Informality and Temporary Migration in Mexico

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Thesis presented for examination for the PhD Degree of the University of London

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May 7th, 2007

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Chapter 1. The Effect of Trade Liberalization on Informality and Wages: Evidence from Mexico.....100%

Chapter 2. Informality and Taxes in Mexico.....50%

Chapter 3. The Returns to Temporary Migration to the United States: Evidence from the Mexican Urban Employment Survey.....100%

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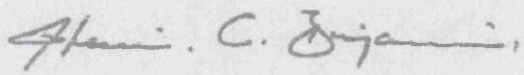


Benjamin Aleman-Castilla

Abstract

This thesis studies two characteristics of the Mexican labour markets: informality and migration to the United States. Chapter 1 studies the impact of NAFTA on informality and wages, the former measured in a reduced form through the fraction of workers without any social or health coverage (unregistered workers). Using data on Mexican and U.S. import tariffs with the Mexican National Survey of Urban Labour (ENEU), I find that reductions in tariffs are related to reductions in unregistered labour. Unregistered labour decreases less in high import-penetration industries and more in export oriented ones. The Mexican tariffs are also negatively related to real wages, while the U.S. tariffs are negatively related to the registered-unregistered wage differentials. Chapter 2 is a joint work with Arturo Ramirez. It uses two Mexican tax reforms to test whether the unregistered sector is sensitive to changes in the tax burden. The first is the 1989 implementation of an asset tax, and the second is the 1999 elimination of accelerated depreciation allowances. The data comes from the ENEU, from which estimates of unregistration are derived; and the Annual Industrial Survey (EIA), from which the differential effects of the 1999 reform on each region and industry are implied. It is found that the response of unregistered labour to changes in taxes is heterogeneous, depending both on the economic sector and the nature of the tax policy. Lastly, chapter 3 studies the effect of temporary migration to the U.S. on labour market outcomes of Mexican workers. It uses panel data from the 1994-2002 ENEU, which is ideal for minimizing self-selection biases common to other sources. Fixed-effects estimation indicates that temporary migrants obtain higher earnings in the U.S. labour market during the period of migration. They also work longer hours and face a higher likelihood of non employment. Finally, the gains from migration are lower for more skilled workers and for those migrating from the most distant regions, relative to the U.S.

Acknowledgements

I am deeply grateful to my supervisor Alan Manning, for his constant support, guidance, and patience. This work would not have been possible without his excellent advice.

I would also like to thank Barbara Petrongolo, Steve Pischke, Steve Redding, and Guy Michaels, members of the faculty at the London School of Economics, for their very useful comments and suggestions.

Thanks also go to Ricardo Sousa, Regis Barnichon, Mariano Bosch, Ghazala Azmat, Urban Sila, and participants at the LSE Labour Economics work in progress seminars, for all the enlightening discussions.

I also thank Gonzalo Hernández Licona for sharing the Mexican National Survey of Urban Labour (ENEU), a database essential to the elaboration of the present work; and Arturo Ramírez Verdugo, both for co-authoring chapter 2 and for sharing the industry-level data from the Mexican Annual Industrial Survey (EIA) for chapter 1.

Special thanks go to my parents Ildefonso and Cristina, my siblings Alejandro and Cristina, my fiancée Susana, and my aunt Martha. It would have been impossible to finish my postgraduate studies without their unconditional support.

Finally, I am very grateful to the Mexican National Council for Science and Technology (CONACYT) for their financial support throughout my PhD studies.

Table of Contents

List of Tables

List of Figures

Chapter 3. The Returns to Temporary Migration to the U.S.: Evidence from the Mexican Urban Employment Survey

General Introduction

This thesis studies two very important characteristics of the Mexican labour markets: informality and migration to the United States. Informality is normally defined as the set of economic activities often, but not exclusively, carried out in small firms or by the self-employed, which elude government requirements such as registration, tax and social security obligations, as well as health and safety rules (Roberts, B.R. (1989)). According to the World Bank (Maloney, W.F. (1999)), between 30 and 40% of the Mexican labour force works in the informal sector. The importance of this phenomenon is thus evident, as it implies that a very large fraction of workers are unprotected. It also means that the corresponding proportion of labour income does not generate fiscal revenue, which directly affects the quantity and the quality of the public goods and services provided by the state. In addition, informality disproportionately affects the less favoured groups, such as the low-skilled workers. Finally, informality does not seem to shrink with economic growth, and it is also an important characteristic of the labour markets in other developing countries.

On the other hand, Mexican migration to the United States has been a very important issue throughout the twentieth century, and its relevance has reached unprecedented levels during the last two decades. Apart from being the hottest topic in the bilateral agenda, it has also become a very important component of the economic relation between the two countries. From the Mexican point of view, remittances of Mexican workers account for approximately 2% of the GDP, which makes them one of the most important sources of income for the economy. It has been estimated that remittances are responsible for 20% of the capital invested in micro enterprises throughout urban Mexico (Woodruff, C. and R. Zenteno (2001)). From the U.S. point of view, Mexicans account for approximately 8% of total employment, and illegal immigration has been constantly generating debates among different groups of interest, leading to the approval in 2006 of a budget of 1,200 million dollars for the construction of a 1,120 kilometers fence along the U.S.-Mexico border.

The objective of the present work is to make three original contributions to the existing literature on both topics. The first one, in chapter 1, consists on analyzing whether trade liberalization leads to an increase or a decrease in the rate of informality, the latter measured empirically in a reduced form through the fraction of workers without any social or health coverage (unregistered workers). Specifically, it studies the impact on unregistration and real wages in Mexico of the North American Free Trade Agreement

(NAFTA), which came into effect on the 1st of January, 1994, and which general objective was to create a free-trade zone, through the establishment of clear and permanent rules for commerce, so as to help increasing trade volume and investment, as well as generating new employment opportunities and better living standards. Using a dynamic industry model with firm heterogeneity, it is predicted that import tariff elimination could reduce the incidence of informality by making more profitable to some firms to enter the formal sector, forcing the less productive informal firms to exit the industry, and inducing the most productive formal firms to engage in trade. The model also predicts market share reallocations towards the most productive firms, and an increase in real wages due to the increased labour demand by these firms. Using data on the Mexican and the U.S. import tariffs together with the Mexican National Survey of Urban Labour (ENEU), it is found that reductions in the Mexican import tariffs are significantly related to reductions in the likelihood of unregistered labour in the tradable industries. Also, unregistration decreases less in industries with higher levels of import penetration, while it decreases more in industries that are relatively more export oriented. Finally, the study confirms that the elimination of the Mexican import tariffs is related to an increase in real wages, and that the elimination of the U.S. import tariff has contributed to the expansion of the Registered-unregistered wage differentials.

The second contribution, in chapter 2, studies the relationship between taxes and informality in Mexico. In the recent theoretical literature, when modelling the informal sector it is generally assumed that there exists a direct relationship between the tax burden and regulations faced by firms and workers, and the likelihood of informal employment in the economy. However, the related empirical literature available to date indicates that there is still mixed evidence on this issue, and only a few studies have been able to link corporate and individual decisions. To fill this gap in the literature, two tax reforms that took place in Mexico during 1987-2002 are used to test the hypothesis that the size of the unregistered sector is sensitive to changes in the tax burden. The first is the introduction of an asset tax in 1989, with which the Mexican government tried to reduce tax evasion. The second is the elimination of accelerated depreciation allowances in 1999. Identification comes from the cross-sectional variation in the effect that these tax reforms had on different sectors and regions of the Mexican economy. The data used comes from two sources: the ENEU, from which estimates of unregistration are derived; and the Mexican Annual Industrial Survey (EIA), from which the differential effects that the tax reforms had on each region and industry are implied. The econometric analysis suggests that the positive relationship between taxes and unregistration

generally assumed in the theoretical literature not always holds, and that whenever it does the response of the likelihood of unregistered employment to changes in the level of taxes is rather heterogeneous, depending both on the particular economic sector and the nature of the tax policy in question. Thus, for the case of the asset taxation the estimates indicate no significant effect on unregistration, while for the case of the elimination of the optional accelerated depreciation scheme there are significant effects in some of the manufacturing industries.

The third and final contribution in chapter 3 presents new evidence on the effect that temporary migration to the United States has on the earnings of Mexican workers. To date, there is a huge body of literature that analyses many different aspects of this phenomenon, such as the characteristics of the migrants, the factors that influence migration, the quantification of legal and illegal migrants, the interconnectedness between international and regional migration in Mexico, or the economic performance of Mexican migrants with respect to the U.S. labour market. However, the economic performance of migrants with respect to the Mexican labour markets has received far less attention, and this the area in which this work attempts to contribute on. It uses data from the ENEU for the period 1994 to 2002. Among other advantages, the panel structure of the survey is ideal for minimizing the problems of self-selection bias that are common in most of the alternative data sources, such as population censuses. Fixed-effects estimation indicates that Mexican workers that migrate temporarily to the United States obtain significantly higher earnings in the U.S. labour market than in the Mexican one during the period of migration. They also tend to work longer hours and face a generally higher likelihood of non employment during the period of return migration. Lastly, the gains from temporary migration are lower for more skilled workers and for those migrating from the most distant regions in Mexico, relative to the United States.

A final section of general conclusions summarizes the most important results of the present work.

Chapter 1. The Effect of Trade Liberalization on Informality and Wages: Evidence from Mexico

1.1. Introduction

Over the last 25 years many Latin American countries have abandoned their import-substitution strategies in order to embrace free trade. While it has been found that this change in policy helped the region to recover from the 1980s period of stagnation and crises by increasing exports, investment, productivity and growth, there has not been any sign of beneficial effects from trade liberalization on the allocation of labour between the formal and the informal sector, the latter defined as the set of economic activities often, but not exclusively, carried out in small firms or by the self-employed, which elude government requirements such as registration, tax and social security obligations, as well as health and safety rules (Roberts, B. R. (1989)). Under the absence of unemployment benefits and a well developed social insurance system, one could think of working in the informal sector as the best alternative for a worker who loses his formal job and is not able to return to the formal sector, either temporarily or permanently, because going into unemployment would leave him receiving no income at all. In fact, one can think of the informal sector as a competitive sector with relatively free worker entry. It is not difficult to find examples of free entry to the informal sector: just think for example of a worker that loses his or her job and becomes a street vendor or opens an informal food stand in his own house. The investment required in both cases is minimal and in general there are no "bureaucratic" or similar kinds of barriers to do so[1].

This chapter focuses precisely on analyzing whether trade liberalization leads to an increase or a decrease in the rate of informality, the latter measured empirically in a reduced form, through the fraction of employed workers without any social or health coverage (unregistered workers). It adds to the existing literature by analyzing the 1990s Mexican experience. The North American Free Trade Agreement came into effect on

[1] Cases in which there could be "bureaucratic" barriers to entry are those activities that are controlled by an informal, clandestine union. An example is perhaps car washing in Mexico City. The only investment a person needs to make in order to enter the business is a bucket and a cloth, but it is well known that this activity is usually controlled by a person or a group that decides if the new car washer will be allowed to work or not, and it normally depends on paying a regular "fee". However, even though this is common practice, the power of these groups is often limited to a small zone or a particular neighbourhood, and the new entrant can always choose to move to another one or to join a more convenient group.

the 1st of January, 1994 and, according to the legal text, its general objective was to create a free-trade zone, through the establishment of clear and permanent rules for commerce, so as to help increasing trade volume and investment, as well as generating new employment opportunities and better living standards[2]. The impact that NAFTA and other trade liberalization processes have had on the Mexican labour market outcomes and living standards has been previously studied by a number of researchers. Among others, Revenga, A. (1995) analyzes how Mexico's 1985-87 trade liberalization affected average employment and earnings; Hanson, G. H. (1994) studies the effect of economic integration with the United States on state-industry employment growth in Mexico. In another paper (Hanson, G. H. (2003)) he examines the impacts of trade and investment liberalization on the wage structure of Mexico. Finally, Nicita, A. (2004) performs an ex-post analysis of the effects of the trade liberalization process in Mexico between 1989 and 2000 on labour income and welfare. However, none of these previous studies has dealt with the effect of trade liberalization on the size of the informal sector. Recent estimates by the World Bank (Maloney, W. F. (1999)) suggest that between 30 and 40% of the Mexican labour force works in the informal sector. From here, the importance of this phenomenon is evident: First, it implies that a significant fraction of Mexican workers are unprotected, which puts them in a vulnerable bargaining position with their employers. Second, it also means that the corresponding proportion of labour income in the country does not generate fiscal revenue, and this is directly reflected in the quantity and the quality of the public goods and services provided by the state. And third, informality disproportionately affects the less favoured groups, such as the low-skilled workers. This intensifies the problems of inequality and poverty for the country as a whole. Furthermore, the informal sector does not seem to shrink with economic growth. In the case of Mexico, while real GDP grew at an average quarterly rate of 3.17% between 1990 and 2002, the unregistration rate also increased and, as estimated in this chapter, it passed from about 47% to approximately 49% of total employment.

Informality is also an important characteristic of the labour markets in other developing countries. Goldberg, P. K. and N. Pavcnik (2003) analyze the cases of Brazil and Colombia, two countries that joined the General Agreement on Tariffs and Trade (GATT) and where the rates of informality are approximately 35% and 50% of the labour force, respectively. They conclude that trade liberalization did not have any significant effect on the size of the informal sector in these countries. Currie, J. and A. Harrison (1997) study the effect of trade reforms on capital and labour in Morocco

[2] NAFTA Secretariat, http://www.nafta-sec-alena.org/DefaultSite/index_e.aspx

during the 1980s, and they find that state-owned firms increased employment by hiring low-paid temporary workers. Even though these previous studies suggest a null or positive effect of the elimination of barriers to trade, the study of the 1990s Mexican experience could provide more conclusive evidence, given that it involves a free trade agreement with the largest economy in the world, which means the bilateral elimination of import tariffs and at the same time a privileged access for the Mexican firms to a much wider market.

The present study uses a dynamic industry model with heterogeneous firms to analyse the possible implications of trade liberalization on the rate of informality. By making more profitable to some firms to enter the formal sector rather than the informal sector, forcing the less productive informal firms to exit the industry, and inducing the most productive formal firms to engage in trade, the model predicts that it is possible for trade liberalization to reduce the incidence of informality. Both the exit of the least productive firms and the additional export sales gained by the more productive firms reallocate market shares towards the more productive firms and contribute to an aggregate productivity increase. The increased labour demand by the more productive firms (due to their larger market shares) will tend to increase more the real wages in industries that experience larger tariff cuts.

These implications seem to be confirmed by the econometric analysis, which mainly relates data on both Mexican and U.S. import tariffs to the Mexican National Survey of Urban Labour (ENEU) for the period 1989 through 2002. To preview the results, reductions in the Mexican import tariffs are found to reduce significantly the likelihood of unregistration in the tradable sectors: a 1-percentage point decline in the Mexican import tariff reduces the probability of unregistration in a given industry by 0.392 percentage points. Combining the trade data with information from the Mexican input-output matrices available to date, an import tariff is also mapped to the non-tradable sectors. The corresponding estimates indicate that the reduction in this weighted tariff, even though positively correlated with, has not have a significant impact on the rate of unregistration, meaning perhaps that the beneficial effect of trade liberalization has not spread outside the tradable industries. Also, when the import tariffs are interacted with different measures of exposure to trade for the manufacturing sectors –which are constructed using data from the Mexican Annual Industrial Survey (EIA), it is found that for a given reduction in the Mexican import tariff, unregistration decreases less in industries with higher levels of import penetration; while for a given reduction in the U.S. import tariff, the rate of unregistration decreases more in those industries that are

relatively more export oriented. Finally, analyzing the effect of trade liberalization on the industry employment shares and the composition of unregistration within industries, it is found that reductions in the U.S. import tariffs are related to an increase in the proportion of workers in a given industry, that reductions in the Mexican import tariff generate a decrease in the fraction of unregistered self-employed, and that the elimination of the U.S. import tariff seems to have a reallocation effect within the unregistered labour force, from salaried to either self-employment or unpaid work.

Regarding the predictions for the wage distribution, this study confirms the conclusions by many other previous studies, in the sense that the elimination of the Mexican import tariff has contributed to increase wages. Industries with larger tariff cuts experienced larger increases in real wages. Finally, the effect of trade liberalization on the wage gap between registered and unregistered workers is also analyzed here, and it is found that the elimination of the U.S. import tariffs on Mexican products has contributed to the widening of this wage differential in the tradable industries.

The rest of this chapter is organized as follows: Section 1.2 presents the theoretical framework. Section 1.3 provides some background on the Mexican trade liberalization process. Section 1.4 gives a description of the main datasets used. Section 1.5 presents a preliminary analysis of the relationship between trade liberalization and the rate of unregistration. Section 1.6 develops the corresponding econometric analysis. Section 1.7 studies the parallel implications for wages. Section 1.8 concludes.

1.2. How Could Trade Liberalization Affect Informality?

In order to give an answer to this question, three things must be considered: first, it is necessary to model the decision process of firms facing the option of producing either in the formal or the informal sector. Second, it is also necessary to incorporate a framework that is able to explain how trade liberalization affects the performance of firms. And third, these two points have to be put together. Under these considerations, a dynamic industry model with firm heterogeneity like the one in Melitz, M. J. (2003) can be used to describe the way in which trade liberalization could affect the rate of informality. The original model shows how the exposure to trade induces only the more productive firms to export while simultaneously forcing the least productive firms to exit. Both the exit of the least productive firms and the additional export sales gained by the more productive firms reallocate market shares towards the more productive firms

and contribute to an aggregate productivity increase. Profits are also reallocated towards more productive firms. This model does not consider different sectors within an industry in which firms could produce, but as shown below, it is relatively easy to include this possibility.

