data sets were preferred (albeit with suitable accountability of its reliability). Appendix C shows the full data set used in the regression analysis in chapter 4 and details the sources for each series. The data sources in appendix C remain consistent with those of appendices A and B, except for GDP per capita in Argentina. The reason for this is because Maddison did not have a full data set for the earlier period that was tested for in the regression analysis, and while consistency was important in appendix A, a greater accuracy of the year on year changes in the variables was more important for the purposes of appendix C. Given the nature of the data presented in appendix C, a number of the sources relate to the official bodies, who were directly involved in the telecom sector. Appendix D (The Diffusion Curves), E (Determining the FLOG Formulae), F (Goodness of Fit Tests) and G (Transformations) provide the supplementary commentary to chapter 2 and detail various aspects of the theoretical modelling work. Lastly, appendix H lists the heads of state that served in Argentina and Mexico during the period under study, as well as the years in which they were in power.

APPENDIX A

Socio-economic Variables

As Thorp comments, at the beginning of the 1900s, Latin America was inhabited by some 70 million people, around 80% lived in the countryside, almost as many were illiterate and life expectancies were below 40 even in the richest countries. Latin America now boasts a combined population in excess of half a billion, around 70% live in cities, literacy rates are almost 90% and life expectancies have doubled in many countries. While their outright achievements seem impressive, their relative economic progress is certainly not. Average GDP per capita of Latin American economies were 14% of the U.S. in 1900, and are still around this level today.[1] Detailed analysis of why this materialised is beyond the scope of this thesis but acknowledgement is very necessary. The main socioeconomic variables referred to throughout the thesis are detailed here, namely, GDP per capita, literacy, life expectancy, export growth, railways per capita and the Historical Living Standards Index (HLSI). The source of each variable is outlined and then explained, followed by a table of the data in the relevant period.

GDP per Capita Levels

The GDP data used in the present section corresponds to the publication of the historical series collected by Maddison. Maddison uses a range of sources, with a preference for independent international bodies where possible, such as ECLA or the World Bank in order to construct the fullest data set possible, hence his value to this study. For the period of 1900-1990, Maddison's GDP per capita data sources for Argentina, Chile, Colombia, Peru and Venezuela can be found in Maddison (1995).[2] For Argentina the estimates used were provided by ECLA/CONADE for 1900-1913, IEERAL for 1913-1980 (at 1960 market prices), and estimates from *el Banco Central de la República Argentina* for 1980-1990 (at 1986 market prices).[3] For Brazil, the data from the period

[1] Thorp (1998).
[2] Maddison A., *Monitoring the World Economy 1820-1992* Paris, OECD Development Centre (1995).
[3] ECLA (1959), - Instituto de Estudios Económicos sobre la Realidad Argentina y Latinoamericana (IEERAL), Estadísticas de la Evolución Económica de la Argentina, 1913-1984 Buenos Aires, Argentina (1986). Argentina, Banco Central de la República Argentina *Estimaciones Anuales de la Oferta y Demanda Globales: Periodo 1980-1990* República Argentina (1993).

of 1900-1985 is from Maddison and Associates (1900-1950 estimates are based on sector weights for 1947; 1950-1985 are based in 1970 prices) and for 1985-1990 from the World Bank.[4] Maddison used data for Chile for 1900-1980 from Hofman and for 1980-1990 from the World Bank.[5] For 1901-1912 for Colombia, due to a lack of data, Maddison applied interpolation based on the average GDP per capita movement in Brazil and Chile. For Colombia, for 1913-1929 he used data from Zimmerman, ECLA for 1929-1950, for 1950-1980 Urdinola and Carizzosa and the World Bank for 1980-1990.[6] For Mexico, data from 1900-1980 is from Maddison and Associates (primarily sourced from INEGI and *Banco de México*) and from 1980-1990 from the World Bank.[7] In Maddison and Associates, it is commented that for 1900-1960s, *Banco de México's* official estimates are not adequately described in the official report.[8] However upon cross-referencing of other sources it is clear that for 1900-1921, the GDP movements are identical to those of Pérez López.[9] Note that these estimates assume that service output (in real terms) moved in line with commodity output and therefore there is potential that these estimates slightly overestimated growth. *Banco de México* takes this into account to some extent by presenting lower growth than Pérez López for 1921-1939, however it is unclear why they have not restated the earlier period subsequently. During 1939-1960, the data are aligned again with Pérez López, who employs more sophisticated techniques in his calculations from 1939 onwards. Despite some of the issues described, *Banco de México* remains the most detailed source of pre-1960 data and hence its use here. From 1960 onwards, Maddison and Associates use the official figures from INEGI.[10] INEGI's series is now seen as the official source for national accounts and is much wider in coverage than the earlier *Banco de México* estimates (indeed for the 1970 figure, it is

[4] Maddison and Associates (1992), p.212. The World Bank, *World Bank Tables* Washington D.C. (1993).
[5] Hofman A., 'International Estimates of Capital: A 1950-1989 Comparison of Latin America and the USA' *Research Memorandum 509* University of Groningen, Institute of Economic Research (1992). The World Bank (1993).
[6] Zimmerman L. J., Arme en rijke landen: Een Economische Analyse (Poor and Rich Countries: An Economic Analysis) The Hague, Uitgerij Albany (1964), - Comisión Económica para América Latina (CEPAL), *Series Históricas del Crecimiento de América Latina* Santiago, United Nations (1978), Urdinola, A. and Carizzosa M. *Povery, Equity and Growth in Colombia* Bogota, The World Bank (1985)., and The World Bank (1993).
[7] Maddison and Associates (1992). Maddison uses Coatsworth's GDP movements until 1910 and INEGI and Banco de México thereafter. Coatsworth J. H., 'The Decline of the Mexican Economy, 1800-1860' in Liehr R., *La Formación de las Economías Latinoamericanos en la época de Simón Bolívar* Berlin, Colloquium Verlag (1989). The World Bank (1993).
[8] Banco de México (1963).
[9] Pérez López (1967).
[10] INEGI (1987).

over 6% higher in absolute value terms). For further information on the differences between *the Banco de México* figures and those of INEGI, refer to Reyes Heroles González Garza and Sidaoui for a full reconciliation.[11] For 1901-1912 in Peru, data are sourced as per Colombia above. Maddison used data from Seminario and Beltrán for 1913-1941, ECLA for 1942-1950, Webb for 1950-1980, and the World Bank for 1980-1990.[12] For Venezuela, Maddison used Baptista for 1900-1970, and for 1970-1990 he used the World Bank.[13] For Uruguay between 1820 and 1949 Maddison used Bertola and Associates, and for 1936-1990 he used Bertola.[14]As is clear, Maddison uses ECLA and the World Bank where possible and for the period of 1990-1998 Maddison used ECLA for all the countries.[15]

In order to make easy comparisons across countries, Maddison is an excellent source since he converted GDP per capita levels from their national currencies into Geary-Khamis dollars (using PPP) and used 1990 as the benchmark year. PPP measures are available from the International Comparison Programme (ICP) of the United Nations, Eurostat and the OECD. The 1990 cross-section level estimates in Maddison are merged with the time series for real GDP growth to show GDP levels for all other years. It is pertinent to point out that a major problem with the national accounts of Latin American economies was the assessment of activity in the informal sector. Recent official revisions for Argentina have been very substantial. Instead of a GDP totalling 2,840m australes in 1980, it is now estimated closer to 3,840m (nearly 36% higher). Maddison pointed out that the Mexican national accounts carry a very large imputation for informal activity also. For instance Maddison adjusted the Mexican GDP downwards in

[11] Reyes Heroles González Garza J. and Sidaoui J. J., *Cuentas Nacionales y Análisis Macroeconómico* document 38, México D.F., Banco de México (1981).
[12] Seminario B. and Beltrán A., *Crecimiento Económico en el Perú 1896-1995* Lima, Universidad del Pacifico (1998), Comisión Económica para América Latina (CEPAL), *Cuadros del Producto Interno Bruto en Dólares de 1950* Santiago, United Nations (1962), CEPAL (1978), Webb R., *The Political Economy of Poverty, Equity and Growth in Peru 1948-85* Washington D.F., The World Bank (1988), The World Bank (1993).
[13] Baptista A., Bases Cuantitativas de la Economía Venezolana 1830-1989 Caracas, Comunicaciones Corporativas (1991), The World Bank, *World Bank Tables* Washington D.C. (1993).
[14] Bertola L., 'El PBI Uruguayo 1870-1936 y otras Estimaciones' *Documento de Trabajo no. 43* Montevideo, Universidad de la República Montevideo (1998). For 1936-1990 GDP is provided by Luis Bertola, ECLAC (1999).
[15] ECLAC (1999). ECLAC publishes estimates of annual volume changes in GDP for the current year the previous 9 years in its annual Prelimenary Overview of the Economies of Latin America and the Caribbean.

some years by almost 18% to correct for apparent exaggeration of output levels in agriculture, manufacturing and some other services.[16]

Table A.1 shows Maddison's GDP per capita levels from 1900-1997; while table A.2 shows the average yearly growth rates in these GDP per capita levels for selected periods

Table A. 1 GDP per Capita, in Levels (1900-1997)

Year	**Argentina**	Brazil	Chile	Colombia	**Mexico**	Peru	Uruguay	Venezuela	LA8
1900	**2,756**	678	2,194	973	**1,366**	686	2,219	821	1,206
1901	**2,880**	730	2,223	1,022	**1,466**	727	2,233	797	1,272
1902	**2,717**	715	2,293	1,020	**1,348**	757	2,572	856	1,237
1903	**2,992**	714	2,139	1,030	**1,483**	798	2,615	913	1,300
1904	**3,191**	713	2,287	1,039	**1,492**	815	2,640	876	1,333
1905	**3,479**	718	2,259	1,053	**1,630**	864	2,334	861	1,400
1906	**3,518**	770	2,408	1,103	**1,594**	921	2,533	799	1,434
1907	**3,459**	755	2,507	1,101	**1,669**	966	2,757	793	1,457
1908	**3,657**	734	2,743	1,096	**1,649**	972	2,973	841	1,488
1909	**3,699**	776	2,726	1,131	**1,680**	976	2,957	865	1,522
1910	**3,822**	769	3,000	1,162	**1,694**	981	3,136	886	1,562
1911	**3,746**	836	2,887	1,201	**1,707**	989	2,957	937	1,582
1912	**3,904**	809	2,968	1,236	**1,718**	1,012	3,508	962	1,617
1913	**3,797**	811	2,988	1,236	**1,732**	1,032	3,310	1,104	1,618
1914	**3,302**	780	2,497	1,163	**1,744**	1,013	2,654	956	1,498
1915	**3,244**	798	2,389	1,129	**1,757**	1,087	2,470	980	1,493
1916	**3,091**	804	2,895	1,222	**1,770**	1,185	2,508	921	1,518
1917	**2,790**	842	2,923	1,292	**1,783**	1,213	2,717	1,069	1,515
1918	**3,248**	808	2,926	1,252	**1,796**	1,205	2,828	1,057	1,558
1919	**3,307**	895	2,480	1,253	**1,810**	1,230	3,135	983	1,581
1920	**3,473**	963	2,768	1,255	**1,823**	1,226	2,674	1,173	1,644

[16] For more information see Maddison (1995), p.166.

