Gains from Trade: Competition and the Factor Market

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Contents

List of Tables

List of Figures

Abstract

How do international trade and economic integration alter competitive pressures in economies? Can economic integration increase welfare by alleviating factor market distortions? What are the precise channels through which trade triggers welfare gains?

This thesis examines how economic integration can alter competitive pressures in both product and factor markets. Endogenising product market imperfections, the new trade theory highlighted a number of previously unrecognised sources of gains from trade. This thesis will suggest that further gains from trade can be derived by endogenising factor market imperfections. Although these gains have been commonly alleged to by practitioners, they have hardly been formalised.

Chapter 2 empirically assesses the importance of the various channels through which procompetitive gains from trade may be attained. Using a panel of 2400 Mexican firms between 1984-1990, it is shown that markups fell with trade liberalisation. It is also suggested that liberalisation has increased total factor productivity of the firms in the sample.

The remainder of the thesis is of a theoretical nature. Chapter 3 focuses on the market for intermediate inputs in the presence of hold-up. In a closed economy, a bilateral monopoly is operating and inefficiencies arise in both product and factor markets. As the economy opens up to trade, procompetitive effects suppress the margin between prices and marginal costs increasing allocative efficiency. If downstream firms become internationally mobile, productive gains may arise from increasing returns to scale and intensified competition in the input market.

Chapter 4 focuses on the unionised labour market. If countries are symmetric, trade will increase competition in the product market raising labour demand. The effect on wages is ambiguous. If firms are internationally mobile, the threat of firm mobility reduces both wages and unemployment.

When a society is rich, it s people don't need to work with their hands; they can devote themselves to activities of the spirit. We have more and more universities and more and more students. If students are going to earn degrees, they've got to come up with dissertation topics. And since dissertations can be written about everything under the sun, the number of topics is infinite. Sheets of paper covered with words pile up in archives sadder than cemeteries, because no one ever visits them, not even on All Souls' Day. Culture is perishing in overproduction, in an avalanche of words, in the madness of quantity. That's why one banned book in your former country [Czechoslovakia] means infinitely more than the billions of words spewed out by our universities.

Milan Kundera, *The Unbearable Lightness of Being*, 1984.

Chapter 1

Introduction

> Nobody ever saw a dog make a fair and deliberate exchange of one bone for another with another dog. Nobody ever saw one animal by its gestures and natural cries signify to another, this is mine, that yours; I am willing to give this for that.
>
> Adam Smith, *The Wealth of Nations*, 1776.

The theory of international trade forms one of the earliest areas of the inquiry into the nature and causes of wealth. Yet, at the close of the twentieth century, the study of international trade theory is as dynamic as ever. Great names such as David Ricardo, Eli Heckscher, Bertil Ohlin and Paul Krugman have all made invaluable contributions in identifying the motivations behind and consequences of international economic transactions between nations. Nonetheless, many unanswered questions continue to challenge trade theorists and policy makers alike.

In this introduction we will argue that the persistent emergence of new problems in trade theory can be intricately linked to changes in the international economic environment. To provide some context and motivation for the present study, this chapter starts with a very brief sampling of some of the existing literature (sections 1.1-1.3). The discussion centres around three different *paradigms*: the classical models, factor market distortions and the new trade theory.[1] The development of each of these is analysed in light of real world trade flows as observed by the modelers at the time of their research. It is argued that models, which may now be criticised for their limitations, once provided great insight into the basic motivations behind trade. This leads us to the objective of the present study in section 1.4. Dramatic changes are presently taking place in the international environment. Once again, this obviously calls for a reconsideration of previously derived results and possibly even for the development of a new *paradigm.* Postponing other questions for future work, this thesis focuses primarily on gains from trade in this new environment. Section 1.5 outlines the dissertation.

1.1 The Classical Models

It is probably fair to say that the formal analysis of international trade was started with the theory of comparative advantage. Although the concept has definitely stood the test of time, it can also claim to be one of the most commonly misinterpreted ideas in economics. It is simple and profound, yet ingenious, and it even has some direct practical implications. In its more succinct form, it states that trade is welfare improving whenever the relative productivities of industries diverge internationally.

With the benefit of hindsight, we can now argue that Ricardo's insights fit into a much wider theoretical framework than his simple examples first

[1]Paradigms were patented in 1962 by Thomas Kuhn in *The Structure of Scientific Revolutions.* A paradigm can be defined as the current dominant vision and according to Kuhn has two essential characteristics: (i) its achievement is sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity; and (ii) it is sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve. [77, p.10] Kuhn argues that as a prerequisite for the existence of science one needs researchers that uncritically accept the existing paradigm and work on points of detail within it as well as those who provide the more revolutionary paradigms.

suggested.[2] Ricardo worked with the assumption of two goods and one factor of production. By altering the number of goods and factors, we can view all the perfectly competitive trade models that have arisen since as special cases of a more general standard trade model.[3] For instance, two goods and two factors generates Heckscher-Ohlin, whereas two goods and three factors yields the Ricardo-Viner model. In this framework, inferences about more complicated higher dimensional models also become relatively straightforward.

Trade data from the nineteenth and early twentieth century, when much of the above work was developed, suggest that trade flows were indeed based on differences between countries.[4] Before 1913, the direction of world trade was dominated by Europe's ever growing demand for food stuffs and raw materials. These were supplied by the colonies in exchange for manufacturing goods. It was a flourishing business! Whereas world output per head grew at an average rate of 7.3 per cent per decade between 1800 and 1913, per capita world trade averaged a growth rate of 33 per cent per decade over the same period [67, ch.5]. Between 1876 and 1913 the volume of export trade in primary products trebled. The spread of industrialisation also increased trade in manufactures and the share of primary products in world trade remained virtually constant, fluctuating between 60 and 65 per cent.

[2]The development of comparative advantage is generally attributed to Ricardo. Thweatt [125] notes that Robert Torrens expressed it already two years earlier, in his 1815 *Essay on the External Corn Trade.* Torrens also suggests that James Mill deserves credit for publicising the idea. Without Mill, it would not have been included in the *Principles of Political Economy* [109].

[3]Unlike the later framework, Ricardo's model of comparative advantage assumed diverging international technologies. In the absence of this assumption, no unique pattern of trade can be generated for the Ricardian case of one factor of production and two goods.

[4]These differences are both attributed to (i) diverging international technologies as in the Ricardian model and (ii) differing factor endowments as in the Heckscher-Ohlin model.

With the onset of the first world war, international trade collapsed.[5] It was not until the end of the second world war that trade flows slowly began to recover.[6] As Europe lay in ruins and many of the former colonies gained independence, a completely fresh start was made. Forces more powerful than factor endowments took command of trade patterns in this new era. In the second half of this century it became increasingly clear that, although comparative advantage was still a decisive step in unraveling the motivations behind international trade, it was no longer exhaustive. The gradual transition of the literature, away from the classical model, is sampled below.

1.2 Factor Market Distortions

One of the first to criticise the standard model and its implications was Gottfried Haberler [49]. In a much celebrated paper, he wrote

> Everybody knows, of course, that it [the classical model] is an idealised case which is never completely realised in actual practice. There are many types of frictions and deviations from the ideal conditions ["distortions"] caused by monopolistic and oligopolistic imperfections of the market, external economies and diseconomies, price and wage rigidities, lack of information...etc. Each of these conditions *may* operate in such a way as to make certain deviations from the free-trade policy rational on purely economic ground.
>
> *The Economic Journal*, 1950, p.227.

[5]In the interwar period, the diminishing trade hypothesis took root. It proposed that the decline in the volume of trade between nations was a byproduct of increasing industrialisation and technological progress. Proponents of the hypothesis argued for instance that technological progress involved the substitution away from the use of raw materials, thereby reducing the demand for international trade. In addition, they also suggested that the spread of industrialisation and the diffusion of knowledge across international borders would do away with any existing comparative advantages.

[6]It actually took until the mid-1970s for international trade as a share of world GDP to recover to its 1913 level.

He proceeded to develop one of the earliest formal economic argument against free trade.[7] Incorporating market imperfections into the analysis of international trade, this paper marked a turning point in the development of trade theory. Over the next twenty years, a very large literature was to emerge on trade policy in distorted markets. It would derive that in the presence of a wide variety of factor market imperfections, trade policy could serve as a second best instrument to remedy domestic market distortions. Magee in his 1973 article *Factor Market Distortions, Production and Trade: A Survey* cites as many as 162 references [88]. Unfortunately, the literature is somewhat eclectic and a comprehensive summary would call for a long listing of alternative factor market imperfections. The interested reader should refer to Bhagwati [5] who synthesises much of the work in his *Generalised Theory of Distortions and Welfare.*

The work on factor market imperfections was mostly motivated by problems relating to the emergence of the third world. This is not surprising. Between 1955 and 1960, the developed world experienced an annual increase in real GNP per head of 10 per cent. The comparable figure for developing countries was only 4 per cent. While the rich were getting richer, the poor were losing out more and more [114, ch.6]. The problems of the third world were becoming increasingly clear in the late fifties. Both in theoretical work and in the actual experience of developing countries, the notion of trade as an engine of growth began to be seriously questioned. It was generally believed that the classical Heckscher-Ohlin model, characterised by smoothly functioning markets, was not appropriate in guiding trade policy for developing countries.[8] The unequivocal adherence to free trade was challenged in academic circles and beyond. It was shown over and again that, under factor

[7]In line with the literature, I refer to economic arguments as those that recommend protection as a means of increasing aggregate welfare rather than achieving some non-economic objective.

[8]See for instance Myint's exposition [99].

market imperfections, trade policy can be used as a second-best remedy. The hegemony of the frictionless classical models had ended.

1.3 Distortions in The New Trade Theory

In the 1960s, the classical models began to face a second challenge. This time around it came from the industrialised world. Since the second world war, the largest and fastest growing component of international trade had been the exchange of manufacturing goods between countries in the developed world. This became particularly clear when economists analysed the consequences of the formation of the European Economic Community (EEC) in the 1960s. Both Verdoorn [132] and Balassa [1] found that trade in Europe was becoming increasingly an exchange of similar goods. Grubel and Lloyd [48] estimated that 71 per cent of the increase in trade in the EEC between 1959 and 1967 was of an intra-industry nature. Initially it was suggested that this could be explained by product heterogeneity within aggregates. However, after Grubel and Lloyd [48] found significant intra-industry trade for Australia at the seven-digit level, the search for a model where product differentiation and economies of scale served as an independent motive for trade was on.

In trying to explain the problems of the third world, most researchers thought it was sufficient to relax some of the assumptions of the classical model. Incorporating factor market distortions into the Heckscher-Ohlin model enabled the formal illustration of real world phenomena. It turned out that the identification of two-way trade was calling for something more drastic: a second standard trade model.

It is worth pointing out that the importance of increasing to scale in explaining trade patterns had been recognised for quite some time. For instance, while developing the factor endowment model, Bertil Ohlin [105] pointed out that

> Most regions would be forced to produce a great many articles on a small scale if they imported nothing from abroad. If manufactured for small home markets only, cash register apparatus, dye stuffs, complicated machines, tools and many other things could be had only at considerable higher cost than at present, when they are produced for the world market. Clearly, the economies of large-scale production make interregional division of labour profitable, irrespective of differences in the prices of the factors of production. In other words, the advantages of specialisation resulting from large-scale production lead to interregional trade. Commodities which can be produced very cheaply in huge factories or in large groups of factories, and which when located together reap benefits from external economies, are spread over large markets, each factory or group of factories being sufficient to satisfy the demand of a large number of consumers. On the other hand, commodities which can be produced with the same or greater efficiency in small establishments, e.g. made-to-order clothing, will generally not travel very far; they will be produced where they are in demand, even if the demand in each region be comparatively small. The former kind of articles will figure prominently in interregional trade, but not the latter.
>
> *Interregional and International Trade*, 1933.

The long dominance of the constant returns to scale models is therefore to be attributed to modeling complexities involving multiple equilibria and indeterminacies. Krugman [74] writes in 1987 'the attempt to formalise trade based on increasing returns seemed until recently to lead to an impenetrable jungle of complexity'.

The earliest attempt at incorporating increasing returns to scale adopted the Marshallian approach, where returns to scale are assumed to be external to the firm, allowing perfect competition to remain. This work dates back as far as Matthews [92] and was continued by for instance Melvin [94] and Kemp and Negishi [66]. It is fair to say that this literature enjoyed only limited success until a key innovation by Ethier [37] led to a breakthrough in 1982. This enabled the first synthesis of the Marshallian increasing returns to scale and the comparative advantage approaches.[9]

[9]Unlike all the previous literature, Ethier [36, 37] works from the allocation of

More relevant to the present study is a second approach, which emerged around 1980. It had been recognised for a long time that if one were to relax the assumption of constant returns, the issue of market structure had to be addressed. Due to breakthroughs in industrial organisation and game theory, this suddenly became possible. Two independent developments can be distinguished. First, Spence [123] and Dixit and Stiglitz [31] revived Chamberlin's large group analysis of competition between similar firms producing differentiated products with increasing returns at the level of the firm. This was applied to international trade by Krugman [71, 73], Helpman [56], Ethier [38] and Dixit and Norman [30] and has turned out to be a particularly flexible and insightful model.[10] The second development consisted of an application of the Bertrand/Cournot oligopoly models to international trade. This became the basis for much of the work in the strategic trade policy literature.

Through the application of the Chamberlinian model of monopolistic competition and the Bertrand/Cournot approaches to oligopoly, new tools were provided to think about a variety of issues in international trade. Armed with these new tools, a group of economists embarked on a rejuvenated effort to attempt to answer the most basic question in international trade: What can be gained? This research agenda is now known as the new trade theory.

Gains from trade in this new literature can be roughly subdivided into three categories. First, gains can be attained through the exploitation of increasing returns. In the Chamberlinian model, the effect of trade on the scale of production depends on the elasticity of demand for individual varieties. If trade increases the elasticity of demand facing each firm - which is plausible since the number of varieties available in the market has increased - the scale of production of each firm will expand.[11] The exploitation of increasing

resources to production and trade rather than the other way around.

[10]An alternative approach by Lancaster [78] is also quite widely used.

[11]Due to the increase in the elasticity of demand, firms will lower their markup over production costs. To continue to break even, they will then need to increase

returns to scale then raises welfare levels.[12]

Second, the new trade theory also identified gains from trade brought about by an expansion in the number of varieties available to consumers. Krugman [72] and Dixit and Norman [30] demonstrate that gains arise as international trade enables consumers to expand the number of horizontally differentiated varieties included in their consumption bundle.[13]

Of crucial importance to the present work is a strand of the literature that examines the potential gains from trade resulting from a third source: increased product market competition. Although this idea can by no means be attributed to the new trade theory, this literature does deserve credit for developing a more insightful formal analysis of the issue. Notable is the work by Krugman [71], which introduces a procompetitive effect from trade into the Chamberlinian large group model mentioned above. International trade then suppresses price-marginal cost margins and gains from trade are observed as product market imperfections reduce. Dixit and Norman [30] suggested that trade may not only reduce allocative inefficiencies, but it may also improve technical efficiency. In their model, the trade-induced increase in competition drives some firms out of the industry as lower prices no longer enable them to cover costs. With a smaller number of firms in equilibrium, increasing returns can be exploited to a greater extent thus promoting productive efficiency.[14]

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their scale of operation.

[12]The gains from trade through the exploitation of economies of scale are also commonly analysed in models of perfect competition and homogeneous products with increasing returns at the level of the industry. This includes work by Melvin [94], Markusen and Melvin [91] and Ethier [36, 37].

[13]In a tangential literature, Gabszewicz et al. [43] have derived further gains from trade when products are vertically differentiated. They demonstrate that competition between rival producers can reduce the prices of higher quality goods to the point where lower quality goods are driven out off the market.

[14]The procompetitive effect of trade can also be found in the reciprocal dumping models of Brander [17] and Brander and Krugman [18].

Whereas in 1913, 20 per cent of UK imports consisted of manufactures, by 1992 this share had risen to almost 80 per cent. Throughout the second half of the twentieth century, it became increasingly clear that observed trade flows were inconsistent with the theoretical structure of comparative advantage and the Heckscher-Ohlin model. Developments in the theory of industrial organisation and in game theory fostered the development of the new trade theory. Endogenising product market imperfections, new motives for international trade were identified. Combining these with the factor endowments model enabled international trade theorists to explain more accurately trade flows between countries.

1.4 Objective of this Study

The new trade theory thus identified three further sources of gains from trade. Welfare gains arise from: (i) the exploitation of increasing returns to scale; (ii) the expansion of the number of available varieties; and (iii) the procompetitive effect that trade exerts on the product market. With increased liberalisation, many academic economists and practitioners believe that this third source of gains from trade is particularly important. However, attempts to empirically assess these gains have so far been limited. The first objective of the present study is to begin to resolve this cleft. To address the impact of trade liberalisation on firm behaviour, this study uses a large plant-level data set. The data cover approximately 80 per cent of Mexican industry from 1984-1990, a period of intense (mostly unilateral) trade liberalisation. Questions asked include: Does trade-induced competition impose a procompetitive discipline on producers? Does trade liberalisation suppress the markups that firms charge over marginal costs? What are the precise mechanisms that bring about welfare gains? Do increased trade flows affect total factor productivity growth?

Endogenising product market imperfections was central to the new trade theory. However, economists have long recognised the importance of factor market imperfections. One of the criticisms of the early literature in the 1950s and 1960s was that the distortions modeled were assumed, rather than derived.[15] In other words, the factor market imperfections were exogenous. As an illustration, Magee [86, 87], Bhagwati and Srinivasan [8] considered a standard Heckscher-Ohlin model in which a factor in one of the two sectors earned a proportional premium, over and above the return to the same factor in the other sector. They proceeded to show that this assumption threw doubt on almost all standard predictions regarding gains from trade and their distribution.[16] Harris and Todaro [51] considered a fairly similar set-up, but narrowed the analysis down to the labour market. They introduced a politically determined minimum urban wage which was assumed to be substantially higher than the agricultural wage. In such a dual labour market structure, they showed that trade policy could serve as a second best policy to remedy the domestic distortions.

The second aim of this study is to assess the analytical possibility and the practical benefits of endogenising factor market imperfections. With the tools provided by the new trade theory as well as recent developments in other areas of economics, it is argued that factor market distortions can now be modeled in a less ad-hoc fashion. In particular, we will apply ideas from the new Keynesian macroeconomics and from the incomplete contracting literature to the study of international economic integration. Questions addressed include: In the presence of factor market distortions, what is the impact of the increased product market competition on factor markets? If trade reduces price-marginal cost markups, what can be inferred about factor

[15]See for instance Jones and Neary [63].

[16]In later work Neary [101] suggested that the researchers had identified unstable equilibria, thus calling into question the validity of their propositions and strengthening the Heckscher-Ohlin theory.

market payments? Is there a potential for further gains from trade as the factor market is disciplined?

Initial trade models tried to motivate trade between countries that differed in some respects. Then, in response to changing trade patterns, the new trade theory endogenised product market imperfections and was thus able to motivate trade between similar countries. However, further drastic changes are presently taking place in the international economic environment. Most importantly, between 1983 and 1990 global foreign direct investment (FDI) flows rose by an annual average of 30 per cent. This thesis will therefore not only evaluate the welfare impact of international trade, it will also examine the consequences of firm mobility. A third aim of this thesis is to determine whether firm relocation and FDI can provoke any further efficiency gains. Will increased competition in the input market raise global welfare?

It has been suggested throughout this introduction that the formal study of international trade is closely linked with developments in the international economic system. The most recent changes include (i) the surge in FDI and in particular in vertical FDI, i.e. the vertical disaggregation of the production process, (ii) the emergence of low-wage competition from the newly industrialising economies and (iii) rapid technological progress which lowers transportation and communication costs thereby increasing the degree of international competition. The most ambitious and long run aim of this research is to see whether endogenising factor market imperfections can provide some insight into the motivations behind these recent developments in international economic relations.

1.5 Organisation of this Study

Chapter 2 is of an empirical nature. It attempts to assess the importance of the various channels through which gains from economic integration may be attained. We concentrate on the opening of the Mexican economy in the period 1984-1990. In 1985, the economy was still following a protectionist trade policy. Average tariffs exceeding 30 per cent and import licenses were required for 94 per cent of all goods produced domestically. By 1989, the average tariff on a production weights basis was 15 per cent and import licenses were only required for 12 per cent of domestic production. Furthermore, negotiations to enter a free trade area with the United States had started. We use a unique panel data set of almost 2300 firms. We measure productive efficiency by estimating total factor productivity (TFP) coefficients using a translog production function. Between 1988 and 1990 we find that for the economy as a whole, TFP grows on average by 8 per cent a year. Moreover, the increase in TFP is several times as rapid as the increase in GDP over the same period. Using our estimates of TFP, we then use a variant of the Hall method to estimate changes in markups. For the economy as a whole, we find that before 1988 firms charged prices that exceeded marginal costs by an average of 35 per cent. After the onset of trade liberalisation, markups dropped by 11 percentage points to 1.24.

The second part of chapter 2 attempts to link the changes in markups and TFP growth with measures of international competition. Most of the results confirm to the predictions of trade theory. Tariffs and the degree of openness are found to be statistically significant in explaining the changes in markups. It is also shown that the concentration ratio of an industry, as expressed by the Herfindahl index, is statistically significant in explaining markups. The final finding in chapter 2 is that trade liberalisation has increased the rate of productivity growth of the firms in the data set. One complicating factor in the analysis is that the period of Mexican trade liberalisation coincides with its recovery from a deep recession. Unfortunately, we were unable to control for the effects of this recession.

Chapter 2 strongly suggests an empirical link between trade liberalisation, markups and the efficiency of firms. This information provides some empirical justification for our theoretical analysis of factor market imperfections and economic integration presented in chapters 3 and 4 of this thesis. We concentrate on distortions in two particular factor markets: intermediate inputs and labour. In both cases, agents are assumed to be engaged in longer term relationships and distortions will result as agents have market power and bargain over the rents to be shared. When agents are involved in longer term relationships, efficiency issues surrounding the bargaining game in the factor market have been highlighted by recent research in incomplete contracting theory. When circumstances (such as transaction costs, bounded rationality or implementation problems) prevent a complete contract from being written in stage 1, the agents will have to bargain over residual income streams in stage 2. The literature has mostly focused on how potential inefficiencies can be reduced or even removed by adopting a particular ownership structure or allowing contract renegotiation. The analysis in this thesis instead examines how international trade and firm mobility may affect the payoffs of the bargaining game, including its disagreement point. Chapters 3 and 4 will show that both allocative and productive efficiency improvements may then be realised, generating additional gains from trade.

Chapter 3 focuses on the effects of economic integration in the presence of incomplete contracting inefficiencies when countries are symmetric in all respects. In line with much of the recent literature, we focus on a particular type of incentive problem common when agents make a relationship specific investment. Under autarky, we have one upstream and one downstream firm and the upstream firm makes a relationship-specific investment. This is shown to lead to hold-up, as the investor is ex post exposed to opportunism. In the presence of bargaining, it cannot capture the full return to its investment.[17] Since the downstream firm is a monopoly in the product mar-

[17]This argument was first formalised by Grout [47], building on arguments con-

ket, we identify both allocative and productive inefficiencies under autarky. As the economy opens up to international trade of the downstream good, pro-competitive effects in the product market suppress the margin between prices and marginal costs increasing allocative efficiency. As long as the upstream good is nontradable, the bargaining game in the input market is unaffected and all productive inefficiencies are preserved. If downstream firms become internationally mobile, productive gains may arise from increasing returns to scale and intensified competition in the input market. It is briefly discussed when relocation of one of the downstream firms is likely to be the equilibrium outcome. The chapter then concludes with a discussion of the distribution of the welfare gains.