1.2.1. The decision of becoming formal.

To begin, as in the original model, assume that the preferences U of the representative consumer are given by a C.E.S. utility function over a continuum of goods indexed by ω. As shown by Dixit, A. and J. Stiglitz (1977), in such a case consumer behaviour can be modelled by considering the set of varieties consumed as an aggregate good $Q \equiv U$ with an aggregate price P. Optimal consumption and expenditure decisions for individual varieties can then be defined as:

$$\begin{aligned} q(\omega) &= Q\left[\frac{p(\omega)}{P}\right]^{-\sigma} \\ r(\omega) &= R\left[\frac{p(\omega)}{P}\right]^{1-\sigma} \end{aligned} \tag{1.1}$$

where $p(\omega)$ is the price for variety ω, P is the aggregate price, R is the aggregate expenditure, and σ refers to the constant elasticity of substitution between any two goods. There is a continuum of firms in the industry, each one producing a different variety. The only factor of production is labour, inelastically supplied at level L, an index of the economy's size. The cost function exhibits constant marginal cost with a fixed overhead cost. Labour used is thus a linear function of output q:

$$l = f + q/\varphi\,, \qquad \begin{array}{l} f > 0 \text{ and common to all firms in a sector} \\ \varphi > 0 \text{ different accross firms} \end{array} \tag{1.2}$$

where f represents the fixed overhead cost, and φ is a productivity parameter. Each firm in the domestic market faces a residual demand curve with constant elasticity σ and thus chooses the same profit maximizing mark-up equal to $\sigma/(\sigma-1) = 1/\rho$. Under these assumptions, the profits of a particular firm can be expressed as the difference between its revenue and the cost of labour:

$$\pi(\varphi) = pq - w\left(f + \frac{q}{\varphi}\right) \tag{1.3}$$

where w is the real wage, common to all firms in a particular industry. Substituting p from (1.1), maximizing (1.3) with respect to q, and using the resulting expression for the profit-maximizing level of output back in this same equation leads to:

$$\pi(\varphi) = k\left(\frac{\varphi}{w}\right)^{\frac{\rho}{1-\rho}} - wf \tag{1.4}$$

where $k = (\rho P_0)^{\frac{1}{1-\rho}}\left(\frac{1-\rho}{\rho}\right)$ and $P_0 = Q^{\frac{1}{\sigma}}P$. Equation (1.4) is a general expression for the maximum level of profits as a function of the productivity parameter, φ. In the Melitz, M. J. (2003) model, there are two types of firms: exporters and non exporters. Non-exporters derive profits only from their sales in the domestic market, and these could be represented by a function like the one in (1.4). Exporters instead get their profits both form their sales in the domestic and the foreign markets. Selling in foreign markets implies incurring an extra marginal cost τ of shipping product units abroad, as well as a fixed cost f_X of entering the foreign markets. Therefore, the total profits of an exporting firm can be expressed as the sum of the typical profit function for a non-exporting firm and another function that represents the profits obtained from exports: $\pi_X(\varphi) = k(\varphi/\tau w)^{\rho/(1-\rho)} - wf_X$. In the present context, apart from these differences between traders and non traders, there might be differences in the profit functions of firms in the formal sector with respect to firms in the informal sector. Consider first the characteristics of the informal firms. Because of their informal status, firms in the informal sector cannot take advantage of any of the trade promoting programs conducted by governmental institutions such as the Secretariat of Finance, the Secretariat of Economy, or the National Bank for Foreign Trade (BANCOMEXT)[3], and it is more difficult for them to import machinery and equipment than for formal firms, since importing would imply exposure to the customs authority and, therefore, to the government. Thus, assume that informal firms cannot import nor export. Also, given that firms in the informal sector evade taxes, every period they face a positive

[3] For a review of the main governmental programs and instruments for promoting Mexico's exports, see MATTAR, J. (1998): "Export Promotion in Mexico," *Integration and Trade 4/5. Institute for the Integration of Latin America and the Caribbean, Inter-American Development Bank.*

probability γ of being caught by the government. If this happens, the government may force them to pay a fine equal to a fraction $\varepsilon > 0$ of its profits. On the other hand, firms in the formal sector pay taxes and worker benefits over wages, so they do not need to hide from the authorities. They can also get involved in trade and thus have access to more intermediates and are in general more productive than firms in the informal sector. In the present framework, for a partition of firms between formal and informal sectors to exist in equilibrium, and in order to get the bigger and more productive firms being formal, the marginal costs of production in the formal sector are modelled as being lower than those in the informal sector, but the fixed overhead costs in the former are assumed to be higher, so that the combination of both ends being higher than the fixed overhead cost in the informal sector. Regarding the marginal costs, the above can be interpreted as saying that the fact that formal firms do not need to hide away from the authorities, that they have access to better intermediates, and that they are generally more productive, more than compensates for having to pay taxes and worker benefits. As for the higher fixed overhead costs, it represents the fact that opening a business in the formal sector implies complying with a number of regulations that the informal sector avoids (e.g. registration, bureaucracy, and corruption). Furthermore, as described above, whenever a formal firm gets involved in trade, it has to pay taxes on imported inputs and exports (per-unit costs), and there is also a fixed cost of entering a foreign market, that does not vary with the volume of exports (i.e. they have to find and inform prospective clients about their products, learn about the practices and rules in the new market, comply with foreign regulations and standards, and set up new distribution channels). As before, for a partition of the formal sector between traders and non-traders to exist in equilibrium, trade costs have to be relatively higher than formality costs.

Thus, to put the above discussion more formally, let $0 < \alpha < 1$ represent the taxes and worker benefits paid by the formal firms over wages, let β represent the fraction by which productivity is higher in the formal sector relative to the informal sector, and let f_I and f_F represent the fixed overhead costs in the informal sector and the formal sector, respectively. It is assumed that $\alpha < \beta$ and that $f_F > f_I$. Also, as in the Melitz, M. J. (2003) model, let τ be the increased marginal cost of serving the foreign market (i.e. tariffs), and let f_X represent the fixed costs of entering the trading sub-sector. Given that access to trade increases the variety and quality of intermediate goods available for the formal firms, one could think of β as being affected by the degree of exposure to trade. In particular, $\beta_\tau < 0$. For a partition between traders and non-traders

within the formal sector to exist, it is assumed that the trade costs relative to the overhead production cost in the formal sector are above a threshold level, or that $\tau^{\sigma-1} f_X > f_F$. The per-unit trade costs are modelled in the standard iceberg formulation, whereby $\tau > 1$ units of a good must be shipped in order for 1 unit to arrive at destination.

At the margin, the decision of a firm of whether to become informal or formal will be based on the comparison of the profits that it could make in the informal sector and the profits that it could make in the non-trading formal sector only. Using equation (1.4) together with the above assumptions leads to the following profit functions for these two types of firms:

$$\pi(\varphi) = \begin{cases} \pi_I(\varphi) = k\left[\dfrac{\varphi}{w}\right]^{\frac{\rho}{1-\rho}} - wf_I & \text{if informal} \\ \pi_F(\varphi) = k\left[\dfrac{(1+\beta)\varphi}{(1+\alpha)w}\right]^{\frac{\rho}{1-\rho}} - (1+\alpha)wf_F & \text{if non - trading formal} \end{cases} \tag{1.5}$$

A firm will choose to become formal whenever its expected profits in this sector are higher than the expected profits in the informal sector; this is $\pi_F^e(\varphi) \geq \pi_I^e(\varphi)$. Recalling that firms in the informal sector face a positive probability of being caught by the government and of paying a fraction of their profits as a fine, this condition defines a cut-off productivity level for firms entering into the formal sector, φ_F^*:

$$\varphi_F^* = \left\{\frac{w^{1/(1-\rho)}\left[(1+\alpha)f_F - (1-\gamma\varepsilon)f_I\right]}{kB}\right\}^{\frac{1-\rho}{\rho}} \tag{1.6}$$

where $B = \left(\dfrac{1+\beta}{1+\alpha}\right)^{\frac{\rho}{1-\rho}} - (1-\gamma\varepsilon)$. Any firm with a productivity parameter above φ_F^* will prefer to produce for the formal sector. In equilibrium, φ_F^* determines the share of firms in the formal and the informal sectors. Similarly, a firm drawing productivity φ produces in the industry if at least the expected revenue from operating in the informal sector covers the expected fixed overhead costs of production, i.e. $\pi_I^e(\varphi) \geq 0$. This defines an overall zero-profit productivity cut-off for the industry, φ^*. Finally, a firm operating in the formal sector will choose to engage in trade whenever its productivity

parameter is such that the extra profits from trade are nonnegative, $\pi_X(\varphi) \geq 0$. This also defines a cut-off productivity level for the trading sub-sector, φ_X^*.

1.2.2. The effects of trade liberalization.

In the Melitz, M. J. (2003) model, trade liberalization comes through a reduction in the per-unit trade costs. A decrease in τ would increase the cut-off productivity level for the industry φ^*, and at the same time it would decrease the cut-off productivity level for the trading sub-sector, φ_X^*. This forces the least productive firms to exit and at the same time it generates entry of new firms into the trading sub-sector. There is also a reallocation of market shares and profits from the least productive to the most productive firms, which contributes to an aggregate productivity gain. Finally, the expanded exposure to trade offers new profit opportunities only to the more productive firms who can cover the entry cost f_X, and it also induces more entry of new firms to the industry, as prospective firms respond to the higher potential returns associated with a good productivity draw. These two effects together increase the labour demand and therefore tend to bid up the real wages in the industry.

To see the implications of this mechanism for the formal/informal decision, note that the cut-off productivity level for formality depends on P_0 through k, and P_0 in turn depends on the aggregate productivity level in the industry. φ_F^* is also a function of real wages, w, and the productivity differential between the formal and informal firms (through B), β. In the present framework, these are the three channels through which trade liberalization could affect the decision of a firm of whether to become formal or to stay in the informal sector.

First, if there is no effect on β, then the only channel in which trade liberalization affects informality is through wages. As in the Melitz (2003) model, a decrease in τ increases the cut-off productivity φ^* and the aggregate productivity level in the industry. As shown in appendix 1A, P_0 would not change, and given that trade liberalization increases the labour demand of the new trading firms and the new prospective entrants to the industry, then the real wages in the industry will also tend to increase. As can be seen in equation (1.6), φ_F^* is an increasing function of wages, hence:

Proposition 1. *If trade liberalization reduces τ, then: 1) real wages in the industry will increase; 2) φ_F^* will increase, inducing less firms to enter the formal sector; 3) φ^* will increase, forcing the least productive informal firms to exit the industry; 4) φ_X^* will decrease, inducing more formal firms to enter the trading sub-sector and increasing their employment share; and 5) there will be an ambiguous effect in the employment share of the informal sector. (proof: see appendix 1B)*

The effect of trade liberalization on wages has been extensively studied by different researchers. For example, Hanson, G. H. (2003) examines the impact of trade liberalization on the wage structure of Mexico during the 1990s. He finds that the policy reforms resulted in an increase of wage dispersion due to an increase in the demand of skill, a reduction of the rents in industries that prior to the reform paid their workers higher wages, and a larger premium for workers in states sharing a border with the United States. Hanson, G. H. and A. Harrison (1999) study the effect of trade liberalization on Mexican wages for the pre-NAFTA period. Using data on Mexican manufacturing plants from 1984 to 1990 and from the Mexican industrial census for 1965-1988, they find that the reduction in tariff protection in 1985 disproportionately affected low-skilled workers. Cragg, M. and M. Epelbaum (1996) also analyze the Mexican case for the 1987-1993 period, and find that the wages of urban workers with completed primary education fell relative to the wages of those with higher levels of schooling. Finally, Attanasio, O., P. K. Goldberg and N. Pavcnik (2003) investigate the effects of the 1980s and 1990s tariff reductions on the wage distribution of Colombia. They identify the increasing returns to college education, the changes in industry wages that hurt sectors with initially lower wages and a higher fraction of unskilled workers, and shifts of the labour force towards the informal sector as the main channels through which trade liberalization affected the wage distribution in that country. Thus, although the effect of trade liberalization on wages has been widely studied before, section 1.7 of this chapter will present new evidence on this subject that confirms the important relationship between trade policy and labour income, and it will also contribute to the existing literature by analyzing the effect of trade liberalization on the wage gap between the formal and the informal sectors, which has not been studied before.

On the other hand, there might be an effect on the productivity differential, β. This could be so because firms in the formal sector may benefit more from trade liberalization than firms in the informal sector, given that they can get involved in trade and therefore have access to better and more intermediates coming from abroad. Thus,

Proposition 2. *If trade liberalization increases productivity in the formal sector, then: 1) points 1, 3, and 4 in proposition 1 will still hold; 2) there will be an ambiguous effect on* φ_F^**; and 3) there will be an ambiguous effect in the employment share of the informal sector. (proof: see appendix 1C)*

Intuitively, if the productivity differential between formal and informal firms increases, then the profits of the formal firms relative to those of the informal firms will also be larger than before. Formal firms will tend to get bigger and at the same time informal firms will tend to get smaller, which will bid up the real wages and could increase the employment share of the formal sector. To date, there is plenty of evidence on the fact that trade liberalization helps in increasing productivity. To mention some examples: Fernandes, A. M. (2003) explores Colombian trade policy from 1977 to 1991. Using a panel of manufacturing plants, she finds a strong positive impact of trade liberalization on productivity. Ferreira, P. C. and J. L. Rossi (2003) analyze the Brazilian trade liberalization process of 1988 to 1990. Using industry level data, they find large and widespread productivity improvements across industries after trade barriers were reduced. Pavcnik, N. (2002) investigates the effects of liberalized trade on plant productivity in Chile. Using plant-level data on Chilean manufacturers, she finds evidence of within plant productivity improvements that can be attributed to trade liberalization for the plants in the import-competing sector. Harrison, A. (1994) measures the relationship between productivity and trade reform using a panel of firms from Ivory Coast. She finds a positive association between more open trade policies and higher productivity growth. The pre-NAFTA Mexican case has also been analyzed before. Tibout, J. and M. Westbrook (1995) examine the effects of trade liberalization on productivity for the period 1984 through 1990. Using plant-level data provided to them by the Mexican Secretariat of Commerce and Industrial Development (nowadays the Secretariat of Economy), they find that average costs in most industries fell with trade liberalization. For importables, the authors find that the cost reductions were due partly to improvements in relative productivity, whereas for exportables they seem to be due to favourable changes in relative prices (imported intermediate goods becoming cheaper).

Overall, the model presented in this section opens the possibility for the effect of trade liberalization on informality to be negative; that is, more trade liberalization leading to a lower rate of informality. In the context of the Mexican experience under NAFTA, the

previous propositions could translate in the following hypotheses regarding the bilateral elimination of the import tariffs:

a. A lower Mexican import tariff allows firms in the formal sector to obtain cheaper inputs, machinery and equipment from the United States, which leads to an increase in their productivity. This effect would contribute to the reallocation of profits and labour from the less efficient informal firms to more efficient formal ones, increasing the employment share of the formal sector.
b. A reduction in the Mexican import tariff cuts down the costs for U.S. firms of operating in Mexico, in the sense that it now becomes cheaper to open a plant in Mexico and import intermediate inputs and materials from the U.S. These new, more productive entrants will increase labour demand in the formal sector and this could as well reduce informality.
c. A lower U.S. import tariff benefits the Mexican producers by allowing them to access the U.S. market in a cheaper and easier way. This would generate new profit opportunities, particularly for the more productive firms in the formal sector that are able to export, leading to an increase in their labour demand and raising real wages.

At the end, after liberalization, one could then observe lower informality rates and higher wages in more productive industries, and perhaps higher informality rates in less productive ones.

1.3. Trade Policy Background

The beginning of the Mexican trade liberalization process can be traced back to 1986, when the country became a member of the General Agreement on Tariffs and Trade (GATT) and stopped its import-substitution industrialization strategy. According to Kate, A. t., C. Macario and G. Niels (2000), and Revenga, A. (1995), the main consequences of these changes in trade policy were: (a) a reduction in the coverage of import license requirements from 100% of the domestic production in 1982 to 25.4% by December 1987, and to 16.5% in 1993; (b) a reduction in the maximum import tariff from 100% in 1985 to 20% in 1988; (c) a reduction of the average import tariff in the manufacturing sector from 23.5% in 1985 to 11% in 1988; and (d) a reduction in the coverage of reference prices in the manufacturing sector from 18.7% in 1985 to 0% in 1988.

In 1993 the country expanded its trade liberalization process by signing the North American Free Trade Agreement (NAFTA) with the United States and Canada, which took effect on the 1st of January 1994, and that aims at the total elimination of import tariffs by 2008. The agreement sets up a trade liberalization calendar that classifies products and by-products in 5 different groups, according to the date and way in which the corresponding import tariffs were going to be eliminated[4]:

- Group A: products and/or by-products for which tariffs were completely eliminated on the 1st of January 1994.
- Group B: products and/or by-products for which tariffs were gradually eliminated in 5 equal annual stages, starting on the 1st of January, 1994, and finishing by the 1st of January, 1998.
- Group C: products and/or by-products for which tariffs were gradually eliminated in 10 equal annual stages, starting on the 1st of January, 1994, and finishing by the 1st of January, 2003.
- Group C+: products and/or by-products for which tariffs were gradually eliminated in 15 equal annual stages, starting on the 1st of January, 1994, and finishing by the 1st of January, 2008.
- Group D: products and/or by-products for which there were no tariffs before and after NAFTA.