1921	**3,471**	963	2,370	1,255	**1,836**	1,257	2,751	1,214	1,631
1922	**3,636**	1,009	2,426	1,255	**1,850**	1,345	3,078	1,241	1,692
1923	**3,898**	1,046	2,885	1,255	**1,884**	1,415	3,170	1,420	1,789
1924	**4,055**	1,024	3,062	1,255	**1,825**	1,524	3,397	1,630	1,822
1925	**3,919**	1,007	3,152	1,255	**1,908**	1,540	3,188	2,081	1,837
1926	**3,994**	1,008	2,850	1,340	**1,991**	1,670	3,398	2,487	1,887
1927	**4,156**	1,060	2,760	1,424	**1,875**	1,674	3,797	2,761	1,929
1928	**4,291**	1,158	3,332	1,490	**1,857**	1,754	3,906	3,057	2,039
1929	**4,367**	1,137	3,455	1,505	**1,757**	1,908	3,847	3,426	2,053
1930	**4,080**	1,048	2,859	1,474	**1,618**	1,663	4,301	3,444	1,913
1931	**3,712**	1,004	2,218	1,448	**1,643**	1,504	3,500	2,754	1,762
1932	**3,522**	1,018	1,844	1,511	**1,373**	1,423	3,196	2,613	1,657
1933	**3,621**	1,076	2,236	1,577	**1,501**	1,558	2,750	2,831	1,752
1934	**3,845**	1,142	2,655	1,526	**1,574**	1,740	3,221	2,995	1,866
1935	**3,950**	1,150	2,761	1,677	**1,660**	1,873	3,356	3,181	1,937
1936	**3,912**	1,235	2,847	1,744	**1,768**	1,931	3,459	3,449	2,013
1937	**4,125**	1,250	3,181	1,751	**1,796**	1,926	3,462	3,896	2,086
1938	**4,072**	1,276	3,161	1,843	**1,794**	1,925	3,676	4,144	2,108
1939	**4,148**	1,263	3,169	1,905	**1,858**	1,905	3,692	4,305	2,136
1940	**4,161**	1,250	3,236	1,895	**1,852**	1,911	3,661	4,045	2,122
1941	**4,304**	1,307	3,141	1,877	**1,949**	1,880	3,682	3,903	2,168
1942	**4,284**	1,229	3,226	1,832	**2,032**	1,807	3,338	3,347	2,116
1943	**4,182**	1,368	3,256	1,792	**2,051**	1,804	3,331	3,575	2,166
1944	**4,579**	1,386	3,256	1,863	**2,159**	1,926	3,705	4,309	2,294
1945	**4,356**	1,390	3,471	1,899	**2,134**	1,964	3,764	5,102	2,304
1946	**4,665**	1,501	3,699	2,017	**2,211**	2,005	4,083	5,948	2,465
1947	**5,089**	1,518	3,240	2,042	**2,221**	2,027	4,313	6,894	2,550
1948	**5,252**	1,596	3,712	2,050	**2,248**	2,059	4,405	7,394	2,656
1949	**5,047**	1,659	3,569	2,107	**2,304**	2,177	4,504	7,544	2,682
1950	**4,987**	1,672	3,670	2,153	**2,365**	2,308	4,659	7,462	2,696
1951	**5,073**	1,702	3,731	2,150	**2,477**	2,426	4,955	7,663	2,765
1952	**4,717**	1,752	3,893	2,214	**2,504**	2,487	4,957	7,992	2,774

1953	**4,874**	1,784	4,112	2,277	**2,439**	2,579	5,139	7,956	2,814
1954	**4,980**	1,848	3,907	2,358	**2,605**	2,583	5,391	8,417	2,909
1955	**5,237**	1,926	3,975	2,373	**2,742**	2,703	5,352	8,750	3,026
1956	**5,285**	1,896	3,957	2,391	**2,843**	2,751	5,360	9,124	3,060
1957	**5,461**	1,994	4,264	2,400	**2,965**	2,810	5,333	10,058	3,203
1958	**5,698**	2,111	4,392	2,383	**3,025**	2,743	5,402	9,816	3,283
1959	**5,241**	2,221	4,042	2,473	**3,016**	2,682	4,860	9,997	3,259
1960	**5,559**	2,335	4,270	2,497	**3,155**	2,969	4,960	9,646	3,387
1961	**5,862**	2,437	4,366	2,540	**3,172**	3,142	5,036	9,002	3,457
1962	**5,677**	2,511	4,465	2,594	**3,211**	3,281	4,858	9,058	3,489
1963	**5,455**	2,463	4,639	2,597	**3,343**	3,334	4,820	9,134	3,485
1964	**5,926**	2,472	4,638	2,675	**3,594**	3,465	4,858	9,562	3,629
1965	**6,371**	2,448	4,577	2,689	**3,702**	3,594	4,860	9,841	3,709
1966	**6,321**	2,527	4,984	2,750	**3,813**	3,788	4,974	9,677	3,785
1967	**6,399**	2,554	5,046	2,784	**3,922**	3,831	4,721	9,922	3,843
1968	**6,578**	2,704	5,128	2,874	**4,073**	3,685	4,747	10,249	3,974
1969	**7,037**	2,860	5,220	2,976	**4,185**	3,676	4,991	10,262	4,127
1970	**7,302**	3,057	5,231	3,094	**4,320**	3,854	5,184	10,672	4,309
1971	**7,530**	3,279	5,597	3,194	**4,365**	3,916	5,130	10,446	4,451
1972	**7,635**	3,539	5,429	3,355	**4,602**	3,930	4,945	10,245	4,620
1973	**7,962**	3,882	5,034	3,499	**4,853**	4,023	4,974	10,625	4,875
1974	**8,334**	4,083	4,992	3,618	**5,013**	4,119	5,123	10,507	5,044
1975	**8,122**	4,190	4,273	3,622	**5,158**	4,326	5,421	10,472	5,086
1976	**7,965**	4,472	4,347	3,716	**5,244**	4,271	5,608	10,929	5,242
1977	**8,304**	4,568	4,700	3,797	**5,293**	4,157	5,639	11,251	5,358
1978	**7,807**	4,681	5,011	4,047	**5,595**	4,049	5,903	11,164	5,455
1979	**8,227**	4,892	5,345	4,184	**5,968**	4,181	6,234	10,920	5,696
1980	**8,206**	5,198	5,680	4,265	**6,320**	4,263	6,577	10,139	5,894
1981	**7,603**	4,852	5,932	4,263	**6,717**	4,342	6,668	9,841	5,782
1982	**7,243**	4,765	5,035	4,212	**6,514**	4,258	6,000	9,356	5,589
1983	**7,383**	4,500	4,810	4,185	**6,088**	3,608	5,614	8,745	5,307
1984	**7,425**	4,646	5,011	4,239	**6,162**	3,692	5,520	8,623	5,400

1985	**6,834**	4,917	5,030	4,282	**6,194**	3,682	5,567	8,521	5,465
1986	**7,224**	5,205	5,228	4,446	**5,834**	3,963	6,023	8,725	5,592
1987	**7,299**	5,273	5,481	4,589	**5,818**	4,210	6,461	8,805	5,669
1988	**7,056**	5,158	5,781	4,682	**5,771**	3,782	6,422	9,080	5,596
1989	**6,523**	5,227	6,283	4,739	**5,899**	3,250	6,462	8,094	5,546
1990	**6,436**	4,923	6,402	4,840	**6,085**	3,021	6,474	8,313	5,465
1991	**6,980**	4,893	6,795	4,821	**6,226**	3,032	6,614	8,965	5,587
1992	**7,497**	4,802	7,506	4,909	**6,333**	2,943	7,055	9,373	5,676
1993	**7,827**	4,939	7,906	5,028	**6,339**	3,047	7,224	9,137	5,785
1994	**8,367**	5,163	8,400	5,240	**6,504**	3,391	7,567	8,620	5,999
1995	**8,005**	5,296	8,974	5,418	**6,001**	3,609	7,365	8,950	5,969
1996	**8,253**	5,366	9,505	5,428	**6,209**	3,623	7,679	8,747	6,082
1997	**8,803**	5,488	9,997	5,409	**6,525**	3,864	8,003	9,155	6,313

Sources: described above.

Table A. 2 GDP per Capita, Average Growth Rates (%), Selected Periods

Year	**Argentina**	Brazil	Chile	Colombia	**Mexico**	Peru	Uruguay	Venezuela	LA8
1901-13	**2.6%**	1.5%	2.5%	1.9%	**2.0%**	3.2%	3.5%	2.5%	2.3%
1914-29	**1.1%**	2.2%	1.6%	1.3%	**0.1%**	4.0%	1.4%	7.9%	1.5%
1930-45	**0.1%**	1.4%	0.7%	1.5%	**1.4%**	0.4%	0.3%	3.1%	0.8%
1946-64	**1.8%**	3.1%	1.7%	1.8%	**2.8%**	3.1%	1.4%	3.5%	2.4%
1965-79	**2.3%**	4.7%	1.1%	3.0%	**3.5%**	1.3%	1.7%	0.9%	3.1%
1980-89	**-2.2%**	0.8%	1.9%	1.3%	**0.0%**	-2.2%	0.5%	-2.9%	-0.2%
1990-97	**3.9%**	0.7%	6.0%	1.7%	**1.3%**	2.3%	2.7%	1.6%	1.6%
1901-45	**1.2%**	1.7%	1.5%	1.5%	**1.1%**	2.5%	1.6%	4.6%	1.5%
1946-97	**1.5%**	2.7%	2.2%	2.0%	**2.2%**	1.4%	1.5%	1.3%	2.0%

Sources: described above.

Literacy Rates

The data for literacy rates are from Hunt, and he sourced these from the national censuses (see Hunt for a detailed methodology).[17] Hunt used interpolations between

[17] Hunt S., *The Human Condition in Latin America, 1900 - 1995* Consultancy paper done in 1997 for R. Thorp (1998).

censuses, and all the 1995 figures were taken from UNESCO.[18] The data in table A.3 represents illiteracy rates and refers to the population aged 15 and over who were unable to read and write.[19] For Chile (in 1895, 1885 and 1875), Colombia (in 1928 and 1918), Mexico (in 1921, 1910 and 1900), Peru (in 1876), and Venezuela (in 1926), literacy data in these censuses was reported with a different minimum age and therefore they were standardised to 15 and over, by applying ratios found in other censuses demonstrating similar demographic and educational characteristics (see Thorp for a detailed methodology).[20] Also of particular note is that for Peru and Uruguay there were large gaps in between censuses.[21] As a result, estimates were derived by tracking the approximate size of specific groups that had known literacy rates, as per Thorp.[22]

Table A. 3 Illiteracy Rates (% of Population age 15 and over, 1900-1995)

Year	**Argentina**	Brazil	Chile	Colombia	**Mexico**	Peru	Uruguay	Venezuela	LA 6	U.S.
1900	**48.7**	65.3	56.5	66.0	**75.6**	75.7	-	-	29.0	11.2
1910	**39.6**	65.1	46.8	60.7	**70.2**	71.2	-	-	31.0	8.2
1920	**31.8**	64.9	36.6	56.2	**64.7**	66.8	-	31.0	35.0	6.5
1930	**25.1**	60.5	25.3	48.1	**63.6**	62.6	-	32.0	37.0	4.8
1940	**18.3**	56.1	27.1	43.1	**53.9**	57.6	-	38.0	40.0	4.2
1950	**12.4**	50.6	21.0	38.2	**39.5**	48.7	-	51.0	48.0	2.6
1960	**8.6**	39.7	16.4	30.4	**34.6**	39.8	68.0	60.0	57.0	2.1
1970	**7.4**	33.8	11.0	21.8	**25.8**	29.6	69.0	65.0	61.0	1.0
1980	**6.1**	25.5	9.3	14.9	**17.0**	19.1	70.0	68.0	65.0	0.5
1990	**4.2**	20.6	6.3	10.3	**12.4**	14.1	72.0	71.0	68.0	-
1995	**3.8**	16.7	4.8	8.7	**10.4**	11.3	73.0	72.0	70.0	1.0

Sources: described above.

[18] United Nations *World Economic Trends* New York, United Nations (1995).
[19] For Argentina's pre-1940, and for the U.S. post-1930 figures are taken as percentage of the population aged 14 and over.
[20] Thorp (1998).
[21] For Peru, between 1876 and 1940, and for Uruguay between 1908 and 1963.
[22] Thorp (1998).

Life Expectancy

Sources for the data on life expectancy rates (table A.4) can be found in Hunt (1997).[23] The only exceptions are data for Cuba and Uruguay pre-1950, which were taken from Pérez Brignoli, while data for 1995 was taken from UNDP.[24] Hunt primarily sources from CELADE, the United Nations Demographic Year books and Arriaga.[25] However for the U.S. he uses the U.S. Bureau of the Census for all years.[26]

Table A. 4 Life Expectancy (1900-1995)

Year	**Argentina**	Brazil	Chile	Colombia	**Mexico**	Peru	Uruguay	Venezuela	LA 6	U.S.
1900	**39**	29	29	-	**25**	-	-	-	29	48
1910	**44**	31	30	31	**28**	-	-	-	31	52
1920	**49**	32	31	32	**34**	-	-	31	35	57
1930	**53**	34	35	34	**34**	-	-	32	37	59
1940	**56**	37	38	38	**39**	37	-	38	40	64
1950	**61**	43	49	49	**48**	40	-	51	48	68
1960	**65**	55	57	57	**57**	48	68	60	57	70
1970	**67**	59	62	61	**61**	54	69	65	61	71
1980	**70**	63	69	66	**67**	60	70	68	65	74
1990	**72**	66	74	69	**71**	66	72	71	68	75
1995	**72**	66	75	70	**72**	67	73	72	70	76

Sources: described above.