In the fourth chapter we change focus to the labour market. To match the institutional context of Western European economies, we assume bargaining between unions and oligopolistic employers when countries are symmetric in all respects. A similar hold-up story can then be told. In the absence of binding contracts, the union will first signal a low wage to promote capital investment by the firm. Once the capital stock has been installed, the union will demand a higher wage in the next period. Since the firm is unable to capture the full returns to its investment, its optimal strategy will be to underinvest in the first stage. It can then be shown that capital mobility of the firm will increase its bargaining power and thus reduce hold-up and underinvestment. Economic integration once again results in productive efficiency gains.

The formal analysis presented in chapter 4 is aimed to capture a slightly different, yet further source of gains from trade. By assuming that capital investments are sunk, we circumvent any efficiency effects outlined in the paragraph above. We employ a framework of new Keynesian macroeconomics, which incorporates the microeconomic foundations of imperfectly competi-

tained in Williamson [134] and Klein, Crawford and Alchian [69].

tive labour and product markets into a macroeconomic framework primarily aimed at studying unemployment. As a result of the market power of firms and the bargaining power of unions, we identify both allocative and productive inefficiencies under autarky. If the economy opens up to international trade, product market competition will increase since more varieties have become available. This will suppress price marginal cost markups thereby alleviating allocative inefficiencies. Furthermore, as the firm now has fewer rents to share, the bargained wage also falls. More workers are hired and the reduction in allocative inefficiencies therefore indirectly triggers smaller productive inefficiencies.

Chapter 4 then proceeds to consider the impact of the threat of foreign direct investment. It is shown that, if firms are internationally mobile, the threat of firm mobility effectively increases the bargaining power of the firm. This reduces both wage levels and unemployment. Since countries are symmetric in all respects, it is the *threat* of FDI that invokes the increase in wage pressure. Even in the absence of any relocation, the 'outside option' effectively increases the bargaining power of the firm thus suppressing wages and increasing employment, aggregate output and net welfare. Although the above analysis assumes that any factor market imperfections are to be attributed to unions, the first section of the chapter could easily be manipulated to show that the results extend to other recent theories of imperfect labour markets, such as the efficiency wage theory.

Chapter 5 summarises and concludes. It considers to what extent this dissertation has successfully addressed its objective and suggests some directions for future work.

Chapter 2

Trade Liberalisation, Markups and Productivity: The Mexican Case

Trade should be free, even in Hell.

Dutch saying

2.1 Introduction

On December 17, 1992, Mexico, Canada and the USA signed the North American Free Trade Agreement (NAFTA). In addition to bringing considerable trade liberalisation in services and agriculture, it was also intended to reinforce the gains made during the late eighties in opening up Mexican industry to foreign competition. Since 1947, shortly after the start of Mexico's industrial expansion, successive governments had instituted increasingly protective trade policies.[1] With the exception of the Mexico-US border region, where separate trade policies were maintained, government intervention in Mexican trade continued to be extensive until the mid 1980s. In 1985, the

[1]For a more detailed description of the development of Mexican trade policy during the twentieth century, refer to King [68] or Reynolds [108].

average tariff was 31 per cent and import licenses were required for 94 per cent of goods produced in all industries. In the same year, the government announced the abrupt ending of the Mexican experience as a closed economy. By 1988, the government had completely abolished export controls. The average tariff was cut to 15 per cent and import licenses were now only required for 12 per cent of national production. The opening of the Mexican economy has by all means been dramatic.

However, the analysis of the Mexican trade opening is of wider interest. As multilateral trade liberalisation has slowed down, bilateral Free Trade Agreements (FTAs) and trading blocs are becoming an increasingly popular means to capture gains from economic integration. Not only are these agreements GATT legal, but they are also considered compatible with the long-run aim of multilateral trade liberalisation. NAFTA is particularly unique in that it is the first FTA between partners of drastically different sizes and levels of economic development. Its experience will have implications for the formation and implementation of further FTAs worldwide.

In assessing NAFTA and other FTAs, the magnitude and mechanism of the gains from trade and integration needs to be analysed. This is particularly important since there is such a large discrepancy between the academic literature on the one hand and the beliefs of most practitioners on the other. Academics have long argued that trade and economic integration induce a range of static efficiency gains, including the exploitation of economies of scale and international differences in factor endowments and technology. Practitioners on the other hand tend to emphasise the importance of dynamic welfare gains from trade and international capital mobility. The empirical measurement of these dynamic welfare gains is still in its infancy.[2]

[2] A small number of recent studies suggest that the debate is still largely unresolved. See for instance Bhagwati [6], Nishimizu and Page [104], Pack [107] and Tybout [127].

This paper aims to shed some light on the magnitude and mechanisms of welfare gains resulting from the opening of the Mexican economy in the late 1980s. The next section briefly outlines the data set. Section 2.3 estimates total factor productivity of manufacturing firms in the Mexican economy. Section 2.4 estimates markups both before and after trade liberalisation. The second half of the paper tries to link the findings on productivity growth and markups to changes in trade policy. Section 2.5 briefly outlines the evolution of Mexican trade policy between 1984 and 1990. Section 2.6 tries to establish a link between trade policy and changes in markups. Section 2.7 examines whether there is any evidence that trade liberalisation has increased productivity growth. Finally, section 2.8 concludes.

2.2 Data

The data set consists of a balanced panel of 2393 firms over a 7 year period (1984-90). Firms are assigned to one of roughly 200 industries at the level of the Mexican census classification. The survey data cover the largest plants that produce on average 80 per cent of the output of each industry.

For each firm we have observations on 69 variables. These observations can be subdivided into three categories. The first category covers the technological structure of the firm. It contains data on firms' inputs and outputs, including production, sales, intermediate inputs, purchases of white and blue collar labour and the capital stock. Since these data are in current pesos, we deflated the capital stock by the price index for investment goods. Other input and output data were deflated by the sectoral price indices.[3] The second type of data consists of firms' location and ownership information. The latter takes the form of the percentage of equity owned by nationals of Mex-

[3]These sectoral indices are at the 'Rama' level, which aggregates the 200-sector Mexican census classification up to 48 industries.

ico, USA and five other countries. We assign firms to being foreign owned whenever more than 50 per cent of their equity is non-Mexican.[4] The third and final type of data concerns openness. In particular, we have sectoral information on the average annual import tariff and the percentage of product lines in the industry subject to import licenses. These trade openness data will allow us to track the evolution of trade policy over the 7 year period and to link it with the performance of firms. A more complete description of the data is provided in the data appendix at the end of this chapter.

2.3 Total Factor Productivity

2.3.1 Estimating the Translog Production Function

To estimate total factor productivity, we employ a general form transcendental logarithmic production function, expressing the logarithm of output as a generalised quadratic function of the logarithms of inputs. The translog production function has become widely used since its inception by Christensen, Jorgenson and Lau [25]. Since it allows second-order approximations to arbitrary technologies, it is much more flexible than either a Cobb-Douglas or a CES specification.

The translog specification for a plant p in industry c in period t is

$$\ln \mathrm{VA}_{pcft} = \mathrm{A}_{cft} + \sum_j \mathrm{a}_j \ln \mathrm{X}^j_{pt} + \frac{1}{2}\sum_j \sum_k \mathrm{b}_{jk} \ln \mathrm{X}^j_{pt} \ln \mathrm{X}^k_{pt} + \epsilon_{pt} \ , \tag{2.3.1}$$

where VA is value added, A represents the logarithm of total factor productivity (TFP) and X^j is input j. Subscript p indexes the 2082 plants, c indexes the 200 industries, f shows whether the firm is under foreign or Mexican ownership and t denotes the years from 1984 to 1990. The three inputs

[4]Since most firms in the data set are either fully Mexican or fully foreign owned, this cut-off at 50 per cent is quite robust.

employed are blue collar labour (BCL), white collar labour (WCL) and capital (K). BCL and WCL are expressed in terms of the number of hours worked by blue collar and white collar labour respectively. To control for changes in the price level, the capital stock is deflated by the investment price index and VA is deflated by sectoral price indices. ϵ_{pt} is the plant-specific disturbance term. Note that 2.3.1 presupposes that the coefficients on inputs are the same for all firms in the economy.[5]

We impose the following decomposition on the technology element

$$\mathrm{A}_{cft} = \mathrm{C} + \tau_t + \Omega_{ft} + \iota_c \ , \tag{2.3.2}$$

where C is a constant, τ_t is a time-specific productivity shock and Ω_{ft} denotes an interactive time-ownership specific constant. This is designed to capture potential productivity differences between foreign and Mexican firms over time and allows us to investigate whether any catch-up has taken place.[6] Productivity shocks at the industry level are captured by ι_c, the industry specific constant.[7]

Some implications of the specification of the model should be highlighted. First, since the factor inputs enter the translog production function logarithmically, their coefficients are simply the elasticities of output with respect to each of the inputs. In contrast, the coefficients on the various components of

[5]We will relax this assumption later in the paper.

[6]Blomström and Wolff [11] suggest that the presence of foreign firms in an industry generates a number of spillovers. In their analysis of Mexican industry, they find that the productivity levels of Mexican firms gradually converge to those of their foreign counterparts.

[7]Tybout and Westbrook [129] and Tybout, de Melo and Corbo [128] have decomposed the change in total factor productivity into changes due to scale efficiency and those due to technical efficiency. They find that improvements in scale efficiency are not associated with increased openness. However, they do find a positive correlation between the exposure to foreign competition and the technical efficiency level of firms. Here, we do not pursue such a decomposition.

the technology term enter linearly and are therefore to be interpreted as percentage changes. To keep the specification of the model as parsimonious as possible, potential interactions between factor inputs and time or nationality dummy variables have been restricted to zero.

Some Estimation Issues

Although the translog production and cost functions have been used widely, their application to panel data sets is less common.[8] Since there are unobservable industry-specific effects, estimating the translog production function using standard ordinary least squares (OLS) techniques would yield biased estimates whenever any of the explanatory variables is correlated with the industry-specific effects. To reduce this problem, we used fixed and random effects at the level of the industry.[9] In the case of fixed effects, all variables are redefined as deviations from the mean for each of the 200 industrial sectors. OLS is then performed using the deviations, a procedure known as the within-groups estimator. The random effect (GLS) estimator is a weighted average produced by the between and within estimators. Since the data set is biased towards the inclusion of larger firms, we consider the fixed effect model to be more appropriate.

Because of collinearity between interaction terms and other variables it is often difficult to estimate the parameters with precision. It is therefore not uncommon to estimate the translog function jointly with the factor de-

[8] The first application to a panel data set is to be attributed to Caves, Christensen and Trethaway [23]. Using a fixed effect model, they analysed the returns to scale and the returns to density in US trunk and local service airlines. An alternative approach based on random effects is used by Caves, Christensen, Trethaway and Windle [24] in modeling rail transportation services.

[9] Alternatively we could have employed fixed and random effects at the level of the firm. However, we consider the loss of degree of freedoms in doing so too large. Furthermore, estimating so many dummies may aggravate the multicollinearity problem inherent in estimating a single equation translog production function.

mand equations. Using cross-equation constraints, efficiency gains may be attained. However, as highlighted by for instance Tybout [126], factor demand equations are difficult to specify properly and are likely to introduce significant biases.[10] We do not pursue this approach.

Finally, since the translog production function is quadratic we have to a posteriori ensure that it is well-behaved, i.e. that output increases monotonically with all inputs and that the function is convex. It can be shown that monotonicity holds whenever each input's share of total output is positive. Convexity of the translog function requires that its bordered Hessian must be negative semidefinite.[11] Both these conditions will be checked a posteriori.

Empirical Results

The results of the estimation of the translog production function 2.3.1 are given in table 2.1. For completeness and comparison, we also report the estimates of the Cobb-Douglas production function. F-tests show that the translog form explains significantly more of the variation in both the fixed and random effects models.[12] In addition to the more traditional arguments, the fact that large plants in the data set are consistently more capital intensive than small plants goes some way in explaining this.[13]

[10]Using Chilean industrial census data, Tybout [126] strongly rejects the cross-equational restrictions commonly employed in estimating the translog function jointly with the factor demand equations.

[11]A clear discussion of the translog production function and its regularity properties can be found in Chung [26, ch.12].

[12]The F-statistic with 6 numerator and 14147 denominator degrees of freedom is 44.85 and 44.79 for the fixed and random effects models respectively. Since the critical value is 2.80, the null hypothesis that the two regressions are equal can be rejected at the 1 per cent level.

[13]Using a very similar data set, Tybout and Westbrook [129] suggest that this fact is inconsistent with the Cobb-Douglas specification but that second-order approximations to arbitrary technologies are flexible enough to capture the dependence of returns to scale on size.

Table 2.1: Production Function Estimates

Regression	Random Effects		Fixed Effects	
	Translog	Cobb-Douglas	Translog	Cobb-Douglas
K	0.0862	0.1821	0.0882	0.1832
	(0.0218)	(0.0053)	(0.0217)	(0.0053)
BCL	0.4581	0.5115	0.4539	0.5057
	(0.0422)	(0.0102)	(0.0421)	(0.0101)
WCL	0.6933	0.3949	0.6960	0.3983
	(0.0362)	(0.0092)	(0.0361)	(0.0091)
K^2	0.0286		0.0292	
	(0.0049)		(0.0049)	
BCL^2	0.1408		0.1426	
	(0.0153)		(0.0152)	
WCL^2	0.1132		0.1148	
	(0.0119)		(0.0119)	
K/BCL	-0.0111		-0.0120	
	(0.0066)		(0.0066)	
K/WCL	0.0009		0.0011	
	(0.0061)		(0.0062)	
BCL/WCL	-0.1472		-0.1486	
	(0.0107)		(0.0107)	
T85	0.0091	0.0098	0.0092	0.0100
	(0.0245)	(0.0247)	(0.0245)	(0.0247)
T86	-0.0675	-0.0675	-0.0678	-0.0679
	(0.0245)	(0.0247)	(0.0245)	(0.0247)
T87	-0.0963	-0.0983	-0.0966	-0.0987
	(0.0245)	(0.0247)	(0.0245)	(0.0248)
T88	-0.1706	-0.1737	-0.1708	-0.1741
	(0.0245)	(0.0247)	(0.0245)	(0.0247)
T89	-0.0401	-0.0437	-0.0402	-0.0439
	(0.0245)	(0.0247)	(0.0245)	(0.0247)
T90	0.0417	0.0362	0.0417	0.0360
	(0.0245)	(0.0247)	(0.0245)	(0.0247)

Table 2.1: Production Function Estimates (Cont'd)

Regression	Random Effects		Fixed Effects	
	Translog	Cobb-Douglas	Translog	Cobb-Douglas
F84	0.2732	0.2956	0.2788	0.3015
	(0.0468)	(0.0472)	(0.0468)	(0.0472)
F85	0.2742	0.2879	0.2801	0.2939
	(0.0469)	(0.0473)	(0.0469)	(0.0473)
F86	0.2877	0.3126	0.2935	0.3187
	(0.0468)	(0.0472)	(0.0468)	(0.0472)
F87	0.2681	0.2989	0.2735	0.3047
	(0.0469)	(0.0472)	(0.0468)	(0.0472)
F88	0.3084	0.3417	0.3138	0.3476
	(0.0468)	(0.0472)	(0.0468)	(0.0472)
F89	0.2875	0.3160	0.2930	0.3220
	(0.0471)	(0.0474)	(0.0470)	(0.0474)
F90	0.2761	0.3023	0.2818	0.3084
	(0.0471)	(0.0475)	(0.0471)	(0.0475)
Constant	-0.2537	0.0800	-0.2026	0.1399
	(0.0836)	(0.0374)	(0.0919)	(0.0550)
R^2	0.774	0.767	0.774	0.767

Number of observations (Nobs): 14297
Standard errors in brackets.

Table 2.1 shows that all the factor inputs have the expected sign and are highly significant. It can be inferred from the estimation of the translog production function that the shares of the various factors in the production process are 0.19 for capital, 0.41 for white collar workers and 0.50 for blue collar workers in both the fixed and random effect models.[14] The shares in the

[14]This can be obtained by differentiating the logarithm of value added with respect to the logarithms of each of the three inputs.

Cobb-Douglas specification follow directly from the coefficients on K, BCL and WCL and are not too dissimilar from the translog estimates. The coefficients suggest that as a whole Mexican industries employ blue collar labour relatively intensively, followed by white collar labour and capital. Adding up the shares, the estimates in table 2.1 suggest that returns to scale are approximately 1.10. F-tests confirm that we can reject the constant returns to scale hypothesis at the 1 per cent level for all 4 estimations.

Turning to the next set of estimates, the time dummies show that between 1984 and 1990 there was only a 4 per cent increase in productivity.[15] Until 1988, productivity was falling with the level being 17 per cent lower in 1988 than it was in 1984. In the final 2 years, the time dummies show that productivity increased very rapidly to generate a net increase by 1990.

The interactive time foreign-ownership dummies show that firms under foreign ownership are consistently more productive than firms under Mexican ownership. Depending on the year and the estimation procedure, foreign firms are 27 to 35 per cent more productive than Mexican firms.[16] In each of the 4 estimations, the productivity gap increases in the middle of the period and then returns to approximately its 1984 level. This may be attributed to the fact that foreign firms are less recession prone than Mexican firms.

To ensure regularity of the translog production function we checked that the monotonicity and convexity conditions held. A posteriori we found that fitted shares from the translog estimates are positive for all but one of the white collar labour observations. Furthermore, after omitting this observation, we found that the bordered Hessians are negative semi-definite at every data point. We therefore conclude that our estimated translog production

[15] F-tests show that we can reject the hypothesis that the time dummies can be dropped at the 1 per cent level.

[16] Unsurprisingly, formal F-tests show that we can reject the hypothesis that the interactive time foreign ownership dummies can be dropped at the 1 per cent level for all specifications in all years.

function is well-behaved.

Finally, we performed a Hausman test based on the difference between the within and GLS estimators. For the translog specification, the test yields a χ^2-value of 40.91. This is distributed as χ^2_{22} under the null and it is not significant at the 5 per cent level. We are therefore unable to reject the hypothesis of no correlation between the individual effects and the explanatory variables.[17] This leads us to discard any endogeneity problems that would require the use of instrumental variables.

Using the estimates in table 2.1, we calculated total factor productivity estimates for all firms.[18] Using value added as a weight, estimates for the manufacturing sector as a whole are presented in figure 2.1. Figure 2.2 disaggregates the TFP estimates by ownership. These data do therefore not support the catch-up hypothesis as put forward by for instance Blomström and Wolff [11].

Disaggregating the Analysis

The analysis so far has assumed common input coefficients for all industries. We tested whether or not this is a justifiable restriction by inserting multiplicative industry-dummies on the first order factor input terms of the translog production function. We initially disaggregated the sample into 48 different industries (the Rama level) and found that the hypothesis that all industries had the same input coefficients could not be rejected at the 5 per cent level. We proceeded to experiment with various other levels of industrial disaggregation and investigated the impact on the significance level of the multiplicative dummies. We eventually decided that a disaggregation of

[17]If the coefficients of the fixed and random effect models differed significantly,this would have implied that the random effects are correlated with the regressors or that the model was misspecified.

[18]Recall that total factor productivity is given by the exponential of A.

the data into 13 industrial sectors was most appropriate. First, whereas further disaggregation produced hardly any significant dummies, at this level of aggregation roughly 70 per cent of the multiplicative dummies were significant. Furthermore, the disaggregation employed here is comparable to other work done in this area.[19]

For each of the 13 sectors, we estimated the translog production function 2.3.1. We then calculated total factor productivity for each of the 13 sectors over the sample period.[20] The results are graphed in figure 2.3. The disaggregated TFP estimates show that the trends in most sectors conform to the aggregate picture. Before 1988, total factor productivity generally declined. This was followed by a rapid pick-up after 1988. The percentage growth rate for all firms in each industry between 1988 and 1990 is given in table 2.2. This table shows that TFP growth over this period is positive for all 13 industrial sectors. Moreover the weighted average growth rate of the 13 sectors, using value added shares, is an astonishing 24.18 per cent over the three year period. The increase in TFP is several times as rapid as the increase in GDP over the same period.

Although the trends in most sectors are very similar, some deviations deserve highlighting. First, the only sectors that experience no decline in TFP over the entire period are automobiles and transportation equipment. Figure 2.3 also shows that the TFP evolution of food, beverages and machinery is somewhat anomalous. In section 2.7 we will use these sectoral differences in productivity growth and we will try to formally link them to (sectoral) changes in trade policy.

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[19]See for instance Harrison [52] and Levinsohn [84].

[20]Recall that TFP is given by exp A_{pcft}. For sake of tractability and compactness, we will restrict ourselves to presenting those results that are of direct relevance to the issues in this paper. The complete estimations of the translog production function can be obtained from the authors.

Table 2.2: **Percentage Growth Rates by Sector**

Number	Sector	TFP Growth 1988-90 (%)
1	Food	16.33
2	Beverages	16.90
3	Textiles	23.47
4	Wood and Paper Products	21.05
5	Chemicals	26.00
6	Metals	21.24
7	Machinery	32.78
8	Tobacco	20.56
9	Leather	21.17
10	Cement	39.22
11	Plastic Products	46.89
12	Automobiles	19.52
13	Transportation Equipment	29.57

2.4 Estimating Markups

In this section we identify the price marginal cost margins of the firms in the sample. Since marginal costs cannot be directly measured from the usual firm or industry data, we estimate marginal costs using a variant of a method first suggested by Hall [50].[21] Levinsohn [84] and Harrison [52] precede the present study in applying the method to panel data sets of firms in developing countries facing trade liberalisation.[22] The essence of the Hall method is to

[21] See also Domowitz, Hubbard and Petersen [32]. A clear overview of the method and the recent literature is provided by Feenstra [41].

[22] Levinsohn [84] considers the 1984 trade liberalisation in Turkey, while Harrison [52] considers the 1985 trade reform in the Ivory Coast. Earlier work by Melo and Urata [93] compares reported price cost margins for two census years before and after the Chilean trade reforms of the 1970s. Research on developed country data is reviewed by Schmalensee [115].

measure marginal cost as the observed change in cost as output rises or falls from one year to the next. For our purposes, one of its assets is that it employs the same data as the measurement of total factor productivity growth presented in the previous section. We diverge from the existing literature in that we use explicit estimates of total factor productivity growth.

2.4.1 The Hall Method

Recall the production function

$$\mathrm{VA}_{\mathrm{pcft}} = \alpha_{\mathrm{pcft}} \mathrm{F}(\mathrm{BCL}_{\mathrm{pcft}}, \mathrm{WCL}_{\mathrm{pcft}}, \mathrm{K}_{\mathrm{pcft}}) \ , \tag{2.4.1}$$

where $\alpha_{\mathrm{pcft}} = \exp(\mathrm{A}_{\mathrm{pcft}})$ is given by 2.3.2. It enters multiplicatively to capture the idea that the change in output is not independent of the level of inputs. Estimates of all components of this production function were obtained in the previous section and are presented in table 2.1.