Apart from tariff elimination, NAFTA also contemplates the partial elimination of many barriers to trade in services and to cross-border investment.

After 1994, Mexico signed other trade agreements with several countries, such as Colombia and Venezuela (1995); Costa Rica (1995); Bolivia (1995); Nicaragua (1998); Chile (1999); the European Union (2000); Israel (2000); El Salvador, Guatemala and Honduras (2001); Iceland, Norway, Liechtenstein and Switzerland (2001); Uruguay (2004); and Japan (2005). Nevertheless, NAFTA remains the most important event for the Mexican trade policy in the last 20 years, as the United States is by far the largest trading partner of the country[5].

[4] The text of the North American Free Trade Agreement and the calendar for Mexico's tariff elimination process can be found at the Mexican Secretariat of Economy's website: http://www.economia-snci.gob.mx/sic_php/ls23al.php?s=502&p=1&l=1

[5] According to data published by the Mexican National Institute of Statistics, Geography and Computing (INEGI), FOB imports from the U.S. represented on average 69% of total Mexican FOB imports between 1990 and 2005. See http://dgcnesyp.inegi.gob.mx/cgi-win/bdieintsi.exe/Consultar.

1.4. Trade and Labour Data

The present study focuses on trade liberalization under NAFTA, and specifically on the import tariff elimination part of the agreement. It uses data on both Mexican and U.S. tariffs. The Mexican data covers the 1988-2002 period and was collected directly from the Law of General Import and Export Tariffs (TIGIE), published by the Mexican government in the Official Journal of the Federation (Diario Oficial de la Federación). During this period the TIGIE was totally modified in February 1988, December 1995 and January 2002. It was also subject to several partial modifications between these years: 84 between 1988 and 1995, and 46 between 1995 and 2002. Among these changes are those regarding NAFTA and its liberalization calendar, starting on January 1994. The data includes ad-valorem tariffs only. Regarding the U.S. tariffs, the data comes from the NBER U.S. Tariff Database, constructed by Robert C. Feenstra, John Romalis and Peter K. Schott[6], and which is based on the Harmonized Tariff Schedule of the United States (HTS). It includes ad-valorem, specific and estimated ad-valorem equivalent (AVE) tariffs based on the MFN rate of the HTS. The file also indicates products that are eligible for tariff preferences under free trade agreements such as with Canada and Mexico, and indicates products eligible for any preferential programs such as the Generalized System of Preferences (GSP). This database covers the period 1989-2001, and was complemented with the year 2002 for the present study, using the original documents of the U.S. tariff schedule published by the United States International Trade Commission[7]. Both the Mexican and the U.S. tariff schedules are based on the International Harmonized System, the global system of nomenclature that is used to describe most world trade in goods. The annual production-weighted average tariffs and their standard deviations are reported in table 1.1. The trade data is linked to individual level data from the Mexican National Survey of Urban Employment (ENEU), carried out by the National Institute of Statistics, Geography and Computing (INEGI) since 1983. It provides information about the state of the Mexican labour market, the main socio-demographic characteristics of the household members aged 12 and above, and housing in the principal urban areas of the country. Among other things, the ENEU provides information about employment status, duration of unemployment,

[6] See: FEENSTRA, R. C., J. ROMALIS, and P. K. SCHOTT (2002): "U.S. Imports, Exports and Tariff Data, 1989-2001," *NBER Working Paper Series*. The database is freely available at http://gsbwww.uchicago.edu/fac/john.romalis/research/

[7] These documents can be found in PDF format at http://www.usitc.gov/tata/hts/archive/index.htm.

Table 1.1: Production-Weighted Average Import Tariffs 1989-2002

	Mexican Tariff on U.S. Imports (% ad valorem)[1]		U.S. Tariff on Mexican Imports (% ad valorem)[2]	
	Mean	S.D.	Mean	S.D.
1989	14.03	0.24	2.87	0.27
1990	13.81	0.27	2.92	0.26
1991	13.96	0.26	2.47	0.26
1992	13.88	0.25	2.53	0.27
1993	13.99	0.26	2.41	0.26
1994	7.43	0.30	1.07	0.15
1995	6.40	0.25	1.63	0.19
1996	5.30	0.22	1.01	0.12
1997	4.24	0.20	0.77	0.09
1998	3.13	0.18	0.58	0.07
1999	2.42	0.14	0.41	0.06
2000	1.93	0.12	0.40	0.06
2001	1.42	0.10	0.40	0.07
2002	0.95	0.09	0.11	0.03

Calculations by the author. Weights equal to the share of Mexican sector production on national GDP. [1] Source: Diario Oficial de la Federacion (Mexico). [2] Source: NBER U.S. Tariff Database.

job characteristics (position, size of workplace, social security coverage, industry affiliation, etc), hours worked, quality of job, and job search. The social security coverage data is used to generate an indicator for the unregistered workers which, even though is a reduced-form measure of informality, it is one of the few measures that can be constructed from employee data from a household survey. A person is classified as working in the unregistered sector if he or she runs a firm of 6 or less employees and does not have any kind of social or health insurance (*unregistered self-employed*), if he or she works for a firm of any size and does not have any kind of social or health insurance (*unregistered salaried*), and if he or she works without receiving any kind of payment (*unpaid workers*). This definition is similar to the one suggested by Maloney, W. F. (1999). The main socio-demographic characteristics covered by the survey are age, gender, kinship, marital status, schooling, place of birth, number of children, and migratory status. Regarding housing, the ENEU obtains information about type of dwelling, ownership, size, services, and construction materials.

The survey is carried out on a quarterly basis. The sample is divided in five independent panels (waves), and each one of them stays in the sample for five consecutive quarters. From 1983 to 1984 it covered only the three main cities in Mexico (Mexico City, Guadalajara and Monterrey). From 1985 to 1991 its coverage was expanded to 16 cities, including also the main cities at the US-Mexico border (Ciudad Juarez, Matamoros,

Table 1.2: Labour Data. Sample Characteristics by Year

Year	Observations	Tradable Industries	Non-tradable Industries	Cities Covered	Unregistered/Total Employment[1]
1989	60,334	238	96	16	47%
1990	62,441	237	94	16	46%
1991	63,082	237	92	16	46%
1992	114,637	243	94	32	47%
1993	123,460	245	96	35	49%
1994	126,976	244	95	37	50%
1995	130,054	246	95	39	52%
1996	138,384	242	99	41	53%
1997	147,271	247	101	43	52%
1998	153,622	245	95	44	50%
1999	173,095	250	96	45	50%
2000	183,999	248	95	45	49%
2001	190,405	246	99	48	49%
2002	184,229	238	93	48	50%
Maximum	190,405	250	101	48	53%
Minimum	60,334	237	92	16	45%
Average	127,520	243	96	35	49%

Source: Mexican National Survey of Urban Employment (ENEU), INEGI. Calculations based on samples restricted to employed people. [1] Estimated as the fraction of employed people that are (a) patrons in a firm with less than 6 employees and that do not have social or health insurance, (b) employees in a firm of any size and that do not have social or health insurance, and (c) employees that do not receive payment.

Nuevo Laredo and Tijuana). In 1992 other 18 cities were included in the survey, and in the subsequent years another 14 cities were added. By the fourth quarter of 2000 there were 48 cities covered by the ENEU (and approximately 51.2% of the total population of the country was living in these cities by that time). This study uses mainly the April-June interviews for each year between 1989 and 2002. Only employed people are included in the sample. Matching the ENEU industry codes with the tariff codes yields an average of 243 tradable industries and 96 non-tradable industries per year. Table 1.2 reports some of the main characteristics of the sample for each one of the years covered here, and table 1.3 summarizes worker characteristics in the registered and the unregistered sectors for the 1994 April-June interview. From the latter it can be seen that hourly wages, years of schooling and the fraction of married workers tend to be higher in the registered sector. The likelihood of being unregistered also appears to be lower for the heads of the household. Regarding the geographic characteristics, the table suggests that unregistration rates are higher in places closer to Mexico City than to the Mexico-U.S. border[8], and lower in places with high exposure to globalization, as

[8] The fraction of people living closer to Mexico City than to the U.S.-Mexico border is estimated with a variable that takes the value 0 if the road distance (in kilometres) from a particular city to the closest major U.S.-Mexico border crossing is shorter than the road distance between that city and Mexico City. It

Table 1.3: Registered and Unregistered Workers 1994

	Registered	Unregistered
Personal Characteristics		
Hourly wages	8.718	6.172
Male	0.639	0.650
Age	33.229	34.888
Experience	17.366	21.329
Schooling	9.865	7.563
Married	0.556	0.498
Cohabitating	0.044	0.064
Head of household	0.487	0.453
No. of children	1.325	2.427
Geographic Characteristics		
Living closer to Mexico City	0.647	0.727
High exposure to globalization	0.296	0.245
Low exporsure to globalization	0.239	0.293
Job Characteristics		
Self-employed	0.030	0.430
Work in less than 6 person establishment	0.115	0.801
Work at home	0.235	0.314
Receive annual bonus	0.867	0.053
Paid vacations	0.811	0.035
Receive credit for housing	0.269	0.006
Health insurance	0.961	0.000
Weekly hours worked	42.261	39.033
Has a second job	0.038	0.026

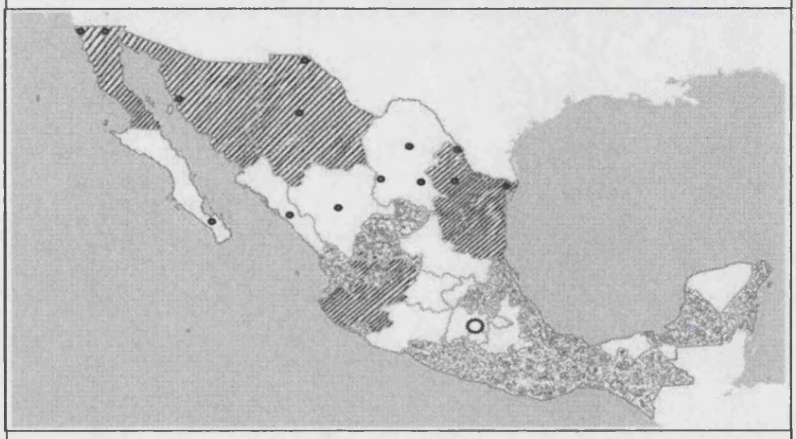
Source: author's calculations based on the Mexican National Survey of Urban Labour (ENEU) INEGI.

measured by Hanson, G. H. (2004)[9]. At first glance this might appear to be redundant, as one may think that cities closer to the Mexico-U.S. border are those located in states with high exposure to globalization. However, figure 1.1 shows that the mapping between these two characteristics is not perfect. Finally, regarding the job characteristics, the table indicates that the rate of self-employment is much higher in the unregistered than in the registered sector. The fraction of people working in establishments of less than 6 persons is also higher, as well as the fraction of people working at home. By the definition of unregistration used here, no one in the unregistered sector receives any kind of social or health insurance.

takes the value 1 otherwise. The distance data comes from the Secretariat of Transport and Communications. The four major border crossings are Tijuana-San Diego, Nogales, Ciudad Juarez-El Paso, and Nuevo Laredo-Laredo.

[9] He measures regional exposure to globalization through the share of *maquiladora* value added, foreign direct investment, and imports in state GDP, each one averaged over the period 1993-1999. Hanson sorts states according to their average rank across the three measures and selects as high-exposure states those whose average rank is in the top third, while low-exposure states are those whose average rank is in the bottom third. The high-exposure states are Baja California, Chihuahua, Nuevo Leon, Sonora, Jalisco, Tamaulipas and Aguascalientes. The low-exposure states are Zacatecas, Quintana Roo, Nayarit, Colima, Guerrero, Veracruz, Chiapas, Campeche, Hidalgo and Oaxaca.

Figure 1.1. Exposure to Globalization and Proximity to the U.S. - Mexico Border



States with high exposure to globalization[1]

States with low exposure to globalization[1]

Cities closer to the U.S.- Mexico border than to Mexico City[2]

Mexico City

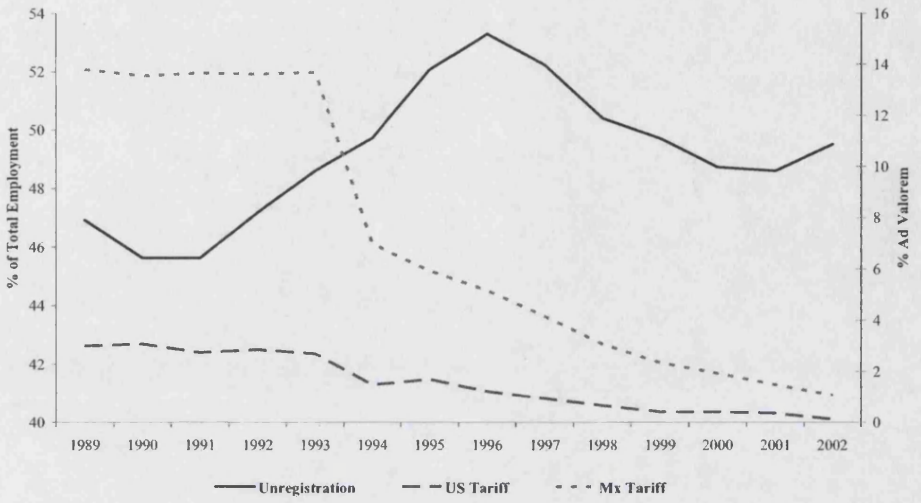
[1] Exposure to globalization as measured by Hanson, G.H. (2004)
[2] Proximity is measured by road distance (kilometers)

1.5. Trade Liberalization and Unregistered Labour: Preliminary Analysis

The analysis of the relationship between trade liberalization and unregistration in this chapter begins by looking at the behaviour of the average import tariffs and unregistration rate across time. As shown in table 1.2, the city coverage of the ENEU survey doubled in 1992. The 16 original cities passed from representing 100% of the observations before 1992 to approximately 40% afterwards[10]. This is a drastic modification that could affect the estimation of the yearly average rate of unregistration. In order to control for this possible bias, the rate of unregistration is obtained from a regression of the indicator for unregistration defined above on a set of city and time dummies, using all the years available in the sample. The estimated year coefficients are then the estimates of the annual average unregistration rate after controlling for the cities included in the survey. These coefficients are finally rescaled so that their mean is equal to the mean of the unregistration rate obtained when using the raw data. The unregistration rate and import tariffs series are plotted in Figure 1.2. The average

[10] The 16 original cities are Mexico City, Guadalajara, Monterrey, Puebla, León, San Luis Potosí, Tampico, Torreón, Chihuahua, Orizaba, Veracruz, Mérida, Ciudad Juárez, Tijuana, Nuevo Laredo, and Matamoros. These cities represent approximately 35% of the total population of the country.

Figure 1.2: Average Import Tariffs and Unregistration



Mexican import tariff on U.S. products remained basically constant at around 14% ad valorem between 1989 and 1993. It then dropped to 7% in the first year of NAFTA (1994), and continued to decrease gradually to approximately 1% in 2002. The U.S. import tariff on Mexican products also remained relatively constant between 1989 and 1993, at around 3%. This low level of pre-NAFTA tariffs reflects the fact that, according to the United States International Trade Commission, Mexico was already being benefited with the Generalized System of Preferences by qualifying as a Beneficiary Developing Country[11]. This average tariff then decreased to 1% during the first year of NAFTA, increased temporarily to 2% in 1995 as a response to the Mexican peso crisis, and continued to decrease gradually to approximately 0.1% in 2002. Regarding the share of unregistration, the figure shows a positive trend starting in 1992 and reaching its peak just after the crisis in 1996, making the average rate to increase from 48% to 53% of total employment. It then decreased gradually to 49% in 2002. From figure 1.2 is difficult to see a clear relationship between trade liberalization and unregistration. On one hand, comparing the level of the latter in the first and the last years of the period suggests that this rate moved to a higher permanent level, and this would imply a negative relationship between tariff reduction and the rate of unregistration[12]. But according to the 1992-1996 positive trend, the transition to this new permanent level of unregistration began 3 years before the implementation of NAFTA, indicating that the change may be due to factors other than the reduction in the

[11] For more detail, see the general notes on the Official Harmonized Tariff Schedule of the United States Annotated, from the HTSA Basic Publication in any year between 1989 and 1994. These documents can be found in the website mentioned in footnote 7.

[12] The correlation coefficients for the series depicted in figure 1.2 are -0.546 between the Mexican import tariff and the rate of unregistration, and -0.484 between the latter and the U.S. import tariff.

import tariffs. On the other hand, there is a negative trend in unregistration between 1996 and 2001, which coincides with the gradual reduction in both the Mexican and U.S. import tariffs, and this would suggest a positive relationship between the level of the tariffs and unregistration. But it is very likely that most of this negative trend is simply reflecting the recovery of the Mexican economy from the 1995 financial crisis.