Export Growth

Data on export growth is from Thorp.[27] Thorp used export data for Argentina and Brazil from Hofman for 1900-1915 and from Wilkie for the period hence.[28] For Chile, figures

[23] Hunt (1997) consultancy paper for Thorp (1998).
[24] Pérez Brignoli H., 'América Latina en la Transición Demográfica 1800-1980' La Transición Demográfica en América Latina y el Caribe volume 1, México D.F., INEGI (1993). Note that all Pérez Brignoli's data are based on the inverse projection method. United Nations Development Programme (UNDP), *Human Development Report* New York, Oxford University Press (1997).
[25] Centro Latinoamericano y Caribeño de Demografía (CELADE), *Boletín Demográfico* 29.58 (1996): 55. United Nations *Statistical Yearbook* New York, United Nations (1951). Arriaga E., *New Life Tables for Latin American Populations in the Nineteenth and Twentieth Centuries* Berkeley, Institute of International Studies, University of California (1968).
[26] For U.S. Bureau of Census see: (http://www.census.gov./ipc).
[27] Thorp (1998).

are from Palma for 1900-1906, Hofman for 1907-1915, and Wilkie for the period thereafter.[29] For Colombia, data are from Hofman for 1900-1915, Wilkie for 1916-1922 and from *Banco de la República* for the subsequent period.[30] Mexico's data are from INEGI.[31] For Peru, for 1900-1912 and 1914-1915, data are based on rate of growth of figures in gold *soles* (from Thorp and Bertram), PAU for 1913, and Wilkie for 1916-1929.[32] For Uruguay, data are from PAU, and for Venezuela data are from Baptista for 1900-1915, and Wilkie for thereafter.[33] Wilkie is an excellent impartial source for this data, using a relatively consistent series constructed by the IMF pre-1937 and from several other primary sources for the period onwards.

Table A. 5 Export Value Growth (% Annual Rate), Selected Periods

Year	**Argentina**	Brazil	Chile	Colombia	**Mexico**	Peru	Uruguay	Venezuela	LA 6
1900-13	**9.0**	5.9	6.5	8.6	**5.9**	7.1	-	5.6	7.0
1913-29	**3.3**	4.0	-0.4	9.8	**3.0**	5.2	-0.4	11.4	3.7
1900-29	**6.4**	3.2	0.9	9.6	**6.6**	8.2	-	7.2	4.7

Sources: described above. Note: data for Mexico exclude the period of 1913-19. For Uruguay, data starts in 1916.

Railways per Capita

In order to construct the data for railways per capita, two sets of data were used: railroad length and population, with the former divided by the latter to complete the series. The railroad length data were taken from Thorp.[34] It is based on Mitchell until 1988 and from ECLAC from 1989 onwards.[35] Meanwhile, the population data for all the countries are

[28] Hofman A., Economic Performance in Latin America - A Comparative Quantitative Perspective Consultancy paper done in 1997 for R. Thorp (1998). Wilkie J. W. and Ruddle K., *Quantitative Latin American Studies: Methods and Findings* SALA Supplement Series 6, Los Angeles, UCLA (1977).

[29] Palma J. G., *Growth and Structure of the Chilean Manufacturing Industry from 1830 to 1935* Doctoral thesis, Oxford University (1979). Hofman (1997), Wilkie J. W., *Statistics and National Policy (supplement 3)* Los Angeles, University of California (1974).

[30] Hofman (1997), Wilkie (1974), Banco de la República, *Principales Indicadores Económicos: 1923-1992* Bogota, Banco de la República (1993).

[31] Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Estadísticas Históricas de México* México D.F. (1990).

[32] Thorp R. and Bertram I. G. *Peru 1890-1977: Growth and Policy in an Open Economy* London, Macmillan (1978). Pan-American Union (PAU), *The Foreign Trade of Latin America since 1913* Washington D.C., Pan American Union (1952), Wilkie (1974).

[33] PAU (1952), Baptista A., *Bases Cuantitativas de la Economía Venezolana, 1830-1995* Caracas, Ediciones Fundación Polar (1997). Wilkie (1974).

[34] Thorp (1998).

[35] Mitchell B. R., *International Historical Statistics: The Americas, 1750-1988* Basingstoke, Palgrave Macmillan (1993). Economic Commission for Latin America and the Caribbean (ECLAC), *Statistical Yearbook for Latin America and the Caribbean* Santiago, United Nations (1996).

from Maddison. The population data from 1900-1949 are from Maddison (1995), while the data after 1950 for all countries are based on official sources from the U.S. Bureau of Census, which provides annual estimates from then onwards.[36] For the first half of the century, Argentinian, Chilean and Columbian population data are sourced from Hofman, Brazilian from IBGE, Mexican from INEGI (supplemented by Greer), Peruvian from the U.N., Uruguayan from Bertola and Venezuelan from Baptista.[37] Maddison's population data from 1950 onwards does not pose some of the problems that arise with other variables such as GDP, since population data does not require aggregation and therefore there are typically fewer gaps in the data set.

In light of the key role that demographic development plays in any country's history, population data must be investigated with regard to the given conditions of national political socio-economic conditions of the period. At the start of the nineteenth century, there was a propensity for governments to overstate their country's true levels and indeed the reverse happened by the 1960s, as populations were understated. Moreover population censuses were compiled on a count basis, and therefore often excluded adjustments for omissions and isolated Indian populations.[38] As a result of the inflated estimates by governments in the early years, population change calculations are problematic since previously existing persons for instance are suddenly found, thereby distorting the real growth rate. Nevertheless, with due acceptance of these facts and suitable cross-reference of sources, the various sources give a solid approximation of estimated populations across different periods.

[36] Maddison (1995), p.99. For U.S. Bureau of Census see: (http://www.census.gov./ipc).

[37] Hofman (1992). Instituto Brasilero de Geografía y Estadística (IBGE), O Brasil em Numeros Rio de Janeiro (1960), p.5. Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Estadísticas Históricas de México* volume I, México D. F (1985), p.311. Greer R. G., *The Demographic Impact of the Mexican Revolution 1910-21* Master's thesis, University of Texas (1966). United Nations, *Demographic Yearbook* New York, United Nations (1960). Bertola L, 'El PBI Uruguayo 1870-1936 y otras Estimaciones' *documento de trabajo no. 43* Montevideo, Universidad de la República Montevideo (1998). Baptista (1991).

[38] Indeed with every updated population estimate (especially since 1920), there was seemingly a new revision to account for the omission of jungle Indians.

Table A. 6 Length of Railroads (metres) per Capita (1900-1995)

Year	**Argentina**	Brazil	Chile	Colombia	**Mexico**	Peru	Uruguay	Venezuela	LA total
1900	**358.0**	85.1	148.7	15.0	**99.9**	49.3	185.8	35.4	92.9
1913	**437.7**	61.7	236.1	21.2	**136.9**	76.8	220.9	31.3	128.0
1929	**323.5**	97.3	202.3	33.2	**137.5**	53.7	160.2	30.7	116.0
1940	**291.5**	83.4	170.1	36.0	**112.8**	45.0	152.7	26.4	100.7
1950	**250.1**	68.7	139.6	30.2	**81.8**	40.6	136.7	20.0	81.8
1970	**166.5**	33.2	88.6	15.9	**46.4**	16.7	106.2	1.9	44.7
1995	**101.4**	18.6	45.1	5.8	**28.6**	8.8	93.3	2.8	25.1

Sources: described above.

Historical Living Standard Index (HLSI)

The HLSI is a commonly used indicator for living standards, and data for this variable was taken from Thorp.[39] The presentation of the HLSI data monitors any changes in the standard of living of a given country with respect to its own median value, making it similar to the U.N.'s Human Development Indicator. The index is based on giving appropriate weights to GDP per capita, life expectancy and rate of adult literacy, hence providing an estimate to a country's standard of living. Thorp constructed the index with her own collected data using the methodology for the construction of the index set out in Astorga and Fitzgerald.[40]

[39] Thorp (1998).
[40] Astorga et al. (2004).

Table A. 7 HLSI (3 Year Average Values, 1950 based), 1900-90

Year	**Argentina**	Brazil	Chile	Colombia	**Mexico**	Peru	Uruguay	Venezuela	LA 6	U.S.
1900	**55**	48	45	40	**39**	-	-	31	45	65
1910	**67**	51	54	47	**48**	-	-	33	53	71
1920	**72**	56	57	54	**62**	-	-	38	60	76
1930	**79**	66	78	66	**60**	-	-	51	69	82
1940	**89**	78	80	79	**74**	83	85	64	80	88
1950	**100**	100	100	100	**100**	100	100	100	100	100
1960	**108**	140	118	119	**125**	129	105	122	124	107
1970	**125**	170	136	140	**155**	157	109	143	147	121
1980	**136**	231	151	162	**187**	182	118	159	177	135
1990	**128**	241	166	175	**190**	176	120	157	181	147

Sources: described above. Note: Mexico's 1920 figure corresponds to the average of 1921-1922.

APPENDIX B

Telegraph & Telephone Data

Given the large range of years under study in this thesis, the availability and quality of statistical economic data varied significantly over time. In the latter part of the nineteenth century and in reality until the 1960s, there were only three sources of official government primary data for Argentina and two for Mexico. In Argentina these are the population censuses of 1869, 1895, 1914, 1947 and 1960, the *Anuario de la Dirección General de Estadística* between 1892 and 1914 and the *Anuario Estadístico de la República Argentina* from 1946 onwards. For Mexico the equivalent sources are the censuses of 1895, 1900, 1910, 1921, 1930, 1940, 1950, 1960 and the *Anuario Estadísticos* from 1893 onwards. As indicated economic data collection after the 1960s was initiated from various regional and international independent bodies in order to augment (and verify) the individual country collection.

One must note that there are various data sets that monitor ICT trends in Argentina and Mexico over (at least) parts of the period under study, although these are typically dedicated to the second half of the twentieth century. The specific information required for this thesis are public domestic electric telegrams sent and the number of fixed line telephone handsets, information which many publications do not always present directly, preferring instead to concentrate on infrastructural data. Further some will present telegrams sent with no breakdown between public and official ones, or frequently just the length of the telegraph network, while others will present the number of telephone lines or the length of lines as opposed to the total number of handsets. It is important to appreciate that many additional sources were examined, but not necessarily mentioned below, as they were discarded even before one began to assess their reliability. Overall, preference was given to the sources with the greatest consistency and scope, given the demands of the thesis, and where possible primary sources were used or continually cross-checked against.

This section lists the sources used for the construction of the telegraph and telephone diffusion data sets. Like appendix A, the sources used are explored first, with a brief overview of the rationale, an assessment of the quality of such data and then the presentation of the data in table form. A priori, it should be easier to gather data for the telephone than for the telegraph given the greater difficulties faced in collecting data during the nineteenth century.

Telegrams Sent per Capita

The data for the total number of telegrams sent for Argentina are from ICPSR for the years of 1877-1910 and for 1911-1930 the data are from Castro Esteves R., *Historia de Correos y Telégrafos de la República Argentina*, Ediciones de la Dirección General de Correos y Telégrafos, which uses the official data from the *Revista de Correos y Telégrafos*.[1] ICPSR data are based on the data collected from the *Statesman's Yearbook* for each individual year.[2] The ICPSR studies used in this thesis were conducted by Banks and his staff at the Centre for Comparative Political Research in the State University of New York, Binghamton. Their ambitious work serves as a basic reference volume for a huge range of interests in the study of politicosocial economy and has been used by various notable academics. Indeed as Wilkie comments 'although a number of political scientists have prepared handbooks of political indicators with times series data, the most important work has been undertaken by Arthur S. Banks'.[3] In covering so much information, some problems arise, namely, specific sources are not always available to fill in war time gaps. This, however, is not a problem here since I only used ICPSR data until 1910. Further, Banks at times overly relies on interpolation to complete data sets

[1] Banks A. S., 'Cross National Time Series, 1815-1973' ICPSR Ann Arbor, University of Michigan, Inter-University Consortium for Political and Social Research: Producer and Distributor (1976), Castro Esteves (1952), pp.204-205. Bose, Walter B. L., 'Los Orígenes del Telégrafo en la Argentina' Revista de Correos y Telégrafos no.81 Buenos Aires, Dirección General de Correos y Telégrafos (15 Mayo 1944).