To estimate price cost margins we totally differentiate the production function and obtain

$$\begin{aligned} \Delta \mathrm{VA}_{\mathrm{pcft}} &= \alpha_{pcft} \left[\frac{\partial \mathrm{F}_{pcft}}{\partial \mathrm{BCL}_{pcft}} \Delta \mathrm{BCL}_{pcft} + \frac{\partial F_{pcft}}{\partial \mathrm{WCL}_{pcft}} \Delta \mathrm{WCL}_{pcft} \right. \\ &\quad \left. + \frac{\partial \mathrm{F}_{pcft}}{\partial \mathrm{K}_{pcft}} \Delta \mathrm{K}_{pcft} \right] + \Delta \alpha_{pcft} \mathrm{F}_{pcft} \ , \end{aligned} \tag{2.4.2}$$

where Δ is the first difference operator defined by $\Delta \mathrm{x}_{\mathrm{pcft}} = \mathrm{x}_{\mathrm{pcft}} - \mathrm{x}_{\mathrm{pcft}-1}$.[23] Assuming that firms profit maximise with respect to output and all three inputs, we can link production to preferences and the markup charged by each firm. As shown by Levinsohn [84], substituting the four first order conditions into the total differential 2.4.2 yields

[23]It should be noted that the approximation in 2.4.2 is best when returns to scale are close to one.

$$\Delta VA_{pcft} - \Delta\alpha_{pcft}\mathrm{F}_{pcft} = \beta_{pcft}\left[\frac{\mathrm{BCW}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{BCL}_{pcft} + \frac{\mathrm{WCW}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{WCL}_{pcft} + \frac{\mathrm{r}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{K}_{pcft}\right], \tag{2.4.3}$$

where BCW is the blue collar wage rate, WCW is the white collar wage rate, r denotes the rental rate of capital and p_t is the sectoral price index.[24] β_{pcft} represents the unobservable estimate of the price cost margin and reflects the market share, the elasticity of demand and the mode of market conduct.[25]

The question of particular interest in this study is whether trade liberalisation has had an impact on marginal cost markups. Although the policy prescriptions of many of the models composing the new trade theory literature are not always in agreement, the implications of trade liberalisation on price marginal cost margins is strikingly uniform: in almost every model, a tariff or a quota increases price cost markup.[26] In what follows, we will assume that the shift in trade policy that gave rise to trade liberalisation took place in 1988.[27] We estimate the following equation

$$\begin{aligned}&\Delta \mathrm{VA}_{pcft} - \Delta\alpha_{pcft}\mathrm{F}_{pcft} = \\ &\quad \beta_{pcft}\left[\frac{\mathrm{BCW}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{BCL}_{pcft} + \frac{\mathrm{WCW}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{WCL}_{pcft} + \frac{\mathrm{r}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{K}_{pcft}\right] + \\ &\quad \gamma\mathrm{D}_t\left[\frac{\mathrm{BCW}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{BCL}_{pcft} + \frac{\mathrm{WCW}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{WCL}_{pcft} + \frac{\mathrm{r}_{pcft}}{\mathrm{p}_t}\Delta\mathrm{K}_{pcft}\right] \end{aligned} \tag{2.4.4}$$

where D_t is 0 during the first four years of the sampling period and equals 1

[24]These have been constructed at the 'Rama' level, a subdivision of the data set into 48 industries.

[25]See Levinsohn [84] for a more detailed exposition.

[26]See for instance Helpman and Krugman [57] for an overview.

[27]Although both licensing requirements and tariffs were scaled back a bit earlier than that, a sharp real devaluation of the peso softened the initial impact of the changes in trade policy.

after 1987. If trade liberalisation has a negative impact on price cost margins than γ will be negative.

2.4.2 Estimating Markups

The literature so far has chosen to restrict the technological shock in some way and then to estimate productivity shocks and markups simultaneously. For instance, Harrison [52] decomposed productivity change into (i) an industry specific component captured by a constant term and (ii) a plant specific component consisting of a plant specific constant and a random disturbance term. Levinsohn [84] restricted the productivity shock to follow a random walk, where the unexpected component was assumed to be comprised of (i) an economy-wide shock to variable factors only indexed by time and (ii) a shock independent of the marginal productivity of variable inputs. The latter is both time and plant specific and is assumed to be orthogonal to the economy-wide shock.

The present analysis diverges from the existing literature in that we employ the technology estimates of the translog production functions obtained in the previous section and therefore only estimate the markup.[28] Substituting the production function estimates into the left-hand side of 2.4.4 gives us a revised measure of output, which has been adjusted to take into account the effects of productivity change. Having controlled for technological change, we are now able to estimate markups directly.

Many of the econometric concerns raised in the literature have been resolved by the use of the technology estimates from the translog production function. One remaining issue is the imposition of prior identifying restrictions on the markup β. In 2.4.4, the markup is indexed by both plant and period, implying negative degrees of freedom. The most common approach

[28]We use the coefficients from the fixed effects models.

is to assume that all firms have the same markup.[29] We experimented with a variety of models. We first employed fixed and random effects at the plant and industry levels. We then grouped the firms into 6 size groups and repeated the estimations. Finally, we differentiated the firms by nationality of ownership. The differences in estimated coefficients in all these cases were minimal. The results are reported in the appendix at the end of this chapter. In line with the literature, we proceed here by assuming that little information is lost by assuming that all firms charge the same markup and we therefore estimate equation 2.4.4 using standard OLS. As before, we first consider all industries in our estimation and then disaggregate the sample into 13 different sectors. Whereas the aggregated estimation of 2.4.4 uses the technology estimates produced by the aggregate production function (table 2.1), the disaggregated markup regressions employ the technology estimates from the disaggregated sectoral translog production functions.

2.4.3 Empirical Results

The results of the OLS estimation of the aggregate markup equation are presented in table 2.3. Since we have no data on the cost of capital, we estimate the model for r=2.5%,r=5% and r=7.5%.[30] For all 3 estimations, the standard errors are relatively small in comparison to the estimates which leads us to conclude that the markups are quite precisely estimated. All coefficients are significant at the 1 per cent level.

[29] See for instance Hall [50], Levinsohn [84] and Harrison [52]. Levinsohn [84] emphasises that this is in contrast with the underlying theory which implies that larger firms act more competitively than smaller firms.

[30] Even if we raise the cost of capital to 20 per cent, the qualitative results do not change. Levinsohn [84] has noted the same feature in his study of the Turkish trade liberalisation of the mid-eighties. He suggests that this may be attributed to the fact that investment as a share of output is relatively small.

Table 2.3: **The Aggregate Markup Equation**

Regression	I	II	III
β	1.35 (0.027)	1.35 (0.027)	1.34 (0.028)
γ	-0.11 (0.027)	-0.11 (0.028)	-0.11 (0.028)
R^2	0.93	0.93	0.93
r(%)	2.5	5	7.5

Number of Observations: 12492

If prices were equal to marginal costs, β would be unity. Table 2.3 suggests that prices are significantly different from marginal costs in all the estimations. We used F-tests to formally show that the null hypothesis that $\beta = 1$ can be rejected at the 1 per cent level in all three cases. Table 2.3 shows that, before 1988 firms charged prices that exceeded marginal costs by an average of 35 per cent. After 1987, markups dropped by 11 percentage points to 1.24.

It should be reiterated that the regressions in table 2.3 presuppose that the input shares of the factors of production are identical for all sectors. Allowing for differences in factor intensity between sectors and using the sectoral technology estimates produces price cost markups as presented in table 2.4. These estimations assume that r=5%.

$\bar{P}_t$

Table 2.4 shows that the markups take a reasonable value for all 13 industries, generally lying between 1 and 2. The change in markups after 1987 is negative for 8 of the 13 industries. This provides some further evidence for the idea that competitiveness increased and markups fell over the second part of the sample period.

Table 2.4: **Sectoral Markup Equations**

Number	Sector	β	γ	R^2	Nobs.
1	Food	1.27	0.17	0.702	1884
2	Beverages	2.12	-0.30	0.678	504
3	Textiles	1.86	-0.29	0.715	1698
4	Wood and Paper Products	1.12	0.08	0.690	1356
5	Chemicals	1.26	-0.05	0.553	2664
6	Metals	1.33	-0.13	0.771	1434
7	Machinery	1.33	-0.10	0.979	882
8	Tobacco	1.31	0.31	0.907	318
9	Leather	1.82	-0.22	0.701	72
10	Cement	1.00	0.14	0.378	810
11	Plastic Products	1.09	0.28	0.856	372
12	Automobiles	1.82	-0.25	0.603	330
13	Transportation Equipment	2.01	-0.18	0.932	168

2.5 Measures of International Competition

In the previous sections we constructed measures of total factor productivity growth and markups. In the next section we attempt to link these measures with changes in the economic environment faced by Mexico in the mid and late eighties. Since it is not possible to summarise all international changes in one variable, we devote this section to an exposition of the various alternative measure of international competition that we consider.

The first measure we employ is the import tariff on output. The data set provides the tariff rate per year per industry, TAR_{ct}. Figure 2.4a shows the average input tariff for the manufacturing sector as a whole, where the average has been weighted by value added. Whereas average tariffs are approximately 30 to 35 per cent until 1987, in 1988 they drop to about 15 per cent. The aggregation in figure 2.4a conceals large differences between the various industrial sectors. For instance, the beverage industries experienced a drop in the production-weighted official tariff rates from 81 per cent in 1985 to 20 per cent in 1990. Table 2.5 presents these sectoral level data on openness.

Table 2.5: Protection of Mexican Industry by Sector

Sector	Tariffs		Licenses	
	1985	1990	1985	1990
Food	30.91	15.43	100.00	11.45
Beverages	80.90	19.85	100.00	37.04
Textiles	39.30	17.27	98.88	1.30
Wood and Paper	33.02	12.31	95.61	0.00
Chemicals	34.48	14.72	89.25	0.00
Metals	24.63	14.42	81.20	0.66
Machinery	40.81	16.37	95.27	41.30
Tobacco	37.34	15.01	55.64	0.00
Leather	44.70	16.90	100.00	0.00
Cement	24.98	13.53	98.91	0.00
Plastics	37.50	14.24	97.49	0.00
Automobiles	24.88	16.41	93.34	0.00
Other Transportation	46.30	18.90	95.10	0.00
Aggregate	39.80	15.81	93.79	12.56

A second measure used is the percentage of output subject to licenses. As in the case of tariffs, the data set provides the license rate per year per industry LIC_{ct}. We computed the overall percentage of production lines that are subject to import licenses. The market share (VA) is used as a weight and the evolution of the license coverage is depicted in figure 2.4b. The figure shows that in 1984, 94 per cent of domestic production was covered by import licenses. In 1985 license coverage started to drop reaching a level of just 13 per cent by 1990. Table 2.5 shows that the differences between sectors are not nearly as pronounced in the case of licenses as they were for tariff rates.

As a further measure of the level of international competition we examine actual trade flows. We construct the following industry and time-specific openness measure, $\mathrm{OPEN}_{\mathrm{ct}}$

$$\mathrm{OPEN}_{\mathrm{ct}} = \frac{\mathrm{IMPORTS}_{\mathrm{ct}}}{\mathrm{VALPROD}_{\mathrm{ct}} + \mathrm{IMPORTS}_{\mathrm{ct}} - \mathrm{EXPORTS}_{\mathrm{ct}}}, \tag{2.5.1}$$

where $\mathrm{IMPORTS}_{\mathrm{ct}}$ denotes the imports of both capital and intermediate goods for each plant and each year, $\mathrm{EXPORTS}_{\mathrm{ct}}$ denotes the exports for each plant in each year and $\mathrm{VALPROD}_{\mathrm{ct}}$ gives the value of domestic production. We constructed an aggregate openness measure, using the market share (VA) as the weight for each firm. This is is shown in figure 2.4c, which suggests a gradual increase in openness between 1984 and 1990.

Finally, as a measure of industry concentration we calculate the Herfindahl index, using value added as the output measure. We refer to this measure as $\mathrm{CONC}_{\mathrm{ct}}$ The limitations of this measure deserve mentioning. Since we have a balanced panel and do not observe entry nor exit, changes in market share are not accurately captured. Furthermore, the Herfindahl index does not take account of contestability considerations.

Although we initially planned to also consider the impact of foreign direct investment (FDI) on firm level efficiency and markups, the data do not lend itself for such analysis. Since it is a balanced panel and no entry nor exit is observed, no suitable measure for changes in the level of FDI can be attained. We therefore exclude the effects of foreign investment from the analysis.

2.6 Markups and Openness

This section presents an attempt to link developments in the international trade regime to changes in marginal cost markups charged by producers. The analysis will be based on the sectoral markups presented in table 2.4.

2.6.1 Correlation Coefficients

Table 2.6 gives the Pearson correlation coefficients for the relevant variables.[31] Sectoral data were used at annual intervals, generating a total of 91 observations. In calculating the correlation coefficients we used value added as a weight. SHARE represents the share of value added that is produced under foreign ownership.

Table 2.6: Correlations between Markups and Openness

	MARKUP	CONC	TARIFF	OPEN	SHARE
MARKUP	+1.00				
CONC	+0.73*	+1.00			
TARIFF	+0.52*	+0.36*	+1.00		
OPEN	−0.33*	-0.06	−0.29*	+1.00	
SHARE	−0.76*	−0.53*	−0.29*	−0.25*	+1.00

* Significant at the 0.05 level.

Table 2.6 shows a large number of significant correlations. First, the data suggest a positive and significant correlation between the tariff rate and the markup. The table also shows a negative and significant relationship between markups and openness. These two correlations suggest that lower trade barriers and increased openness can be associated with lower markups. In addition, we find that the markup is positively correlated with the Herfindahl concentration index. Finally, table 2.6 suggests that the markup tends to be lower when foreign-owned firms produce a larger share of the industry's output.

[31]We also estimated the Spearman's and Kendall's rank correlation coefficients. Whereas the Pearson correlation coefficient tends to pick up linear associations, these measures tend to be better at capturing nonlinear trends. We found very similar qualitative results for all three measures and therefore only report the Pearson correlation coefficients.

Table 2.6 also highlights some further issues of interest. Rather unsurprisingly, it shows that openness increases as the tariff rate falls. More interestingly, it suggests a positive and significant relation between the share of foreign ownership and the openness of an industrial sector. The correlation between the tariff rate and the share of foreign ownership is negative. Unfortunately, the correlation coefficients do not enable us to draw inferences about the direction of causality. The most plausible interpretation seems that foreign firms choose to operate in those industrial sectors that are relatively more open to international trade.

2.6.2 Another Regression

We will proceed to try to establish a more formal link between changes in markups and the evolution of Mexican trade policy in the eighties. As above we use data at the sectoral level.

The equation we estimate is

$$\mathrm{MARKUP_{st}} = \theta_0 + \theta_1 \mathrm{TAR_{st}} + \theta_2 \mathrm{OPEN_{st}} + \theta_3 \mathrm{CONC_{st}} + \epsilon_{\mathrm{st}} \;, \qquad (2.6.1)$$

where subscript s denotes the sectoral level, where $s = 1, \dots .13$. Since the markup is only assumed to change in 1988, we only consider 2 time periods: pre and post trade liberalisation. As before, we assume that the change in policy occurs in 1988.[32] This reduces the number of observations to 26.

Note that we have excluded license coverage from 2.6.1. We originally performed a regression which also include license coverage as a dependent variable. Suspecting that the dependence was particularly strong between tariffs and import licenses, we decided to omit one of the two as an attempt to reduce multicollinearity. We experimented by including each one in turn

[32]We calculated sectoral averages of the independent variables. Using value added as a weight, our pre-trade observations averaged over the years 1984-1987, whereas our post-trade observations are the mean of the remaining years.

and found that the estimations differed minimally. We eventually selected the tariff rate, primarily because it varies relatively more at the sectoral level.[33]

Since the variables in the regression reflect means rather than individual observations, the appropriate method of estimation is weighted least squares (WLS), where the weight is value added.[34] The results of the WLS estimation of 2.6.1 are reported in table 2.7.

Table 2.7: Markups and International Trade

θ_0	θ_1	θ_2	θ_3	R^2	Nobs.
0.9953**	0.0053*	−0.8006**	4.0630**	0.714	26
(0.1142)	(0.0030)	(0.3366)	(0.8298)		

* Significant at the 0.10 level.

** Significant at the 0.05 level.

The regression in table 2.7 reveals that markups are lowered when the economy becomes more open. It also suggests that reductions in the tariff rate will lower the markup, although this relationship is only significant at the 10 per cent level. The regression supports the hypothesis that trade imposes a procompetitive discipline on producers. The entry of internationally traded goods into the market forces firms located in Mexico to adjust their markups and lower their prices.

[33]In addition, one could argue that the tariff measure 'incorporates' exchange rate movements more accurately. The initial impact of the changes in trade policy was softened by a real devaluation of the peso. Since tariffs came down slightly later than quotas, they are a more suitable measure of the threat of foreign competition.

[34]Although heteroscedasticity does not destroy the unbiasedness and consistency properties of the usual ordinary least squares estimators, they are no longer efficient. Weighted least squares is the most common approach to remediation. It is also not implausible that the above regression suffers from endogeneity problems. Unfortunately, we were unable to construct any appropriate instruments.

2.7 Productivity and Openness

The impact of the trade opening on total factor productivity growth is the final missing link in the analysis. This section presents an attempt to formally link the changes in markups and the international regime to changes in the rate of total factor productivity growth.

2.7.1 Some More Correlation Coefficients

Table 2.8 gives the Pearson correlation coefficients for the relevant variables.[35] As before, we used sectoral data at annual intervals and employed value added as a weight in calculating the correlation coefficients. To allow for underlying sectoral differences in total factor productivity, we first differenced the data and generated a variable ΔTFP.[36]

Table 2.8: Correlations between TFP Growth and Openness

	ΔTFP	OPEN	TARIFF	ΔMARKUP	SHARE
ΔTFP	+1.00				
OPEN	+0.30*	+1.00			
TARIFF	−0.28*	−0.25*	+1.00		
ΔMARKUP	-0.17	-0.12	+0.11	+1.00	
SHARE	0.06	+0.24*	−0.24*	+0.40*	+1.00

* Significant at the 0.05 level.

ΔMARKUP represents the change in the markup for each sector. This is equal to $\gamma_s \mathrm{D}_t$ as estimated in equation 2.4.4 and as reported in table 2.4.

[35] Again, we also used the Spearman's and Kendall's rank correlation coefficients, but found that the differences were minimal.

[36] Alternatively, we could have worked with ratios. Some experimentation has led us to believe that this would produce similar results.

Recall that for each industrial sector it therefore takes on only one of two values.

Table 2.8 suggests a positive correlation between trade liberalisation and total factor productivity growth. As tariffs are lowered and openness increases, ΔTFP rises. A decrease in markups is associated with higher total factor productivity growth, but this correlation is not significant at the 5 per cent level. Finally, there is a slight positive correlation between the share of foreign ownership and productivity growth.

2.7.2 A Final Regression

We conclude this analysis with a final regression of the trade policy measures and the markup on total factor productivity growth.

As in the previous section, we first included both the tariff rate and license coverage as explanatory variables. Suspecting multicollinearity, we then decided to omit the license coverage variable. The equation we estimated is

$$\Delta \mathrm{TFP}_{\mathrm{st}} = \phi_0 + \phi_1 \mathrm{OPEN}_{\mathrm{st}} + \phi_2 \mathrm{TARIFF}_{\mathrm{st}} + \phi_3 \Delta \mathrm{MARKUP}_{\mathrm{st}} + \epsilon_{st} \ , \quad (2.7.1)$$

where subscript s denotes the sectoral level, where $s = 1, \ldots.13$ and $t = 1985, \ldots..1990$. The change in the markup ΔMARKUP only has a pre and a post trade liberalisation value and is therefore constant over the 1984-87 and over the 1988-90 periods.

We estimated 2.7.1 using WLS, where the appropriate weight is given by value added. Table 2.9 shows the estimated links between trade and total factor productivity growth. The regression suggests that TFP growth is inversely related to the tariff rate. As tariff rates are lowered and trade is liberalised, total factor productivity growth picks up. TFP also accelerates when the economy becomes more open. Finally, lower markups increase productivity growth although this link is not found to be statistically significant at the 10 per cent level.

Table 2.9: **TFP Growth and Trade Policy Measures**

ϕ_0	ϕ_1	ϕ_2	ϕ_3	R^2	Nobs.
0.0346	0.1735**	−0.0018*	-0.1014	0.149	78
(0.0319)	(0.0825)	(0.0010)	(0.0948)		

The impact of trade on total factor productivity growth can thus be subdivided into direct effects and an indirect effect. Table 2.9 shows that lowered tariffs and increased openness directly translate into TFP growth. Interestingly, our regressions also suggest that there is a further indirect effect, operating through the procompetitive discipline that trade imposes on the product market. As markups come down, productivity growth increases. Unfortunately, this link is not statistically significant.

2.8 Concluding Remarks

Mexico implemented a wideranging program of trade liberalisation in the late eighties. Making this process irreversible is one of the more important objectives of NAFTA. Assessing the impact of this reform process on market structure and productivity growth is therefore an essential element in any comprehensive evaluation of NAFTA. In this paper, we used data obtained from the Industrial Survey in Mexico, combined with trade statistics and data on foreign ownership, to begin just such an evaluation.

We first of all found a link between trade liberalisation and decreased price cost margins. After the opening up of the economy, price cost margins fell on average 11 per cent. We found that the tariff rate and the actual openness of the economy were statistically significant in explaining these changes.

We also established a - somewhat weaker - link between trade opening and total factor productive growth of firms. We find that between 1988 and 1990, TFP growth on average exceeds 8 per cent a year. This is several times as fast as GDP grew over the same period. We also find some evidence that lower tariffs and increased openness have contributed to the increase in productivity growth.

One problem we incurred in the analysis in this chapter is that Mexican trade liberalisation coincided with the recovery of the Mexican economy from a deep recession. Distinguishing between trade liberalisation and economy-wide macroeconomic forces is very difficult. One possible clue may be provided by the behaviour of markups. There is some weak evidence that markups fall with demand. For instance, in their study of German manufacturing industries, Flaig and Steiner [42] find the marginal cost markup to be procyclical. Berndt et al. [3] also find a procyclical markup for General Motors and Ford. However, they identify a countercyclical markup for Chrysler.

If markups indeed behave procyclically, the role for trade liberalisation in explaining the trends identified in this chapter is strengthened. However, although there may be some evidence that reduced markups may be attributed to trade liberalisation rather than the business cycle, this evidence is rather weak. Several theories argue instead that markups are countercyclical, thus weakening the argument for trade liberalisation.

In this chapter we have claimed that trade liberalisation has a procompetitive effect on the product market and therefore reduces price marginal cost markups. Furthermore, we have suggested that this procompetitive discipline also affects the factor market. The remainder of this thesis focuses on theoretical arguments behind these links. How does increased competition affect incentives in the factor market? In the next chapter we turn to the market for intermediate goods, followed by the labour market in chapter 4. Incorporating factor market imperfections will be a crucial step in the analysis.

2.9 Appendix

The following table shows estimated markups using fixed effect models and setting the cost of capital at 5 per cent. The technology estimates used are those generated by the aggregate translog production function (table 2.4).

Table A1: Experiments with the Aggregate Markup Equation

Regression	I	II	III	IV
β	1.34 (0.027)	1.34 (0.027)	1.34 (0.027)	1.35 (0.027)
γ	-0.10 (0.027)	-0.10 (0.027)	-0.10 (0.027)	-0.10 (0.027)
R^2	0.93	0.93	0.93	0.93
grouped by	industry	plant	ownership	plant size

There are 12492 observations and all coefficients are statistically significant at the 1 per cent level.

2.10 Data Appendix

The data come from several sources. The data on the technological structure of the firm are from the Encuesta Industrial Anual from 1984 to 1990 inclusive. Observations are identified by a four digit industrial code, a plant code and a year. The data cover the largest plants, on average accounting for approximately 80 per cent of the output in each industry. The data also included price indices for investment goods and as well as sectoral price indices for output. The data on ownership were carried out as an additional survey. Finally, the openness data were constructed by Adriaan Ten Kaete.