To analyze these series at a more disaggregated level, figure 1.3 decomposes figure 1.2 by economic sectors. Once again, an unambiguous relationship between the average tariffs and the rate of unregistration does not seem to be present. Perhaps the strongest evidence of a positive relationship comes from the *Primary metals* and the *Farms, forestry & fishing* sectors. The change to a new steady state level of unregistration is clearer for the *Mining* and the *Food, beverages & tobacco* sectors. As in figure 1.2, the transition appears to begin before the implementation of NAFTA and to peak during the financial crisis. For the rest of the sectors, the behaviour of the rate of unregistration is either erratic or does not seem to be affected by the import tariff elimination process. The last panel in figure 1.3 summarizes the trends of unregistration in the non tradable sectors. Unregistration increases with the Mexican crisis in 1995 and it does not decrease to its pre-1995 levels afterwards, indicating perhaps that any beneficial effect steaming from trade liberalization has not permeated significantly to these sectors.

Table 1.4 summarizes the changes of the import tariffs and the unregistration rate for the tradable sectors over the 1989-2002 period. It shows the percentage point changes from the 1989-91 to the 2000-02 averages. Six of the sectors experienced a reduction in their unregistration rates. The largest increase in the unregistration rate is of 5.6 percentage points in the *Mining* and *Food, beverages & tobacco* sectors, while the largest decrease is of 5.2 percentage points in the *Farms, forestry & fishing* sector. It can also be seen that the *Textiles, apparel & leather* and the *Mining* sector are the ones with the largest and smallest tariff cuts respectively, both under the Mexican and the U.S. schedules[13]. The reduction in the Mexican import tariff is on average 9.6 percentage points larger than the change in the U.S. import tariff.

At an even higher level of disaggregation, tables 1.5 and 1.6 list the 50 most and the 50 less liberalized industries respectively, in terms of reduction in import tariff percentage points. For each of these industries, the tables show the 4-digit code used by INEGI in the ENEU, a brief description of the industry, the economic sector to which they belong, and the percentage point change between the 1989-91 and the 2000-02 average

[13] The *Mining* sector was nonetheless the one with the lowest levels of pre-NAFTA tariffs. See figure 1.3.

Figure 1.3: Average Import Tariffs and Unregistration Rates by Sector

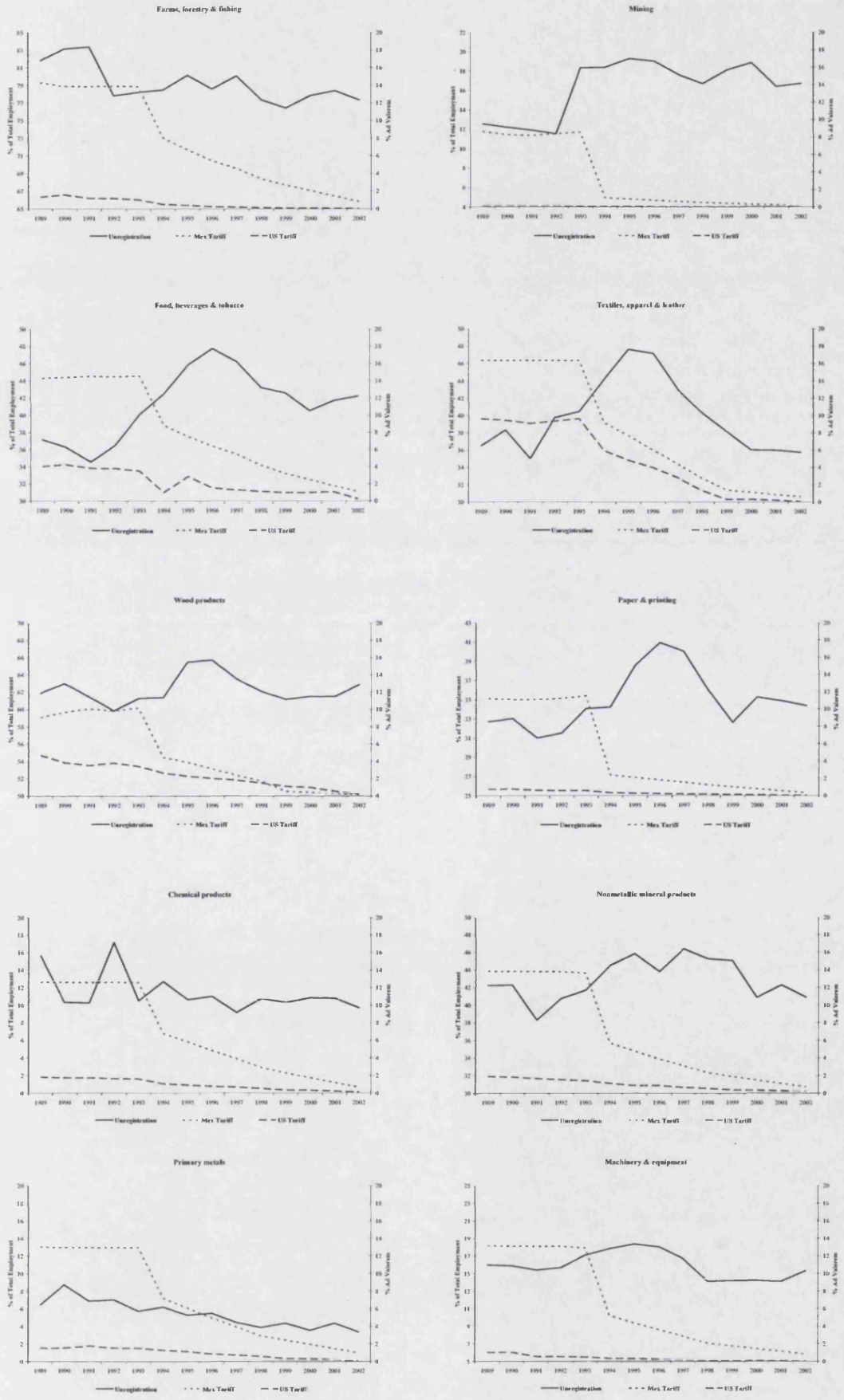


Figure 1.3 (continued)

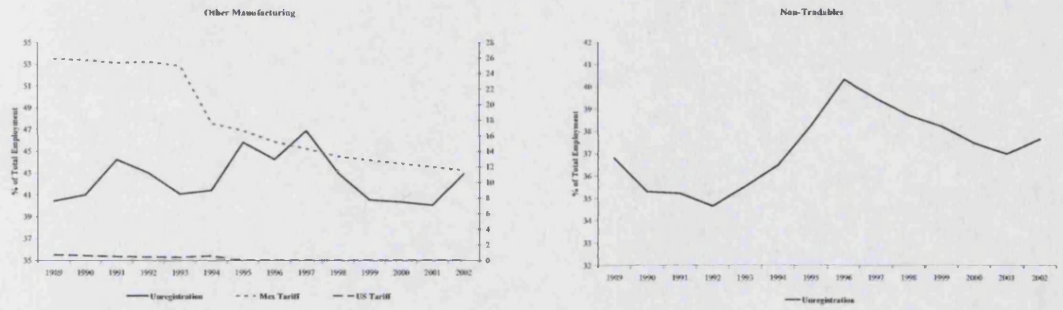


Table 1.4: Change in Import Tariffs and Unregistration by Sector (Percentage Points)

	1989-91 to 2000-02[a]		
Sector	**Unregistration**	**Mex**	**US**
Farms, forestry & fishing	-5.2	-12.6	-1.3
Mining	5.6	-8.1	-0.2
Food, beverage & tobacco	5.6	-12.6	-3.3
Textiles, apparel & leather	0.1	-15.5	-9.2
Wood products	-0.7	-9.3	-3.4
Paper & printing	2.0	-10.6	-0.7
Chemical products	-1.4	-11.4	-1.5
Nonmetallic mineral products	1.8	-12.7	-1.5
Primary metals	-3.3	-11.5	-1.4
Machinery & equipment	-1.6	-12.0	-0.8
Other manufacturing	-1.6	-13.7	-0.6
Maximum	5.6	-8.1	-0.2
Minimum	-5.2	-15.5	-9.2
Average	0.1	-11.8	-2.2

Source: author's calculations based on the Mexican National Survey of Urban Labour (ENEU) INEGI, Diario Oficial de la Federacion (Mexico), and the NBER U.S. Tariff Database. [a] Changes calculated as the difference between the 2000-02 and the 1989-91 averages.

unregistration rate and import tariffs. The industries included in table 1.5 (table 1.6) are those that, when sorting all the industries in the sample according to the change of the Mexican and the U.S. import tariffs separately, appear in the top 100 (bottom 100) in both cases. The main things to notice from the ranking in table 1.5 are the following: first, it is dominated by the *textiles, apparel & leather* economic sector, with 25 industries in the list; second, 25 industries experienced a decrease in their rates of unregistration during this period; third, the largest reductions in import tariffs are of approximately 20 percentage points; and fourth, the change in the Mexican import tariff is on average 9.2 percentage points larger than the change in the U.S. import tariff. The missing data in the "Unregistration" column corresponds to industries that did not appear in the sample for some of the years considered here. The tariff and unregistration changes are plotted against each other in figures 1.4 and 1.5. The simple regression lines fitted in these figures suggest a slightly positive relationship between the reductions in imports tariff and the changes in unregistration.

Regarding table 1.6, it can be seen that the *Machinery & equipment* and the *Mining* sectors dominate the "least liberalized" ranking, with 12 and 10 industries respectively. 28 industries had their unregistration rates reduced, and the largest reductions in import tariffs are of approximately 11 percentage points. Notice that for many of these industries, the change in the U.S. import tariff is equal to zero because they were already fully liberalized in 1989-91, due to the Generalized System of Preferences. The decrease in the Mexican import tariff is on average 8.6 percentage points larger than the change in the U.S. import tariff. Figures 1.6 and 1.7 plot these import tariffs changes against the unregistration changes. The fitted regression lines indicate that, unlike the most liberalized industries, changes in the import tariffs are now negatively correlated with changes in unregistration.

Finally, table 1.7 offers a look at the evolution of unregistration in the non-tradable sectors[14]. It shows the percentage point changes from the 1989-91 to the 2000-02 average rates. The *Hotels, restaurants & trade* sector is the only one that experienced a reduction in unregistration, of about 0.5 percentage points. The largest increase is of 8 percentage points for the *Financial services & real estate* sector. The average change in unregistration in the non-tradable sectors (bottom row in the table) is an increase of approximately 3 percentage points.

[14] *Petroleum & coal extraction* is classified as non-tradable because of two reasons: first, it mainly refers to petroleum extraction activities and not to the marketing of its outputs (such as oil or gas) which are mostly included in the *Chemical products* sectors; and second, petroleum extraction in Mexico is an exclusive activity of the state-own company, PEMEX.

Table 1.5: 50 Most Liberalized Industries

INEGI Code	Description	Sector	Unregistration	Change Mex	Change US
105	Fruits	Food, beverages & tobacco	-0.10	-18.66	-4.08
205	Horses, mules and donkeys	Farms, forestry & fishing	0.25	-15.50	-2.08
206	Poultry	Farms, forestry & fishing	-0.08	-15.28	-5.03
208	Lambs	Farms, forestry & fishing	.	-14.60	-1.96
1112	Cream, butter, cheese	Food, beverages & tobacco	-0.08	-13.86	-6.72
1201	Dehydrated fruits and vegetables	Food, beverages & tobacco	-0.09	-18.11	-4.21
1202	Prepared and packed fruits and vegetables	Food, beverages & tobacco	-0.05	-15.65	-5.62
1602	Piloncillo, Panela or Mascabado	Food, beverages & tobacco	0.00	-14.72	-2.15
1611	Ethyl alcohol	Food, beverages & tobacco	.	-18.15	-3.07
1901	Regional candies and jelly	Food, beverages & tobacco	0.08	-18.66	-7.64
1903	Candies and chocolates	Food, beverages & tobacco	-0.06	-18.66	-7.64
1942	Ice cream	Food, beverages & tobacco	0.04	-13.52	-14.67
2001	Agave liquors	Food, beverages & tobacco	-0.41	-20.00	-4.51
2011	Non-fermented alcoholic beverages	Food, beverages & tobacco	0.10	-18.15	-3.07
2012	Wines	Food, beverages & tobacco	0.16	-19.38	-4.53
2201	Softdrinks and purified water	Food, beverages & tobacco	0.03	-17.00	-3.32
2421	Threads	Textiles, apparel & leather	-0.06	-14.69	-9.00
2432	Cashmeres, cloths and similar products	Textiles, apparel & leather	0.04	-14.00	-20.40
2601	Impregnated textiles	Textiles, apparel & leather	0.29	-18.07	-4.55
2611	Padding and similar articles	Textiles, apparel & leather	-0.07	-17.57	-5.41
2612	Carpets and similar articles	Textiles, apparel & leather	-0.06	-15.60	-3.93
2613	Felts	Textiles, apparel & leather	0.50	-20.00	-10.94
2614	Quilted textiles	Textiles, apparel & leather	-0.21	-16.25	-13.22
2621	Lace and similar articles	Textiles, apparel & leather	0.07	-18.15	-10.27
2631	Cotton and bandages	Textiles, apparel & leather	-0.02	-15.00	-13.48
2641	Tapestry	Textiles, apparel & leather	-0.10	-18.36	-5.00
2642	Buttons, sequins, and similar articles	Textiles, apparel & leather	0.09	-18.86	-15.54
2643	Sheets and tablecloths	Textiles, apparel & leather	-0.06	-18.99	-7.36
2644	Other textiles	Textiles, apparel & leather	0.15	-18.39	-7.82
2701	Socks and tights	Textiles, apparel & leather	-0.05	-20.00	-16.43
2702	Sweaters and vests	Textiles, apparel & leather	-0.03	-19.70	-10.27
2703	Knitted articles	Textiles, apparel & leather	-0.17	-19.25	-15.12
2711	Male cloths, except shirts and uniforms	Textiles, apparel & leather	-0.06	-18.13	-11.17
2717	Underwear	Textiles, apparel & leather	.	-17.50	-9.29
2721	Hats and caps	Textiles, apparel & leather	0.07	-18.33	-9.96
2722	Palm-made hats	Textiles, apparel & leather	-0.11	-18.00	-11.94
2723	Gloves, handkerchiefs, ties and scarfs	Textiles, apparel & leather	-0.31	-17.68	-14.00
2801	Tanned leather	Textiles, apparel & leather	-0.06	-17.55	-14.40
2811	Leather products, exc shoes and clothes	Textiles, apparel & leather	0.02	-13.69	-2.86
2812	Non-plastic shoes	Textiles, apparel & leather	0.01	-17.50	-15.50
2821	Sandals and similar articles	Textiles, apparel & leather	0.19	-18.75	-7.69
2901	Sawmill production	Wood products	0.07	-15.02	-2.79
3001	Wooden furniture	Wood products	-0.01	-15.42	-5.77
3002	Box Spring mattresses	Wood products	0.07	-15.00	-12.35
4201	Plastic tubes and contours	Chemical products	-0.02	-13.46	-3.33
4511	Bricks and tiles	Nonmetallic mineral products	0.07	-15.52	-5.20
4512	Refractory products	Nonmetallic mineral products	0.14	-14.16	-1.63
5601	Automobiles, trucks and tractors	Machinery & equipment	-0.01	-13.88	-1.97
5701	Metallic bodyworks and parts	Machinery & equipment	0.00	-14.02	-1.98
5902	Watches and clocks	Other manufacturing	-0.12	-17.37	-2.87
Maximum			0.50	-13.46	-1.63
Minimum			-0.41	-20.00	-20.40
Average			0.00	-16.88	-7.68

The change is calculated as the difference between the 2000-2002 and the 1989-1991 averages. The missing observations in the "Unregistration" column are due to the fact that such industries did not appear in the ENEU labour survey for some of the years considered here.