[2] Scott Keltie J., *The Statesman's Yearbook* Fourteenth annual publication, London, Macmillan and Co. (1900), various publications from 1900 onwards. The Statesman's yearbooks draws the data from annual official sources; Memorias del Ministerio del Interior de la Republica Argentina presentada al Congreso Nacional, Memoria presentada por el Ministro de Estado en el departamento de Hacienda al Congreso nacional, Handbook of the Argentine Republic, Anuarios de la Dirección General de Estadística, and Boletín del Instituto Geográfico Argentino. Also note that in observation of the saturation level of telegrams, it was clear that ICPSR was twice as large as other points of reference such as Castro Esteves (1952) or Mitchell (1993). This seems to indicate that ICPSR was accounting for total telegrams (sent and received) rather than just telegrams sent and although not perfect, it was decided to divide this total by two. Moreover given the smoothness of the data alignment with Castro Esteves this was seemingly a sensible course of action.

[3] Wilkie (1974), p.18.

and while this is acceptable for population or ICT growth at least in the earliest stages (since they are typically on an upward trend), it is less relevant to literacy rates for example because educational development did not always grow. For these reasons, ICPSR data use has been restricted to only the early portions of the time series and only in regard to variables like ICT growth, in order to fill gaps that could not otherwise be suitably filled. Indeed, although Castro Esteves was the preferred source, since his *Historia de Correos y Telégrafos de la República Argentina (Dirección General de Correos y Telecomunicaciones)* data are directly sourced from the *Revista de Correos y Telégrafos*, there are insufficient and unsatisfactory data in the early years. For instance there was only sporadic and inconsistent sent and received figures in the years 1887 and 1888 and between 1889-1898 (and 1900-1902) there is no data available whatsoever. It is only after 1910 that the data remains consistent, which is indicative of the level of accounting quality starting to improve and it is from this point onwards that I use this data. Arguably the third national census of 1914 should be the most useful source, but the problem with this is that it does not have any data until 1895.[4] As for the period after that, the reason why I did not use this source is because it only displays the aggregated total number of telegrams sent, with no differentiation between public and official telegrams sent. Mitchell is also a useful source of information but it was not used in this instance primarily for a lack of a full data set.[5] For example Mitchell is missing data from 1916-1923, and does not have any data at all before 1895 for Argentina. Although Mitchell directly presents INDEC's official numbers, which is important, it is not clear what the breakdown of the telegram totals are. INDEC appears to account for government telegrams sent as well as public ones, as the series is consistently higher than ICPSR and Castro Esteves. Moreover, Mitchell rounds the data to the nearest one tenth of a million and so they are much less accurate, especially in the earlier period when the numbers are naturally much lower.

[4] República Argentina, Comisión Nacional del Censo, *Tercer Censo Nacional, 1914* Buenos Aires, Talleres Gráficos de L. J. Rosso y Cía. (1916-1917).
[5] Mitchell B. R., *International Historical Statistics: The Americas 1750-2000* 5th ed., New York, Palgrave Macmillan (2003b).

It is important to accept that there are variations (even if small) across almost all of the main data sets that exist for this particular information in the two countries. The differences in size can sometimes be explained by the capture of domestic versus international totals or the slightly varied aggregation methods, but often the subtleties are not fully disclosed and cross-referencing data sets is therefore critical. For instance, ICPSR explicitly states that its totals are domestic telegrams, while in Castro Esteves it is not so obvious. Although not disclosed, it makes sense that an industry account of the telegrams would not include government ones since these were often not paid for and hence they may simply have been disregarded in the internal accounts. Further, Castro Esteves' totals are in line with ICPSR and are typically slightly lower than other sources, it would therefore seem plausible that Castro Esteves totals also accounted for domestic telegrams only. In light of the evidence, this would indicate that Castro Esteves was the most appropriate source to use. The data were directly sourced from the official *Revista de Correos y Telégrafos*, and this was a suitable authority on the telegraph sector, hence its adoption over other sources, for the part of the telegraph series in the latter period, where a greater range of sources were available to choose from.

The collection of data regarding total telegrams sent in Mexico was somewhat easier than in Argentina, since the whole period of 1877-1925 was available and collected directly from one official source, the 1940 *Anuario Estadístico* of INEGI.[6] This is the most useful source because it provides data for every year, and it explicitly separates the number of telegrams sent by the public and those sent by the government, unlike any of the other available sources. Again, Mitchell is a reliable source for the telegram data as he only uses primary data, which is strongly preferred. However, as in the case for Argentina above, although a full data set is available, there is again no differentiation between telegraphs sent by the public, the state or from internal servicing. Mitchell only presents an aggregated total and there are some minor discrepancies due to rounding (to the nearest one tenth of a million).

[6] Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1940* capítulo XI 'Comunicaciones y Transportes', cuadro 386, Mensajes y Palabras Transmitidas por la red Telegráfica Federal, México D.F. (1942), pp.588-589.

Once the total numbers of telegrams sent were collected, these were divided by the country's population to obtain telegrams sent per capita. The population data for Argentina was collected from Ferreres' *Dos Siglos de Economía Argentina* for the years of 1877-1889, who sourced the earliest period of the data from the Argentinian population census data published in INDEC.[7] For 1890 and 1900-1930 I used Maddison for Argentina's population. Maddison sourced his data from Bethell's *Cambridge History of Latin America* for up to 1890 and Hofman for the other years as described above.[8] For 1896-1899 I used Vázquez Presedo's *Estadísticas Históricas Argentinas.*[9] To complete the data set it was necessary to apply geometric interpolation for 1891-1895 based on the 1890 and 1896 numbers. For Mexico's population data it was possible to use Maddison for the whole period.[10] Maddison used Rosenblat and Rosenzweig for the years 1877-1890, INEGI for 1895-1909 and 1921-1949, and Greer for 1910-1921, again as described earlier.[11] The reason for using different sources in the case of Argentina unlike in the case of Mexico was because Maddison unfortunately did not have a complete data set for the years in which I needed to use Ferreres and Vázquez Presedo. Mitchell again is another valuable source for this information, however he only presents the official numbers cited in the censuses and does not present any of his own interpolations or accepted calculations of economists to fill the gaps in between censuses. As a result, Maddison was preferred in his presentation of a fuller yearly data set. It is pertinent to bring the reader's attention to a point raised by Vázquez Presedo; who demonstrated that almost every new construction of a data time series for population causes estimates to be revised. Banco Central de la República Argentina's figures for instance are different, for the very same year, in their 1964, 1966, 1971 and 1975 estimates.[12]

---

[7] Ferreres O. J., *Dos Siglos de Economía Argentina 1810-2004* cuadro 2.1 'Población Total, Urbana y Rural' Buenos Aires, Fundación Norte y Sur (2005), p.128. Instituto Nacional de Estadística y Censos (INDEC), *La Población de Argentina* Buenos Aires (1975).

[8] Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003). Bethell (1986a), Hofman (1992).

[9] Vázquez Presedo V., *Estadísticas Históricas Argentinas (Comparadas), Primera Parte, 1875-1914* Buenos Aires, Ediciones Macchi (1971), p.16.

[10] Maddison (2003).

[11] Rosenblat A., *La Población Indígena de la América desde 1492 hasta la Actualidad* Buenos Aires, Institución Cultural Española (1945), Rosenzweig F., *Fuerza de Trabajo y Actividad Económica por Sectores, Estadísticas Económicas del Porfiriato* México D.F., Colegio de México (1960), INEGI (1985), p.311, Greer (1966).

[12] Vázquez Presedo V., *Estadísticas Históricas Argentinas (Compendio 1873-1973)* Buenos Aires, Instituto de Economía Aplicada (1988), p.17.

As described, since there are various data sets available for almost every economic indicator, there is no guarantee that the ones ultimately chosen will be the most accurate to one telegram sent or the best population estimate to the nearest one person. However, what I have attempted to do is to balance the requirements of the thesis with the perceived reliability and consistency of the available information in order to construct data sets that are clear and usable. The table below presents the final series of telegrams sent per 100 people.

Table B. 1 Telegrams Sent per 100 People: Argentina and Mexico (1877-1925)

Year	Argentina	Mexico	Year	Argentina	Mexico
1877	5.4	1.0	**1901**	17.8	17.7
1878	6.0	1.0	**1902**	17.8	19.9
1879	6.6	1.1	**1903**	17.8	21.5
1880	7.1	0.9	**1904**	17.9	22.2
1881	7.6	1.1	**1905**	18.0	23.8
1882	8.0	0.7	**1906**	18.0	25.7
1883	9.0	1.2	**1907**	33.7	26.1
1884	9.9	0.6	**1908**	48.1	25.4
1885	10.8	0.4	**1909**	61.5	26.6
1886	11.6	1.0	**1910**	73.8	27.4
1887	12.3	2.3	**1911**	62.0	29.9
1888	13.0	3.1	**1912**	68.0	30.8
1889	13.6	3.7	**1913**	79.3	24.6
1890	14.6	4.7	**1914**	64.3	14.2
1891	15.1	4.5	**1915**	65.3	19.1
1892	15.6	5.6	**1916**	68.8	15.1
1893	16.0	5.2	**1917**	74.1	11.6
1894	16.4	6.5	**1918**	75.5	24.5
1895	16.8	7.5	**1919**	80.1	24.3
1896	17.1	9.1	**1920**	83.5	26.3
1897	17.3	10.1	**1921**	76.2	29.0
1898	17.6	10.2	**1922**	75.8	26.0
1899	17.8	18.6	**1923**	76.3	26.2
1900	17.8	16.7	**1924**	78.5	26.0
			1925	78.2	27.4

Sources: described above.

Telephones per Households

It is important to appreciate that a number of international bodies now look at telephone data in some detail given its standing in economics. However most of these studies did not begin until the second half of the century and hence the data does not go back far

enough for the purposes of this thesis. This means that the following construction of telephones per households is reliant upon less rigorous sources for the earliest period under consideration. This should not really pose much of a problem however, since this period relates to the flattish part of the s-curve and these data points are relatively less critical (since they do not contribute to the regression analysis, i.e. they do not correspond to the 10-90% period of diffusion). The quality of these statistics is naturally dependent upon a certain degree of culture, the civic spirit of the administrative directors who carried out the data collection and generically the leaders of the companies, who were forced to provide these numbers in an efficient, true and fair fashion (to a certain extent this holds for the telegraph too).

The data for the total number of telephone handsets in Argentina is from ICPSR for the years of 1897-1913 and from Ferreres for 1918-2000.[13] ICRSR's data are based on the Statesman's Yearbook and the World's Telephones by AT&T.[14] Ferreres' data for the years of 1918-1959 are estimated on the basis of the growth data regarding the number of telephones presented in ENTel's *Anuario Estadístico 1974*.[15] For 1960-1970 Ferreres used telephone statistics presented in INDEC's *Estadísticas Telefónicas*, and for 1993-2000 those from INDEC's *Estadísticas de Servicios Públicos* (various years).[16] For the years of 1971-1990 he used Vázquez Presedo.[17] Mitchell is also a very strong alternative source, as he only presents the official data from INDEC but after long consideration, I decided against it, again in preference for a fuller data set. For Argentina, Mitchell only has one reading before 1919, which came in 1913 and pleasingly this is exactly in line with the figure presented below (with respect to Mitchell's rounding to the nearest thousand telephone handsets). As with much of the data collection of this ilk, full methodology disclosure and consistency of reporting is not always forthcoming. Even among official statistical publications, there are sometimes discrepancies from the same

[13] Banks (1976), Ferreres (2005), pp.393-394, cuadro 4.8.2 'Telecomunicaciones'.
[14] Scott Keltie (1900), various publications from 1900 onwards. American Telephone and Telegraph Company, *The World's Telephones* New York, AT&T (1957), various years between 1957 to 1992.
[15] Empresa Nacional de Telecomunicaciones (ENTel), *Anuario Estadístico 1974* Buenos Aires (1974).
[16] Instituto Nacional de Estadística y Censos (INDEC), *Estadísticas Telefónicas 1970* Buenos Aires (1970). Instituto Nacional de Estadística y Censos (INDEC), *Estadísticas de Servicios Públicos* Buenos Aires (various years between 1995-2004).
[17] Vázquez Presedo V., *Estadísticas Históricas Argentinas (Suplemento 1970-1990)* Buenos Aires, Ediciones Macchi (1994).

body across their own publications in different years, see for example the census data differences between 1980 compared to 1973, or Mitchell's versus INDEC's immediately after the Second World War. Although often citing the same primary sources, the rationale for revisions/updates are often not disclosed. A potential explanation for some of the variations may be the use of telephones handsets in service rather than telephone handsets effectively sold. To mitigate this issue I primarily used the most recently updated source.

Indeed, this specific data series is one that particularly highlights the difficulties in assessing the reliability of a given data set in countries like Argentina and Mexico, with discrepancies arising between sources that are theoretically referencing each other. For instance the data for the total fixed line telephone handsets in Argentina in the period between 1965 and 1973 (from various sources) is presented in table B.2.