Since we suspected that the data set contained a number of errors, we designed several criteria to screen the data. We excluded all establishments for which

(i) gross value of output ≤ 0
(ii) value added ≤ 0
(iii) exports $>$ sales
(iv) imports $>$ sales
(v) ownership information was unclear
(vi) total number of workers ≤ 0
(vii) total costs ≤ 0

After applying these criteria we were left with 2082 establishments. All the results in chapter 2 are based on this sample.

Figure 2.1: Total Factor Productivity of All Firms

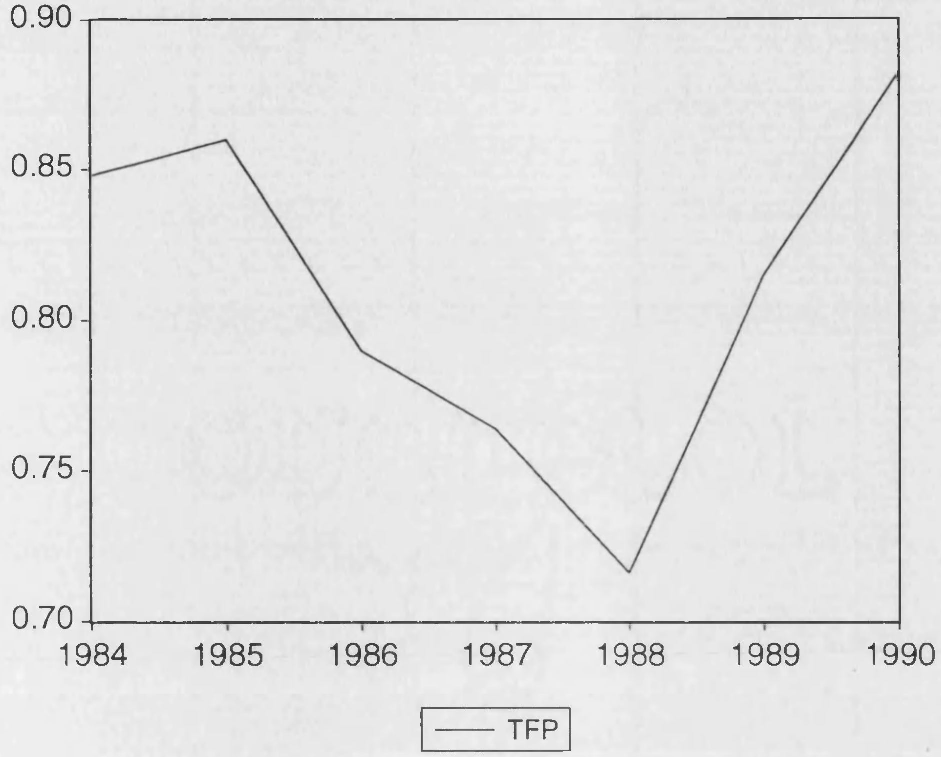


Figure 2.2: Total Factor Productivity of All Firms by Ownership

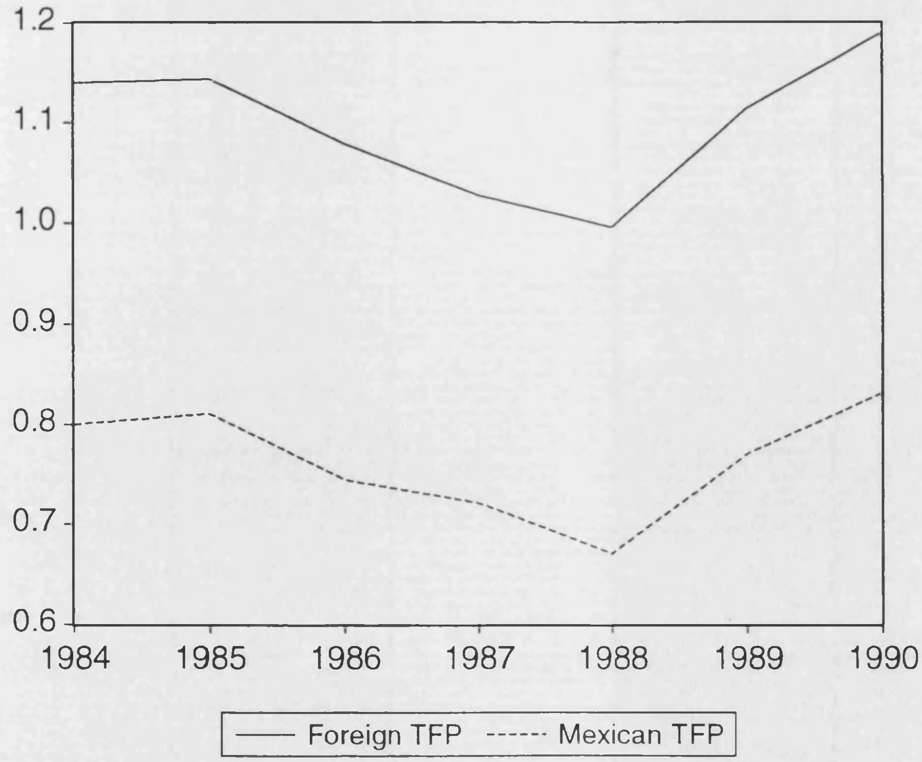


Figure 2.3: Total Factor Productivity by Industrial Sector

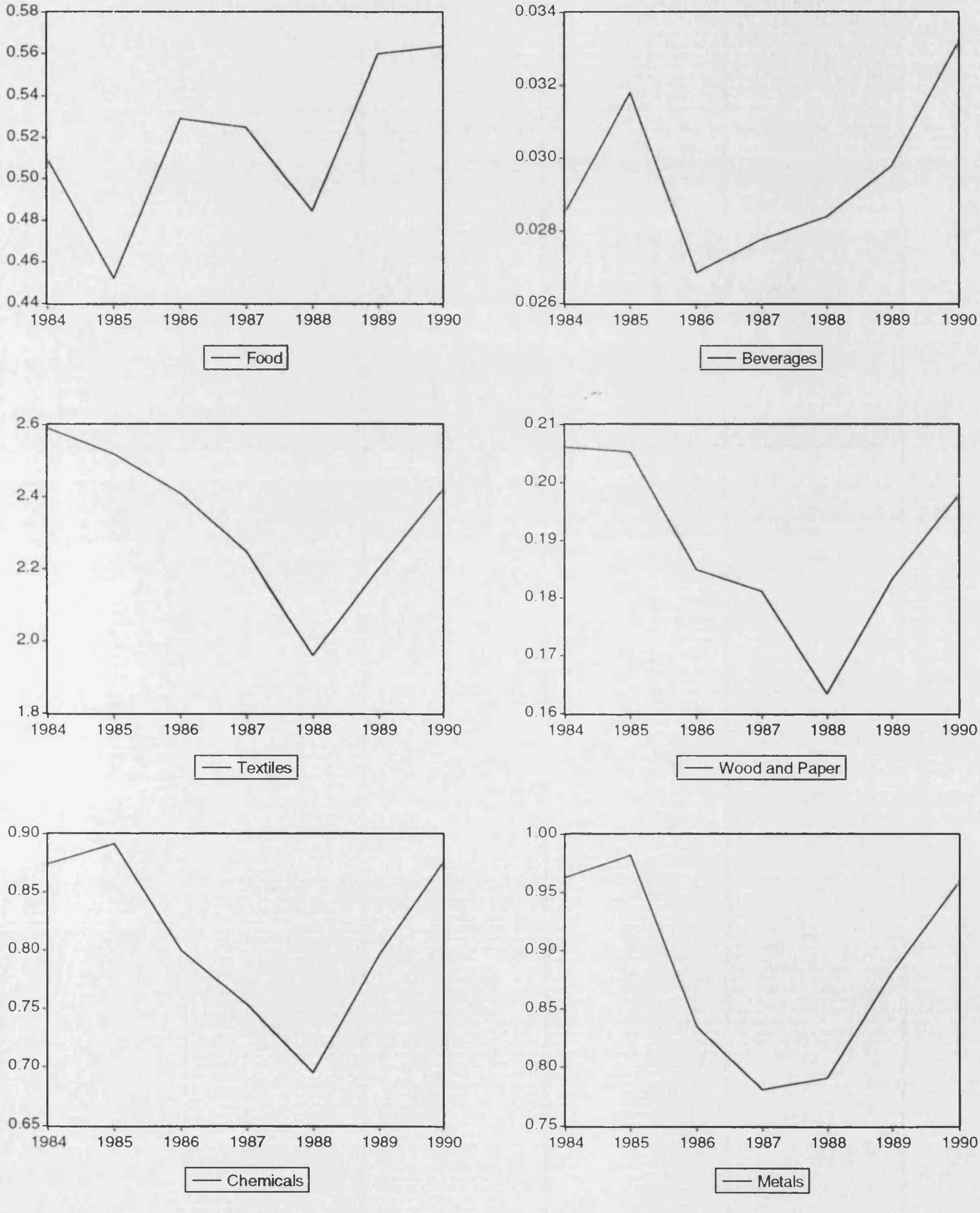


Figure 2.3: Total Factor Productivity by Industrial Sector (Cont'd)

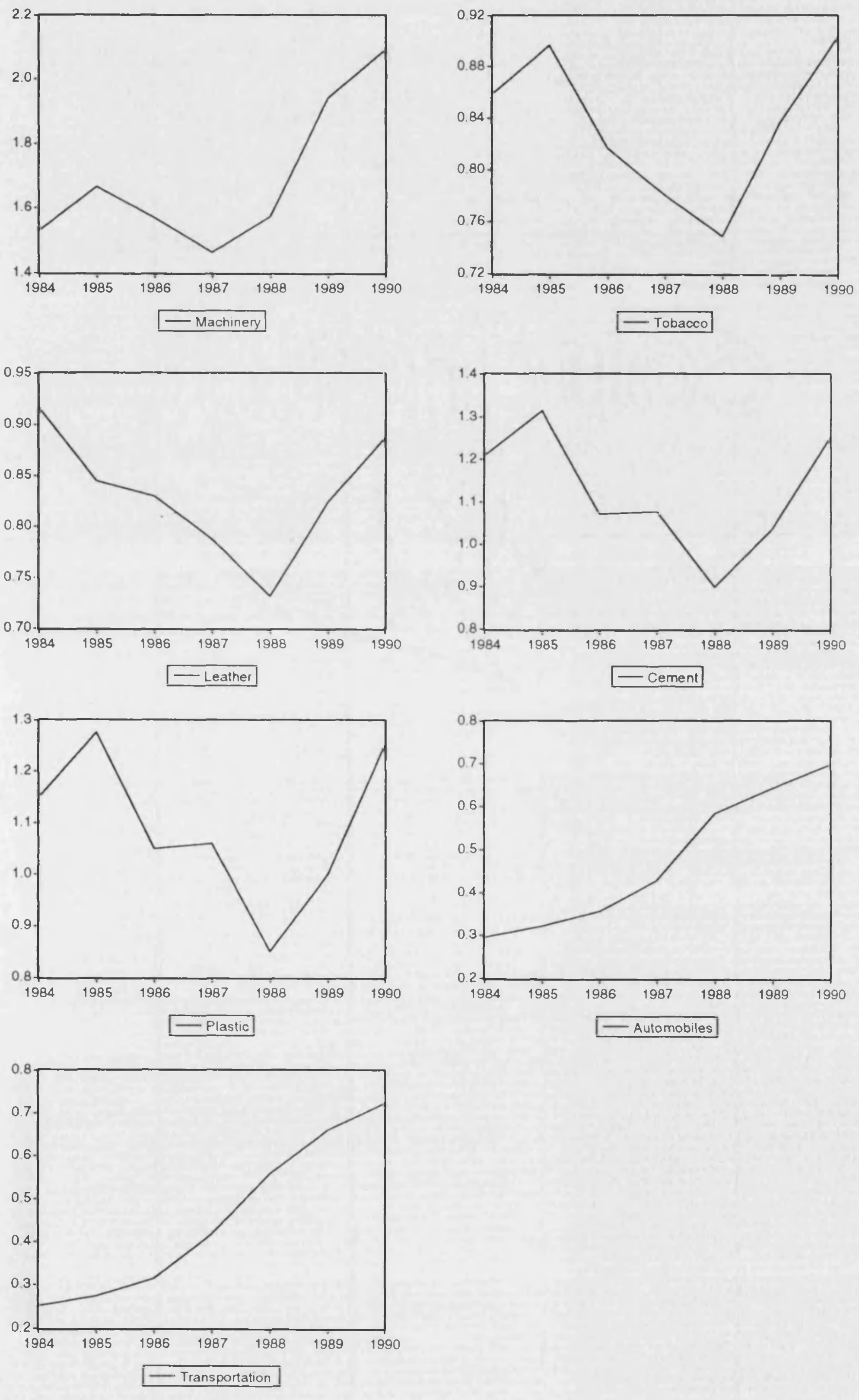
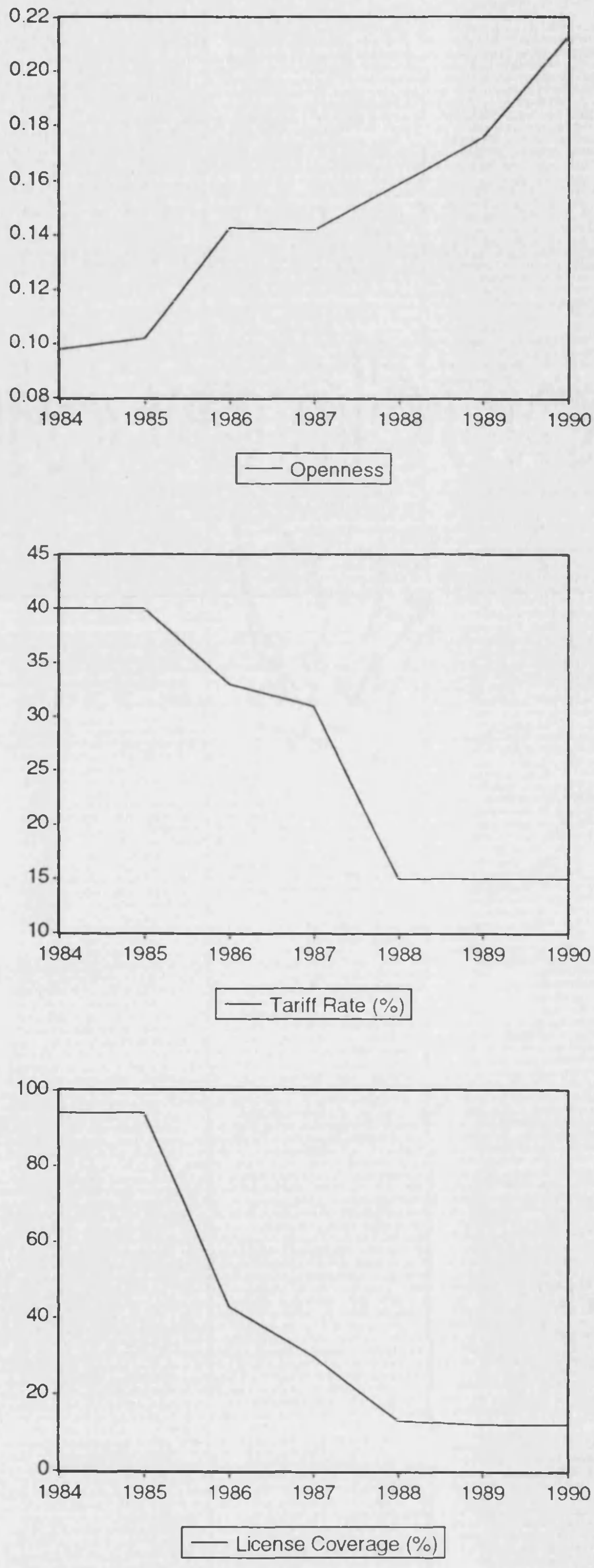


Figure 2.4: The Evolution of Mexican Trade Policy



Chapter 3

Efficiency Gains from Economic Integration: The Hold-up Problem

> Here's the rule for bargains: Do other men, for they would do you.
>
> Charles Dickens, *Martin Chuzzlewit*, 1844.

3.1 Introduction

International economists have long preoccupied themselves with proving the gains from trade. Initially, the formal derivations of these gains were restricted to perfectly competitive, constant returns to scale environments where countries traded to exploit their relative complementarities. Casual observation suggests that trade also takes place between countries producing only slightly different varieties within generally similar product groups. Recent advances in industrial organisation and game theory have supported the formal derivation of gains from trade in models of imperfect competition and increasing returns to scale.

The study of gains from trade in the presence of market distortions first became popular in the 1950s. Initially, gains from trade results were driven by rather ad-hoc factor market distortions. Following developments in game theory and industrial organisation, the new trade theory succeeded in the derivation of various alternative mechanisms of trade-related welfare gains in the presence of product market imperfections. These include welfare gains from an expansion of the available varieties, the exploitation of increasing returns to scale and the procompetitive effect that trade exerts on the product market.

In this chapter we examine the effects of factor market distortions in the framework suggested by the new trade literature. To model factor market distortions, we employ recent ideas from the theory of incomplete contracts. We assume that the industrial structure of the industry in question can be represented by a vertically linked, bilateral monopoly. An upstream firm supplies an intermediate good to a downstream firm. The upstream firm makes a cost-reducing investment. We demonstrate that under autarky there is a hold-up problem and the upstream firm underinvests. We then allow for some forms of international economic integration and derive both allocative and productive efficiency gains. As in many models not based on factor endowments, we find that trade in goods and factors are imperfect substitutes.

The chapter can be outlined as follows. In section 3.2, we describe the closed economy model. We assume production in the sector of interest is organised as a bilateral monopolistic relationship and identify the equilibrium inefficiencies. The remainder of the chapter analyses the consequences as the economy gradually begins to integrate with a second country. Section 3.3 considers unrestricted trade of the downstream good. It is shown that downstream product trade reduces allocative inefficiencies, but does not affect productive inefficiencies. The central part of this chapter follows in section 3.4, which considers the possibility of relocation of one of the downstream firms. It is argued that relocation may bring about productive efficiency gains that can be attributed to (i) increasing returns to scale and (ii) the reduction of the hold-up problem. After a brief discussion of the distribution of the above gains, section 3.5 concludes. The appendix to this chapter presents a richer and more complicated model and tries to suggests how the conclusions in the main part of the chapter may be affected if allocative and productive inefficiencies are more closely intertwined.

3.2 The Closed Economy

3.2.1 The Basic Model under Autarky

Production

The model in this section is a partial equilibrium model, focusing on the production of one industrial sector, labeled X. Production in X is organised as a bilateral monopolistic relationship, with an upstream firm supplying an intermediate product to a downstream firm.[1] The downstream firm in turn acts as a monopolist in the product market and thus faces both factor and product market imperfections. It is assumed that the downstream firm only demands one unit of the upstream product. As in Hart and Tirole [55], the downstream firm has limited needs, i.e. the upstream firm faces an inelastic demand for its output. The upstream good can be viewed as a piece of machinery or technology that allows the downstream firm to produce at constant marginal cost, C^d. The appendix at the end of this chapter presents an alternative case, where the level of investment of the upstream firm does

[1]As in much of the literature on trade and trade policy under market imperfections, we assume an exogenously specified market structure. Some attempts have been made to develop models that generate alternative market structures for different parameterisations of the model. A particularly interesting example is presented in Horstmann and Markusen [59].

not only affect variable production costs of the upstream firm, but also of the downstream firm. The implications of this will be considered in due course.

As a prerequisite for production, the upstream firm needs to make a cost-reducing investment. Since the upstream and downstream firms are involved in a long-run bilateral trading relationship, these upstream investments are likely to be party-specific. Specific investments refers to a situation where an assets full productive value is only attained within the specific trading relationship that it was designed for. Asset specificity creates a 'lock-in' effect, as the two firms will find it beneficial to trade amongst themselves rather than with outsiders.[2]

These asset specificities will serve as a motive for vertical integration. In this paper we assume that the costs associated with merging exceed the benefits, so that no integration occurs. Recent work in incomplete contracting theory has suggested a wide range of motives that may keep firms from integrating. For instance, Holmström and Tirole [61] suggest that integration may lead to a loss of information about the subordinate's performance. Further incentive problems are highlighted by Grossman and Hart [45] and Hart and Moore [54]. Hart and Tirole [55] suggest that prohibitive legal costs may prevent mergers or that an efficient court may forbid foreclosure.[3]

We model decision making by the upstream and downstream firms as a two-stage process. In the first stage, the upstream firm decides how much to invest. This investment is sunk immediately. Let $C^u(I_i)$ denote the marginal production costs of the upstream firm, expressed as a function of the in-

[2]Williamson [134] suggests that the presence of switching costs can result from a wide range of different specificities, including site specifity, human capital specificity (e.g. through learning by doing), physical capital specificity, brand name capital or dedicated assets.

[3]For a more detailed discussion, refer to Hart and Holmström [53], who discuss a variety of further integration costs, including costs brought about by uncertainty about future outcomes as well as implementation costs. Institutional factors, such as anti-trust legislation may also prevent firms from merging.

vestment level by the upstream firm, I_i, where i=a,f,c, for autarky, free trade of the downstream good and capital mobility of the downstream firm respectively.[4] Let

$$\frac{dC^u(I_i)}{dI_i} < 0 \ , \tag{3.2.1}$$

and

$$\frac{d^2C^u(I_i)}{dI_i^2} > 0 \ , \tag{3.2.2}$$

implying that investment reduces the marginal costs of production, but at a decreasing rate. In the second stage, the upstream firm produces and the good is supplied to the downstream firm. The downstream firm then uses it in its production process and sells its goods in the final product market.

Consumption

Utility takes the quasi-linear form

$$U_a = Z + \frac{1}{\alpha}\left(X_a^d\right)^{\alpha} \ , \tag{3.2.3}$$

where $0 < \alpha < 1$ and Z is a second consumption good. Demand for the downstream good X^d under autarky is then given by

$$X_a^d = \left(\mathrm{P}_a^d\right)^{-\mu} \ , \tag{3.2.4}$$

providing income is no less than $\mathrm{P}_a^d X_a^d = \mathrm{P}^{\frac{\alpha}{1-\alpha}}$. P_a^d is the price of the downstream good under autarky and $\mu = \frac{1}{1-\alpha}$ denotes the price elasticity of demand faced by the downstream producer. Note that $|\mu| > 1$ implies that the price charged by the downstream monopolist always exceeds its marginal cost. Quasi-linear utility dictates that the demand for X^d is only a function of its price P^d. It is independent of income or the price of Z. As the price of

[4]We shall employ general cost functions throughout the analysis. A tractable alternative could use linear demands and quadratic investment costs. All the qualitative results of the model carry through in this context. For the use of linear prices, see for instance Farrell and Gallini [40].

X^d falls, the quantity demanded rises, but there is no income effect in the demand for X^d.

Bargaining

As the firms are unable to commit to a price beforehand, the future return of present actions will depend on the bargaining position of the upstream and downstream firms at a future date. At that date, the two firms take the investment decision of the upstream firm as given and bargain over any gains from exchange. We model the bargaining behaviour between the upstream and the downstream firm using the asymmetric Nash bargaining solution, with a fixed threat point involving no trade between the two agents.[5] We suppose that a constant fraction, β, of the surplus of supplying the downstream firm accrues to the upstream firm, where $0 < \beta < 1$. The remaining share $1 - \beta$ goes to the downstream firm.