Figure 1.4. Changes in Unregistration and the Mexican Import Tariff 1989-91 to 2000-02
Most Liberalized Industries

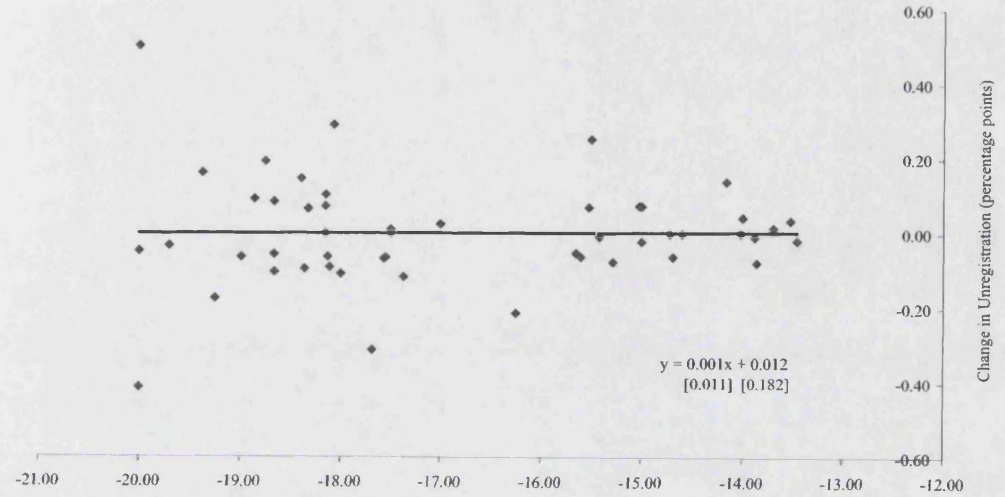


Figure 1.5. Changes in Unregistration and the U.S. Import Tariff 1989-91 to 2000-02
Most Liberalized Industries

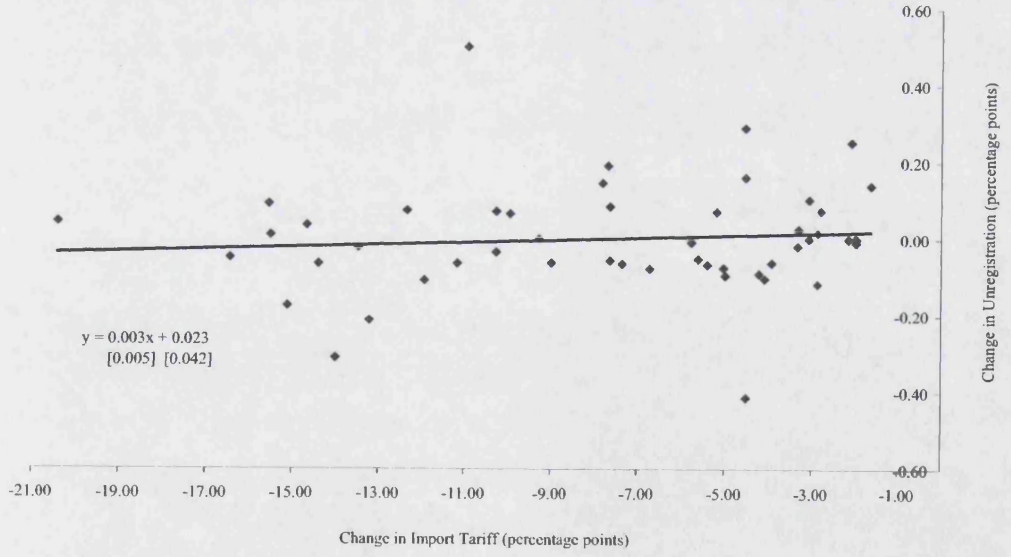


Table 1.6: 50 Less Liberalized Industries

INEGI Code	Description	Sector	Unregistration	Change Mex	Change US
201	Cattle	Farms, forestry & fishing	0.02	-1.85	0.00
203	Sheep	Farms, forestry & fishing	0.36	-10.77	-0.10
204	Goats	Farms, forestry & fishing	-0.10	-5.53	-0.20
207	Milk producer cattle and goats	Farms, forestry & fishing	-0.19	-7.80	-0.07
413	Other products from the sea	Farms, forestry & fishing	.	-8.00	0.00
501	Coal & graphite	Mining	-0.06	-6.29	0.00
511	Coke & anthracite	Mining	.	-7.91	0.00
701	Iron extraction	Mining	-0.02	-3.75	0.00
901	Limestone extraction	Mining	0.55	-10.00	0.00
911	Gypsum extraction	Mining	0.00	-6.67	0.00
921	Chippings & sand extraction	Mining	-0.03	-8.19	0.00
931	Extraction of clay, marble, quartz, etc.	Mining	0.02	-9.10	-0.05
941	Silica extraction	Mining	0.00	-10.00	0.00
1001	Fluorite extraction	Mining	-0.13	-10.00	0.00
1021	Salt & salt mines	Mining	-0.16	-10.00	0.00
1411	Corn milling	Food, beverages & tobacco	-0.01	-6.40	0.00
1801	Food for animals	Food, beverages & tobacco	0.03	-7.63	0.00
3023	Wood coffins	Wood products	-0.13	-9.22	0.00
3025	Other wooden products, exc. furniture	Wood products	-0.02	-4.58	0.00
3121	Paper made containers	Paper & printing	0.15	-7.43	0.00
3122	Cardboard made containers	Paper & printing	-0.05	-5.51	-0.02
3123	Other paper and cardboard products	Paper & printing	-0.06	-9.12	0.00
3201	Newspapers & magazines	Paper & printing	-0.03	-4.53	-0.02
3211	Printing, lithography & bookbinding	Paper & printing	0.01	-7.52	0.00
3301	Petroleum refining	Chemical products	-0.04	-9.90	0.00
3311	Lubricants & additives	Chemical products	0.06	-10.99	0.00
3501	Colourings & pigments	Chemical products	0.00	-7.73	-0.06
3521	Primary chemical products	Chemical products	-0.02	-9.99	0.00
3711	Cellulose & synthetic fibres	Chemical products	0.03	-9.78	-0.35
3801	Medicines	Chemical products	0.01	-9.04	-0.27
3901	Soaps, detergents and similar products	Chemical products	0.00	-10.97	0.00
4044	Other chemical products	Chemical products	0.15	-11.29	0.00
4401	Hydraulic cement	Nonmetallic mineral products	-0.03	-10.04	0.00
4521	Gypsum products	Nonmetallic mineral products	-0.04	-9.39	0.00
4522	Lime	Nonmetallic mineral products	0.00	-10.00	0.00
4701	Copper metallurgy and byproducts	Primary metals	0.00	-10.16	0.00
4711	Aluminum metallurgy	Primary metals	-0.09	-8.54	-0.21
4801	Metallic furniture	Machinery & equipment	-0.06	-9.81	-0.39
4911	Metallic structures, containers & platforms	Machinery & equipment	-0.01	-10.12	-0.20
5011	Tools for agriculture	Machinery & equipment	0.02	-10.83	-0.45
5041	Smelting of nonferrous metallic parts	Machinery & equipment	-0.04	-11.03	-0.42
5081	Kitchen pans	Machinery & equipment	0.11	-7.34	-0.45
5083	Other metallic products	Machinery & equipment	0.02	-9.74	-0.28
5112	M&E for the food industry	Machinery & equipment	0.12	-10.89	0.00
5151	Nonelectric extinguishers & pumps	Machinery & equipment	0.05	-10.07	-0.43
5171	Sewing machines	Machinery & equipment	-0.07	-10.87	0.00
5211	Electric industrial M&E	Machinery & equipment	-0.01	-11.06	-0.20
5301	Electric apparatuses and parts	Machinery & equipment	-0.04	-8.58	-0.11
5801	Ships	Machinery & equipment	-0.04	-10.18	0.00
5922	Candles	Other manufacturing	0.21	-10.06	-0.17
Maximum			0.55	-1.85	0.00
Minimum			-0.19	-11.29	-0.45
Average			0.01	-8.72	-0.09

The change is calculated as the difference between the 2000-2002 and the 1989-1991 averages. The missing observations in the "Unregistration" column are due to the fact that such industries did not appear in the ENEU labour survey for some of the years considered here.

Figure 1.6. Changes in Unregistration and the Mexican Import Tariff 1989-91 to 2000-02
Less Liberalized Industries

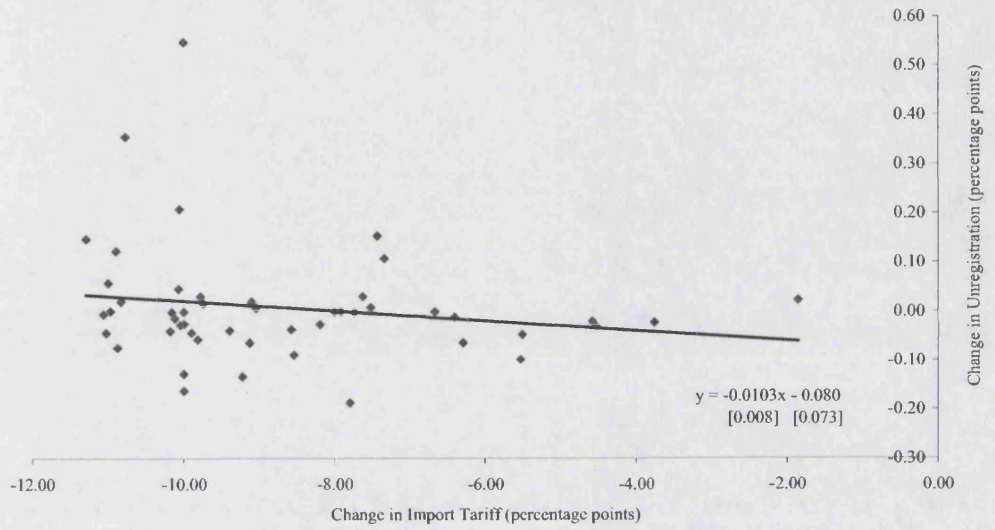


Figure 1.7. Changes in Unregistration and the U.S. Import Tariff 1989-91 to 2000-02
Less Liberalized Industries

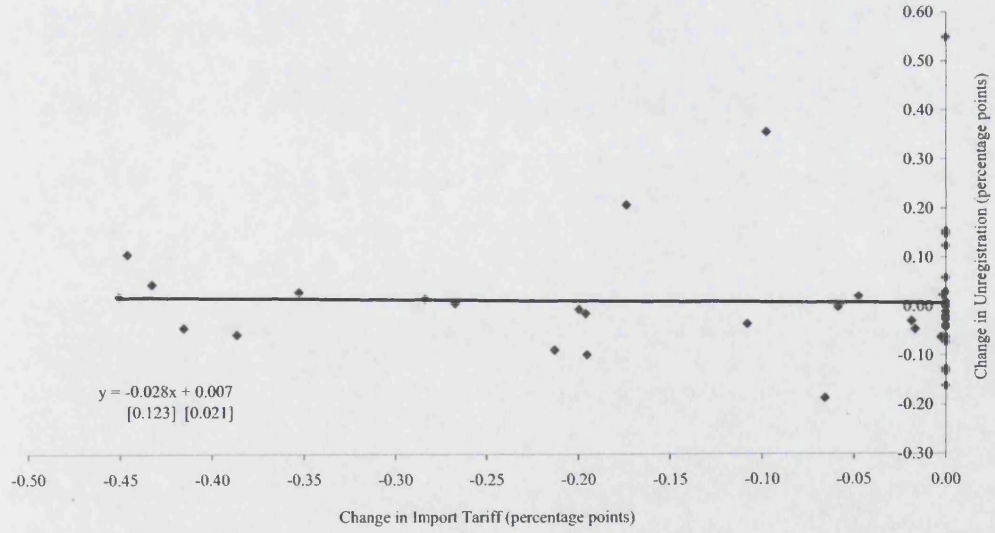


Table 1.7: Changes in Rates of Unregistration for the Non-tradable Sectors (Percentage Points)

Sector	1989-91 to 2000-02[a]
Petroleoum & coal extraction	5.4
Construction	2.1
Electricity, gas & water	1.8
Hotels, restaurants & trade	-0.5
Transport & storage	2.3
Financial services & real estate	8.0
Personal, professional and social services	1.7
Maximum	8.0
Minimum	-0.5
Average	3.0

Source: author's calculations based on the Mexican National Survey of Urban Labour (ENEU) INEGI, Diario Oficial de la Federacion (Mexico), and the NBER U.S. Tariff Database. [a] Changes calculated as the difference between the 2000-02 and the 1989-91 averages.

In sum, the main conclusions from this preliminary analysis are the following:

- When looking at the average unregistration rate and import tariffs (figure 1.2), it is not clear that trade liberalization affects in some way the level of unregistration. At this stage, it is impossible to distinguish the effect of tariff elimination from an apparent change in the permanent level of unregistration and the effect of the Mexican financial crisis of 1995.
- The analysis of the data for the tradable sectors separately (figure 1.3) suggests that trade liberalization may have helped in reducing the rate of unregistration in some sectors more than in others, such as the *Primary metals* and *Farm, forestry & fishing* sectors.
- The statistics in table 1.4 show that the *Mining* sector is the one with the largest increase in unregistration and the smallest reduction in tariffs. However, there is not enough evidence of a linear and positive relationship between the level of the tariffs and unregistration across sectors since, for example, the sector with the largest tariff cuts (*Textiles, apparel & leather*) is not the one with the largest decrease in unregistration. Regarding the non-tradable sectors, table 1.7 shows that the average unregistration rate increased by about 3 percentage points during the period of study.
- Finally, the industry level data in tables 1.5 and 1.6 indicate that 50% of the most liberalized and 56% of the less liberalized industries experienced a decrease in their

rates of unregistration between 1989 and 2002. The summary statistics at the bottom of these tables show that the average unregistration rate for the less liberalized industries increased by 0.01 percentage points more than that for the most liberalized ones. This could be suggesting that the larger the tariff cut, the more helpful trade liberalization becomes in reducing these rates.

1.6. Trade Liberalization and Unregistered Labour: Econometric Analysis

Even though useful, the evidence presented in the previous section is inconclusive and a deeper analysis of the effect of trade liberalization on unregistration is required. This section aims at studying this relationship in a more formal way. The main strategy implemented here is a two-stage estimation process based on the one used by Goldberg, P. K. and N. Pavcnik (2003). The first step involves the estimation of a linear probability model of the form:

$$y_{ijt} = H_{ijt}\beta_{Ht} + I_{ijt} * ip_{jt} + \varepsilon_{ijt} \tag{1.7}$$

where y_{ijt} is an indicator that takes the value of 1 if worker i in industry j at time t is employed in the unregistered sector, and it is equal to 0 if he is employed in the registered sector; H_{ijt} is a vector of worker characteristics such as years of schooling, a quadratic term on years of experience, marital status, gender, position within the household (whether he is the head of the family or not), and geographic location; I_{ijt} is a set of industry dummies that indicate worker i's industry affiliation; and ε_{ijt} is the error term. The coefficients ip_{jt} capture the part of the variation in unregistered employment that cannot be explained by worker characteristics, but that is attributable to worker i's industry affiliation. These coefficients should reflect the influence of any change in the market conditions at the industry level such as import tariff elimination, given that these tariffs are the same for all the firms in a particular industry. For this reason, they are the adequate measure of unregistration to link with the trade data. Following Goldberg & Pavcnik, these coefficients are denoted *industry unregistration differentials*. Equation (1.7) is estimated separately for each year in the sample.

In the second stage, these industry unregistration differentials are pooled over time and regressed on the Mexican import tariff, the U.S. import tariff, a set of industry and time

indicators, and a set of interactions between the industry dummies and a time trend. A weighted least squares estimation is used, with weights equal to the inverse of the variance of the unregistration differentials from the first stage.

Because of the rotating panel structure of the ENEU survey described in section 1.4, a fifth of the sample in any year appears as well in the following one, and this might be a source of autocorrelation for the error term in the second stage model. To account for this, the standard errors are computed using the Newey-West method with one lag. Regarding the first stage, Huber/White/sandwich standard errors clustered at the industry level are estimated in all the regressions.

1.6.1. First Stage Results

Apart from providing the estimates of the industry unregistration differentials, the first stage estimation is also useful to study the determinants of unregistered labour at the individual level. The results are reported in table 1.8. As expected from the human capital theory, the probability of being unregistered decreases with years of experience and schooling. It is also lower for married workers, but not for those cohabitating with a partner without being married. Males seem to be more likely to be unregistered than females. This result does not seem to support what Roberts, B. R. (1989) finds for the labour market of Guadalajara, but it is consistent with Goldberg, P. K. & N. Pavcnik (2003) findings for Colombia. The table also shows that the likelihood of unregistration is significantly lower for the head of the household and higher for the second provider of income in the family (*secondhead*). This seems to be a reasonable result if one considers that, as found by Roberts, B. R. (1989) and argued by Maloney, W. F. (1999), the deductions made for welfare in registered employment are perceived as a disadvantage by many workers. Since social welfare in Mexico normally covers not only the worker but his family as well, there is no benefit for the second provider of income to work in the registered sector and pay the welfare deductions to get his own social insurance, as he is already covered by the one from the head of the household. Regarding the geographic characteristics, the probability of unregistration appears to be positively correlated with the natural logarithm of the population of the city were the worker lives, and also with the proximity to Mexico City (*relative distance*). However, the estimated coefficients are statistically significant only for a few years of the sample. Finally, the estimates indicate that the likelihood of unregistration is significantly lower