Table B. 2 Telephone Handsets in Argentina (1965-1973)

Source	1965	1966	1967	1968	1969	1970	1971	1972	1973
Vázquez Presedo (1873-1973)[18]	1,498,000	1,527,000	1,553,000	1,600,000	1,668,000	1,746,000	1,826,000	1,952,000	2,065,000
INDEC (1973)[19]	1,498,000	1,527,000	1,553,000	1,600,000	1,668,000	1,746,000	-	-	-
Mitchell (1998)[20]	1,498,000	1,527,000	1,554,000	1,600,000	1,668,000	1,748,000	1,828,000	1,952,000	2,065,000
INDEC, *Anuario Estadístico* (1979-80)	1,383,591	-	-	-	-	1,591,312	1,661,431	1,776,750	1,877,061
Ferreres[21]	1,497,841	1,526,766	1,553,281	1,599,861	1,668,426	1,746,015	1,661,400	1,776,800	1,877,100
Average	1,475,086	1,526,942	1,553,320	1,599,965	1,668,107	1,715,465	1,744,208	1,864,388	1,971,040

Table B.2 shows some of the differences in telephone handset data across some of the main sources. Aside from a couple of readings, the discrepancies between the readings

[18] Vázquez Presedo (1988).
[19] INDEC, *Anuario Estadístico de la República Argentina 1973* Buenos Aires (1974), using the primary source of ENTel and the private providers.
[20] Mitchell, B. R., *International Historical Statistics: The Americas, 1750-1993* New York, Palgrave Macmillan (1998).
[21] Ferreres (2005).

are typically no greater than 2% from the average. However it is interesting to note that to the nearest thousand, the data between 1966 and 1969 is identical, yet in 1970 four out of the five readings are different. In reality the discrepancies are quite small but table B.2 neatly highlights the fact that assessing reliability and (or) methodology discrepancies can be an arduous and imperfect task.

For Mexico, the total number of telephone handsets also was compiled from ICPSR during the early period (1898-1934) and from INEGI's *Anuario Estadísticos* for the majority of the period thereafter. The reason why I was unable to use INEGI for the whole period was again due to a lack of data availability. ICRSR's data are based on the *Statesman's Yearbook.*[22] The data for 1935-1940 are from INEGI's *Anuario Estadístico de los Estados Unidos Mexicanos, 1940*, for 1941-1952 I used INEGI's *Anuario Estadístico de los Estados Unidos Mexicanos, 1951-1952*, for 1953-1961 I used INEGI's *Anuario Estadístico de los Estados Unidos Mexicanos, 1960-1961*, and for 1962-1971 I used INEGI's *Anuario Estadístico de los Estados Unidos Mexicanos, 1970-1971.*[23] For 1972-1974 I applied geometric interpolation from the data points in 1971 and 1975 (due to lack of available data). For 1975-1980 I used INEGI's *Anuario Estadístico de los Estados Unidos Mexicanos, 1980*, for 1981-1989 I used INEGI's *Anuario Estadístico de los Estados Unidos Mexicanos, 1990*, and for 1992-1994 I used INEGI's *Anuario Estadístico de los Estados Unidos Mexicanos, 1995.*[24] For the years between 1995-2000

[22] Scott Keltie (1900), various publications from 1900 onwards.

[23] Instituto Nacional de Estadística Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1940* capítulo XI. Comunicaciones y Transportes, cuadro 391. 'Empresas telefónicas, aparatos y subscriptores, por entidades federativas' México D.F. (1942), p.592. Instituto Nacional de Estadística Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1951-52* capítulo X. Comunicaciones y Transportes, cuadro 262. 'Empresas telefónicas, aparatos y subscriptores' México D.F. (1954), p.715. Instituto Nacional de Estadística Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1960-61* capítulo XII. Comunicaciones, cuadro 12.10. 'Empresas telefónicas, aparatos y subscriptores' México D.F. (1963), p.465. Instituto Nacional de Estadística Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1970-1971* capítulo XII. Comunicaciones y Transportes, cuadro 12.12. 'Empresas telefónicas, aparatos y subscriptores' México D.F. (1973), p.570.

[24] Instituto Nacional de Estadística Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1980* capítulo II. Infraestructura y servicios básicos, cuadro 2.1.11. 'Empresas telefónicas, aparatos y subscriptores' México D.F. (1982), p.35. Instituto Nacional de Estadística Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1990* capítulo II.I Comunicaciones, cuadro 2.1.9. 'Localidades con Servicio Telefónico, Aparatos, subscriptores y demanda de servicio' México D.F. (1992), p.35. Instituto Nacional de Estadística Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1995* capítulo 13 Comunicaciones, cuadro 13.11. 'Aparatos telefónicos en servicio por tipo de subscriptores 1980-1994' México D.F. (1996), p.334.

I used geometric interpolation based on the data of 1994 and 2005 supplied by ITU.[25] The interpolation during these years was necessary because the measurement of telephone growth changed, as telephone lines, rather than handsets, became the new main measure. Mitchell yet again is an excellent source for this type of data but as per INEGI, there is limited data in the earlier period. Indeed, there is only one reading before 1927, which was 1913 and this was again consistent with the data used in ICPSR (with respect to Mitchell's rounding). Of further note, one must point out that the telephone data collected in Mexico by INEGI was collected from the *Oficina de Reglamentación y Estadística de la Dirección General de Correos y Telégrafos.* Meanwhile from 1935 onwards, data from the different small private telephone providers was provided directly by the companies in their reports to *Dirección General de Estadística.*

To obtain the total telephones per households, the total number of telephone handsets was divided by the country's total households. The data for Argentina's total households are available from the censuses with the exception of the 1914 national census which did not include the total number of households. The household data until 1947 was collected from the first, second and fourth censuses.[26] For the years from 1960 onwards, data are from INDEC's *Anuario Estadísticos.*[27] For the years in between the data points provided by the censuses, household data were geometrically interpolated, since no other reliable sources exist. In the case of Mexico, the total number of households was obtained from

[25] International Telecommunication Union (ITU), *ICT Statistics Database* ICT Eye (http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx). Data used are from INEGI, base on numbers provided by the *Secretaría de Comunicaciones y Transportes, Dirección General de Políticas y Normas de Comunicaciones.*

[26] The total number of households for 1895 is from República Argentina, Comisión Nacional del Censo, *Primer Censo Nacional, 1869* capítulo XXVI. 'Edificación', Buenos Aires, Imprenta del Porvenir (1872), p.XIII. For 1895 it is from República Argentina, Comisión Nacional del Censo, *Segundo Censo de la República Argentina, 1895* vol III, capítulo VII. 'Edificación', Buenos Aires (1898), p.XVII. For 1947 República Argentina, Comisión Nacional del Censo, *Cuarto Censo General de la Nación 1947* Resultados Generales del Censo de Población, cuadro 17. 'Formas de Convivencia', Buenos Aires (1947), Buenos Aires (1951), p.26. Note that the 1947 census did not show the total number of households, instead used the average number of persons living in a household. However for the purposes of this study, this posed no real problem.

[27] For 1960 and 1970 household data I used, Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 1979-1980* cuadro 9.7.1. 'Viviendas particulares ocupadas', Buenos Aires (1981), p.269. For 1980 and 1991 data are from Instituto Nacional de Estadística y Censos (INDEC), *Anuario Estadístico de la República Argentina 2000* volume 16, cuadro 2.2.1 'Total de hogares particulares y hogares con necesidades básicas insatisfechas', Buenos Aires (2000), p.89.

INEGI's *Anuarios Estadísticos.*[28] For the earlier period under consideration, that is the years before 1929, Mexico's household data were extrapolated by plotting a best fit through the data points, given the lack of reliable available information. This gave the equation function: Households = 3E-17 $e^{(0.0274 \times Year)}$. Household data were geometrically interpolated between the figures in the *Anuarios*. The table below presents the final series of telephone handsets per 100 people.

[28] For the years of 1929 and 1939 data were obtained from INEGI (1996), cuadro 3.1 'Principales características de las viviendas'. For 1950 and 1960, I used INEGI (1963), capítulo IV. 'Edificios y Viviendas', cuadro 4.1. 'Tenencia de vivienda, por entidades federativas, datos censales', p.117. For data in 1970, I used INEGI (1973), capítulo IV. Vivienda, cuadro 4.1. 'Número de viviendas según tipo de tenencia, por entidades federativas', p.173. For 1990 I used INEGI (1992), capítulo II. cuadro 2.4.4 'Viviendas particulares y ocupantes por tipo de tenencia según entidad federativa y clase de vivienda', p.155. For 2000 I used - Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 2006* capítulo III. 'Vivienda y Urbanización', cuadro 3.2. 'Viviendas particulares habitadas por número de ocupantes' México D.F. (2007), p.66.

Table B. 3 Fixed Telephone Handsets per 100 Households: Argentina and Mexico (1900-2000)

Year	Argentina	Mexico	1930	18.1	2.7	1961	29.7	8.6	1992	52.0	72.9
1900	1.7	0.7	1931	18.0	2.9	1962	29.5	9.2	1993	58.4	79.7
1901	2.3	0.9	1932	17.5	3.0	1963	28.9	9.6	1994	64.7	86.3
1902	2.9	1.1	1933	17.1	3.1	1964	28.7	10.3	1995	72.4	85.4
1903	3.5	1.2	1934	16.6	3.2	1965	28.1	11.4	1996	75.0	84.5
1904	4.0	1.4	1935	16.9	3.4	1966	27.6	12.5	1997	77.0	83.6
1905	4.5	1.5	1936	17.2	3.6	1967	27.1	13.7	1998	81.1	82.8
1906	5.0	1.7	1937	17.8	3.9	1968	26.8	15.0	1999	82.2	81.9
1907	5.4	1.8	1938	18.2	4.2	1969	26.9	16.5	2000	85.4	81.1
1908	5.7	1.9	1939	18.4	4.5	1970	27.2	18.3	*Sources: described above.*		
1909	6.1	2.1	1940	18.7	4.6	1971	25.6	20.0			
1910	6.4	2.2	1941	18.8	4.6	1972	27.1	22.7			
1911	6.6	2.3	1942	18.9	4.8	1973	28.3	25.1			
1912	6.9	2.3	1943	18.7	5.0	1974	29.2	27.3			
1913	7.1	2.4	1944	18.5	5.1	1975	29.5	29.3			
1914	-	-	1945	18.3	5.3	1976	29.5	32.0			
1915	-	-	1946	18.2	5.4	1977	29.3	34.6			
1916	-	-	1947	18.7	5.7	1978	29.3	37.1			
1917	-	-	1948	19.2	6.0	1979	29.9	39.1			
1918	15.3	-	1949	19.8	6.4	1980	30.4	41.6			
1919	15.2	2.2	1950	21.4	5.4	1981	31.4	44.6			
1920	15.1	2.1	1951	22.4	5.7	1982	32.5	46.8			
1921	15.5	2.2	1952	24.0	5.8	1983	33.7	48.5			
1922	15.1	2.2	1953	25.4	6.0	1984	33.9	50.3			
1923	15.5	2.2	1954	27.0	6.2	1985	34.9	52.7			
1924	16.0	2.2	1955	27.8	6.3	1986	36.2	54.0			
1925	16.1	2.3	1956	28.0	6.6	1987	37.1	55.8			
1926	16.4	2.5	1957	28.1	7.0	1988	40.1	57.2			
1927	17.0	2.7	1958	28.6	7.4	1989	43.1	61.4			
1928	17.3	2.8	1959	28.7	7.8	1990	41.2	64.5			
1929	17.8	2.6	1960	29.4	8.3	1991	46.3	67.2			

APPENDIX C

Data used in the Regression Analysis

As demonstrated in appendix B, the rationale for discrepancies between data sets is not always easily identified. Moreover, something which is more pertinent to the data listed below is that even where some series are higher or lower than others, the year on year changes (especially in macroeconomic variables) are often the same. This is sometimes explained by the individual's presentation of the data and is not always necessarily due to the base (e.g. weather rebased on 1950 GDP per capita, versus 1990 Geary-Khamis), but rather the actual construction of the series. The key point to highlight here is the fact that in the regression analysis, where year on year changes are used as the regressed figures, these will be unaffected by these discrepancies. The sources of the variables used in the regression analysis in chapter 4 are listed below, followed by a table with the data.