The Nash solution implies that firms will maximise the joint gains from trading the upstream good,

$$\max_{\mathrm{P}_a^u} \Omega_a = \left[\left(\mathrm{P}_a^d - C^d\right) X_a^d - \mathrm{P}_a^u\right]^{1-\beta} \left[\mathrm{P}_a^u - C_a^u\right]^{\beta} \ , \tag{3.2.5}$$

where P_a^u is the price of the upstream good bargained by the upstream and downstream firms under autarky. Note that the investment costs encountered by the upstream firm are sunk in the second stage and therefore do not enter the bargain. To highlight this, we have suppressed the dependence of upstream prices and costs on investment. The literature commonly refers to

$$b_a = (\mathrm{P}_a^d - C^d) X_a^d \tag{3.2.6}$$

as the benefit of the upstream good to the downstream firm. The overall

[5]We selected the Nash bargaining solution because of its great generality and its simple form which does not require any specification of the bargaining process. The fixed threat point (0,0) implies that levels of trade are not contractually specified and can therefore not be enforced by a court. For further detail, see Osborne and Rubinstein [106].

surplus from trade between the two firms can then be denoted by

$$b_a - C_a^u \; , \tag{3.2.7}$$

where the price of the upstream good is set to affect this division. We will also assume that

$$b_a > C_a^u \; , \tag{3.2.8}$$

so that the two firms are involved in a trading relationship. To eliminate any bargaining inefficiencies due to information asymmetries we assume that profits and upstream production costs are common knowledge in the second stage.

The solution to the bargaining problem between the upstream and downstream firm is obtained by maximising 3.2.5, giving

$$\mathrm{P}^u(I_a) = b_a + (1-\beta)\Big(C^u(I_a) - b_a\Big) \; . \tag{3.2.9}$$

3.2.2 Solving the Basic Model

Having specified the model, we can now solve for the industry equilibrium. As usual, we consider the second stage first.

Second Stage: Downstream Prices

In the second stage, the downstream firm takes the upstream level of investment as given and sets prices to solve the following maximisation problem

$$\begin{aligned} \max_{\mathrm{P}_a^d} \Pi_a^d &= (\mathrm{P}_a^d - C^d) X_a^d(\mathrm{P}_a^d) - \mathrm{P}_a^u \\ \text{subject to } \mathrm{P}_a^u &= b_a + (1-\beta)\Big(C_a^u - b_a\Big) \; . \end{aligned} \tag{3.2.10}$$

The constraint reiterates that the price of the intermediate good is determined by Nash bargaining between the two firms, with β commonly interpreted as the bargaining power of the upstream firm. As before, we have suppressed the dependence on investment to illustrate that investment is sunk in the second stage.

The first order conditions of the downstream monopolist satisfies

$$\mathrm{P}_a^d\left(1-\frac{1}{\mu}\right)=C^d, \tag{3.2.11}$$

where $|\mu|$ is the price elasticity of demand facing the downstream monopolist. The equilibrium product price decreases as the price elasticity of demand increases.

First Stage: Upstream Investment

In the first stage, the upstream firm decides how much to invest, taking into account the effect that its investment will have on second stage prices. The upstream firm maximises

$$\begin{aligned}\max_{I_a}\Pi^u(I_a) &= \mathrm{P}_a^u - C^u(I_a) - I_a \\ \text{subject to } \mathrm{P}^u(I_a) &= b_a + (1-\beta)\big(C^u(I_a) - b_a\big)\ ,\end{aligned} \tag{3.2.12}$$

Substituting in the constraint, we obtain

$$\max_{I_a}\Pi^u(I_a)=\beta(b-C^u(I_a))-I_a\ . \tag{3.2.13}$$

The first order condition implies that investment by the upstream firm occurs at

$$\frac{dC^u(I_a)}{dI_a}=-\frac{1}{\beta}\ . \tag{3.2.14}$$

As the outcome of the firm's maximisation problem, we will refer to this as the privately optimal level of investment.

3.2.3 Efficiency

The level of upstream investment only affects the fixed costs of the downstream firm. Since downstream prices are set as a mark-up over downstream variable costs, any investment distortion is independent of potential consumption distortions. In analysing efficiency and welfare effects, the second-best problem does therefore not arise. This implies that productive and allocative distortions can be analysed separately.

Productive Efficiency

Equation 3.2.14 defined the solution to the actual and privately optimal investment level of the upstream firm. The following simple argument, adapted from Grout [47], will demonstrate that this level does not coincide with the socially efficient investment level.

To show this, we proceed to calculate the socially optimal investment level by maximising

$$\max_{I_a} W(I_a) = b_a - C^u(I_a) - I_a \ , \tag{3.2.15}$$

where W is a measure of social welfare.[6] Equation 3.2.15 generates the following first order condition:

$$\frac{dC^u(I_a)}{dI_a} = -1 \ . \tag{3.2.16}$$

As a comparison of conditions 3.2.14 and 3.2.16 indicates, bilateral bargaining over the upstream good results in a distortion of the investment incentives of the upstream firm. The convexity of $C^u(I_a)$ dictates that the upstream firm will underinvest with respect to the socially optimal outcome. The level of underinvestment increases as the bargaining power of the firm decreases. Once the upstream investment has been made in stage one of the game, the investor is vulnerable to the no-trade threat from the specific buyer. It is precisely this threat that enables the downstream firm to capture a portion

[6]Alternatively this outcome can be viewed as the optimal level of upstream investment when the upstream and downstream firms are vertically integrated.

of the cost savings induced by the specific investment of the upstream firm, a situation referred to as the hold-up problem. The downstream firm can capture a larger portion of these saving as β falls, resulting in lower levels of upstream investment and thus greater social inefficiencies. Williamson [134] refers to the behaviour of the downstream firm as *opportunism.*

Allocative Efficiency

As shown by equation 3.2.11, the monopolist sets prices as a markup over marginal costs. As long as $1 < \mu < \infty$ price exceeds marginal revenue and the quantity of output supplied by the downstream firm is less than the Pareto optimal quantity. The societal loss resulting from this allocative inefficiency is larger when demand faced by the downstream firm becomes less elastic.

We have shown in this section that in the presence of hold-up, the economy is plagued by both allocative and productive inefficiencies. Downstream product prices are excessively high and upstream investment is too low relative to the socially optimal outcome. The magnitude of these inefficiencies depends on consumer preferences, the properties of the cost function of the upstream firm and the size of β. Interestingly, the appendix shows that when upstream investment affects downstream variable costs, the observed investment level may be either greater or smaller than the socially optimal level.

Having identified the equilibrium inefficiencies under autarky, the next section proceeds to analyse the impact of downstream product trade. The core of this chapter follows in section 3.4, which analyses the impact of firm mobility on upstream investment distortions.

3.3 Trade of the Downstream Product

Now assume that there exist two economies of the type just outlined in section 3.2.1. We will refer to them as *Home* and *Foreign*. To highlight the main issues of the paper, suppose that both countries have identical market size, tastes, technologies and factor endowments, and that there exist no physical, cultural or institutional transportation costs between the two nations. We treat the two countries as a single integrated market for the downstream product, where competitors set prices for the combined market rather than setting them independently for each nation.[7] We further assume that both upstream firms produce a homogeneous product whereas the downstream firms produce two horizontally differentiated varieties within the same general product group. Suppose that the two economies open up to trade, and that only the downstream product is tradable.[8] This non-tradability of the upstream good dictates that the bargaining game between the two firms is unaffected by trade and facilitates the distinction between investment and consumption distortions.

This section will show that there exist allocative efficiency gains from trade, even if *Home* and *Foreign* are identical in all respects. The market power of the downstream firm is reduced and a more efficient market structure replaces the former monopoly. The following analysis is supplementary to Markusen [90], where similar results are derived in an environment of Cournot-Nash competition. Before analysing efficiency issues we first incorporate two horizontally differentiated downstream varieties into the demand

[7]The segmented markets perception would introduce a further strategic incentive for international trade. For an exposition of reciprocal dumping see the classic paper by Brander and Krugman [18]. A discussion of the integrated versus segmented market perception and its impact on trade theory can be found in Markusen [90] or Venables [130].

[8]Spencer and Jones [121, 122] and Karp and Sioli [64] have identified strategic incentives for restricting trade of the upstream good.

side of the model presented in section 3.2.1.

3.3.1 The Model under Downstream Product Trade

When more than one downstream variety is available to consumers, X^d in 3.2.4 is a composite of the form

$$X_t^d = \left[(X_{h,t}^d)^{(\sigma-1)/\sigma} + (X_{f,t}^d)^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)} , \tag{3.3.1}$$

where X_h^d denotes the quantity of the variety of the downstream good produced by a home firm and X_f^d is the quantity of the variety of the downstream good produced by the foreign firm. The subscript t denotes the free trade situation. The parameter σ is such that $\sigma > 1$, where a smaller σ indicates a stronger consumer preference for variety per se.

With X_t^d as a composite, We can think of the consumption decision as taking place in two stages: first the consumer considers how much of the composite to consume by solving the overall maximisation problem. Then the consumer decides how much of the different varieties to consume.

Solving the first stage maximisation problem, we find that

$$X_t^d = \left(\mathrm{P}_t^d\right)^{-\mu} , \tag{3.3.2}$$

where $\mu = \frac{1}{1-\alpha}$, the elasticity of demand faced by the industry as a whole with respect to the price index P_t^d, where

$$\mathrm{P}_t^d = \left[\left(\mathrm{P}_{h,t}^d\right)^{1-\sigma} + \left(\mathrm{P}_{f,t}^d\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} . \tag{3.3.3}$$

$\mathrm{P}_{h,t}^d$ represents the price of the domestically produced downstream variety under trade and $\mathrm{P}_{f,t}^d$ gives the price of the variety produced in the foreign country. Note also that symmetry assumptions and the absence of any trade barriers imply that the prices of each variety is the same in both countries.

The second stage demand for any specific variety can now be derived. As in Dixit and Stiglitz [31], the demand for any particular variety is given by

$$X^d_{j,t} = X^d_t \left(\frac{\mathrm{P}^d_t}{\mathrm{P}^d_{j,t}} \right)^{\sigma} , \tag{3.3.4}$$

for $j = h, f$, where h denotes the domestically produced downstream variety and f the foreign variety. Note that under autarky demand for one variety - as given by 3.3.4 - reduces to demand for the industry as a whole - represented by 3.3.3.

Second Stage: Downstream Prices

With the introduction of free trade of the downstream goods the industrial structure is changed from monopolistic to duopolistic. Strategic interactions have to be considered and the second stage maximisation problem becomes

$$\begin{aligned} \max_{\mathrm{P}^d_{j,t}} \Pi^d_{j,t} &= (\mathrm{P}^d_{j,t} - C^d) X^d_{j,t}(\mathrm{P}^d_{h,t}, \mathrm{P}^d_{f,t}) - \mathrm{P}^u_{j,t} \\ \text{subject to } \mathrm{P}^u_{j,t} &= b_{j,t} + (1-\beta)\left(C^u_{j,t} - b_{j,t}\right) , \end{aligned} \tag{3.3.5}$$

for $j = h, f$. The subscript t indexes the free trade trade situation. Note that the nontradability of the upstream good implies that the general form of the bargaining game in the input market is unaffected.

Assuming that the two downstream firms take one another's price as constant, profit optimisation in a Bertrand-Nash fashion produces the following first order condition

$$\mathrm{P}^d_{j,t} \left(1 - \frac{1}{e_{j,t}} \right) = C^d , \tag{3.3.6}$$

where $e_{j,t}$ denotes the perceived elasticity of demand of the firm producing the variety associated with country j. As in Smith and Venables [118], we substitute 3.3.2 and 3.3.3 into 3.3.4 and differentiate with respect to $\mathrm{P}^d_{j,t}$. Employing Bertrand conjectures, we then obtain

$$e_{j,t} = \sigma - (\sigma - \mu)\, s_{j,t} , \tag{3.3.7}$$

where μ is the aggregate industry demand elasticity and s_j is the share of the downstream firm of country j in each market. As before, σ represents the elasticity of demand with respect to the price of the variety itself, and subscript t denotes the situation under free trade. As 3.3.7 demonstrates, the perceived elasticity of demand depends both on the elasticity of demand for a single differentiated product, σ, and on the perceived effect of the action of one firm on the cumulative industry supply.

Whenever the industrial structure is not monopolistic (i.e. $s_j < 1$),

$$\sigma > \mu. \tag{3.3.8}$$

The intuition here is rather simple. If one of the two downstream duopolists changes its price, the change in quantity demanded faced by the particular firm exceeds the change in demand for the industrial sector in its entirety. Hence, the elasticity of demand for its own variety, σ, is greater than the aggregate industry demand elasticity, where the latter includes the actions of the second firm.

First Stage: Upstream Investment

Under free downstream product trade, the upstream firm maximises

$$\begin{aligned} \max_{I_{j,t}} \Pi^u(I_{j,t}) &= \mathrm{P}^u_{j,t} - C^u(I_{j,t}) - I_{j,t} \\ \text{subject to } \mathrm{P}^u(I_{j,t}) &= b_{j,t} + (1-\beta)\big(C^u(I_{j,t}) - b_{j,t}\big) \,, \end{aligned} \tag{3.3.9}$$

for $j = h, f$.

Maximising gives the following first order condition

$$\frac{dC^u(I_{j,t})}{dI_{j,t}} = -\frac{1}{\beta} \,. \tag{3.3.10}$$

The privately optimal level of investment under trade of the downstream product has therefore remained unchanged from its autarky level.

3.3.2 Efficiency

This section will illustrate that the equilibrium allocative inefficiencies that were present under autarky have been reduced by the introduction of free trade. However, the productive inefficiencies still persist. Profits of both the upstream and downstream firms fall under trade.

Allocative Efficiency

As 3.2.10 and 3.2.11 show, under autarky the perceived elasticity of demand is solely determined by the curvature of the aggregate industry demand curve. With the introduction of free trade the industrial structure is changed from monopolistic to duopolistic. Equation 3.3.7 suggests that this will increase the perceived elasticity of demand of each of the two downstream firms. Now that a substitute is available, consumers will be more responsive to price changes of one of the two varieties. Since C^d is constant, the profit maximising conditions 3.2.11 and 3.3.6 imply that

$$\mathrm{P}_a^d > \mathrm{P}_{j,t}^d \, . \tag{3.3.11}$$

for $j = h, f$, the varieties produced by the home and foreign firms respectively.

Opening the economy to trade lowers the price charged by the downstream firm in each country. The increase in the perceived elasticity of demand reduces the size of the markup of prices over marginal costs, which in turn diminishes the extent of the allocative inefficiency. These changes are all driven by the procompetitive effects of opening a monopolistic sector of the economy to international trade and so reducing the concentration of market power.[9]

[9]Note that the above results do not trivially extend to the analysis of vertical product differentiation. Gabszewicz et al. [43] derive that the number of products that can exist in a vertically differentiated product market is bounded from

Productive Efficiency

Trade of the downstream good has no impact on productive efficiency. As the industrial structure of each of the participating countries remains one of a bilateral monopoly, the bargaining game between the upstream and downstream firm remains unchanged. Trade of the downstream product therefore does not alter the first stage upstream investment maximisation problem and productive inefficiencies remain as under autarky.[10]

This result is specific to the assumption that the benefit of the upstream good to the downstream firm is independent of the level of investment. In the present set-up downstream marginal production costs are constant and independent of upstream investment levels. This separates the consumption and the investment distortions. The appendix considers the case where upstream investment affects the variable production costs of both the upstream and the downstream firms. It shows that international trade then reduces both the consumption as well as the investment distortions.

3.3.3 Distribution of Gains

We have just shown that trade in the downstream product encourages competition between two former monopolists and thus reduces distortions in the

above and is independent of market size. They proceed to show that there exists a tendency for the total number of products coexisting at equilibrium to fall under free trade, with low quality goods being driven out of the market. An interesting extension to the present model would involve the introduction of a vertically differentiated product space.

[10]It would be very interesting to consider the impact of the upstream good also being tradable. However, within bargaining theory there is no general agreement on how to model this. A framework of double margins may be able to offer some further insight but is beyond the scope of this chapter.

product market. After some substitutions, we can proceed to show that the utility of a representative consumer is strictly higher under trade, i.e.

$$
\begin{aligned}
\alpha U_{j,t}{}^{\frac{1}{\alpha}} &= \frac{2^{\sigma-\mu}}{\alpha}\left(\frac{\sigma+\mu}{\sigma+\mu-1}C^d\right)^{-\mu} \\
&> 1^{\sigma-\mu}\left(\frac{\mu}{\mu-1}C^d\right)^{-\mu} \\
&= \alpha U_{j,a}{}^{\frac{1}{\alpha}}\ , \qquad (3.3.12)
\end{aligned}
$$

for j=h, f. Increased utility under trade is the result of two different forces. First, increased competition reduces downstream markups over production costs. This is captured by the second component of the utility function. In addition, trade has doubled the number of varieties available to the consumer and as consumers value variety per se, this further raises consumer welfare. This is captured by the first term of the utility expression. These two forces cumulatively act to generate an increase in consumer satisfaction.

As a result of trade and competition, the downstream producers now face a higher elasticity of demand for their particular product type. This induces the downstream duopolists to decrease their markup over marginal costs. The elasticity of demand dictates that total revenue of the downstream firms increases. However, as the industrial structure in the product market changes from monopolistic to duopolistic, total costs also rise. Some algebraic manipulation illustrates that the benefit of the upstream good to the downstream firm will fall as a result of trade.

$$
\begin{aligned}
b_{j,t} = (\mathrm{P}^d_{j,t} - C^d)X^d_{j,t} &= 2^{\frac{\sigma-\mu}{-(\sigma-1)}}\frac{1}{\sigma+\mu}\left(\frac{\sigma+\mu}{\sigma+\mu-1}C^d\right)^{1-\mu} \\
&< \frac{1}{\mu}\left(\frac{\mu}{\mu-1}C^d\right)^{1-\mu} = (\mathrm{P}^d_{j,a} - C^d)X^d_{j,a} \\
&= b_{j,a}\ . \qquad (3.3.13)
\end{aligned}
$$

The algebra here may seem to hide the simple intuition. As the change in industrial structure reduces markup and increases demand, total revenue increases, but not by as much as total production costs. The benefit of the upstream good to the downstream firm is therefore reduced. Equation 3.2.9 indicates that this lowered benefit will translate into a drop in the price of the upstream good. Both upstream and downstream firms therefore face lower profits, with the distribution of the losses being determined by β, the relative bargaining power of the firms.

The direction of the overall welfare effects are systematically summarised in table 3.1. It suggests that free trade of the downstream product benefits consumers at the cost of producers. However, as net allocative efficiency gains are attained, compensation of the firms is a viable policy option.

Table 3.1: The Welfare Effects of Downstream Product Trade

Agent	Magnitude	Sign
Consumers	$U_{j,t} - U_{j,a}$	+
Downstream Firm	$(1-\beta)(b_{j,t} - b_{j,a})$	-
Upstream Firm	$\beta(b_{j,t} - b_{j,a})$	-

In the above table $U_{j,a}$ denotes utility under autarky for a consumer in $j = h, f$. $U_{j,t}$ denotes utility under trade of the downstream product, $b_{j,a}$ is the benefit of the upstream good to the downstream firm under autarky, $b_{j,t}$ denotes this same benefit under trade of the downstream product, and β denotes the relative bargaining power of the two firms.

3.4 Mobility of the Downstream Firm

Suppose that economic integration proceeds to the next stage and that the downstream firms can choose to locate in either country. We assume that the upstream firms stay internationally immobile. Three alternative equilibrium outcomes are now possible. First, the firms may choose to continue to produce in their respective home countries. The outcome then reduces to the free trade scenario outlined in the previous section. Alternatively, one of the two downstream firms may choose to move to the other country. Because of the symmetric nature of the model, we will restrict the analysis to the case in which the foreign downstream firm may relocate to the home country. As the upstream good is non-tradable, the domestic upstream firm will then supply both downstream firms. In contrast to Bolton and Whinston [12], we assume there are no supply assurance problems.

In this section, we first assume that the foreign downstream firm relocates and examine the impact of this move on the first stage investment decision of the upstream firm. This provides some insight as to if and when it would be optimal for one of the downstream firms to relocate. We proceed to briefly suggest under what circumstances relocation is more likely to be the equilibrium outcome. Lastly, we consider efficiency gains and distributional consequences.

3.4.1 The Model under Capital Mobility

The entry of the foreign downstream firm provides the upstream firm with the opportunity to sell one unit of its product to the new buyer. However, because of the specificity of the investments that the upstream firm has made, these assets cannot be redeployed to the foreign user without some sacrifice of productive value. We will therefore assume that a trading relationship of the upstream firm with the foreign downstream firm results in the upstream production cost corresponding to an investment of λI, where $\lambda \in [0, 1]$. $\lambda = 0$ corresponds to the most extreme form of asset specificity, whereas $\lambda = 1$ signifies the absence of any trade specific investments. Variable production costs of the upstream firm are then given by $C^u(\lambda I_c)$, where the subscript c denotes capital mobility of the downstream firm.

Bargaining

As in Hart and Tirole [55], we shall assume that the bargaining power of the upstream firm is not worsened when a second downstream firm enters the market. Suppose that the upstream firm now captures a fraction β' of the surplus of supplying a downstream firm, where $\beta' \geq \beta$ so that the upstream firm does (weakly) better bargaining with two downstream firms than with one. We also assume that $\beta' < 1$, so that the competition between the downstream firms is not fierce enough for all downstream profits to be eliminated.

Bargaining between the domestic upstream and downstream firm now maximises

$$\max_{\mathrm{P}^u_{h,c}} \Omega_a = \left[\left(\mathrm{P}^d_{h,c} - C^d\right) X^d_{h,c} - \mathrm{P}^u_{h,c}\right]^{1-\beta'} \left[\mathrm{P}^u_{h,c} - C^u_{h,c}\right]^{\beta'} . \tag{3.4.1}$$

This yields the following price for the upstream good

$$\mathrm{P}^u_{h,c} = b_{h,c} + (1-\beta')\left(C^u_{h,c} - b_{h,c}\right) . \tag{3.4.2}$$

Bargaining between the domestic upstream and the foreign downstream firm maximises

$$\max_{\mathrm{P}^u_{f,\lambda c}} \Omega_a = \left[\left(\mathrm{P}^d_{f,c} - C^d\right) X^d_{f,c} - \mathrm{P}^u_{f,\lambda c}\right]^{1-\beta'} \left[\mathrm{P}^u_{f,\lambda c} - C^u_{f,\lambda c}\right]^{\beta'} , \tag{3.4.3}$$

yielding

$$\mathrm{P}^u_{f,\lambda c} = b_{f,c} + (1-\beta')\left(C^u_{f,\lambda c} - b_{f,c}\right) . \tag{3.4.4}$$

Suppose further that

$$b_{f,c} > C^u_{f,\lambda c} , \tag{3.4.5}$$

so that trade with both upstream firms is beneficial.[12]

[12]Alternatively, one could model the entry of the second downstream firm in the market as an outside option for the domestic upstream firm. This approach is particularly appropriate when there are supply assurance concerns.

Second Stage: Downstream Prices

Because of the symmetric nature of the model and the absence of any barriers to trade, the downstream maximisation problem is analogous to the free trade situation. Although the profits of the upstream firm may be altered as the price of the upstream good changes, this can be fully attributed to changes in fixed costs and therefore does not affect the downstream pricing decision.