Table 1.8: Linear Probability Model for Unregistration

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
experience	-0.003 ***	-0.003 ***	-0.002 *	-0.002 ***	-0.003 ***	-0.002 **	-0.002 **	-0.003 ***	-0.003 ***	-0.003 **	-0.002 **	-0.002 *	-0.002	-0.002
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
experience^2	0.00008 ***	0.00008 ***	0.00007 ***	0.00008 ***	0.00009 ***	0.00008 ***	0.00008 ***	0.00008 ***	0.00009 ***	0.00009 ***	0.00009 ***	0.00009 ***	0.00008 ***	0.00008 ***
	[0.00001]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00001]	[0.00002]	[0.00002]	[0.00002]	[0.00001]	[0.00002]	[0.00002]	[0.00001]	[0.00001]
schooling	-0.006 **	-0.005 **	-0.004	-0.006 **	-0.006 **	-0.005	-0.005 *	-0.006 **	-0.005 **	-0.008 ***	-0.007 ***	-0.007 ***	-0.007 ***	-0.007 **
	[0.003]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
married	-0.018	-0.018 *	-0.008	-0.014	-0.011	-0.020 ***	-0.017 ***	-0.022 ***	-0.018 ***	-0.020 ***	-0.017 **	-0.017 **	-0.018 ***	-0.010
	[0.011]	[0.011]	[0.009]	[0.009]	[0.009]	[0.006]	[0.006]	[0.005]	[0.007]	[0.006]	[0.007]	[0.006]	[0.006]	[0.007]
cohabitating	0.015 **	0.010	0.010	0.016 **	0.007	0.005	-0.002	-0.004	0.003	0.002	0.005	0.007	-0.001	0.005
	[0.007]	[0.010]	[0.008]	[0.006]	[0.008]	[0.008]	[0.007]	[0.007]	[0.005]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
male	0.045 ***	0.045 ***	0.040 ***	0.043 ***	0.032 ***	0.028 **	0.027 **	0.028 **	0.023 *	0.024 *	0.015	0.011	0.011	0.011
	[0.011]	[0.011]	[0.012]	[0.012]	[0.013]	[0.013]	[0.013]	[0.013]	[0.014]	[0.013]	[0.014]	[0.015]	[0.016]	[0.016]
firsthead	-0.029 **	-0.017 *	-0.028 ***	-0.032 ***	-0.031 ***	-0.027 ***	-0.039 ***	-0.041 ***	-0.040 ***	-0.034 ***	-0.028 ***	-0.036 ***	-0.023 ***	-0.029 ***
	[0.012]	[0.010]	[0.009]	[0.011]	[0.011]	[0.010]	[0.011]	[0.012]	[0.011]	[0.009]	[0.007]	[0.007]	[0.006]	[0.007]
secondhead	0.063 ***	0.063 ***	0.056 ***	0.061 ***	0.067 ***	0.062 ***	0.051 ***	0.056 ***	0.054 ***	0.061 ***	0.054 ***	0.049 ***	0.056 ***	0.049 ***
	[0.017]	[0.019]	[0.019]	[0.019]	[0.016]	[0.019]	[0.016]	[0.014]	[0.013]	[0.013]	[0.012]	[0.012]	[0.013]	[0.011]
ln(population)	0.013	0.015	0.007	0.001	-0.014 *	-0.014	-0.013	-0.001	0.673	0.002	0.0003	0.0002	0.007 ***	0.002
	[0.009]	[0.011]	[0.011]	[0.008]	[0.008]	[0.009]	[0.008]	[0.006]	[1.603]	[0.008]	[0.003]	[0.003]	[0.003]	[0.002]
relative distance	0.010	0.014	0.030	0.026	0.054 **	0.054 *	0.076 ***	0.030	-2.981	0.057 **	0.041 *	0.031	0.035	0.106 ***
	[0.024]	[0.020]	[0.019]	[0.024]	[0.025]	[0.032]	[0.025]	[0.025]	[7.241]	[0.028]	[0.025]	[0.022]	[0.027]	[0.024]
high exposure	0.010	0.0006	-0.002	-0.002	-0.076 **	-0.108 ***	-0.076 ***	-0.043 **	2.141	-0.070 ***	-0.099 ***	-0.103 ***	-0.143 ***	-0.088 ***
	[0.023]	[0.019]	[0.020]	[0.017]	[0.031]	[0.030]	[0.022]	[0.017]	[5.209]	[0.018]	[0.024]	[0.030]	[0.030]	[0.023]
low exposure	0.010	0.079 ***	0.013	-0.001	-0.069 ***	-0.086 *	-0.064	0.026	2.357	-0.023	-0.104 ***	-0.091 ***	-0.068 **	-0.082 ***
	[0.023]	[0.025]	[0.029]	[0.024]	[0.024]	[0.050]	[0.041]	[0.026]	[5.605]	[0.028]	[0.033]	[0.031]	[0.026]	[0.025]
No. Obs.	60,334	62,441	63,082	114,637	123,460	126,976	130,054	138,384	147,271	153,622	173,095	183,999	190,405	184,229

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include city and industry dummies. Robust standard errors clustered at the industry level are shown in brackets.

Table 1.9: Average Year-to-Year Correlations of Estimated Unregistration Differentials by Sector

Sector	Average 1989-2002[1]
Farms, forestry & fishing	0.699
Mining	0.673
Food, beverage & tobacco	0.830
Textiles, apparel & leather	0.594
Wood products	0.909
Paper & printing	0.862
Chemical products	0.492
Nonmetallic mineral products	0.886
Primary metals	0.180
Machinery & equipment	0.767
Other manufacturing	0.651
Non-Tradable	0.920
Maximum	0.920
Minimum	0.180
Average	0.705

[1] Average correlation coefficients at the sector level of the industry unregistration differentials estimated with the linear probability model in the first stage.

for workers living in a state with high exposure to globalization (for 9 years of the sample) and higher for those living in a state with low exposure to it (for 8 years of the sample).

Although not reported, the regressions in the first stage also included a set of city dummy variables. In most of the cases these indicators were individually and jointly statistically significant, suggesting that geographic location is an important determinant of the likelihood of unregistration. Also, as for Brazil and Colombia in Goldberg, P. K. & N. Pavcnik (2003), the estimated unregistration differentials (i.e. the coefficients of the industry dummies) are correlated through time, with the year-to-year correlation coefficients ranging from 0.74 to 0.95, and averaging 0.85. Table 1.9 breaks down these correlations by economic sector. The highest coefficients are those for the *Non-tradable*, *Wood products*, *Non-metallic mineral products* and *Paper & Printing* sectors; and the lowest ones are those for the *Primary Metals*, *Chemical products*, and *Textiles, apparel & leather* sectors. A high (low) year-to-year correlation could be indicative of a low (high) sensitivity of the likelihood of unregistration to changes in the level of import tariffs.

1.6.2. Second Stage Results

After controlling for individual characteristics and city fixed effects, the next step in this estimation procedure is to pool the unregistration differentials over time and to relate them to the import tariffs data. The estimated equation is of the following form:

$$ip_{jt} = T_{jt}\beta_T + Y_t\gamma_Y + D_j\delta_D + (D_j \times tr_t)\phi_{(D\times tr)} + \varepsilon_{jt} \quad (1.8)$$

where ip_{jt} is the unregistration differential for industry j at time t, T_{jt} is the matrix of Mexican and U.S. import tariffs, Y_t is a matrix of year indicators, D_j is a matrix of industry indicators, $(D_j \times tr_t)$ refers to the set of interactions between the industry dummies and a time trend, and ε_{jt} is the error term. Identification of β_T therefore comes from within-industry fluctuations of T around a time trend. A Mexican and U.S. tariff of 0% is artificially assigned to the non-tradable industries, so that these industries are not dropped from the sample. In this way, these observations do not contribute to the estimation of the coefficients in β_T but they are useful in getting more precise estimates of the year effects γ_Y. The year indicators are included to remove the aggregate variation from all the other variables in the right-hand side of equation (1.8), like the tariff variables. Likewise, industry indicators are included to control for unobserved industry characteristics that may be constant through time. The inclusion of the interactions between the industry dummies and the trend accounts for the possibility that different industries may follow different paths through time, for example due to factors such as the Mexican crisis (by which export oriented industries benefited more from a depreciation of the peso than other industries).

Apart from using the standard import tariffs, the effect of trade liberalization on unregistration can also be estimated by using an input-output matrix to calculate an import tariff that reflects the taxes payable on imported inputs more precisely. The input-output matrix shows the intersectoral transactions at current producer prices, which can be expressed as shares of the total output of each sector. These shares are then used to construct a weighted tariff that reflects the interdependence of sectors in the production process. For example, suppose that the inputs that the *Mining* sector obtains from the *Machinery & equipment* sector represent 25% of its total output, the inputs from the *Chemical products* represent another 25%, and the rest of the inputs are

obtained internally. If the average sector import tariffs were 15%, 20%, and 10% respectively, the weighted tariff for the *Mining* sector would be:

$$(0.25 \times 0.15) + (0.25 \times 0.20) + (0.50 \times 0.10) = 0.1375 \qquad (1.9)$$

or 13.75%. Furthermore, the input-output matrix also contains the share of imported inputs for each sector. Assuming for example that 35% of all inputs used in the *Mining* sector are imported, its weighted tariff (from now on the IOM tariff) becomes 4.81% (that is 0.1375 times 0.35 times 100). Therefore, apart from summarizing the intersectoral dependence, the IOM tariff also reflects the relative importance of imports across sectors. Among the virtues of this tariff, it makes now possible to assign a real import tariff to the non-tradable sectors, because of their interactions with the tradable ones. Its disadvantage is that the input-output matrix data for Mexico is not publicly available at the industry level, so this tariff can only be calculated at the sector level. Nevertheless, this alternative approach is explored here, as it might be useful to shed more light in understanding the effect of trade liberalization on unregistration for the whole economy. There are four matrices available and unfortunately the most recent one is from 1980[15]. The weights used to generate the IOM tariff are the average weights derived from these matrices (1970, 1975, 1978 and 1980). Although these do not capture the evolution of the intersectoral relationships between 1989 and 2002 (which might have been affected by the trade liberalization process) they should at least reflect their historical interactions.

Finally, as mentioned above, equation (1.8) is estimated using weighted least squares with weights equal to the inverse of the variance of the unregistration differentials from the first stage, and the standard errors are computed using the Newey-West method with one lag.

Table 1.10 reports the estimates of equation (1.8). Column (a) presents the estimates obtained for the current values of the import tariffs. When the unregistration differentials are regressed on each one of the tariffs separately (panels 1 to 3) it can be seen that both the Mexican and the IOM tariffs have positive and significant coefficients. Panel 1 indicates that a 1-percentage point decline in the current Mexican import tariff reduces the probability of unregistration in a given industry by 0.392

[15] The matrices were originally generated by the Mexican central bank, and later on by INEGI. The publicly available versions contain aggregated data for 18 economic sectors. They can be found at http://www.inegi.gob.mx/est/default.asp?c=1629 .

Table 1.10. Effect of Trade Liberalization on Unregistration

		(a)	(b)	(c)
1	Mex Tariff	0.392 ***	0.504 ***	0.283 ***
		[0.128]	[0.133]	[0.077]
	No. Obs.	4737	4403	4403
2	US Tariff	-0.144	-0.086	-0.124
		[0.252]	[0.193]	[0.163]
	No. Obs.	4697	4376	4360
3	IOM Tariff	0.080 **	0.058	0.044 **
		[0.037]	[0.036]	[0.022]
	No. Obs.	4737	4403	4403
4	Mex Tariff	0.338 **	0.491 ***	0.275 ***
		[0.144]	[0.144]	[0.085]
	US Tariff	-0.139	-0.123	-0.148
		[0.249]	[0.190]	[0.162]
	IOM Tariff	0.042	0.007	0.011
		[0.042]	[0.038]	[0.024]
	No. Obs.	4697	4376	4360

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include year dummies, industry dummies and industry trends. Newey-West standard errors with 1 lag are shown in brackets.

(a) Current tariffs

(b) 1-year lagged tariffs

(c) Sum of current and 1-year lagged tariffs

percentage points. This effect falls to 0.338 when the three import tariffs are used together in the regression of panel 4, but remains statistically significant at a 5% level. The significance of the IOM coefficient is lost in this last specification.

Column (b) explores the possibility that adjustments in the likelihood of unregistration with respect to changes in the level of import tariffs may require some time to take place. Using the 1-year lagged values instead, the column reports larger effects for the Mexican tariff and smaller ones for the U.S. and the IOM tariffs. Only the first one is statistically significant. According to panel 4, a 1-percentage point decrease in the Mexican import tariff is related to a 0.491 percentage point reduction in the probability of unregistration.

The last column in the table uses the sum of the current and the 1-year lagged tariffs as regressors, so as to summarize the dynamic effects found in the other two. The estimates confirm the importance of the Mexican import tariff. Panel 4 indicates that a two-year cumulated reduction of 1-percentage point in this tariff generates a 0.275 percentage point reduction in the probability of unregistration. A significant effect for

the IOM tariff is also obtained when this is used separately as regressor, but it is not robust to the inclusion of the other tariffs in the equation.

All the estimated coefficients for the U.S. import tariff are not significantly different from zero, and this is likely to be the case if one recalls that the U.S. tariffs on Mexican imports were already low before NAFTA due to the GSP (see previous section), and that it is precisely the Mexican import tariff the one that is changing the most after 1994. As for the IOM tariff, the estimates in table 1.10 are all of positive sign, and this would in principle support hypothesis (a) in section 1.2: lower Mexican import tariffs would allow Mexican firms to obtain cheaper inputs, machinery and equipment from the United States, which could lead to an increase in productivity and to a reduction of unregistration. However, the fact that the estimated coefficients for this tariff are not statistically significant for any of the regressions in panel 4 may also indicate that the effect of trade liberalization has not spread throughout the non-tradable sectors.

Another possibility worth exploring is that trade liberalization may have different effects on the rate of unregistration in industries with different degrees of exposure to trade. For example, an export oriented industry may benefit more from the elimination of the U.S. import tariff than other industries, or perhaps an industry with a relatively high share of imported inputs or means of production benefits more from the elimination of the Mexican import tariff. To see if this is the case, equation (1.8) is modified in order to include a set of interactions between the tariffs and the following measures of exposure to trade:

- *Exporter*, an industry's net sales in foreign markets as a share of the market value of its total output.
- *Importer*, the share of an industry's machinery and equipment of production that is imported directly.
- *Import Penetration*, an industry's imports of final products as a share of the market value of its total output.

The data used to generate the first two measures comes from the Annual Industrial Survey, carried out by INEGI, and which objective is to generate information about the trends of the main economic variables of the national manufacturing sector. INEGI follows a non-probabilistic sampling procedure to determine the group of manufacturing plants that will be surveyed. It excludes *maquiladoras*, basic petrochemical plants, refineries, and also micro-industry plants (i.e. plants with less than

Table 1.11: Exposure to Trade By Sector

	1994-2002 Average Values		
Sector	Exporter[a]	Importer[b]	Import Penetration[c]
Mining	0.001	0.001	0.021
Food, beverage & tobacco	0.053	0.037	0.451
Textiles, apparel & leather	0.120	0.056	0.603
Wood products	0.102	0.035	0.385
Paper & printing	0.040	0.103	1.160
Chemical products	0.128	0.060	0.504
Nonmetallic mineral products	0.128	0.036	0.622
Primary metals	0.246	0.112	0.364
Machinery & equipment	0.227	0.078	24.983
Other manufacturing	0.147	0.066	1.768
Maximum	0.246	0.112	24.983
Minimum	0.001	0.001	0.021
Average	0.119	0.058	3.086

Source: author's calculations based on the Annual Industrial Survey (INEGI). [a] Net sales in foreign markets as a share of the market value of total output. [b] Share of machinery and equipment of production that is imported directly. [c] Imports of final products as a share of the market value of total output.

15 employees). Among other things, this source contains annual measures of total employment, remunerations, operating costs, output, sales, income, assets, and depreciation for industries in the manufacturing sectors. The sample available for this study covers the period 1994 through 2002, and it is aggregated at the 6-digit level, following the International Standard Industrial Classification. The data on final product imports used in constructing the third variable comes from the international trade statistics generated by the BANXICO-INEGI-SAT-Secretariat of Economy work group, and that is publicly available from INEGI[16]. The period covered is 1993 through 2002. The three variables were calculated for each industry in each available year. Table 1.11 summarizes these measures at the sector level. The *Primary metals* sector is the one with the highest levels of relative exports and imports of machinery and equipment, while the *Mining* sector is the one with the lowest levels. Regarding import penetration, the *Machinery & equipment*, *Other manufacturing* and *Paper & printing* sectors seem to import more final products than the ones they produce domestically.

[16] BANXICO is the Mexican Central Bank and SAT is the Tax System Administration. Data available in Banco de Información Económica, INEGI's website: http://dgcnesyp.inegi.gob.mx/cgi-win/bdieintsi.exe/NIVJ1001640016#ARBOL.

Table 1.12. Unregistration and Exposure to Trade

	(a)	(b)	(c)
Mex Tariff	0.334 *	0.613 ***	0.328 ***
	[0.200]	[0.208]	[0.123]
Mex Tariff * Importer	0.095	-2.379	-0.905
	[2.321]	[2.217]	[1.331]
Mex Tariff * Imp.Penetration	-0.015 **	-0.009	-0.007
	[0.007]	[0.009]	[0.005]
US Tariff	-0.527 *	-0.308	-0.448 **
	[0.291]	[0.229]	[0.203]
US Tariff * Exporter	5.922 **	3.181	3.907 ***
	[2.364]	[1.976]	[1.493]
IOM Tariff	0.039	-0.026	-0.010
	[0.060]	[0.054]	[0.034]
IOM Tariff * Importer	0.010	0.592	0.306
	[0.486]	[0.415]	[0.262]
IOM Tariff * Imp.Penetration	0.002 **	0.001	0.0009 *
	[0.0008]	[0.001]	[0.0005]
No. Obs.	4697	4376	4360

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include year dummies, industry dummies and industry trends. Newey-West standard errors with 1 lag are shown in brackets.

(a) Current tariffs

(b) 1-year lagged tariffs

(c) Sum of current and 1-year lagged tariffs

The 1994-2002 industry averages of these variables were multiplied by the import tariffs to generate interactions for the whole 1989-2002 period. These new covariates are included in the estimation of an equation like the one in (1.8). The results are reported in table 1.12. The estimates for the current values of the tariffs in column (a) indicate that for a given reduction in the Mexican import tariff, the rate of unregistration decreases less in industries with higher levels of import penetration than in other industries. This may be so because those industries were already under strong foreign competition before NAFTA and had previously adjusted their levels of unregistered workers, or maybe because this foreign competition increased with NAFTA, forcing some firms in those industries to increase their unregistered labour force instead of reducing it. Also, the elimination of the U.S. import tariff helps in reducing the rate of unregistration in industries that are relatively more export oriented. Firms for which the main market is the U.S. benefit more from the elimination of the U.S. import tariffs on Mexican products than firms for which the main market is the domestic one. Regarding

the IOM tariff, there is a modest positive effect of trade liberalization on unregistration for industries with a higher degree of import penetration.