Argentina's Telegraph Regression Data (see table C.1):

- Telegrams sent per 100 people: data for the whole period were my own construction (see appendix B, table B.1).
- GDP per capita: for 1891-1899 data are from Cortés Conde R., *Estimaciones del Producto Bruto Interno de Argentina, 1875-1935* documento de trabajo no. 3 (1994). For 1900-1916 data are from the Economic Comision for Latin America (ECLA), *El Desarrollo Económico de la Argentina* Santiago, United Nations (1959).
- Population (mid-year, in thousands): data for 1890, and from 1900-1916 are from Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003). For 1891-1895 data were calculated using geometric interpolation based on data from 1890 and 1896. Data for 1896-1899 are from Vázquez Presedo V., *Estadísticas Históricas Argentinas (Comparadas), Primera Parte, 1875-1914* Buenos Aires, Ediciones Macchi (1971).
- Budget: budget data corresponds to the budget for the *Administración Nacional de Correos y Telégrafos*. Data for the whole period is from, República Argentina, Dirección General de Estadística, *Extracto Estadístico de la*

República Argentina Los Gastos de la Administración Nacional, Según los Presupuestos Respectivos, en $ oro, Durante los últimos 50 Años, cuadro 'Correos y Telégrafos', Buenos Aires (1916), pp. 281-282. The data are based on the original published in Argentina's third and fourth national censuses.

- Urban population: urban population as a percentage of total population was collected for the whole period from Ferreres O. J., *Dos Siglos de Economía Argentina 1810-2004* cuadro 2.1 'Población Total, Urbana y Rural', Buenos Aires, Fundación Norte y Sur (2005). This source used interpolation from the data in the census from , Instituto Nacional de Estadística y Censos (INDEC), *La Población de Argentina* Buenos Aires, Series Investigaciones Demográficas (1973), recalculating the absolute value from the series of Población. According to the 1973 census, urban areas are defined as the percentage of the total population living in cities of 2,000 or more people.
- Average cost per telegram: the cost of an average telegram is calculated as the total gross revenue divided by the total number of telegrams. Data for 1895-1916 is from, Economic Commission for Latin America (ECLA), *El Desarrollo Económico de la Argentina* Argentine Postal Movement in 1918 According to Provinces and Territories, see table III. 'Movement at the National Telegraph Offices from 1895-1918', Santiago, United Nations (1959), p.128. These data are based on the original published in Argentina's third and fourth national censuses.
- Length of national telegraph lines (in km): data for the whole period are from Castro Esteves R., *Historia de Correos y Telégrafos de la República Argentina* tomo V, Buenos Aires, Ediciones de la Dirección General de Correos y Telégrafos (1952). Castro Esteves used oficial data from Bose, Walter B. L., 'Los Orígenes del Telégrafo en la Argentina' *Revista de Correos y Telégrafos* no.81 Buenos Aires, Dirección General de Correos y Telégrafos (15 Mayo 1944).
- Usage of the national telegraph lines: this series was my own construction for the whole period, using the number of telegrams sent (see appendix B, table B.1) divided by length of national telegraph lines (sourced above).

Table C. 1 Telegraph Regression Data Used: Argentina (1891-1916)

Year	Telegrams sent per 100 people	GDP per capita	Population (000)	Budget ($ oro)	Urban population (%)	Aver cost per telegram	Length National Teleg Lines (km)	Usage of National Telegraph
1891	15.1	2,341	3,483	902,196	36.0	-	-	-
1892	15.6	2,711	3,593	1,218,326	36.3	-	-	-
1893	16.0	2,786	3,707	1,385,441	36.7	-	-	-
1894	16.4	3,116	3,825	1,394,085	37.0	-	-	-
1895	16.8	3,350	3,946	1,536,261	37.4	0.25	-	-
1896	17.1	3,595	4,071	1,867,750	38.2	0.24	-	-
1897	17.3	2,831	4,233	2,063,623	39.0	0.23	-	-
1898	17.6	2,981	4,357	2,436,130	39.7	0.25	-	-
1899	17.8	3,405	4,477	2,704,474	40.5	0.23	20,330	31.4
1900	17.8	2,918	4,693	2,686,614	41.3	0.23	20,844	32.0
1901	17.8	3,077	4,873	2,772,434	42.1	0.24	21,372	32.5
1902	17.8	2,932	5,060	2,869,703	42.9	0.23	21,912	32.9
1903	17.8	3,259	5,254	2,995,004	43.7	0.24	22,464	33.3
1904	17.9	3,507	5,455	3,382,272	44.5	0.23	23,237	33.7
1905	18.0	3,863	5,664	3,259,911	45.3	0.23	23,960	34.0
1906	18.0	3,878	5,881	4,075,368	46.2	0.21	24,757	34.3
1907	33.7	3,784	6,107	4,893,293	47.0	0.22	25,098	65.6
1908	48.1	3,971	6,341	4,893,240	47.8	0.23	25,335	96.4
1909	61.5	3,982	6,584	5,722,385	48.6	0.23	25,820	125.5
1910	73.8	4,082	6,836	6,633,950	49.4	0.23	26,173	154.2
1911	62.0	3,996	7,098	7,227,963	50.3	0.24	30,097	160.6
1912	68.0	4,156	7,370	8,521,102	51.1	0.25	33,477	149.6
1913	79.3	4,038	7,653	9,071,242	51.9	0.26	36,145	168.0
1914	64.3	3,481	7,885	10,151,962	52.7	0.24	38,674	131.2
1915	65.3	3,364	8,072	10,442,388	53.0	0.23	38,783	135.8
1916	68.8	3,212	8,226	10,500,000	53.3	0.28	40,492	139.7

Sources: described above.

Mexico's Telegraph Regression Data (see table C.2):

- Telegrams sent per 100 people: data for the whole period were my own construction (see appendix B, table B.1).
- GDP per capita: data used are from 1890 only due to the lack of consistent and comparative available figures for the earlier period. The data for 1890, 1895 and 1900-1907 were collected from Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003). Data for 1891-1894, and for 1896-1899, were calculated using geometric interpolation based on data from 1890, 1895 and 1900.
- Population (mid-year, in thousands): data for the whole period are from Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003).
- Budget: budget data corresponds to the budget for the *Secretaría de Comunicaciones y Obras Públicas*. Data for 1891-1900 are from México, Peñafiel A. *Anuario Estadístico de 1893* cuadro 'Resumen de los Presupuestos de Egresos de la Federación en los años Fiscales de 1868 a 1900', México D.F., Dirección General de Estadística (1894), pp. 284-285. For 1901-1907 data are from the - República Mexicana, Dirección General de Estadística, *Tercer Censo de Población de los Estados Unidos Mexicanos, 1910* 'Presupuestos de egresos de la Federación en los años Fiscales de 1901 a 1911', México D.F. (1920), pp. 92-93.
- Urban population: data refers to the percentage of urban population. Data for the whole period are from ICPSR; Banks A. S., 'Cross National Time Series, 1815-1973' *Inter-university Consortium for Political and Social Research (ICPSR)* Ann Arbor, MI: ICPSR: Producer and Distributor (1976). The definition used here is the percentage of the total population living in cities of 20,000 or more people.
- Length of national telegraph lines (in km): data for the whole period is from Instituto Nacional de Estadística, Geografía e Informática (INEGI), *Anuario Estadístico de los Estados Unidos Mexicanos, 1940* capitulo XI. 'Comunicaciones y Transportes', cuadro 384, Oficinas y Longitud de las líneas Telegráficas, México D.F. (1942), pp. 383-384.

- Usage of the national telegraph lines: this series was my own construction for the whole period, using the number of telegrams sent (see appendix B, table B.1) divided by length of national telegraph lines (sourced above).

Table C. 2 Telegraph Regression Data Used: Mexico (1881-1907)

Year	Telegrams sent per 100 people	GDP per capita	Population (000)	Budget ($ oro)	Urban population (%)	Length National Teleg Lines (km)	Usage of National Telegraph
1881	1.1	-	10,524	-	9.75	-	-
1882	0.7	-	10,652	-	9.72	16,252	4.4
1883	1.2	-	10,781	-	9.59	16,820	7.6
1884	0.6	-	10,912	-	9.55	21,000	3.3
1885	0.4	-	11,044	-	9.52	16,629	2.7
1886	1.0	-	11,178	-	9.48	17,151	6.7
1887	2.3	-	11,313	-	9.36	19,288	13.4
1888	3.1	-	11,450	-	9.33	21,514	16.5
1889	3.7	-	11,589	-	9.28	24,119	17.7
1890	4.7	1,011	11,729	-	9.25	24,774	22.5
1891	4.5	1,034	11,904	4,399,346	9.39	25,401	21.2
1892	5.6	1,058	12,083	4,483,569	9.57	27,210	24.7
1893	5.2	1,083	12,263	3,922,142	9.75	28,935	21.9
1894	6.5	1,107	12,447	4,455,097	9.92	30,202	26.8
1895	7.5	1,132	12,663	4,669,516	9.99	31,547	30.3
1896	9.1	1,175	12,822	4,635,089	10.12	31,855	36.6
1897	10.1	1,220	13,014	5,450,217	10.29	32,137	41.0
1898	10.2	1,266	13,209	5,652,111	10.35	32,194	42.0
1899	18.6	1,314	13,406	6,294,936	10.49	32,394	76.9
1900	16.7	1,366	13,607	7,497,388	10.53	31,346	72.3
1901	17.7	1,466	13,755	8,699,840	10.59	31,824	76.3
1902	19.9	1,348	13,904	9,461,829	10.71	33,017	83.7
1903	21.5	1,483	14,055	9,743,724	10.73	34,165	88.5
1904	22.2	1,492	14,208	10,209,605	10.84	35,706	88.3
1905	23.8	1,630	14,363	11,346,645	10.85	34,841	98.2
1906	25.7	1,594	14,519	12,537,332	10.94	34,914	106.8
1907	26.1	1,669	14,676	14,573,854	10.94	35,153	108.9

Sources: described above.

Argentina's Telephone Regression Data (see table C.3):

- Telephone handsets per 100 households: data for the whole period were my own construction (see appendix B, table B.3).
- GDP per capita: data for the whole period are from Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003).
- Population (mid-year, in thousands): data for the whole period are from Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003).
- Urban population: data refers to the percentage of urban population. Data for the whole period are from Ferreres O. J., *Dos Siglos de Economía Argentina 1810-2004* cuadro 2.1 'Población Total, Urbana y Rural' Buenos Aires, Fundación Norte y Sur (2005). For 1943-1960 Ferreres used interpolation based on the data in the census from Instituto Nacional de Estadística y Censos (INDEC), *La Población de Argentina* Buenos Aires, Serie Investigaciones Demográficas (1975), recalculating the absolute value from the series of Población. For 1961-1980 Ferreres used interpolation based upon the census data in Instituto Nacional de Estadística y Censos (INDEC), *Situación y Evolución Social* Sintesis no.4, Buenos Aires (1994), recalculating the absolute value from the series of Población. For 1981-1997 Ferreres used interpolation based upon the census data in Instituto Nacional de Estadística y Censos (INDEC), *Censo Nacional de Población, Hogares y Viviendas 2001* Buenos Aires (2001), recalculating the absolute value from the series of Población.
- Waiting list for main telephone lines: data used are from 1975 onwards and were collected from ITU (www.itu.int). Data for 1985-1986 were calculated using geometric interpolations, based on the data for 1984 and 1987, due to lack of consistent reliable data.
- Total annual invest in telecom (US$): data used are from 1981 onwards and were collected from ITU (www.itu.int).