First Stage: Upstream Investment

Given the entry of a second downstream firm and the changes in relative bargaining power induced by this entry, the upstream firm now maximises

$$\begin{aligned}\max_{I_{h,c}} \Pi^u(I_{h,c}) &= \Big(\mathrm{P}^u(I_{h,c}) - C^u(I_{h,c})\Big) + \Big(\mathrm{P}^u(\lambda I_{h,c}) - C^u(\lambda I_{h,c})\Big) - I_{h,c} \\ \text{s. t. } \mathrm{P}^u(\lambda I_{h,c}) &= b_{f,c} + (1-\beta')\Big(C^u(\lambda I_{h,c}) - b_{f,c}\Big) \\ \text{and } \mathrm{P}^u(I_{h,c}) &= b_{h,c} + (1-\beta')\Big(C^u(I_c) - b_{h,c}\Big) \ . \end{aligned} \tag{3.4.6}$$

Maximising 3.4.6 gives

$$\frac{dC^u(I_{h,c})}{dI_{h,c}} + \lambda\frac{dC^u(\lambda I_{h,c})}{d\lambda I_{h,c}} = -\frac{1}{\beta'} \ . \tag{3.4.7}$$

If $\lambda = 0$ and $\beta' = \beta$, equation 3.4.7 reduces to the autarky situation, as in equation 3.2.14. In the case of full asset specificity, the foreign downstream firm cannot extract any productive value from the good produced by the domestic upstream firm, and will therefore never choose to relocate. The equilibrium reduces to the free trade scenario.

In the limiting case that $\lambda = 1$ and $\beta' = \beta$, equation 3.4.7 reduces to

$$\frac{dC^u(I_{h,c})}{dI_{h,c}} = -\frac{1}{2\beta'} \ . \tag{3.4.8}$$

Because of the convexity of $C^u(I_{h,c})$, the relocation of the downstream firm results in an increase in investment. By selling two units of the upstream good, the upstream producer is able to cover a larger portion of its fixed costs. Note that the result here is driven entirely by increasing returns to scale and that the bargaining power of the upstream firm has remained unchanged. The hold-up problem therefore persists.

In the likely case that the bargaining power of the upstream firm is increased by the entry of the foreign downstream firm, i.e. $\beta' > \beta$, the upstream firm is able to capture a larger portion of the return on its investment regardless of the degree of asset specificity. As equation 3.4.7 shows, the convexity of $C^u(I_{h,c})$ implies that the first stage optimisation of upstream investment is such that

$$I_{h,c} > I_{h,a} \ . \tag{3.4.9}$$

Any welfare gains in this scenario can be attributed to an increase in the bargaining power of the upstream firm, reducing the scope for downstream opportunism. As hold-up is reduced, the upstream firm is now able to capture a larger share of the returns to its investment and will therefore invest more.

3.4.2 Efficiency

It was shown earlier that through a reduction in market power, trade of the downstream product improved allocative efficiency. As a result of the symmetric nature of the model and the absence of any barriers to trade, mobility of the downstream firm does not add any further allocative gains.

If one of the downstream firms decides to relocate, productive efficiency gains will be realised. These may operate through two distinct mechanisms. (i) As the upstream supplier can now sell two units, it is able to cover a larger portion of its fixed costs. The exploitation of increasing returns to scale provides an incentive for increased upstream investment. (ii) As in Hart and Tirole [55], the entry of the second downstream firm into the bargaining game (weakly) increases the bargaining power of the upstream firm. The upstream firm can therefore capture a (weakly) larger portion of the return to its investment than under trade or autarky. This stimulant of productive efficiency gains is inversely related to the magnitude of $\beta' - \beta$.

The appendix shows that the qualitative results are identical when we assume that upstream investment affects downstream variable costs.

3.4.3 Relocation

It remains to be analysed under what circumstances it would be profitable for the foreign downstream firm to relocate to the home country. Because of the symmetric nature of the model and the absence of any physical or man-made trade barriers, the demand faced by the downstream firm is independent of its location. Hence, the relocation decision of the downstream firm is only a function of the price of the upstream good. Recall from 3.4.2 that if the foreign firm chooses to relocate the price of the upstream good is given by

$$\mathrm{P}^u(\lambda I_{f,c}) = b_{f,c} + (1-\beta')\Big(C^u(\lambda I_c) - b_{f,c}\Big) \ . \tag{3.4.10}$$

If the foreign downstream firm does not relocate and chooses to stay in the foreign country, the price it pays for the upstream good is given by

$$\mathrm{P}^u(I_{f,c}) = b_{f,c} + (1-\beta)\Big(C^u(I_{f,c}) - b_{f,c}\Big) \ . \tag{3.4.11}$$

Comparing 3.4.10 and 3.4.11, three different effects can be identified. First, the price of the upstream good tends to be higher when the foreign firm relocates because of asset specificity. Since the investment of the domestic upstream firm is geared towards the domestic downstream firm, there is some sacrifice of productive value when it is redeployed to the foreign user. Second, increasing returns to scale dictate that the price of the upstream good is lower in 3.4.10 than in 3.4.11. If the foreign firm relocates, the domestic upstream firm supplies two units of its product. Since this enables the firm to cover a larger portion of its fixed costs, upstream investment will increase. This lowers upstream variable production costs and therefore also the price of the upstream good in 3.4.10. Third, relocation of the foreign downstream firm may increase the bargaining power of the domestic upstream firm. Although this lowers the share of the surplus that the downstream firm can capture, it also reduces hold-up and therefore increases upstream investment. This in turn lowers the variable production costs of the upstream firm and thus the price of the upstream good. The net effect of this third force on $\mathrm{P}^u(\lambda I_{f,c})$ is ambiguous.

The qualitative effects of trade in the downstream good and relocation of the downstream firm are summarised in table 3.2.

Table 3.2: The Determinants of the Price of the Upstream Good

	Autarky	Trade	Capital Mob.
Bargaining power	β	β	$\beta' \geq \beta$
Benefit	$b_{j,a}$	$b_{j,t} < b_{j,a}$	$b_{j,t} = b_{j,c}$
Investment	$I_{j,a}$	$I_{j,a} = I_{j,t}$	$I_{h,c} \geq I^*_{h,t}$
$\mathrm{P}^d_{j,i}$	$\mathrm{P}^d_{j,a}$	$\mathrm{P}^d_{j,t} < \mathrm{P}^d_{j,a}$	$\mathrm{P}^d_{j,t} = \mathrm{P}^d_{j,c}$

* $I_{h,c} > I_{h,t}$ if the downstream firm relocates.

Recall that j=h,f.

Relocation of the foreign firm is therefore more likely when asset specificities are smaller, increasing returns are larger, and when a change in the bargaining power of the upstream firm leads to larger savings in variable upstream production costs.[13]

[13]It was suggested earlier that one can model the entry of the second downstream

3.4.4 Gains from Capital Mobility

The domestic upstream firm is obviously a clear beneficiary of the move to downstream firm mobility. The demand for its products has doubled relative to the free trade situation. As its bargaining power may also have gained strength, it can claim a larger portion of downstream profits which increases the return to its investments. In the present model, it is arbitrary which downstream firm will relocate. In a more general model, many variables would affect the outcome, including transportation costs, asymmetric demands and production costs.

Total revenue of the downstream firms will not be affected by firm mobility compared to the free trade scenario. Since the price of the upstream good can only fall, downstream firms are (weakly) better off. If neither firm moves, the capital mobility scenario reduces to free trade as outlined in section 3.3.1. Both firms will increase profits if either one relocates. Depending on the degree of asset specificity, the rise in profits may be smaller for the relocating firm than for the other downstream producer.

Since the price of the downstream product under capital mobility remains identical to the free trade price, consumers are in no way affected.[14]

3.5 Concluding Remarks

This chapter has made an attempt at a more formal identification of productive efficiency gains arising from trade and economic integration. It is

firm as an outside option for the upstream firm. In the absence of any asset specificities it is then easy to show that the relocation of the foreign firm enables the domestic upstream firm to capture all the returns to its investment, i.e. $P^u_{h,c} = P^u_{f,c} = b_{f,c} = b_{h,c}$. In this set-up, the downstream firms will therefore never choose to relocate.

[14]In a general equilibrium model employment effects would have an impact on consumer welfare.

argued that economic integration reduces the magnitude of the *hold-up* and thus increases investment. In contrast to many trade models, the present model suggests that trade is an imperfect substitute for factor mobility. The relocation of the downstream firm generates efficiency gains over and above those resulting from trade of the downstream product alone.

The results in this chapter were arrived at in a fairly simple symmetric framework. The obvious question to raise is to what extent the results obtained might generalise.

A first extension would involve abandoning the symmetry between the two nations. Differing country sizes, asymmetric demands and production costs should be allowed for to capture many forces in the international economy. Although this may alter the magnitude of some of the forces in the model, the qualitative predictions will remain unaltered. One of the potential assets of such an asymmetric approach is that it will remove some of the ambiguities in the model. A closely related extension would centre around the issue of transportation costs and their effect on the location decisions of the downstream firm. As before, the framework presented in this paper would still be suitable, but the relative importance of the forces would be modified by the pervasiveness of physical and man-made trade barriers. A final extension would involve the identification of potential efficiency gains in other input markets, most notably labour. This will involve an analysis of the impact of economic integration on the bargaining position of trade unions.

A central assumption in the paper is the notion that the benefit of the upstream good to the downstream firm is independent of the level of investment. This greatly facilitates the analysis by separating the consumption and investment distortions. Relaxing this assumption, the appendix suggests the following results: (i) under autarky, privately optimal investment is less than socially optimal investment (ii) trade of the downstream good reduces the consumption as well as the investment distortions, and (iii) downstream firm mobility may generate productive efficiency gains through the exploitation of increasing returns to scale or a reduction in the hold-up problem. The intuition behind all these results is presented in the appendix.

Although it makes no pretense at generality, it is hoped that this chapter has provided some insight into the formalisation of productive efficiency gains from trade that have long been recognised, but are yet to be extensively formalised. Using the tools of the new trade theory literature as well as recent developments in incomplete contracting theory, this chapter hopes to have shown that the modeling of endogenous imperfections in the market for intermediate inputs will generate further gains from trade. The next chapter makes an attempt to endogenise market imperfections in a second input market: the labour market. Further gains from trade will then be derived.

3.6 Appendix

In the main text of this chapter, we considered the case where the investment of the downstream firm only affects the fixed costs of the upstream firm. Since the pricing decision of the downstream firm is based on variable costs only, this set-up enabled us to separate the consumption and investment distortions.

This appendix considers the case where the upstream investment decision enters the variable costs of both the upstream and the downstream firms. Since the benefit of the upstream good to the downstream firm is now dependent on the upstream investment level, the consumption and investment distortions are no longer separable. The aim of this appendix is to sketch how this may alter the results of the model. We first solve the model under autarky and then discuss the implications of (i) free trade of the downstream good and (ii) downstream firm mobility.

3.6.1 Autarky

Bargaining

As in the main text of chapter 3, bargaining between the upstream and the downstream firm maximises

$$\max_{\mathrm{P}_a^u} \Omega_a = \left[\left(\mathrm{P}_a^d - C_a^d\right) X_a^d - \mathrm{P}_a^u\right]^{1-\beta} \left[\mathrm{P}_a^u - C_a^u\right]^{\beta} . \tag{A.1}$$

Although this maximisation problem is identical to 3.2.5, it should be noted that downstream variable costs C_a^d are no longer exogenous and now depend on upstream investment levels.

Maximising A.1 yields

$$\mathrm{P}^u(I_a) = b_a + (1-\beta)\Big(C^u(I_a) - b_a\Big) , \tag{A.2}$$

where the benefit of the upstream good to the downstream firm is given by $\left(\mathrm{P}_a^d - C_a^d\right) X_a^d$ and depends on the upstream investment decision.

Second Stage: Downstream Product Prices

Taking the level of upstream investment as give, the second stage maximisation problem of the firm is

$$\begin{aligned}
\max_{\mathrm{P}_a^d} \Pi_a^d &= (\mathrm{P}_a^d - C_a^d) X_a^d(\mathrm{P}_a^d) - \mathrm{P}_a^u \\
\text{subject to } \mathrm{P}_a^u &= b_a + (1-\beta)\big(C_a^u - b_a\big) \, . \qquad \text{(A.3)}
\end{aligned}$$

As before, prices are set as a markup over marginal costs where the size of the markup depends on preferences. The present maximisation differs from 3.2.10 in that C_a^d, X_a^d and b_a^d are affected by the first stage investment decision.

The first order condition of the downstream monopolist satisfies

$$\mathrm{P}_a^d = \left(\frac{e_a}{e_a - 1}\right) C_a^d \equiv \alpha_a C_a^d, \qquad \text{(A.4)}$$

where e_a is the perceived elasticity of demand of the downstream firm. Under autarky, this is equal to μ, the elasticity faced by the industry as a whole. We denote the markup by α. As before, the subscript a indexes the autarky outcome.

First Stage: Upstream Investment

In the first stage, the upstream firm decides how much to invest, taking into account the effect that its investment will have on second stage prices of both the upstream and the downstream goods. It will maximise

$$\begin{aligned}
\max_{I_a} \Pi^u(I_a) &= \mathrm{P}_a^u - C^u(I_a) - I_a \\
\text{subject to } \mathrm{P}^u(I_a) &= b(I_a) + (1-\beta)\big(C^u(I_a) - b(I_a)\big) \, , \qquad \text{(A.5)}
\end{aligned}$$

Substituting in the constraint gives

$$\max_{I_a} \Pi(I_a) = \beta \left[b(I_a) - C^u(I_a) \right] - I_a \ , \tag{A.6}$$

where $b(I_a) = (p^d - C^d) X^d_a$. Maximising with respect to upstream investment yields a few direct effects and an indirect effect operating through $b(I_a)$. A change in investment directly affects upstream profits through the change in production and investment costs. Further indirect effects are triggered since changes in production costs affect the price of the downstream good as well as product demand. However, the envelope theorem suggests that, if prices are set optimally in the second stage, the impact of a change in prices on $b(I_a)$ can be ignored. We therefore only have to consider the direct effects.

Maximising A.6 generates the following first order condition

$$\frac{dC^u(I_a)}{dI_a} = -\frac{1}{\beta} - X^d_a \frac{dC^d(I_a)}{dI_a} \ . \tag{A.7}$$

For simplicity, assume that $C^d_a = d_0 - d_1 I_a$. A.7 then reduces to

$$\frac{dC^u(I_a)}{dI_a} = -\frac{1}{\beta} + X^d_a d_1 \ . \tag{A.8}$$

Efficiency

In the socially optimal case, without any investment or consumption distortions, β equals to unity and X^d_a is at its socially optimal level. It was shown in chapter 3 that investment falls as the bargaining power of the upstream firm is reduced and hold-up increases. Condition A.8 shows that this result extends to the present scenario, where upstream investment affects the variable production costs of the downstream firm. However, A.8 suggests that in the present framework there is a further possible source of investment inefficiencies. The second term on the right hand side shows a positive relationship between downstream demand and upstream investment levels. Deviations of downstream demand from its socially optimal level has repercussions for the level of upstream investment.

3.6.2 International Downstream product Trade

When two formerly closed economies commence trading relationships, the perceived elasticity of demand facing a downstream firm will fall. As shown in the main text of the chapter, the two downstream firms will reoptimise and will lower the markup charged. This will lead to an increase in downstream product demand. Hence, $X_t^d > X_a^d$.

A.8 shows that the reduction in the consumption inefficiency, signified by the increase in downstream product demand, will also decrease the investment distortion. In contrast to the analysis in chapter 3, we here find that international trade reduces the investment distortion through an increase in downstream product demand.

3.6.3 Capital Mobility of the Downstream Firm

In the main text of chapter 3 we derived that relocation of one of the downstream firms may lead to efficiency gains. These gains can either be attributed to the exploitation of increasing returns to scale or through a reduction in the hold-up problem. In the framework presented in this appendix gains due to increasing returns to scale operate in a manner similar to that presented in chapter 3.

If β, the share of the rents accruing to the upstream firm, increases then the first term on the right hand side of A.8 suggests that hold-up reduces. As the upstream firm is able to capture a larger share of the returns to its investment, it will invest more. In addition, A fall in product prices will increase downstream demand which in turn will further stimulate investment.

In contrast to the main text of chapter 3, this appendix has shown that international trade will reduce investment inefficiencies when upstream investment affects downstream production costs. The general efficiency results, presented in the main body of chapter 3, can easily be extended to a situation where upstream investment levels affect downstream production costs.

Chapter 4

Economic Integration and the Unionised Labour Market

If A is success in life, then A equals X plus Y plus Z.
Work is X; y is play; and Z is keeping your mouth shut.

Albert Einstein, 1950.

4.1 Introduction

The impact of international trade on domestic labour markets has become a heated topic of debate in political circles and beyond. Ross Perot's image of a *giant sucking sound* captivated at least a portion of his American audience. With the ever accelerating pace of economic integration, interest and concern has also spilled over to the academic community. A literature attempting to link sluggish and unequal OECD wage and employment growth to trade related factors is now emerging. The theoretical basis for this work is the perfectly competitive Heckscher-Ohlin-Samuelson (HOS) model where trade is based on differences in factor endowments. The message so far is mixed. Most authors agree that biased changes in technology explain at least part of the recent wage and employment trends in North America and Europe.

But this is where opinions bifurcate. Some of the recent literature suggests that international trade also has a significant role to play.[1] Other authors contend that biased technological change is almost solely responsible for the observed labour market changes.[2]

Most of the recent literature on trade and labour markets has focussed on the globalisation phenomenon. There is no doubt that trade with 'the South' has increased in recent decades. In the European Union (EU), imports from newly industrialising economies (NIE's) have risen from 5% of total imports in 1970 to a current 12%. However, Krugman [75] emphasises that although these imports have effectively emerged out of nothing, they still only compound to 1.3% of total EU GDP. This basic message is reiterated by a recent survey of a number of large Dutch firms.[3] They report that their most menacing competitors do not originate in low-wage countries. Instead, they are based in other European Union countries, the United States and Japan.[4] The present study analyses the impact of these procompetitive effects of regionalisation on domestic labour markets.

In smoothly functioning labour markets, the new trade theory has demonstrated that intra-industry trade will raise real wages. As international trade

[1]See Berman, Bound and Grilliches [2], Borjas, Freeman and Katz [14], Leamer [82, 83], Murphy and Welch [98], Sachs and Shatz [113] and Wood [135].

[2]See Bhagwati and Dehejia [7], Krugman and Lawrence [76], and Lawrence and Slaughter [79]. Of course it is quite plausible that biased technological change is not autonomous and instead induced by trade related factors.

[3]More details can be found in *De Volkskrant*, 06/01/96; and *The Economist*, 27/01/96.

[4]It would be an exaggeration to fully attribute the recent intensification of competition in both product and labour markets to international factors. In a recent study, Konings and Vandenbussche [70] suggest that between 1980 and 1984, 58.8% of a sample of UK firms reported an intensification of competition from within the UK. 52% of the firms experienced an increase in competition from abroad. Between 1985 and 1989 the respective numbers for the same sample were 49% and 69%. These data suggest that, whereas the firms facing an increase in UK competition is falling, the increase in foreign competition is rising rapidly.

enables countries to benefit from economies of scale and lower unit costs, consumer prices fall compared to autarky. In addition, the increase in foreign competition may squeeze price-cost markups further lowering product prices and increasing consumer welfare. An emerging literature suggests that these results may no longer hold when there are labour market imperfections.[5] Driffill and van der Ploeg [33] suggest that unions may set higher wages under international trade since this enables them to bring about a reduction in the supply of goods and thus turn the terms of trade in their favour. Danthine and Hunt [28] show that integration can be viewed as a move towards the decentralisation of the bargaining structure. This may either increase or decrease real wages. An increase in wages is also demonstrated by Naylor [100]. Another strand of the literature proposes that trade may lower wages. Huizinga [62] assumes that trade increases the elasticity of labour demand and proceeds to show that international market integration reduces inefficiencies. Driffill and van der Ploeg [34] suggest that the reduction in trade barriers lowers the domestic price of foreign goods. This increases competition and wages are lowered as the power of monopoly unions falls. Finally, Sørensen [119] shows how the impact of trade on labour markets depends on the exact labour market structure in the integrating economies.

The present chapter models the impact of economic integration on the labour market using a more integrated view of the labour market. We model

[5] An alternative literature examines the impact of labour market institutions on trade. Brander and Spencer [19] study the effect of unions on trade patterns and policy in a Cournot duopolistic product market. Grossman [44] investigates the wage and employment behaviour of a unionised sector that is confronted by an increase in international competition, modeled as a fall in prices. Mezzetti and Dinopoulos [96] build on this analysis and suggest that the results crucially depend on whether the union is wage or employment oriented. Zhao [136] studies the effect of FDI in a similar framework. Clemenz [27] examined the potential contribution of efficiency wage theorems to the study of international trade. Since our aim is to analyse the impact of globalisation trends on wages, we reverse the causality and study the effect of economic integration on a unionised labour market.

the procompetitive impact that economic integration has on industrial structure, pricing strategies and the bargaining game between unions and firms. In contrast to the existing literature, the results are interpreted in a macroeconomic framework. We distinguish between different stages of economic integration. We first focus on the impact of trade and then consider a further procompetitive effect formed by the threat of firm relocation. Foreign direct investment has surged in recent years. In the 1980s, outflows from OECD countries increased by 220% and inflows by 308%. It has been argued that these figures do not capture the full extent of the impact of the increased firm mobility on OECD economies. The threat of firm relocation, even in the absence of actual movement, may have a further effect on OECD labour markets. The perfectly competitive HOS model, in which trade and factor mobility are perfect substitutes, provides only limited insight into these questions. In addition to capturing the procompetitive impact of trade, the model developed in this paper also identifies the consequences of the threat of firm relocation. The effects of the actual relocation of firms are deferred to future work.

The remainder of this chapter can be outlined as follows. The firm level model is set out in the next section. The model combines techniques from the new trade theory with recent developments in New Keynesian macroeconomics. We first illustrate the equilibrium for a closed economy. We then introduce a second identical economy and analyse the impact of trade and the threat of firm mobility. This section is of a partial equilibrium nature and its primary aim is to identify the forces at work. In section 4.3, the model is aggregated to the industry level. We now examine the overall effects of trade and the threat of firm mobility taking into industry level effects. Welfare and distributional issues are then considered. Section 4.4 concludes.

4.2 Firm Level Equilibrium

4.2.1 The Basic Model

Consumers

Suppose that utility takes the quasi-linear form

$$U = Z + \frac{S^{1-a}}{a} X^a \,, \tag{4.2.1}$$

where

$$X = \left[\sum_{i=1}^{SM} x_i{}^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)} \,. \tag{4.2.2}$$

and $0 < a < 1$. The composite X consists of a number of horizontally differentiated varieties x_i. Z represents a second homogeneous consumption good. The parameter σ in 4.2.2, the elasticity of demand for a single differentiated product, is such that $\sigma > 1$, where a smaller σ indicates a stronger consumer preference for variety per se. 4.2.2 is strictly concave. S is a size parameter and is set to one under autarky.

We can think of the consumption decision as taking place in two stages: first the consumer considers how much of the composite to consume by solving the overall maximisation problem. Then the consumer decides how much of the different varieties to consume.

Solving the first stage maximisation problem, we find that demand is

$$X = SP^{-\mu} \,, \tag{4.2.3}$$

providing that income is no less than $PX = P^{\frac{a}{a-1}} S$, where S denotes size and $\mu = \frac{1}{1-a}$, the elasticity of demand faced by the industry as a whole with respect to the price index P, where

$$P = \left[\sum_{i=1}^{SM} (p_i)^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \,, \tag{4.2.4}$$

where p_i represents the price of the variety produced by downstream firm i. We restrict $|\mu| > 1$, implying that the prices charged by the downstream monopolist always exceed marginal cost. Note that the demand for the horizontally differentiated good is independent of income and the price of Z. As the price of X falls, the quantity demanded rises, but there is no income effect in the demand for X.