The results for the 1-year lagged values in column (b) indicate that these effects are only contemporary, as none of the estimated coefficients for the interactions is significantly different from zero. Finally, the estimates for the two-year cumulated tariffs in column (c) confirm the importance of most of the effects identified in column (a).

The last part of the analysis in this section consists of looking at the impact of trade liberalization on the industry's employment share, the composition of unregistration (i.e. its effect on self-employment, unregistered salaried, and unpaid workers, separately), and the size of the labour force of firms. The employment share of a particular industry is measured as its fraction of total employment in the economy. As described in section 1.4, self-employment is measured as those persons in an industry that run a firm of 6 or less employees and that do not have any kind of social or health insurance. Similarly, the unregistered salaried are the persons that work for a firm of any size and that do not have any kind of social or health insurance. Likewise, the unpaid workers are the workers that do not receive any kind of payment. Finally, firm's labour force size is measured as the natural logarithm of the total labour force in the industry's average firm, and it is estimated from the data collected by the ENEU survey when the interviewed workers are asked about the total number of people in their workplaces.

The industry's employment share and the average firm's labour force size are computed for each industry in each year of the sample, and are then regressed on the import tariffs using the model in equation (1.8). For the cases of self-employment, unregistered salaried and unpaid workers, the econometric strategy is the same two-stage procedure as the one used for total unregistration above. The results are reported in table 1.13. The estimates in the first column indicate that trade liberalization has generated some labour force reallocations across industries through the elimination of the U.S. import tariff on Mexican products: a 1-percentage point reduction in this tariff increases an industry's employment share by 0.033 percentage points. This result is consistent with the theory in Melitz (2003), as it would suggest that the new profit opportunities in the U.S. market induce firms in more liberalized industries to increase their labour demand.

The second to fifth columns in table 1.13 refer to the composition of unregistration. The second column is simply repeating column (a) from table 1.10, in order to compare it with the results for each type of unregistration separately. The third to fifth columns

Table 1.13. Effect of Trade Liberalization on Employment Shares, Composition of Unregistration, and the Size of Firms

		Employment Share[1]	Total Unregistration	Self-Employment	Unregistered Salaried	Unpaid Workers	ln(Labour Force)[1]
1	Mex Tariff	-0.010	0.392 ***	0.219 **	0.096	0.077	-0.312
		[0.021]	[0.128]	[0.092]	[0.102]	[0.059]	[0.346]
	No. Obs.	4746	4737	4737	4737	4737	4732
2	US Tariff	-0.033 *	-0.144	-0.312 *	0.451 **	-0.283 ***	-0.840
		[0.020]	[0.252]	[0.173]	[0.182]	[0.108]	[0.699]
	No. Obs.	4706	4697	4697	4697	4697	4692
3	IOM Tariff	-0.488	0.080 **	0.048 *	0.008	0.024 *	-0.332
		[0.758]	[0.037]	[0.027]	[0.029]	[0.013]	[9.254]
	No. Obs.	4746	4737	4737	4737	4737	4732
4	Mex Tariff	-0.001	0.338 **	0.185 *	0.097	0.056	-0.400
		[0.011]	[0.144]	[0.099]	[0.113]	[0.070]	[0.449]
	US Tariff	-0.031 *	-0.139	-0.308 *	0.449 **	-0.279 ***	-0.761
		[0.017]	[0.249]	[0.173]	[0.180]	[0.109]	[0.707]
	IOM Tariff	-0.451	0.042	0.025	0.0002	0.016	7.711
		[0.669]	[0.042]	[0.029]	[0.033]	[0.017]	[12.029]
	No. Obs.	4706	4697	4697	4697	4697	4692

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include year dummies, industry dummies and industry trends. [1]All the estimates are obtained using weighted least squares, with weights equal to the number of observations available for each industry-year. Newey-West standard errors with 1 lag are shown in brackets.

present these results. They indicate two main things: first, that a 1-percentage point reduction in the Mexican import tariff on U.S. products reduces unregistered self-employment by 0.185 percentage points, and it does not seem to affect significantly the probability of becoming an unregistered salaried or an unpaid worker. Second, they also indicate that a 1-percentage point reduction in the U.S. import tariff increases the likelihood of unregistered self-employment and unpaid work by 0.308 and 0.279 percentage points respectively, while it reduces the probability of unregistered salaried employment by 0.449 percentage points. Even though the coefficient for the U.S. tariff is larger (in absolute terms) than the coefficient from the Mexican tariff in the case of the unregistered self-employed, the overall effect of trade liberalization on this type of unregistration is very likely to be determined by the second one because, as shown in table 1.1, the average Mexican tariff is higher than the U.S. one for every year in the sample. Also, given that the effect of trade liberalization on total unregistration is mainly through the elimination of the Mexican import tariff (as shown in the second column of table 1.13), the consequence of the reduction in the U.S. tariffs seems to be principally a reallocation of workers within the unregistered sector. That is, while the elimination of the Mexican tariff increases the incentives for people in the unregistered self-employment sub-sector to move into the registered sector, the elimination of the

U.S. tariff may be simply inducing people in the unregistered salaried sub-sector to move into the unregistered self-employment and the unpaid work sub-sectors.

A possible interpretation of these results could be the following. Trade liberalization makes it more attractive for owners of firms to register, as it is only through registration that they can take advantage of the cheaper and better inputs, machinery or equipment produced in the U.S. (because registered firms are the only ones that can get involved in trade). Owners of firms in the unregistered sector are concentrated either in the self-employment or in the unpaid work sub-sectors (regarding the unpaid workers, about 97% of the people in this category works for a family business, and the median age is approximately 23 years[17]. A good example of this type of worker could then be a student that helps his parents running a family-owned restaurant every day after classes). Thus, when trade liberalization takes place, those unregistered employees that could either run their own unregistered firm or work in a family business instead of being employed by someone else would be more attracted to move into self-employment or into unpaid work in the family business, as the potential profits that they could derive from those activities are now greater due to the lower trade costs. In other words, within the unregistered sector, trade liberalization could be making more profitable to become an entrepreneur than to remain employed in someone else's firm as an unregistered salaried.

Finally, the last column in table 1.13 shows the estimates from regressing the natural logarithm of the size of the average firm's labour force. Trade liberalization does not seem to have any significant effect on the size of the labour force, at least as reported by interviewed workers.

Summing up, the econometric analysis in this section shows the following conclusions:

- From the first stage results, the probability of unregistered employment decreases with years of experience and schooling. It is also lower for married and female workers. Within a household, the likelihood of unregistration is significantly lower for the first provider of income and significantly higher for the second provider, which supports the results of Roberts, B. R. (1989) and Maloney, W. F. (1999).
- Regarding geographic location, the results imply that the probability of unregistration varies significantly across cities. It is also higher for workers that live closer to Mexico City than to the U.S.-Mexico border, and lower for workers living in a state with high exposure to globalization, as defined by Hanson, G. H. (2004).

[17] Average values calculated from the 1989-2002, April-June ENEU interviews.

- Industry affiliation is also an important determinant of unregistration. As for Brazil and Colombia in Goldberg, P. K. & N. Pavcnik (2003), the estimated unregistration differentials are correlated through time, particularly in the *Non-tradable*, *Wood products*, *Non-metallic mineral products* and *Paper & Printing* sectors.
- From the second stage results, the estimates suggest a significant effect of trade liberalization on the probability of unregistered employment. Specifically, a 1-percentage point decline in the Mexican import tariff is associated with a 0.392 percentage point reduction in the likelihood of unregistration. The U.S. import tariff does not seem to have a significant effect, which is a reasonable outcome considering its already low level in the pre-NAFTA period. The analysis also suggests that the benefits of trade liberalization have not spread over to the labour force in the non-tradable sectors in a statistically significant sense.
- When the import tariffs are interacted with different measures of exposure to trade for the manufacturing sectors, the analysis indicates that for a given reduction in the Mexican import tariff, unregistration decreases less in industries with higher levels of import penetration. Likewise, the elimination of the U.S. import tariff helps in reducing unregistration in industries that are relatively more export oriented.
- Finally, trade liberalization affects the employment shares and the composition of unregistration across industries, but it does not seem to have an impact on the size of the firm's labour force. The level of the U.S. import tariff is negatively related to the industry's share of total employment. The elimination of the Mexican import tariff reduces self-employment in the tradable industries, and the elimination of the U.S. import tariff seems to have a reallocation effect within the unregistered labour force, from salaried to either self-employment or unpaid work.

Overall, the econometric analysis of the behaviour of unregistered labour seems to provide supporting evidence for the hypothesis that the tariff elimination process undertaken by Mexico when joining NAFTA in 1994 has helped in reducing the incidence of informality. The next section studies the effect of trade liberalization on the industry wage differentials and the intra-industry registered-unregistered wage gap.

1.7. Trade Liberalization and Wages

The analysis in the previous section shows that trade liberalization in Mexico is significantly related to reductions in the probability of unregistered employment within

the tradable economic sectors. This finding provides empirical support for one of the implications of the theoretical model discussed in section 1.2. This section analyzes the effect of tariff elimination on wages and the registered-unregistered wage differential.

The econometric analysis here starts by estimating the effect of import tariffs elimination on industry wage differentials, in order to complement the results of previous studies with the ENEU data. A two-stage approach similar to the one used for unregistration in the previous section is implemented. The first step consists of estimating a log-wage equation of the following form:

$$\lg wage_{ijt} = H_{ijt}\beta_{Ht} + I_{ijt} * ip_{jt} + \varepsilon_{ijt} \tag{1.10}$$

where $\lg wage_{ijt}$ is the natural logarithm of the wage for worker i in industry j at time t, H_{ijt} is a vector of worker characteristics and geographic location variables, I_{ijt} is a set of industry dummies that indicate worker i's industry affiliation, and ε_{ijt} is the error term. The coefficients ip_{jt} capture the part of the variation in wages that is attributable to worker i's industry affiliation. These coefficients are denoted *industry wage differentials* and they capture the difference in wages that is attributable to industry affiliation. Equation (1.10) is estimated separately for each year in the sample. As with unregistration, in the second stage these industry wage differentials are pooled over time and regressed on the Mexican import tariff, the U.S. import tariff, the IOM tariff, a set of industry and time indicators, and a set of interactions between the industry dummies and a time trend. A weighted least squares estimation is used, with weights equal to the inverse of the variance of the wage differentials from the first stage.

The results for the first stage are reported in table 1.14. They indicate that wages increase with years of experience and schooling, are higher for married people and for those cohabitating with a partner. They are also higher for males, for the head of the household and for the second provider of income, when compared to the other members of the family. Regarding the geographic characteristics, the estimates show that earnings increase with the population size of the city in which the worker lives, that they are higher for people living in states with high and low exposure to globalization than for those living in states with an intermediate level of exposure, and that they are higher in places closer to the U.S.-Mexico border than to Mexico City, which agrees with the findings of Hanson, G. H. (2003). Although not reported, the regressions in table 1.14

Table 1.14. Linear Regression of ln(Wages)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
experience	0.025 ***	0.026 ***	0.026 ***	0.028 ***	0.028 ***	0.028 ***	0.027 ***	0.027 ***	0.025 ***	0.024 ***	0.021 ***	0.021 ***	0.020 ***	0.018 ***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
$experience^2$	-0.00030 ***	-0.00031 ***	-0.00030 ***	-0.00033 ***	-0.00033 ***	-0.00032 ***	-0.00030 ***	-0.00029 ***	-0.00026 ***	-0.00026 ***	-0.00023 ***	-0.00023 ***	-0.00023 ***	-0.00020 ***
	[0.00002]	[0.00002]	[0.00002]	[0.00003]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00001]	[0.00002]	[0.00002]	[0.00001]
schooling	0.072 ***	0.076 ***	0.079 ***	0.083 ***	0.085 ***	0.088 ***	0.088 ***	0.090 ***	0.089 ***	0.085 ***	0.081 ***	0.083 ***	0.080 ***	0.076 ***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.004]
married	0.088 ***	0.108 ***	0.102 ***	0.106 ***	0.106 ***	0.099 ***	0.102 ***	0.093 ***	0.104 ***	0.114 ***	0.098 ***	0.103 ***	0.097 ***	0.098 ***
	[0.007]	[0.008]	[0.010]	[0.008]	[0.009]	[0.008]	[0.007]	[0.007]	[0.010]	[0.010]	[0.010]	[0.010]	[0.008]	[0.009]
cohabitating	0.018	0.018	0.012	0.015	0.028 *	0.016	0.023	0.021 *	0.010	0.035 ***	0.031 ***	0.033 **	0.027 ***	0.027 **
	[0.019]	[0.013]	[0.019]	[0.013]	[0.016]	[0.014]	[0.017]	[0.012]	[0.016]	[0.011]	[0.011]	[0.014]	[0.010]	[0.011]
male	0.059 ***	0.057 ***	0.034	0.017	0.020	0.013	0.008	0.009	0.002	0.016	0.030	0.047 **	0.054 **	0.052 **
	[0.020]	[0.019]	[0.024]	[0.028]	[0.030]	[0.030]	[0.026]	[0.029]	[0.024]	[0.023]	[0.025]	[0.023]	[0.023]	[0.021]
firsthead	0.108 ***	0.125 ***	0.123 ***	0.111 ***	0.118 ***	0.119 ***	0.111 ***	0.114 ***	0.120 ***	0.119 ***	0.128 ***	0.121 ***	0.125 ***	0.108 ***
	[0.011]	[0.014]	[0.012]	[0.008]	[0.010]	[0.013]	[0.011]	[0.007]	[0.010]	[0.010]	[0.010]	[0.008]	[0.009]	[0.009]
secondhead	0.049 ***	0.056 ***	0.064 ***	0.064 ***	0.064 ***	0.067 ***	0.077 ***	0.067 ***	0.064 ***	0.064 ***	0.074 ***	0.063 ***	0.059 ***	0.051 ***
	[0.010]	[0.011]	[0.010]	[0.009]	[0.015]	[0.009]	[0.009]	[0.008]	[0.010]	[0.007]	[0.009]	[0.008]	[0.008]	[0.009]
ln(population)	0.020 **	0.037 ***	0.170 ***	0.124 ***	0.072 ***	0.126 ***	0.069 ***	0.015	14.914 ***	16.446	0.011 ***	0.020 ***	-0.009	-0.004 **
	[0.008]	[0.007]	[0.014]	[0.010]	[0.014]	[0.015]	[0.014]	[0.011]	[3.734]	[12.249]	[0.002]	[0.004]	[0.008]	[0.002]
relative distance	-0.432 ***	-0.547 ***	-0.503 ***	-0.432 ***	-0.164 ***	-0.342 ***	-0.100 ***	-0.169 ***	5.871 ***	-74.285	-0.116 ***	-0.248 ***	-0.144 ***	-0.203 ***
	[0.036]	[0.039]	[0.034]	[0.028]	[0.022]	[0.030]	[0.029]	[0.029]	[1.567]	[55.248]	[0.017]	[0.048]	[0.016]	[0.038]
high exposure	0.097 ***	0.0323	0.399 ***	0.312 ***	0.314 ***	0.265 ***	0.226 ***	-0.149 ***	-26.133 ***	51.983	0.017	0.094 ***	0.611 ***	0.106 ***
	[0.025]	[0.024]	[0.025]	[0.019]	[0.039]	[0.025]	[0.032]	[0.021]	[6.595]	[38.841]	[0.030]	[0.028]	[0.097]	[0.022]
low exposure	0.084 ***	0.076 ***	0.323 ***	0.473 ***	-0.037	0.625 ***	0.291 ***	0.094 **	-25.735 ***	63.108	0.193 ***	-0.102 ***	0.671 ***	0.108 ***
	[0.024]	[0.025]	[0.035]	[0.030]	[0.058]	[0.068]	[0.068]	[0.044]	[6.481]	[46.925]	[0.039]	[0.024]	[0.099]	[0.034]
No. Obs.	52,716	53,743	53,711	97,987	102,574	106,323	108,302	115,633	122,504	130,862	148,642	159,810	164,539	159,643

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include city dummies and industry indicators. Robust standard errors clustered at the industry level are shown in brackets

also included a set of city dummies, which in most of the cases where both individually and jointly significant. The estimated industry wage differentials are correlated through time, but not as strongly as the unregistration differentials in the previous section. The year-to-year correlation coefficients range from 0.29 to 0.80 and averaging 0.55. This suggests that wages could be highly sensitive to changes in the level of import tariffs.

In the second stage the industry wage differentials are pooled over time and regressed on the Mexican, the U.S. and the IOM tariffs, a set of year and industry fixed effects, and a set of interactions between the industry dummies and a time trend, as specified in the following equation, which parallels equation (1.8) in the previous section:

$$ip_{jt} = T_{jt}\beta_T + Y_t\gamma_Y + D_j\delta_D + (D_j \times tr_t)\eta_{(D\times tr)} + \varepsilon_{jt} \tag{1.11}$$

As before, a Mexican and U.S. tariff of 0% is artificially assigned to the non-tradable industries. The year indicators are included to remove the aggregate variation from all the other variables in the right-hand side of equation (1.11). The industry indicators are included to control for unobserved industry characteristics that may be constant through time. The inclusion of the interactions between the industry dummies and the trend accounts for the possibility that different industries may follow different paths through time. Therefore, as with unregistration in equation (1.8), identification of β_T comes from within-industry fluctuations of T around a time trend.