Table C. 3 Telephone Regression Data Used: Argentina (1943-1997)

Year	Telephones per 100 households	GDP per capita (1990)	Population (000)	Urban population (%)	Waiting lines	Total annual investment in telecom (US$)
1943	18.7	4,182	14,877	61.1	-	-
1944	18.5	4,579	15,130	61.4	-	-
1945	18.3	4,356	15,390	61.6	-	-
1946	18.2	4,665	15,654	61.9	-	-
1947	18.7	5,089	15,942	62.2	-	-
1948	19.2	5,252	16,307	63.0	-	-
1949	19.8	5,047	16,737	63.8	-	-
1950	21.4	4,987	17,150	64.6	-	-
1951	22.4	5,073	17,517	65.4	-	-
1952	24.0	4,717	17,877	66.2	-	-
1953	25.4	4,874	18,231	66.9	-	-
1954	27.0	4,980	18,581	67.7	-	-
1955	27.8	5,237	18,928	68.4	-	-
1956	28.0	5,285	19,272	69.2	-	-
1957	28.1	5,461	19,611	69.9	-	-
1958	28.6	5,698	19,947	70.6	-	-
1959	28.7	5,241	20,281	71.3	-	-
1960	29.4	5,559	20,616	72.0	-	-
1961	29.7	5,862	20,951	72.8	-	-
1962	29.5	5,677	21,284	73.5	-	-
1963	28.9	5,455	21,616	74.2	-	-
1964	28.7	5,926	21,949	75.0	-	-
1965	28.1	6,371	22,283	75.7	-	-
1966	27.6	6,321	22,612	76.4	-	-
1967	27.1	6,399	22,934	77.0	-	-
1968	26.8	6,578	23,261	77.7	-	-
1969	26.9	7,037	23,600	78.3	-	-
1970	27.2	7,302	23,962	79.0	-	-
1971	25.6	7,530	24,364	79.4	-	-
1972	27.1	7,635	24,780	79.8	-	-
1973	28.3	7,962	25,210	80.3	-	-
1974	29.2	8,334	25,646	80.7	-	-

1975	29.5	8,122	26,082	81.1	584,000	-
1976	29.5	7,965	26,531	81.5	622,000	-
1977	29.3	8,304	26,984	81.9	698,000	-
1978	29.3	7,807	27,440	82.2	776,000	-
1979	29.9	8,227	27,902	82.6	863,000	-
1980	30.4	8,206	28,370	83.0	934,000	-
1981	31.4	7,603	28,863	83.4	894,000	409,090,912
1982	32.5	7,243	29,341	83.8	951,730	389,781,821
1983	33.7	7,383	29,802	84.2	1,026,203	371,384,119
1984	33.9	7,425	30,236	84.6	1,000,000	353,854,789
1985	34.9	6,834	30,675	85.0	794,300	337,132,000
1986	36.2	7,224	31,146	85.4	630,912	299,339,503
1987	37.1	7,299	31,621	85.8	501,046	265,783,545
1988	40.1	7,056	32,091	86.1	789,336	235,989,209
1989	43.1	6,523	32,559	86.5	780,000	209,501,680
1990	41.2	6,436	33,022	86.8	775,000	284,230,929
1991	46.3	6,980	33,492	87.2	312,336	385,614,912
1992	52.0	7,497	33,959	87.4	373,717	1,292,805,248
1993	58.4	7,827	34,412	87.7	448,000	2,036,777,856
1994	64.7	8,367	34,864	87.9	496,070	2,237,214,720
1995	72.4	8,005	35,311	88.1	110,566	2,061,515,392
1996	75.0	8,253	35,754	88.4	33,206	1,710,581,632
1997	77.0	8,803	36,203	88.6	19,476	1,347,673,856

Sources: described above.

Mexico's Telephone Regression Data (see table C.4):

- Telephone handsets per 100 households: data for the whole period were my own construction (see appendix B, table B.3).
- GDP per capita: data for the whole period is from Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003).
- Population (mid-year, in thousands): data for the whole period are from Maddison A., *The World Economy: Historical Statistics* Paris, OECD Development Centre (2003).
- Urban population: data refers to the percentage of urban population. Data for 1950 are from Oxlad, *Población Censada y Tasas de Crecimiento Medio Anual, Según Cuidades, 1950-1990 Boletín Demográfico*, Edición Especial: Urbanización y Evolución de la Población Urbana de América Latina (1950 - 1990), Centro Latinoamericano de Demografía (2002). Data for 1951-1959 were calculated using geometric interpolations, based on the data for 1950 and 1960. For 1960-1979 data are from the World Bank, *World Development Indicators* (www.data.worldbank.org). From 1980 onwards data were collected from ITU (www.itu.int).
- Waiting list for main telephone lines: data used are from 1975 onwards and were collected from ITU (www.itu.int).
- Total annual invest in telecom (US$): Data used are from 1975 onwards and were collected from ITU (www.itu.int).

Table C. 4 Telephone Regression Data Used: Mexico (1945-1997)

Year	Telephones per 100 households	GDP per capita (1990)	Population (000)	Urban population (%)	Waiting lines	Total annual invest in telecom (US$)
1945	5.3	2,134	23,724		-	-
1946	5.4	2,211	24,413		-	-
1947	5.7	2,221	25,122		-	-
1948	6.0	2,248	25,852		-	-
1949	6.4	2,304	26,603		-	-
1950	5.4	2,365	28,485	42.5	-	-
1951	5.7	2,477	29,296	43.30	-	-
1952	5.8	2,504	30,144	44.08	-	-
1953	6.0	2,439	31,031	44.87	-	-
1954	6.2	2,605	31,959	45.67	-	-
1955	6.3	2,742	32,930	46.49	-	-
1956	6.6	2,843	33,946	47.32	-	-
1957	7.0	2,965	35,016	48.17	-	-
1958	7.4	3,025	36,142	49.03	-	-
1959	7.8	3,016	37,328	49.91	-	-
1960	8.3	3,155	38,579	50.8	-	-
1961	8.6	3,172	39,836	51.6	-	-
1962	9.2	3,211	41,121	52.4	-	-
1963	9.6	3,343	42,434	53.3	-	-
1964	10.3	3,594	43,775	54.1	-	-
1965	11.4	3,702	45,142	54.9	-	-
1966	12.5	3,813	46,538	55.7	-	-
1967	13.7	3,922	47,996	56.5	-	-
1968	15.0	4,073	49,519	57.4	-	-
1969	16.5	4,185	51,111	58.2	-	-
1970	18.3	4,320	52,775	59.0	-	-
1971	20.0	4,365	54,407	59.8	-	-
1972	22.7	4,602	55,984	60.5	-	-
1973	25.1	4,853	57,557	61.3	-	-
1974	27.3	5,013	59,123	62.0	-	-
1975	29.3	5,158	60,678	62.8	145,000	310,244,480
1976	32.0	5,244	62,220	63.5	253,000	505,694,144

1977	34.6	5,293	63,760	64.2	219,000	321,106,208
1978	37.1	5,595	65,296	64.9	241,000	407,850,880
1979	39.1	5,968	66,826	65.6	314,000	362,807,008
1980	41.6	6,320	68,347	66.4	408,895	394,340,224
1981	44.6	6,717	69,969	67.0	549,756	588,120,000
1982	46.8	6,514	71,641	67.7	609,736	400,464,288
1983	48.5	6,088	73,363	68.3	829,592	320,308,320
1984	50.3	6,162	75,080	69.0	917,302	504,202,368
1985	52.7	6,194	76,767	69.6	1,317,720	485,871,584
1986	54.0	5,834	78,442	70.2	756,800	410,323,520
1987	55.8	5,818	80,122	70.8	769,972	505,941,216
1988	57.2	5,771	81,782	71.4	863,061	598,184,768
1989	61.4	5,899	83,367	72.0	1,058,211	792,451,008
1990	64.5	6,085	84,914	72.6	1,111,000	1,397,456,896
1991	67.2	6,226	86,488	73.1	1,010,000	1,871,965,952
1992	72.9	6,333	88,111	73.7	662,533	3,054,393,088
1993	79.7	6,339	89,749	74.2	260,000	2,682,623,232
1994	86.3	6,504	91,338	74.8	196,850	2,500,552,192
1995	85.4	6,001	92,880	75.3	70,798	1,491,200,768
1996	84.5	6,209	94,399	75.0	69,000	1,779,847,296
1997	83.6	6,525	95,895	80.0	91,000	1,906,691,968

Sources: described above.

APPENDIX D

The Diffusion Curves

Technology diffusion was originally modelled by Roger's theoretical two-step process: p, (the point of initial adoption), which is quicker for inexpensive technologies, and q (the diffusion speed or the rate of diffusion), which is higher for technologies subject to network effects. Hence:

Technology Diffusion = F (p, q)

Essentially the initial point of adoption 'p' is known from the data, and by plotting the diffusion pattern one can determine the speed of diffusion 'q' from the plotted graph. The point of saturation (represented by M from here onwards), in addition to these variables, is then directly derived from the upper asymptote of the S-shaped distribution curve. Mathematically, the growth rate of adoption, i.e. the number of adopters over the time, $N(t)$ is proportional to the total number of adopters. The growth rate at time, t is then defined by the derivative $dN(t)/d(t)$ and this relationship is then fundamentally represented by the exponential growth model (in differential form) as follows:

[1] $\frac{dN(t)}{d/t} = \alpha N(t)$

This concept is based on the fact that the logistic curve (most common type of S-curve) maps that of the exponential curve. Equation [1] can then be solved by introducing *e* (the base of the natural logarithm). The familiar solution of which, is:

[2] $N(t) = \beta e^{\alpha t}$ (where α = growth rate constant and β = coefficient of imitation)

The coefficient of imitation, β (internal influence) – in regard to the potential adopters {M-N} that can adopt – is the accepted behavioural theory of the population, implicit in the process of substitution. At this stage the exponential growth model in equation [2] must be modified for it to fit the S-curve shape. This is done by adding a 'negative feedback' function in relation to the absolute saturation of the potential adopters (denoted by M), as in [3] below.

[3] $\left[1 - \frac{N(t)}{M}\right]$ which applied to [1] now gives:

[4] $\frac{dN(t)}{d(t)} = \alpha N(t)\left[1 - \frac{N(t)}{M}\right]$
(negative feedback)

Note that the feedback term is close to 1 when N(t) << M and N(t) approaches zero, explaining the exponential element to the logistic curve. As N(t) tends to M, the growth rate decreases to zero as the maturity stage in the rate of adoption of the new technology is reached and the curve tends to the upper asymptote. Given [2], one is in a position to solve [4] through integration and then substitution. Since the diffusion is proportional to the amount of diffusion already achieved and the amount of diffusion still to come, the solution to equation [4] is:

[5] $N(t) = \frac{M}{1+e^{[-\alpha-\beta t]}}$

Note that the two parameters α, β fully describe the logistic curve. Factually, at this point it seems prudent to consider that symmetric S-curves are rarely found in the diffusion of a new technology. Ordinarily, the resulting S-curve is actually positively skewed, with the final stage of the diffusion process transpiring at a much reduced speed than forecast by a typical symmetric S-curve.[1] However, the fundamental problem materialises upon manipulation of the logistic equation in [5], which can be done simply to produce a form that will enable the calculation of α and β from a simple linear regression method.

[6] $\ln = \left[\frac{N(t)}{M-N(t)}\right] = \alpha t + \beta$

This result is also found to be the case with the Gompertz curve,

[7] $-\ln = \left[-ln\frac{N(t)}{M}\right] = \alpha t + \beta s$

And various others, which is the key rigidity causing the need for a more flexible model. Because these models can be transformed into equations with a nonlinear function of N(t), being represented as a linear function of time, means that the point of inflection and the symmetric nature of the process are predetermined rather than being data-determined as in the FLOG model.

[1] Dixon R., 'Hybrid Corn Revisited' *Econometrica* 48.6 (1980): 1451–61.

APPENDIX E

Determining the FLOG Formulae

First the data are subjected to the K-S and A-D goodness of fit tests to decide which specific curve, nestled within the Flexible Logistic Growth (FLOG) model specification the data most closely resembles. The tables below detail the results:

The following calculations and notation use EasyFit 4.1 Professional Edition (Mathwave Technologies):

Table E. 1 Argentina Telegraph: Goodness of Fit Tests for the Best-Fitting Curves

Model	Kolmogorov Smirnov		Anderson Darling		
	Statistic	Rank	Statistic	Rank	Overall Rank
Normal	0.2171	4	1.0792	3	4
Logistic	0.2389	5	1.3784	4	5
Log-Logistic (2P)	0.1906	3	0.9290	2	3
Log-Logistic (3P)	0.1717	2	0.8085	1	1
Weibull (3P)	0.1537	1	1.4239	5	2*

**The Weibull (3P) has been pushed down the ranking due to a very weak Anderson-Darling reading.*

Table E. 2 Mexico Telegraph: Goodness of Fit Tests for the Best-Fitting Curves

Model	Kolmogorov Smirnov		Anderson Darling		
	Statistic	Rank	Statistic	Rank	Overall Rank
Normal	0.1413	1	0.7076	3	1
Logistic	0.1639	4	0.8860	4	4
Log-Logistic (2P)	0.2331	5	1.4105	5	5
Log-Logistic (3P)	0.1469	2	0.6984	2	2
Weibull (3P)	0.1478	3	0.6231	1	3

Table E. 3 Argentina Telephone: Goodness of Fit Tests for the Best-Fitting Curves

Model	Kolmogorov Smirnov		Anderson Darling		
	Statistic	Rank	Statistic	Rank	Overall Rank
Normal	0.1508	3	1.2213	3	3
Logistic	0.16832	4	1.5766	4	4
Log-Logistic (2P)	0.2065	5	1.7324	5	5
Log-Logistic (3P)	0.13714	1	0.90628	2	1
Weibull (3P)	0.14194	2	0.8633	1	2

Table E. 4 Mexico Telephone: Goodness of Fit Tests for the Best-Fitting Curves

Model	Kolmogorov Smirnov		Anderson Darling		
	Statistic	Rank	Statistic	Rank	Overall Rank
Normal	0.2540	3	2.5694	1	2
Logistic	0.2761	4	2.9866	2	4
Log-Logistic (2P)	0.2990	5	5.8692	5	5
Log-Logistic (3P)	0.1571	1	4.3813	3	1
Weibull (3P)	0.1644	2	4.8866	4	3

It is clear that Argentina's telegraph/telephone and Mexico's telephone curves should all be modelled to the FLOG by a three parameter log-logistic curve, whilst the Mexican Telegraph (due to its symmetry) is more closely fitted by a normal curve.