The second stage demand for any specific variety can now be derived. As in Dixit and Stiglitz [31], the demand for any particular variety is given by

$$x_i = X\left(\frac{P}{p_i}\right)^{\sigma} . \tag{4.2.5}$$

Firms

Consider the industrial sector of the domestic economy composed of i=1....M firms, where M is large but finite. The number of firms is fixed. Each firm produces a distinct variety of a horizontally differentiated good and faces an identical cost function. The determination of employment and wages at the firm level is modeled as a two-stage game. In the first stage workers and unions bargain over wages. Taking wages as given, in the second stage firms simultaneously set prices and employment levels. As usual, the game is solved backwards. In this section we hold wages constant and solve for the firm's problem.

All firms face the following constant returns to scale Cobb-Douglas production function

$$x_i = N_i^{\alpha} K^{1-\alpha} , \tag{4.2.6}$$

where N_i is employment and K denotes the predetermined capital stock of each firm. We suppose that capital is sunk so that employment is the only factor input endogenised in the model. Firms will choose to maximise profit

$$\max_{N_i} \Pi_i = p_i x_i - W_i N_i , \tag{4.2.7}$$

where W_i denote the nominal wage of workers in firm i. Maximising 4.2.7 shows that labour is hired until its marginal revenue product equals the wage rate

$$N_i = K \left(\frac{W_i}{\alpha \kappa \mathrm{p}_i} \right)^{-\frac{1}{1-\alpha}} , \tag{4.2.8}$$

where

$$\kappa_i = 1 - \frac{1}{e_i} . \tag{4.2.9}$$

e_i is the perceived elasticity of demand faced by firm i. This elasticity depends both on the elasticity of demand for a single differentiated product, denoted from here on as σ, and on the perceived effect of the action of one firm on the cumulative industry supply, μ. Alternatively, μ can be interpreted as the elasticity of demand when all firms raise prices simultaneously. When firm i changes its price while other prices remain unchanged, the elasticity of demand is given by e_i. As in Smith and Venables [118], we obtain this perceived elasticity by substituting equations 4.2.3 and 4.2.4 into 4.2.5 and differentiating with respect to p_i. Employing Bertrand conjectures, we then obtain

$$e_i = \sigma - (\sigma - \mu) s_i , \tag{4.2.10}$$

where s_i denotes the market share of firm i. 4.2.10 shows that κ, the inverse of the price marginal cost mark-up, is nondecreasing in μ and σ and nonincreasing in the market share of firm i, s_i. κ can be interpreted as an indicator of product market competitiveness.

Wage Determination

In the previous section we solved for the second stage firm's problem. Taking into account the impact of wages on second stage product demand, this section turns to first stage wage setting. Since product demand for any particular good depends on prices set by other firms, wage setting in one firm is affected by wage setting in other firms.

In modeling wage determination, we follow quite closely Layard et al. [81]. All domestic workers belong to one of the firm-level unions.[6] The wage rate is viewed as the outcome of a bargaining process between a risk-neutral union and a firm, where both players aim to maximise their respective objectives. Bargaining is modeled using the axiomatic Nash solution. We ignore effort and assume that bargaining is over nominal wages only, leaving the right-to-manage to the firm. To guarantee an efficient bargain, assume that all variables are common information before the onset of the bargain.

We assume that unions aim to maximise rents.[7] The union objective for the ith firm-union bargain is

$$U_i = N_i(W_i - b) \ , \tag{4.2.11}$$

where U_i denotes the utility function of union i, and b is the expected real income a union member obtains when he is not employed by the firm in question.[8] We assume that no single firm is large enough to affect b. The

[6]If unions were sector rather than firm-specific, the labour demand faced would be less elastic. The negative employment consequence of increasing the wage rate is worse when there is only a wage increase in one firm than if the wage increase concerns all firms in the sector.

[7]See Rosen [111], de Menil [95] and Calvo [20]. We adopted rent maximisation for simplicity. There is considerable debate over the appropriate choice of a union's maximand. However, most authors agree that unions maximise some function in which both the real wage and employment enter positively. We adopted the simplest function possible, but wish to emphasise that the fundamental results are not affected by the choice of more complicated union objective functions. For some empirical support, refer to Dertouzos and Pencavel [29].

[8]As in much of the literature, the union objective function differs from the consumers utility function. The indirect utility function following from the demand specification of the model is given by $U_i = W_i + \frac{1-\alpha}{\alpha} P^{-\frac{\alpha}{1-\alpha}} S$. The union member's utility is increasing in product wages and decreasing in in the price index P. Unless

objective function 4.2.11 shows that the union only cares about the wage surplus and the number of workers in the firm. The linearity of the union utility function implies that workers are risk-neutral. In the case that bargaining is unsuccessful, no production will take place and workers will receive the fallback income b. Since only surplus income in excess of b enters the utility function of the union, the union's threat point equals zero.

The objective for each firm is to maximise profits as given by 4.2.7. If wage negotiations fail the firm has no outside option and its fallback income $\bar{\Pi}$ is zero.

In the first stage, each union and each firm bargain over wages, where both parties know that the solution is confined to the labour demand schedule generated in the second stage of the game. Assuming that the union gets a fraction β of the firm's profits, the generalised Nash bargain is[9]

$$\max_{W_i} \Omega_i = \Pi_i U_i^{\beta} \ , \tag{4.2.12}$$

subject to second stage labour demand as given by 4.2.8. Since the threat points of both the union and the firm are zero, they do not affect the wage bargain.

Maximising 4.2.12 gives the following first order condition for the bargained wage

$$\frac{\partial \log W_i}{\partial W_i} = \frac{\beta}{W_i - b} + \frac{\beta}{N_i}\frac{\partial N_i}{\partial W_i} + \frac{1}{\Pi_i}\frac{\partial \Pi_i}{\partial W_i} \ . \tag{4.2.13}$$

the firm is very large, these price effects are secondary and objective function 4.2.11 seems a reasonable - and definitely commonly used - approximation of reality.

[9] Although we chose to employ the axiomatic Nash Bargaining solution, the same result can be attained using the noncooperative approach due to Rubinstein [112]. Binmore, Rubinstein and Wolinsky [9] demonstrated that the generalised Nash Bargaining solution is the limit, as the time between bargaining rounds goes to zero of a noncooperative sequential offer bargaining game. One of the advantages of this noncooperative approach is that β can be interpreted as the relative discount rates of the firm and the union. β will be lower the higher the relative discount rate of the union and can in principle be measured using economic information.

After some algebraic manipulation and use of the envelope theorem, it can be shown that

$$W_i = b\left[1 - \frac{1}{\epsilon_{NW} + \frac{N_i W_i}{\Pi_i \beta}}\right]^{-1} , \tag{4.2.14}$$

where the wage elasticity of employment, ϵ_{NW}, is given by

$$\epsilon_{NW} = \left|\frac{\partial N_i}{\partial W_i}\frac{W_i}{N_i}\right| = [1-\alpha\lambda]^{-1} , \tag{4.2.15}$$

where $\lambda = 1 - \mu^{-1}$. Using second stage labour demand 4.2.8 reveals that the expected relative share of wages in the model is given by

$$\frac{W_i N_i}{\Pi_i} = \frac{\alpha\kappa_i}{1-\alpha\kappa_i} . \tag{4.2.16}$$

With the Cobb-Douglas production function, wage and profit shares are independent of wages and prices. It is easily shown that labour's share of total revenue is decreasing in both labour intensity (α) and product market competitiveness (κ).

Substituting equations 4.2.15 and 4.2.16 into 4.2.14 gives the following expression for wages

$$W_i = \left[\frac{\beta(1-\alpha\kappa_i) + \alpha\kappa_i(1-\alpha\lambda)}{\alpha\kappa_i(1-\alpha\lambda) + \beta\alpha\lambda(1-\alpha\kappa_i)}\right] b \equiv \psi b , \tag{4.2.17}$$

where $\psi \geq 1$ denotes the markup over the fallback income b. Note that the bargaining outcome is bordered by the competitive ($\beta = 0$) and the monopoly union ($\beta = 1$) solution. An exercise in basic differentiation reveals that the wage rate is increasing in the bargaining power of the union β and decreasing in product market competitiveness κ and in λ.

4.2.2 Autarky

Under autarky, all firms face an identical cost function and we can concentrate on the symmetric equilibrium, with $p_i = p$, $x_i = x$, $N_i = N$, $W_i = W$,

$\Pi_i = \Pi$, $U_i = U$ and $s_i = s$, $\forall i$. Equation 4.2.3 then reduces to

$$\mathrm{P} = (SM)^{\frac{1}{1-\sigma}} p \,. \tag{4.2.18}$$

Equilibrium firm level employment can be calculated by substituting equations 4.2.18 and 4.2.5 into the first order condition 4.2.8. This generates

$$N = K \left\{ \frac{W K^{\frac{1}{\mu}}}{\alpha \kappa S^{\frac{1}{\mu}\left(\frac{1-\mu}{1-\sigma}\right)} M^{\frac{1}{\mu}\left(\frac{\sigma-\mu}{1-\sigma}\right)}} \right\}^{\frac{-1}{1-\alpha\lambda}} , \tag{4.2.19}$$

where W_i is given by equation 4.2.17. It is straight-forward to show that firm level employment is an increasing function of market size, labour intensity and product market competitiveness and a decreasing function of the wage rate.

4.2.3 International Trade

We proceed to analyse the effect of international trade on the bargained real wage and employment. The present section identifies the basic forces at the firm level. A more general analysis of the industry equilibrium follows in the next section of the paper.

For simplicity we assume that there exist two economies of the type just outlined in section 4.2.1. To highlight the main issues of the paper, suppose that both countries are identical in all respects: they have identical market size, tastes, technologies and factor endowments. Furthermore, assume that there exist no physical, cultural or institutional transportation costs between the two nations. We treat the two countries as a single integrated market, where competitors set prices for the combined market rather than setting them independently for each nation.[10] In what follows we will analyse the

[10]The segmented markets perception would introduce a further strategic incentive for international trade. For an exposition of reciprocal dumping see the clas-

impact of trade as a change in the market size parameter S. Since the two countries are identical in all respects, S will double from 1 under autarky to 2 under international trade.

Allocative Efficiency

Since in equilibrium all firms will be of the same size, the perceived elasticity of demand in 4.2.10 can can be rewritten as

$$e = \sigma - (\sigma - \mu)\frac{1}{SM} \ . \tag{4.2.20}$$

This shows that international trade reduces the relative market share of a typical manufacturing firm thereby increasing the perceived elasticity of demand faced by each firm. As relatively more firms are now in the industry, the effect of the action of one individual firm on cumulative industry supply falls. Since producers face a relatively more competitive environment, the marginal cost mark-up falls reducing allocative inefficiencies.

It is now straight-forward to show that κ, the inverse of the price marginal cost markup, increases as the economies start trading. Substituting 4.2.20 into 4.2.9 it follows that

$$\frac{d\kappa}{dS} = \frac{d\kappa}{de}\frac{de}{dS} = \frac{(\sigma - \mu)}{e^2}\frac{1}{S^2 M} > 0 \ , \tag{4.2.21}$$

since σ, the elasticity of demand for a single differentiated product always exceeds μ, the elasticity of demand faced by the industry as a whole. International trade therefore lowers the markup that firms charge.

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sic paper by Brander and Krugman [18]. A discussion of the integrated versus segmented market perception and its impact on trade theory can be found in Markusen [90] or Venables [130].

Wage Determination

The impact of international trade on the bargained wage is given by differentiating 4.2.17 with respect to S, yielding

$$\begin{aligned}\frac{dW}{dS} &= \frac{dW}{d\kappa}\frac{d\kappa}{dS} \\ &= \frac{-\alpha\beta\,(1-\alpha\lambda)^2\,b}{(\alpha\kappa(1-\alpha\lambda)+\alpha\beta\lambda(1-\alpha\kappa))^2}\frac{(\sigma-\mu)}{e^2}\frac{1}{S^2M} < 0\ . \quad (4.2.22)\end{aligned}$$

As international trade increases competition, a higher κ decreases markups. This in turn depresses the excess rents that are to be divided between capital and labour, thus lowering wages.

There is some empirical evidence on the relationship between market concentration and wage levels. Stewart [124] finds a strong association between product market power and the ability of unions to sustain wage differentials. Borjas and Ramey [15] find that increased imports have eroded rents formerly earned by US producers. This has translated into reduced wage premiums. In more recent work [16] they argue that the impact of foreign competition on the labour market depends on the market structure of the industry. In highly concentrated industries imports have lowered the wages of less-skilled workers. The impact on the wage structure is much smaller when a competitive industry is penetrated. An empirical study by Katz and Summers [65] estimates that, after adjustment for skill levels, wages in export-intensive industries were 11 per cent above average, whereas wages in import-intensive industries are 15 per cent below average.

Employment

To analyse the impact of international trade on employment, we substitute the price index into the profit maximising condition 4.2.8 and differentiate with respect to S. This gives

$$\begin{aligned}\frac{dN}{dS} &= \frac{\partial N}{\partial S} + \frac{\partial N}{\partial W}\frac{dW}{dS} + \frac{\partial N}{\partial \kappa}\frac{d\kappa}{dS} \\ &= \frac{N}{1-\alpha\lambda}\left[\frac{1-\mu}{(1-\sigma)\mu S} + \frac{1}{\kappa} - \frac{1}{W}\frac{dW}{dS}\right] > 0\ , \end{aligned} \tag{4.2.23}$$

where dW/dS is given by 4.2.22 and is negative. The effect of trade on employment can thus be subdivided into a direct and two indirect effects, where the latter operate through the real wage rate and the markup. The direct effect suggests that factor demand increases with international trade. The construction of the price index 4.2.18 reflects the notion that consumers value variety per se. Hence, as the number of varieties available to consumers increases, firms face a higher demand for their products. This in turn translates into an increase in the firm's demand for labour.

The first indirect effect operates through the markup κ. As international trade alters the perceived elasticity of demand of firms, they lower their markup and the prices charged to consumers. This increases product demand which translates into an increase in the firm's demand for labour.[11] The reduction in distortions in the product market brings the economy closer to a first-best outcome and raises firm level employment. The second indirect effect operates through first stage wage determination. As the competitive discipline imposed by international trade reduces product market rents, the Nash maximands are altered. Since there are fewer rents to be shared, the bargained wage is lowered as in 4.2.22. Lower wage rates spur each firm to increase their labour intake thus increasing firm level employment. The direct and indirect effects are all positive and thus reinforce one another.

[11]Note that an increase in S also lowers the price index P thereby reducing both product and labour demand. However, this turns out to be a second order effect.

4.2.4 Firm Mobility

We now assume that each firm has the option to relocate to the other country. Labour remains immobile. Recall that we have assumed away any transportation costs, so that relocation is only a function of differences in labour costs. If a firm relocates, it has to move its capital and incurs a cost ηK, where $\eta > 0$ and K is the capital stock of the firm. We analyse the impact of unrestricted international firm mobility (foreign direct investment) on the domestic economy.

In the presence of international firm mobility, each firm now has the outside option to relocate abroad. The fallback threat-point of the firm then equals the potential profits that a firm could make if it relocated. Let the profits at this disagreement point be denoted by $\bar{\Pi}$. The firms incremental utility from bargaining is given by $\Pi - \bar{\Pi}$. The union's utility level continues to be given by 4.2.11 and its fallback utility level remains at zero. The generalised Nash bargain is now

$$\max_{W} \Omega = \left(\Pi - \bar{\Pi}\right) U^{\beta} . \tag{4.2.24}$$

Differentiating 4.2.24 shows that the bargained wage must now satisfy

$$\frac{\partial \log \Omega}{\partial W} = \frac{\beta}{W - b} + \frac{\beta}{N}\frac{\partial N}{\partial W} + \frac{1}{\Pi - \bar{\Pi}}\frac{\partial \Pi - \bar{\Pi}}{\partial W} . \tag{4.2.25}$$

It can then be shown that

$$W = b\left[1 - \frac{1}{\epsilon_{NW} + \frac{NW}{(\Pi - \bar{\Pi})\beta}}\right]^{-1} . \tag{4.2.26}$$

Since the two countries are identical in all respects, we know that

$$\bar{\Pi} = \Pi - \eta K , \tag{4.2.27}$$

where ηK denote the moving costs incurred by a relocating firm. Note that $\bar{\Pi}$ is always non-negative. If $\eta K \geq \Pi$, the firm still has the outside option to shut down so that $\bar{\Pi} = 0$. The outcome then reduces to the free trade situation. In what follows we shall therefore assume that $\Pi > \eta K$ so that the value of the outside option is strictly positive.

To solve for the axiomatic Nash bargain, we substitute 4.2.27 into 4.2.26 and obtain

$$W = \left[\frac{\frac{\eta K}{\Pi}\beta\,(1-\alpha\kappa) + \alpha\kappa\,(1-\alpha\lambda)}{\alpha\kappa\,(1-\alpha\lambda) + \frac{\eta K}{\Pi}\beta\alpha\lambda\,(1-\alpha\kappa)} \right] b \equiv \xi b\;, \tag{4.2.28}$$

Comparing 4.2.28 to 4.2.17 shows that under firm mobility the coefficient β is replaced by $\frac{\eta K}{\Pi}\beta$. Since $\eta K/\Pi < 1$, this implies that firm mobility effectively reduces the share of the rents accruing to the union.

So far we have focused on the relocation problem of the first firm. Since the identical cost structure implies that no firm will actually relocate, all firms see themselves as facing the problem outlined above and general equilibrium considerations can be ignored. It should be emphasised that the the results in this section are entirely driven by the threat of a firm to relocate. No actual relocation is taking place.

Because of the symmetry of the model we know that $\bar{\Pi} < \Pi$. This implies that the outside option is nonbinding. The relocation threat of the downstream firm is therefore not credible. The appendix shows that one of the properties of the axiomatic Nash Bargaining solution is that the fall-back threat point still affects the bargaining outcome, even when it is nonbinding. However, this is not the case for the noncooperative bargaining model of Rubinstein [112]. The results of this section do therefore not extend to that solution concept.

Wage Pressure

In the previous section we suggested that under Nash bargaining, the threat of firm relocation provides an outside option to the firm. Equation 4.2.28

showed that this can effectively be analysed as a reduction in β, the bargaining power of the union. To analyse the impact of capital mobility on employment, we therefore differentiate the profit maximising condition with respect to β, giving

$$\begin{aligned}\frac{dN}{d\beta} &= \frac{dN}{dW}\frac{dW}{d\beta} \\ &= -\frac{1}{1-\alpha\lambda}\frac{N}{W}\left[\frac{\kappa(1-\alpha\kappa)(1-\alpha\lambda)^2}{(\kappa(1-\alpha\lambda)+\beta\lambda(1-\alpha\kappa))^2}\right] < 0\ . \quad (4.2.29)\end{aligned}$$

Since unions bargain over wages only, there is no direct effect. The indirect effect operates through first stage wage bargaining. The relocation threat of firms effectively reduces the share of the rents that workers are able to capture. As bargained wages fall, firm level employment increases.

The above analysis provides an economic argument for some union s'efforts to form crossborder labour unions. Even when international wage levels are identical, the threat of firm relocation harms the bargaining power of the unions. Cross-border unions can remove a firm's outside option. Although this is obviously desirable from a worker's perspective, it is harmful from an efficiency perspective as factor market distortions are not reduced.

A paper by Driffill and van der Ploeg [33] addresses precisely this issue. In the face of increased international competition between firms, do unions have an incentive to go international as well and cooperate with unions abroad? They find that if monopoly trade unions remain concerned with national rather than international objectives, the welfare of the union members may be lowered as their wages are bid downwards.

4.3 Industry Equilibrium

The analysis above focused on the effects of international trade and firm mobility in a partial-equilibrium firm level model. In this section, we aggregate the firm level results, following closely Layard, Nickell and Jackman [81]. In doing so, we will employ wage-setting and price-setting schedules to situate the economy-wide equilibrium.[12]

4.3.1 Autarky

In an economy wide equilibrium, the expected fallback income b is no longer exogenous. The interaction between b and the unemployment rate u now has to be considered. We model b as follows

$$b = (1-u)\bar{W} + uB \ , \tag{4.3.1}$$

where $\bar{W}$ denotes the outside wage and B exogenous non-labour income. Because all bargaining firms and unions are identical, it follows that

$$W_i = \bar{W} = W \qquad \forall i \ . \tag{4.3.2}$$

Combining equations 4.2.17, 4.3.1 and 4.3.2 yields the following aggregate wage (WS) equation

$$W = \frac{\psi u}{1-\psi(1-u)} B \ , \tag{4.3.3}$$

where ψ is the markup over the fallback income b. It can easily be shown that for $\psi > 1$, the wage equation is negatively sloped in W-u-space. At low levels of unemployment, unions feel that they are in a strong bargaining position and demand higher levels of nominal wages for given prices. The concavity of the WS schedule implies that, as unemployment rises, wages fall at an increasing rate. It is straight forward to show that a higher non-labour income B and a higher markup ψ shift the wage curve to the right.

The second relationship pinning down general equilibrium is the labour demand equation. This is given by the aggregate version of equation 4.2.19

[12]For a treatment of this approach see Carlin and Soskice [21], Layard, Nickell and Jackman [81] and Lindbeck [85].

$$W = \alpha\kappa S^{\frac{1-\mu}{(1-\sigma)\mu}} M^{\frac{\sigma-\mu}{(1-\sigma)\mu}} K^{\frac{(\alpha-1)(1-\mu)}{\mu}} L^{\frac{\mu(\alpha-1)-\alpha}{\mu}} (1-u)^{\frac{\mu(\alpha-1)-\alpha}{\mu}} \quad , \tag{4.3.4}$$

where $N = (1-u)L$ and L represents the exogenously given manufacturing labour force. The literature sometimes refers to 4.3.4 as the price-setting (PS) schedule, since prices are set as a markup over labour costs. The price setting equation gives the 'feasible' wage that price-setters are willing to concede to given a certain level of unemployment u. The PS schedule is positively sloped in W-u-space, implying that the markup rises with the level of economic activity. The convexity of the PS schedule suggests that it does so at a decreasing rate.

Combining the price and the wage equation allows us to solve for the equilibrium industry wide levels of unemployment and wages.

4.3.2 International Trade

As before, we model international trade as an increase in the market size S. As increased competitiveness reduces product market rents, the markup that a union can attain for its workers falls. Differentiating 4.3.3 shows that international trade will induce a downward shift of the WS curve.

Since the feasible real wage is increasing in S, 4.3.4 shows that international intra-industry trade shifts the PS schedule up.[13] As the markup falls, product prices will be lower and demand will increase. To meet this increase in demand, firms will want to hire more labour shifting the PS schedule up. This is depicted in figure 4.1.

International trade will therefore generate an unambiguous reduction in unemployment. On the factor market side, as the bargained wage falls, labour

[13]Note that as S increases κ also increases shifting up the PS curve further.

demand increases. This is reinforced by the effects on the product market, where lowered product prices raise labour demand by firms.[14]

The overall effect on wages is ambiguous. There are two opposing forces operating through the product and factor markets. In the factor market, reduced markups will lead to lower product market rents translating into a lower equilibrium real wage. However, increased demand in the product market will raise labour demand and thus increases wages. The net effect of trade on wages is therefore ambiguous.[15]

Welfare

Trade-induced increases in competition reduce both product and labour market distortions. Although the effect on wages is ambiguous, employment unambiguously increases as a consequence of international trade. Gains from trade are attained as both product and factor market distortions are reduced and the economy is moved closer to a first-best outcome.