The relevant EasyFit parameters relating to the chosen curves must then be transformed[1] to find the standardised α and β parameters. Since the other two parameters that parametise the FLOG are known: as $\mu = 0$ and $\kappa = 1$ for the log-logistic and $\mu = 0$ and $\kappa = 0$ for the normal, one can fully parameterise the FLOG.

Table E. 5 EasyFit Parameters of the Best-Fitting Curves

	Model	α	B	γ	Δ	M
Argentina Telegraph	Log-logistic (3P)	1.3609	0.31568	-0.00359	n/a	n/a
Mexico Telegraph	Normal	n/a	n/a	n/a	0.3463	0.3862
Argentina Telephone	Log-logistic (3P)	1.9529	0.4132	-0.0599	n/a	n/a
Mexico Telephone	Log-logistic (3P)	0.7916	0.11984	-0.00014587	n/a	n/a

Table E. 6 Transformed Parameters

	Model	A	B	M	K
Argentina Telegraph	Log-logistic (3P)	-24.286	6.800	0	1
Mexico Telegraph	Normal	-5.354	0.213	1	1
Argentina Telephone	Log-logistic (3P)	-11.600	2.870	0	1
Mexico Telephone	Log-logistic (3P)	-34.255	7.800	0	1

Table E. 7 Final FLOG Formulas

	Formula	T
Argentina Telegraph	$N = \{1 + e[24.286 - 6.8 \ln t]\}^{-1}$	$t(u,k) = \ln t$
Mexico Telegraph	$N = \{1 + e[5.354 - 0.2127\, t]\}^{-1}$	$t(u,k) = t$
Argentina Telephone	$N = \{1 + e[11.6 - 2.87 \ln t]\}^{-1}$	$t(u,k) = \ln t$
Mexico Telephone	$N = \{1 + e[34.255 - 7.8 \ln t]\}^{-1}$	$t(u,k) = \ln t$

[1] See Appendix G for details on transforming parameters.

APPENDIX F

Goodness of fit Tests

Kolmogorov-Smirnov Test:

Based on the empirical cumulative distribution function (ECDF): assume that we have a random sample $x_1,..., x_n$ from some distribution with CDF F(x). The empirical CDF is denoted by: $F_x(x) = \frac{1}{n} \times [number\ of\ observations \leq x]$

Definition

The Kolmogorov-Smirnov statistic (D) is based on the largest vertical difference between the theoretical and the empirical cumulative distribution function:

$$D = \max_{1 \leq i \leq n} \left(F(x_i) - \frac{i-1}{n}, \frac{i}{n} - F(x_i) \right)$$

Hypothesis Testing

The null and the alternative hypotheses are:

- H_0: the data follow the specified distribution;
- H_A: the data do not follow the specified distribution.

The hypothesis regarding the distributional form is rejected at the chosen significance level (α) if the test statistic, D, is greater than the critical value obtained from a table. The fixed values of α (0.01, 0.05 etc.) are generally used to evaluate the null hypothesis (H_0) at various significance levels. A value of 0.05 is typically used for most applications; however, in some critical industries, a lower α value may be applied.

The standard tables of critical values used for this test are only valid when testing whether a data set is from a completely specified distribution. If one or more distribution parameters are estimated, the results will be conservative: the actual significance level will be smaller than that given by the standard tables, and the probability that the fit will be rejected in error will be lower.

P-Value

The P-value, in contrast to fixed values, is calculated based on the test statistic, and denotes the threshold value of the significance level in the sense that the null

hypothesis (H_0) will be accepted for all values of less than the P-value. For example, if P=0.025, the null hypothesis will be accepted at all significance levels less than P (i.e. 0.01 and 0.02), and rejected at higher levels, including 0.05 and 0.1. The P-value can be useful, in particular, when the null hypothesis is rejected at all predefined significance levels, and you need to know at which level it could be accepted. EasyFit displays the P-values based on the Kolmogorov-Smirnov test statistics (D) calculated for each fitted distribution.

The Anderson-Darling Test

Definition

The Anderson-Darling statistic (A^2) is defined as

$$A^2 = -n - \frac{1}{n}\sum_{i=1}^{n}(2i-1)x[lnF(X_t) + \ln(1 - F(X_{n-i+1}))]$$

Hypothesis Testing

The null and the alternative hypotheses are:

- H_0: the data follow the specified distribution;
- H_A: the data do not follow the specified distribution.

The hypothesis regarding the distributional form is rejected at the chosen significance level (α) if the test statistic, A^2, is greater than the critical value obtained from a table. The fixed values of α (0.01, 0.05 etc.) are generally used to evaluate the null hypothesis (H_0) at various significance levels. A value of 0.05 is typically used for most applications; however, in some critical industries, a lower α value may be applied. In general, critical values of the Anderson-Darling test statistic depend on the specific distribution being tested. However, tables of critical values are readily available only for several of the most widely used distributions. The Anderson-Darling test implemented in EasyFit uses the same critical values for all distributions. These values are calculated using the approximation formula, and depend on the sample size only. This kind of test (compared to the "original" A-D test) is less likely to reject the good fit, and can be successfully used to compare the goodness of fit of several fitted distributions.

APPENDIX G

Transformations

In order to estimate the parameters of the FLOG, a few intermediate steps need to be taken. Easyfit will generate the parameters in figure G.1, but the FLOG requires the parameters of figure G.2.

Figure G.1

Model	Parameters		
Normal	δ_E	μ_E	
Logistic	δ_E	μ_E	
Log-Logistic (2P)	α_E	β_E	
Log-Logistic (3P)	α_E	β_E	γ_E
Weibull (3P)	α_E	β_E	γ_E

→

Figure G.2

Model	Parameters			
Normal	α	β	μ	κ
Logistic	α	β	μ	κ
Log-Logistic (2P)	α	β	μ	κ
Log-Logistic (3P)	α	β	μ	κ
Weibull (3P)	α	β	μ	κ

Note that the α, β of figure G.1 are not the same as those of figure G.2. Also note that some calculations must be carried out on the parameters in figure G.1, before they can actually be transformed. So in reality the full process is as follows:

Figure G.1

Model	Parameters		
Normal	δ_E	μ_E	
Logistic	δ_E	μ_E	
Log-Logistic (2P)	α_E	β_E	
Log-Logistic (3P)	α_E	β_E	γ_E
Weibull (3P)	α_E	β_E	γ_E

→

Figure G.3

Model	Parameters		
Normal	δ_N	μ_N	
Logistic	δ_L	μ_L	
Log-Logistic (2P)	α_{LL2}	β_{LL2}	
Log-Logistic (3P)	α_{LL3}	β_{LL3}	γ_{LL3}
Weibull (3P)	α_W	β_W	γ_W

→

Figure G.2

Model	Parameters			
Normal	α	β	μ	κ
Logistic	α	β	μ	κ
Log-Logistic (2P)	α	β	μ	κ
Log-Logistic (3P)	α	β	μ	κ
Weibull (3P)	α	β	μ	κ

To get from the parameters of figure G.1 to figure G.2 it is necessary to compare the formulae of the Cumulative Distribution Function generated in EasyFit with the standard formula for the respective s-curve in question. In this study it has only been necessary to transform the parameters of the Normal and Log-Logistic, and thus these parameter transform actions will be demonstrated below.

Transforming a Normal

These are the Cumulative Distribution (where x is the function of time) and Normal Distribution formulae:

$$F(x) = \{1 + e - \left[\frac{x-\mu}{\sigma}\right]\}^{-1} \qquad \text{and} \qquad N = \{1 + e[-\alpha - \beta t]\}^{-1}$$

Through the appropriate manipulation and basic algebra it can be found that:

Table G.1

EasyFit Calculated Parameter	FLOG Parameter
$-\mu / \delta$	α
$1 / \delta$	β

Source: EasyFit

where: μ = (1 – [EasyFit Calculated Mean]) x (No. of yrs in the series)
β = EasyFit Calculated Standard Dev (when StatAssist[1] inputs are μ and δ = no of yrs in the series / μ)

Transforming a Log-Logistic (3P)

These are the Cumulative Distribution (where x is the function of time) and three parameter Log-Logistic Distribution formulae:

$$F(x) = \{1 + \left[\frac{\beta}{x-\gamma}\right]^{\alpha}\}^{-1} \qquad \text{and} \qquad N = \{1 + e[-\alpha - \beta \ln t]\}^{-1}$$

Table G.2

EasyFit Calculated Parameter	FLOG Parameter
$-\ln[(\beta-\gamma)^{\alpha}]$	α
A	β

Source: EasyFit

where: α = when β and γ are inputted in StatAssist such that ([No. of yrs in the series / EasyFit Calculated Mean] $\equiv \alpha$). *N.B. α may have to be estimated where the EasyFit mean calculation is not accurately computable.*

β = (1 – [EasyFit Calculated Mean]) x (No. of yrs in the series)

$\gamma = -\beta / \alpha$

[1] StatAssist is the dynamic tool in-built in EasyFit.

APPENDIX H

Heads of State

Argentina

1862	Bartolomé Mitre
1868	Domingo Sarmiento
1874	Nicolás Avellaneda
1880	Julio Argentino Roca
1886	Miguel Juárez Celman
1890	Carlos Pellegrini
1892	Luís Sáenz Peña
1895	José Uriburu
1898	Julio Argentino Roca
1904	Manuel Quintana
1906	José Figueroa Alcorta
1910	Roque Sáenz Peña
1914	Victorino de la Plaza
1916	Hipólito Yrigoyen
1922	Marcelo Torcuato de Alvear
1928	Hipólito Yrigoyen
1930	José Félix Uriburu
1932	Agustín Justo
1938	Roberto Ortiz
1940	Ramón Castillo
1943	Arturo Rawson, 5-7 June
	Pedro Ramírez, 7 June -9 Mar 1944
1944	Edelmiro Farrell
1946	Juan Perón
1955	Eduardo Lonardi, 23 Sept-13 Nov
	Pedro Aramburu, 13 Nov- 1 May 1958
1958	Arturo Frondizi
1962	José María Guido
1963	Arturo Illía
1966	Juan Onganía
1970	Roberto Levingston
1971	Alejandro Lanusse
1973	Héctor Cámpora, 27 May-13 July
	Raúl Lastiri, 13 July-12 Oct
	Juan Perón, 12 Oct-1 July 1974
1974	Isabel Perón
1976	Jorge Videla
1981	Roberto Viola, 29 Mar-22 Dec
	Leopoldo Galtieri, 22 Dec-17 June 1982
1982	Reynaldo Bignone
1983	Raúl Alfonsín
1989	Carlos Menem
1999	Fernando de la Rúa

Mexico

1864	Maximilian I
1867	Benito Juárez
1872	Sebastián Lerdo de Tejada
1876	José María Iglesias
1876	José Porfirio Díaz
1880	Manuel González
1884	José Porfirio Díaz
1911	Francisco León de la Barra, 25 May-6 Nov
	Francisco Madero, 6 Nov-18 Feb 1913
1913	Victoriano Huerta
1914	Venustiano Carranza
1920	Adolfo de la Huerta, 21 May-1 Dec
	Álvaro Obregón, 1 Dec-1 Dec 1924
1924	Plutarco Elías Calles
1928	Emilio Portes Gil
1930	Pascual Ortiz Rubio
1932	Abelardo Rodríguez
1934	Lázaro Cárdenas
1940	Manuel Ávila Camacho
1946	Miguel Alemán
1952	Adolfo Ruiz Cortines
1958	Adolfo López Mateos
1964	Gustavo Díaz Ordaz
1970	Luis Echevarría Álvarez
1976	José López Portillo
1982	Miguel de la Madrid
1988	Carlos Salinas de Gortari
1994	Ernesto Zedillo
2000	Vicente Fox Quesada