We are able to make some inferences about the distribution of the gains from trade. The firms unambiguously lose. As product market rents are dissipated through increased international competitiveness, the rents to be shared between firms and workers fall. Furthermore, the Cobb-Douglas technology implies that the relative share of the rents is given by

$$\frac{\Pi}{WN} = \frac{1 - \alpha\kappa}{\alpha\kappa} . \tag{4.3.5}$$

This demonstrates that the firm will only be able to claim a relatively smaller share of the rents when product market competitiveness increases. It is therefore hit twice. To examine the impact on the income of the workers,

[14]Mathematically this result can be confirmed by equating 4.3.4 and 4.3.3 and implicitly differentiating with respect to S.

[15] Implicit differentiation of the equilibrium condition defined by the PS and WS curves does not resolve this ambiguity.

we have to make the following distinctions. The workers who were initially unemployed and found employment because of international trade will be better off. The welfare of those who remain unemployed is unaffected: they continue to receive the same welfare payment B. Finally, the individuals who were employed both before and after trade may either be better or worse off. As outlined above, the effect of an increase in S on the bargained wage is ambiguous.

Varying the Number of Firms

One possible limitation of the analysis presented here is that the number of firms is kept fixed. If economic integration lowers profits, it is reasonable to expect that some firms will leave the industry. We will briefly outline the effects of such behaviour.

First, as fewer firms remain in the industry, the perceived elasticity of demand for each firm will be less. This will increase the markups that firms charge over production costs. As more rents are generated, unions will be able to bargain higher wages for their workers. This will result in an upward shift of the WS curve. As long as the number of firms in the market under trade is greater than under autarky, international trade will still result in a net leftward shift of the WS curve as in figure 4.1. However, the magnitude of the shift will be smaller the more firms leave the industry. Wages and unemployment will then decrease by relatively less.

Introducing a variable number of firms will also have an impact on labour demand. The effect here is ambiguous. Although there are fewer firms in the market when the economy trades, the remaining firms all face a boost in product demand. This will translate into an increase the number of workers that the firm wishes to hire. If there is a net increase in labour demand, the PS curve will shift to the left by more than depicted in figure 4.1. A net decrease in labour demanded will shift PS1 to the right. Unfortunately, the net effects on wages and employment are ambiguous. If labour demand falls the reduction in unemployment, already dampened by the above upward shift of the WS curve, is suppressed further.

4.3.3 Firm Mobility

Condition 4.2.28 illustrated that the introduction of capital mobility decreases the surplus income over labour costs. It was argued that the effect of capital mobility on the bargained wage can be analysed as a decrease in β, i.e. the share of the rents that the union can claim.

The aggregation process generates the following industry WS schedule

$$W = \frac{\xi u}{1 - \xi(1-u)} B \, , \tag{4.3.6}$$

where ξ represents the new markup with the threat of firm mobility. Differentiation shows that the markup ξ is increasing in β. Hence, since mobility leads to increased wage pressure the WS curve will shift downwards reducing unemployment and lowering wages. Unlike wage setters, price setters are only indirectly affected by the potential for firm mobility. As the level of economic activity increases, the mark-up of prices over wages falls as shown by the movement along the PS curve. This is summarised in figure 4.2. We thus observe unambiguous decreases in unemployment and the bargained wage rate.

Welfare

Productive efficiency gains are attained as increased wage pressure reduces distortions in the labour markets. Although there are net gains, the distribution of these gains will be uneven. Some formerly unemployed workers will be better off since the increased wage pressure reduces the unemployment rate. Workers who were employed both before and after the threat of firm mobility will encounter lower wages.

It is interesting to note that the share of the profits accruing to the union and the firm only depends on the labour intensity α and product market competitiveness κ. The threat of firm relocation does not alter this distribution.

FDI and International Trade

To analyse the joint effects of international trade and the threat of foreign direct investment, the effects in figures 4.1 and 4.2 should be superimposed. This suggests a definite decrease in unemployment. As in the case of international trade, the impact on wages is ambiguous. However, when there also exists a threat of firm relocation, a drop in wages is relatively more likely than under trade alone.

4.4 Concluding Remarks

Over the past 15 years, an extensive literature has emerged reanalysing the entirety of trade theory using a framework of product market imperfections and increasing returns to scale. So far, factor market distortions have been largely ignored. However, their prominence in most economies is indisputable. This paper can be viewed as part of a wider goal to study the interactions between economic integration and factor market distortions. In the case of a unionised labour market, we have derived gains from international trade and firm mobility. We also suggested that the distribution of these gains may be uneven.

In contrast to much of the recent theory on trade and wages, the above analysis suggests that international trade and the threat of firm relocation may affect employment and wages in the labour market. Although unions are fairly powerful in most of Europe, this is not the case in the United States. More formal work is needed to determine whether the above results extend to other theories of wage determinations under market imperfections. The primary candidate is the efficiency wage theory.

An obvious but very important extension to the present paper is the introduction of international cost asymmetries and transportation costs. Some firms will then decide to relocate and the impact on the labour market and aggregate welfare will diverge from the present scenario. In such a framework, the location decision of the firm can be explicitly modeled using auctioning theory.

A further interesting extension would endogenise the capital stock. Adding a further stage to the bargaining game would lead to a hold-up problem as described by Grout [47] and Manning [89]. In the absence of binding contracts, the union would first signal a low wage to promote capital investment by the firm. Once the capital stock has been installed, the union will demand a higher wage in the next stage. Since the firm is unable to capture the full returns to its investment, its optimal strategy will be to underinvest in its capital stock. In such a scenario, further welfare gains may be derived as economic integration changes the incentive and bargaining structure. Chapter 3 of this thesis has demonstrated this for the intermediate input market.

4.5 Appendix

This appendix contrasts the treatment of outside options in the axiomatic Nash and the noncooperative Rubinstein bargaining models. This will highlight that the results in section 4.4 do not extend to a noncooperative framework.

4.5.1 Axiomatic Nash Bargaining

Consider the solution to the generalised Nash bargain[16]

$$\max_{\Pi,U} \Omega = \left(\Pi - \bar{\Pi}\right) U^{\beta} \,, \tag{A.1}$$

subject to $\bar{\Pi} \leq \Pi$. Assuming that all surplus is exhausted we can construct the following Lagrangian

$$\mathcal{L} = \beta \ln U + \ln(\Pi - \bar{\Pi}) + \lambda(1 - U - \Pi) \,. \tag{A.2}$$

Taking the first order conditions and making some basic substitutions yields

$$\Pi = \frac{1}{\beta + 1} + \frac{\beta}{\beta + 1}\bar{\Pi} \,. \tag{A.3}$$

This shows that the payoff to the firm is always increasing in its fall-back threatpoint. The analysis in the main text of the chapter is based on this relationship.

4.5.2 The Rubinstein Bargaining Model

When there are non-binding outside options, the solution to the noncooperative bargaining model by Rubinstein [112] differs from the outcome of the

[16]The exposition in this section follows closely Booth [13, ch.5].

axiomatic Nash model outlined above. The outside option of relocation is not a credible threat. The firm is always better off to stay and try to 'renegotiate'. Since the solution to the Rubinstein game is a subgame perfect equilibrium, it is not affected by such noncredible threats.

Hence, whenever $\bar{\Pi} < \Pi$, the outside option will not alter the equilibrium bargain between the firms and the unions in the Rubinstein case. The symmetric model in this chapter therefore dictates that the mere threat of relocation does not increase wage pressure.

Note that in the presence of international labour cost asymmetries the outside option may become a binding constraint for the firm. Whenever $\bar{\Pi} \geq \Pi$, the bargain struck between the worker and the firm will give the firm $\bar{\Pi}$, the amount just equal to its outside option. This will imply that workers need to accept a reduction in wages. When wages fall below b, the expected real income that a union member obtains when not employed by the firm, the firm will choose to relocate.

Figure 4.1: International Trade

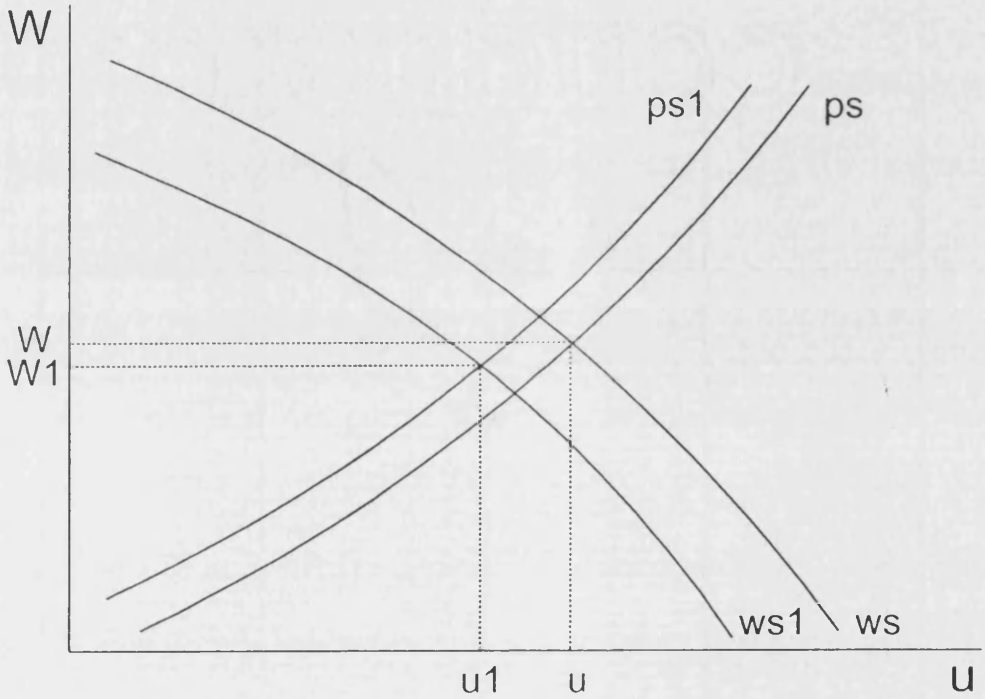
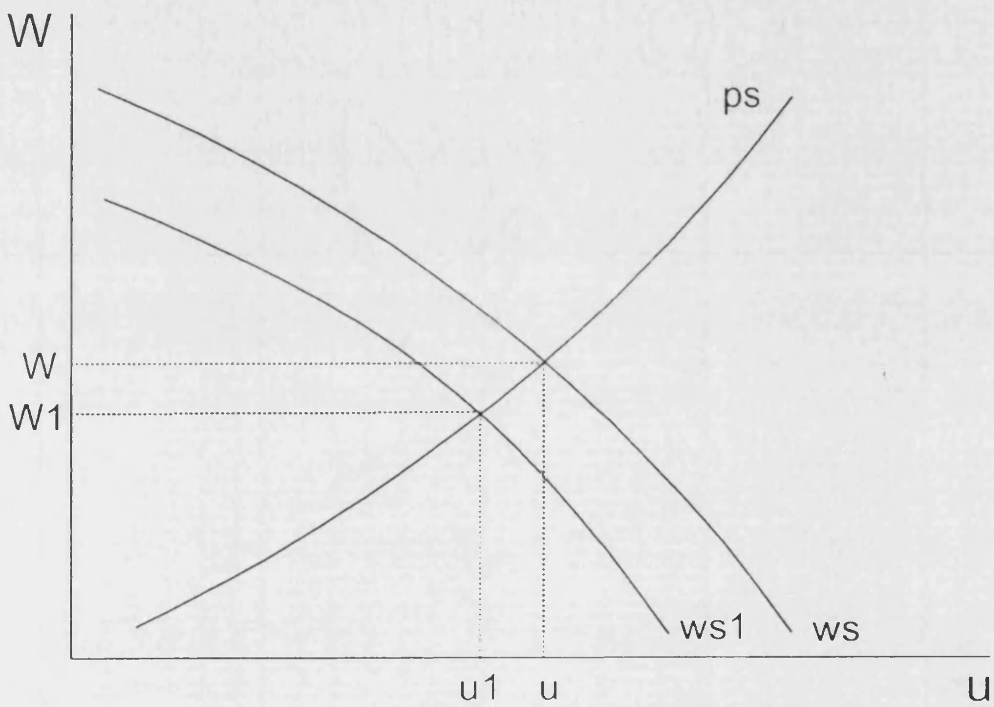


Figure 4.2: Firm Mobility



Chapter 5

Concluding Remarks

Oh, most lame and impotent conclusion!

Shakespeare, *Othello*, 1604.

5.1 Deriving Gains from Trade

One of the primary aims of this dissertation was to explore the benefits of incorporating factor market imperfections into the formal analysis of economic integration. Postponing other questions for future work, chapters 3 and 4 of this thesis focused on the derivation of gains from trade when factor markets are distorted. Because of the surge in foreign direct investment during the eighties and early nineties, we considered both the impact of product trade as well as that of firm mobility. In contrast to the Heckscher-Ohlin model, we found that trade in goods and firm mobility are not perfectly substitutable. Below, we briefly recapitulate the main results of chapters 3 and 4 and suggest some extensions.

Chapter 3 identified gains from trade in the presence of hold-up. In the case of a bilateral monopoly in a closed economy, it was shown that the privately optimal investment level is less than the socially optimal level, leading to a productive inefficiency. The main conclusion of chapter 3 was that firm mobility is likely to reduce the extent of this productive inefficiency. We attributed this to (i) increasing returns to scale and/or (ii) an increase in the bargaining power of the investor, which enabled him to capture a larger share of the returns thus reducing hold-up.

For simplicity, the model in the main text in chapter 3 was set up so that productive and allocative inefficiencies could be separated. The appendix to chapter 3 considered an alternative set-up, where the consumption and investment distortions were intertwined. It was then suggested that, even in the absence of firm mobility, free trade may be sufficient in reducing the investment distortions.

As in much of the incomplete contracting literature, the industrial structure and production technology employed in chapter 3 were highly specific. Furthermore, since one easily runs into technical problems with multi-person bargaining games, the set-up of the model makes it very difficult to consider the tradability of the upstream good. A possible alternative modeling technique would involve the use of double marginalisation as first introduced by Spengler [123]. The following set-up may be worth exploring in future work.

Analogous to chapter 3, suppose a vertical production structure with one upstream and one downstream firm. Because of its market power, a monopoly producer of an intermediate good will then charge the downstream firm a price in excess of production costs. However, the downstream firm is a monopolist in the product market and will thus charge a further markup over costs. This leads to a double price distortion, occurring because each firm adds its own price-cost margin at each stage of production. Since the price of the good to the downstream firm exceeds the production cost to the upstream firm, demand of the upstream good will be too low relative to the socially optimal level. Similarly, since consumers are also charged a price in excess of costs, production of the downstream firm will also be less than the socially optimal level. In the closed economy case, there thus exist both productive and allocative inefficiencies.

When economies are symmetric, free trade will increase the number of upstream and downstream firms in the market. Using either Bertrand or Cournot competition, it can then be shown that trade will reduce the markups over marginal production costs. If only the downstream good is tradable, the allocative inefficiency will be reduced, but the productive inefficiency will persist. If both the upstream and the downstream goods are tradable, both inefficiencies will lessen. In the case of Bertrand competition with homogenous products, free trade of both the upstream and the downstream good with only one other country is sufficient for removing all inefficiencies. Although this set-up is slightly different from the hold-up problem in chapter 3, it is more general - and definitely more tractable - and conveys very similar ideas.

Chapter 4 identified gains from trade when the labour market is unionised. Whenever unions have some bargaining power, workers will be paid wages in excess of their marginal products. The size of this markup depends on a variety of factors, including the market power of the firm. Hence, as international trade increases the number of firms in the market, the elasticity of demand perceived by each firm increases. The market power of firms then falls and so do the wages of workers. Since the difference between wages and the value of the marginal product of labour is suppressed, efficiency increases.

Chapter 4 also showed that the threat of firm mobility can effectively be analysed as a reduction in the bargaining power of unions. However, when countries are symmetric, this result only holds under axiomatic Nash bargaining. The results do not hold when the cooperative Rubinstein bargaining solution is used. Yet, it is still hoped that it provides some motivation for the recent emergence at a European level of crossborder labour unions.

The analysis in chapter 4 calls for two obvious extensions. First, the relative importance of unions varies greatly across economies. Although they are quite powerful in large parts of Europe, this is not the case in other continents. Other theories of imperfectly competitive labour markets therefore also need to be explored. A fairly large number of models of wage determination suggest some relationship between market power and wages, including expense preference models and some versions of efficiency wages.[1] They will thus be particularly suitable candidates for further work. A second extension would analyse the impact of - the threat of - foreign direct investment on wage setting. In the context of the present public policy debate, it would be particularly interesting to consider an asymmetric set-up, where domestic firms are faced with the possibility of relocation to low-wage countries. It may be possible to model the location decision of a firm as the outcome of an auction with labour unions in various countries.

5.2 Measuring Gains from Trade

Although the existence of procompetitive gains from trade has long been recognised by academic economists and practitioners alike, only few attempts have been made to measure these gains. The objectives of chapter 2 of this thesis was to begin to bridge this gap and to empirically assess the importance of procompetitive gains from trade.

Chapter 2 presented an analysis of the impact of trade liberalisation on 2400 Mexican firms between 1984 and 1990. Two main conclusions emerged from this chapter. First, we found a negative correlation between the openness of the economy and the markups charged by firms. In the first part

[1]See for instance Smirlock and Marshall [116], Nickell, Vainiomaki and Wadhwani [103] and Layard, Nickell and Jackman [81].

of the sample period the economy was almost completely closed to international trade. We estimated that prices exceeded marginal costs by an average of 34 per cent before 1988. In the second part of the period, the relevant figure dropped to 23 per cent. This was shown to be a statistically significant decrease. The second main finding in chapter 2 was that total factor productivity grew faster in the final few years of the sample period. This was positively correlated with various measures of trade openness. We also estimated that average increases in total factor productivity after 1987 were three times as high as the pick-up in GDP. As pointed out earlier, one complicating factor in our study is the fact that trade liberalisation coincided with the recovery of the Mexican economy from a deep recession.

Since the data set used in chapter 2 was a balanced panel, it was not suitable for analysing the impact of foreign direct investment on productivity and markups. A more comprehensive identification of the precise mechanisms through which welfare gains are attained would decompose the impact of economic integration into effects due to international trade and those due to foreign direct investment. We hope to be able to find data sets that will enable us to pursue such work in the future.

Although other studies have aimed to empirically analyse the impacts of trade and economic integration on economies, we believe our study is particularly insightful and comprehensive. The opening of the Mexican economy is about as close to a controlled experiment as an international economist can hope to get. Whereas the economy was still virtually closed in the mid 1980s, at present it is a member of a free trade agreement. Not only is the 'experiment' unique, we also believe that the data set has the potential to be particularly enlightening. It has both breadth and depth, covering a substantial number of firms and providing detailed information about each firm in the sample. We hope that this will provide one building step in finally enabling international trade theorists to identify more accurately the channels through which gains from trade and economic integration occur in the late twentieth century.

5.3 Factor Market Imperfections in Future Work

It was suggested in the introduction that the long-run aim of the research presented in this thesis is to examine whether endogenising factor market imperfections can provide some insight into recent developments in international economic relations. The author thus hopes to move beyond the mere formalisation of gains from trade - as has been the topic of this thesis. It therefore seems appropriate to conclude with a sampling of issues to be addressed in future work. Two common questions underline all the work: How do economic integration and technological change interact? What is their impact on the labour market? The incorporation of factor market imperfections will be central in addressing these questions. We motivate the research with a brief description of some recent economic trends.

In the past fifteen years demand for less-skilled workers has fallen in the developed world. In the United States, real hourly wages of the less-educated have dropped by as much as 25 per cent since 1979. In most European countries, where wages are more rigid, the relative decline in demand of less-skilled workers has instead been reflected in an increase in unemployment rates of less-skilled workers. Over the same period, the global economy has grown at an unprecedented rate. Because of their parallel timing, it has been suggested by a number of (often influential) people that there exists a causal link between globalisation trends and the developments in the labour market.

The literature that has emerged in the past few years has highlighted time and again that the mere concordance of globalisation with increased inequality does not imply that one caused the other. Rather than blaming globalisation, a number of papers point the finger at technological change, which has allegedly been particularly biased against unskilled workers in the past fifteen years. Academic economists have thus divided themselves into two camps: the trade versus technology battle is presently raging![2]

Depending on the conviction of their authors, most papers in the existing literature model either trade or technology as an exogenous labour market shock. They then proceed to analyse the impact of this shock and judge their model by how well its predictions match the observed trends. However, treating trade and technological change as independent factors is not very realistic. The rate and direction of technological change is likely to be affected by developments in the international economy. While trade affects technological change, the reverse causation is also indisputable. As technology lowers transportation and communication costs, the degree of economic integration rises.

In future work, I would like to investigate these links between technological change and economic integration using endogenised factor market imperfections. The first question I propose to answer is how trade and FDI affect technological change. A small macroeconomic literature has arisen suggesting that integration may increase the long-run growth rate.[3] Instead, I plan to focus on the microeconomic principles of firm behaviour rather than to engage in a macroeconomic analysis. In the presence of factor market imperfections such as hold-up, how do international trade and increased competition alter firm incentives? Are the payoffs to R&D and technological change affected? What is the impact on the quality level of products?[4]

[2]Wes [133] provides an overview of this debate.

[3]Rivera-Batiz and Romer [110] and Grossman and Helpman [46] suggest that economic integration, via the spread of ideas across international borders, can trigger a permanent acceleration of economic growth.

[4]The models in this thesis all assumed horizontal differentiation. I intend to do further experimentation with theories of vertical product differentiation. Gab-

I would also like to investigate how technological change affects international trade and the location decisions of firms. As technological change reduces transportation costs, international trade flows will increase. With plummeting international communication costs, technological change also affects the location decisions of multinational corporations. I intend to motivate the recent rise in the so-called vertical FDI, where various stages of the production process are geographically disaggregated. Although horizontal foreign direct investment is still more important quantitatively than foreign direct investment, its relative importance is falling.

One of the important implications of chapters 3 and 4 in this thesis is that, in contrast to the Heckscher-Ohlin model, trade and firm mobility are no longer perfect substitutes. As this is a common result under any type of market imperfections, a literature trying to motivate FDI is rapidly emerging. Since Dunning [35], the multinational enterprise is generally analysed in a framework of ownership, location and internalisation advantages. As an attempt to identify the links between technological change - modeled as falling transportation costs - and the location decisions of firms, I would like to explore to what extent internalisation advantages are the motivation behind the recent increases in vertical FDI. I intend to use the contractual approach - including the hold-up framework - as outlined in chapter 3.[5] The main question of interest is whether falling transportation costs increased

scewicz et al. [43] suggest that low qualities may disappear as a result of trade, increasing the average quality of goods in the market. Motta and Thisse [97] suggest that integration may lead to deindustrialisation and welfare losses in peripheral areas. I would like to use the incomplete contracting framework of chapter 3 to analyse the effect of economic integration on the quality level of the goods produced internationally? Will investment in R&D increase as hold-up reduces? Or will strategic motivations induce a divergence in the quality levels of goods produced internationally?

[5]Internalisation has already been modeled as an endogenous response to market failure by for instance Ethier [39], and Horstmann and Markusen [60, 58]. Also relevant is Smith [117].

the attractiveness of FDI relative to alternatives such as outsourcing and trade. What may be the incentives for a firm to own the separate stage of production? How does the outcome compare to a licensing agreement with an independent foreign firm? In what ways is vertical disintegration fostered and propelled by present international economic trends?

Having scrutinised the links between technological change and globalisation, I would eventually like to explore whether incorporating these interactions provides a less eclectic framework for evaluating the relative importance of technological change and globalisation in explaining recent labour market trends. As outlined above, I intend to build on various areas of economic research. I hope that this will be an interesting contribution to a literature where researchers in international economics, labour economics and industrial organisation have often failed to cooperate.

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