Table 1.15 reports the estimates of equation (1.11). All but one of the estimated coefficients are negative, indicating a negative correlation between import tariffs and industry wage differentials. Column (a) presents the estimates obtained for the current values of the import tariffs. There is a negative and significant effect on wages coming from the elimination of the IOM tariff, and this effect is robust to the inclusion of the Mexican and the U.S. import tariff in the estimated equation (panel 4). Column (b) explores the possibility that adjustments in wages with respect to changes in the level of import tariffs may require some time to take place. Using the 1-year lagged values, the column reports smaller effects for the Mexican and the U.S. import tariffs, but again only the one from the IOM tariff is statistically significant at a 5% level. Column (c) summarizes the dynamic effects by using the sum of the current and the 1-year lagged tariffs as regressors. Panels 3 and 4 confirm the relevance of the changes in the IOM import tariffs for changes in wage differentials.

Table 1.15. Effect of Trade Liberalization on Wages

		(a)	(b)	(c)
1	Mex Tariff	0.290 [0.180]	-0.205 [0.168]	-0.145 [0.096]
	No. Obs.	4720	4388	4388
2	US Tariff	-0.216 [0.315]	-0.044 [0.356]	-0.085 [0.208]
	No. Obs.	4680	4361	4345
3	IOM Tariff	-0.121 ** [0.052]	-0.129 ** [0.052]	-0.074 *** [0.029]
	No. Obs.	4720	4388	4388
4	Mex Tariff	-0.128 [0.188]	-0.038 [0.183]	-0.048 [0.104]
	US Tariff	-0.246 [0.316]	-0.074 [0.359]	-0.108 [0.209]
	IOM Tariff	-0.116 ** [0.055]	-0.134 ** [0.056]	-0.076 ** [0.031]
	No. Obs.	4680	4361	4345

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include year dummies, industry dummies and industry trends. Newey-West standard errors with 1 lag are shown in brackets.

(a) Current tariffs

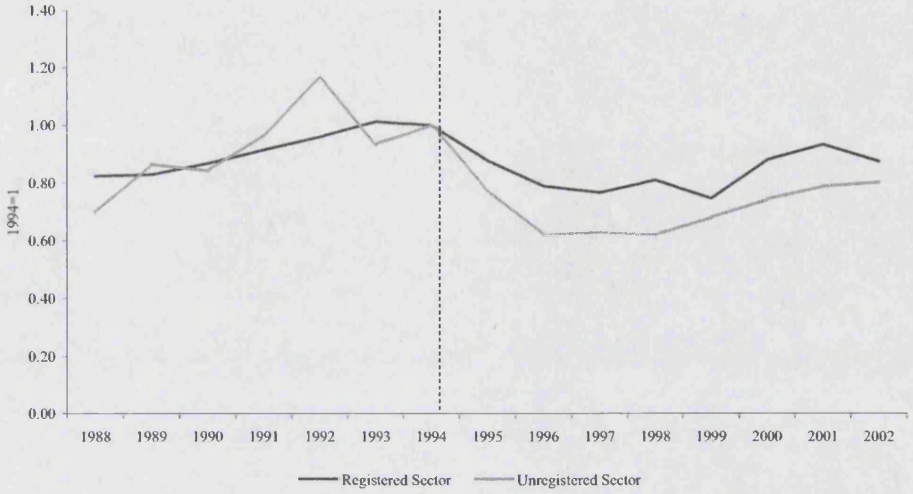
(b) 1-year lagged tariffs

(c) Sum of current and 1-year lagged tariffs

The conclusion from the estimates in table 1.15 is that the elimination of the IOM import tariff has contributed to the increase in wages. Industries with larger cuts in tariffs experienced larger increases in wages, and this result is valid both for the tradable and the non-tradable sectors. It is important to stress what the significant effect on the IOM tariff could mean here: typically, domestic industries lobby for higher tariffs to protect their output and hence the wages paid to their workers. The estimates in table 1.15 seem to suggest instead that industries with higher levels of protection are hurt because their inputs become more expensive.

The next step is to estimate the effect of trade liberalization on the registered-unregistered wage gap. As pointed out by Robbins, D. (1996), empirical work relating trade liberalization and income distribution has identified the important anomaly that the former has helped in shifting income towards high-skilled labour by increasing its

Figure 1.8. Average Real Hourly Wages



relative demand in many developing countries[18]. Considering that the average years of schooling in the registered sector is typically higher than in the unregistered sector (see table 1.3), the effects of this skill-biased technological change should also be present when comparing these two. To see this, figure 1.8 plots the average real hourly wages (in 2002 pesos) for the registered and the unregistered sectors in Mexico using the April-June ENEU interviews with 1994 as the base year. The chart clearly shows that after enacting NAFTA in 1994 average wages in the unregistered sector have remained lower than their counterpart in the registered sector. From 1989 to 1994 inclusive, real hourly wages in the unregistered sector represented on average 99.02% of the real hourly wages in the registered sector. From 1995 to 2002 this figure dropped to 81.03%. Table 1.16 presents the changes of the registered-unregistered wage gap and the import tariffs at the sector level over the period 1989 through 2002[19]. The wage gap index increased in 12 out of 18 sectors during those years. The largest increase is of 2.23 points for the *Primary metals* sector, while the largest decrease is of 3.39 points for the *Personal, professional and social services* sector. Although not reported in the table, while the average change in the wage gap for the tradable sectors is positive and equal to 0.66 points, it is negative and equal to -0.74 points for the non-tradable ones. This

[18] Anomaly in the sense that this result is not what would be predicted by the standard Hecksher-Ohlin model of the International Economics theory, considering that low-skilled labour is the abundant factor of production in LDCs.

[19] The changes in the wage gap are calculated as follows: For each year and economic sector the wage gap in real hourly wages is obtained by taking the difference between real wages in the registered and the unregistered sectors. The resulting series is expressed setting the estimated gap for 1994 as the base observation (1994=1). The change in the wage gap is then obtained as the difference between the 1989-1991 and the 2000-2002 average values of this index.

Table 1.16: Change in Import Tariffs and Registered-Unregistered Wage Differential by Sector

	1989-91 to 2000-02[a]		
Sector	**Wage Differential[b]**	**Mex**	**US**
Tradables:			
Farms, forestry & fishing	0.32	-12.6	-1.3
Mining	-0.59	-8.1	-0.2
Food, beverage & tobacco	1.75	-12.6	-3.3
Textiles, apparel & leather	0.89	-15.5	-9.2
Wood products	0.11	-9.3	-3.4
Paper & printing	0.28	-10.6	-0.7
Chemical products	1.00	-11.4	-1.5
Nonmetallic mineral products	-0.23	-12.7	-1.5
Primary metals	2.23	-11.5	-1.4
Machinery & equipment	0.04	-12.0	-0.8
Other manufacturing	1.45	-13.7	-0.6
Non-tradables:			
Petroleoum & coal extraction	-0.48		
Construction	-3.35		
Electricity, gas & water	0.18		
Hotels, restaurants & trade	0.95		
Transport & storage	1.00		
Financial services & real estate	-0.08		
Personal, professional and social services	-3.39		
Maximum	2.23	-8.1	-0.2
Minimum	-3.39	-15.5	-9.2
Average	0.12	-11.8	-2.2

Source: author's calculations based on the ENEU survey (INEGI), Diario Oficial de la Federacion (Mexico), and the NBER U.S. Tariff Database. [a] Changes calculated as the difference between the 2000-02 and the 1989-91 averages. [b] Wage gap calculated as the difference between average real hourly wages between the registered and the unregistered sectors (2002 pesos, 1994=1).

Figure 1.9. Changes in Wage Differentials and the Mexican Import Tariffs 1989-91 to 2000-02
Tradable Sectors

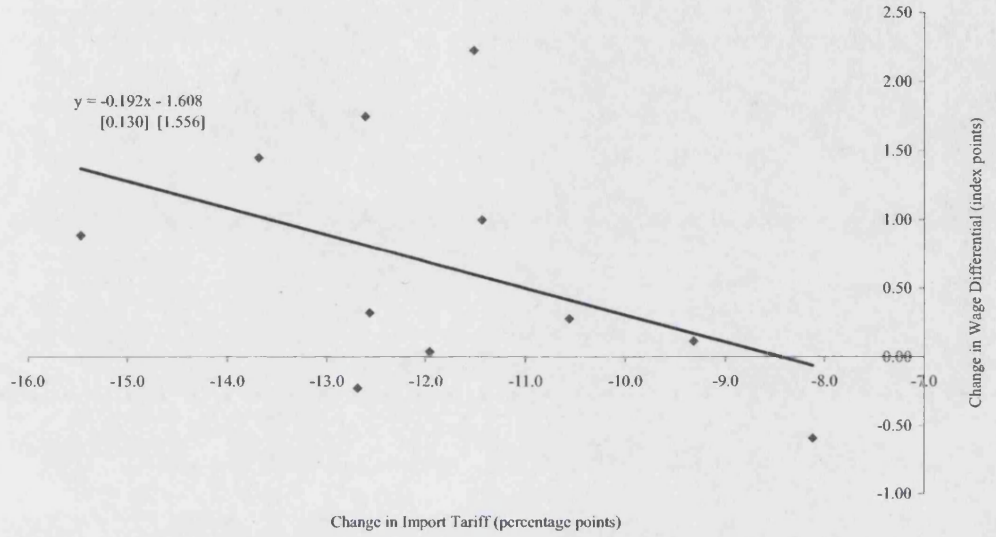
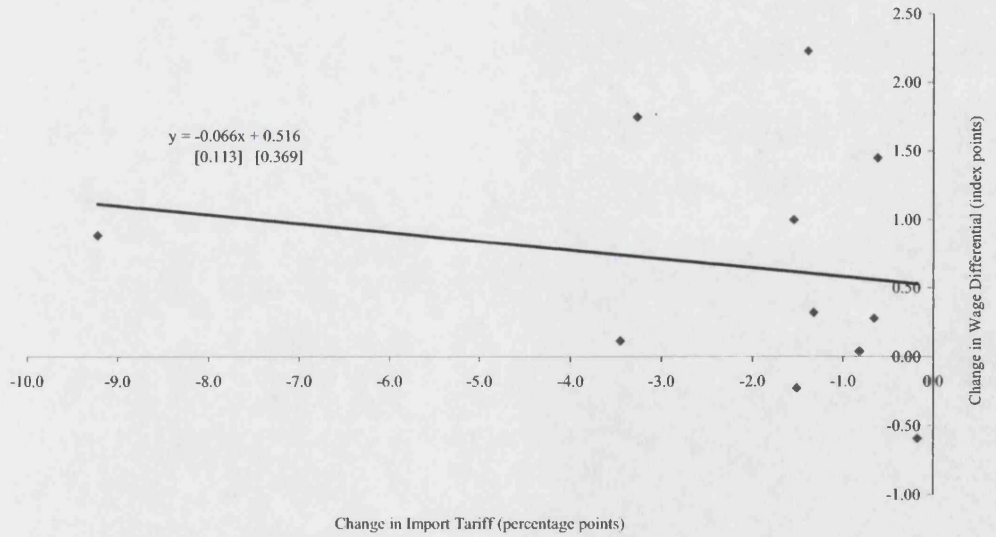


Figure 1.10. Changes in Wage Differentials and the U.S. Import Tariffs 1989-91 to 2000-02
Tradable Sectors



could be indicative of a negative relationship between the level of the tariffs and the wage differentials, which seems to be confirmed by figures 1.9 and 1.10: within the tradable sectors larger reductions in both the Mexican and the U.S. import tariffs are associated with larger increases in the wage gap. In order to estimate the effect of trade liberalization on the wage gap formally, equation (1.10) is modified in the following way:

$$\lg wage_{ijt} = H_{ijt}\beta_{Ht} + (H_{ijt} \times f_{ijt})\delta_{(H\times f)t} + I_{ijt} * ip_{jt} + (I_{ijt} \times f_{ijt})\phi_{(I\times f)jt} + \varepsilon_{ijt} \qquad (1.12)$$

where $(H_{ijt} \times f_{ijt})$ is a matrix of interactions between the vector H_{ijt} and an indicator for registration f_{ijt} that takes the value of 1 if worker i in industry j at time t works in the registered sector and 0 otherwise; $(I_{ijt} \times f_{ijt})$ is a matrix of interactions between the industry dummies and the registration indicator; and the rest of the terms are as defined before. The new coefficients $\delta_{(H\times f)t}$ capture the part of the variation in wages that is attributable to differences in individual and geographic characteristics between the registered and the unregistered workers. The coefficients $\phi_{(I\times f)t}$ are denoted *within-industry registered-unregistered wage differentials* and they capture the difference in wages between registered and unregistered workers that is attributable to industry affiliation. Equation (1.12) is estimated separately for each year in the sample. As before, in the second stage these wage differentials are pooled over time and regressed on the Mexican import tariff, the U.S. import tariff, the IOM tariff, a set of industry and time indicators, and a set of interactions between the industry dummies and a time trend. The results for the first stage are reported in table 1.17. The interactions with the registration indicator suggest that there are not important differences in returns to potential experience between the sectors, but the effects of more years of schooling, being the head of a household, living in a bigger city, living closer to the U.S.-Mexico border, or living in a state with low exposure to globalization are in general significantly larger for the registered workers. As with the previous estimations, the regressions in table 1.17 also included a set of city dummies, and the interactions of these with the registration indicator. In most of the cases these variables where both individually and jointly significant, indicating that geographic location is an important determinant of earnings, and that its effect varies across registered and unregistered workers. The estimated registered-unregistered wage differentials are correlated through time, with

Table 1.17. Linear Regression of ln(Wages)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
experience	0.026 ***	0.024 ***	0.027 ***	0.028 ***	0.027 ***	0.027 ***	0.025 ***	0.025 ***	0.023 ***	0.023 ***	0.019 ***	0.020 ***	0.019 ***	0.017 ***
	[0.001]	[0.002]	[0.002]	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
experience*registration	-0.004 **	0.002	-0.002	-0.002	0.001	-0.0002	0.004 *	0.003 *	0.004 **	0.0005	0.001	0.001	0.0002	0.001
	[0.002]	[0.003]	[0.002]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
experience^2	-0.00033 ***	-0.00032 ***	-0.00034 ***	-0.00035 ***	-0.00034 ***	-0.00034 ***	-0.00030 ***	-0.00029 ***	-0.00026 ***	-0.00028 ***	-0.00024 ***	-0.00025 ***	-0.00026 ***	-0.00022 ***
	[0.00002]	[0.00003]	[0.00002]	[0.00003]	[0.00003]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]
experience2*registration	0.00008 ***	0.00001	0.00007 **	0.00005 **	0.00004 *	0.00006 ***	-0.000001	0.00001	0.00001	0.00005 **	0.00005 **	0.00005 **	0.00008 ***	0.00006 ***
	[0.00002]	[0.00003]	[0.00003]	[0.00002]	[0.00002]	[0.00002]	[0.00003]	[0.00003]	[0.00002]	[0.00003]	[0.00002]	[0.00002]	[0.00002]	[0.00002]
schooling	0.063 ***	0.063 ***	0.062 ***	0.069 ***	0.067 ***	0.070 ***	0.066 ***	0.070 ***	0.070 ***	0.065 ***	0.060 ***	0.061 ***	0.057 ***	0.054 ***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
schooling *registration	0.012 ***	0.021 ***	0.026 ***	0.022 ***	0.029 ***	0.030 ***	0.036 ***	0.033 ***	0.034 ***	0.032 ***	0.033 ***	0.036 ***	0.037 ***	0.036 ***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.005]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]
married	0.115 ***	0.151 ***	0.125 ***	0.144 ***	0.134 ***	0.115 ***	0.135 ***	0.120 ***	0.140 ***	0.143 ***	0.128 ***	0.144 ***	0.124 ***	0.136 ***
	[0.012]	[0.013]	[0.018]	[0.010]	[0.011]	[0.009]	[0.009]	[0.010]	[0.010]	[0.011]	[0.012]	[0.008]	[0.010]	[0.008]
married*registration	-0.048 ***	-0.072 ***	-0.041 *	-0.071 ***	-0.046 ***	-0.026 **	-0.061 ***	-0.051 ***	-0.069 ***	-0.056 ***	-0.053 ***	-0.074 ***	-0.048 ***	-0.069 ***
	[0.014]	[0.015]	[0.023]	[0.013]	[0.014]	[0.012]	[0.010]	[0.011]	[0.010]	[0.012]	[0.013]	[0.009]	[0.011]	[0.010]
cohabitating	0.051 **	0.067 ***	0.047 *	0.057 ***	0.061 ***	0.035 ***	0.064 ***	0.052 ***	0.044 **	0.066 ***	0.065 ***	0.071 ***	0.049 ***	0.058 ***
	[0.023]	[0.016]	[0.026]	[0.014]	[0.018]	[0.013]	[0.021]	[0.013]	[0.018]	[0.010]	[0.010]	[0.015]	[0.011]	[0.012]
cohabitating*registration	-0.079 ***	-0.105 ***	-0.083 ***	-0.099 ***	-0.078 ***	-0.044 *	-0.100 ***	-0.079 ***	-0.078 ***	-0.068 ***	-0.077 ***	-0.079 ***	-0.047 ***	-0.063 ***
	[0.026]	[0.025]	[0.026]	[0.021]	[0.023]	[0.024]	[0.024]	[0.017]	[0.021]	[0.013]	[0.014]	[0.017]	[0.012]	[0.013]
male	0.111 ***	0.102 ***	0.085 ***	0.057 *	0.059	0.061 **	0.052	0.063 **	0.033	0.054 **	0.085 ***	0.095 ***	0.095 ***	0.095 ***
	[0.021]	[0.021]	[0.030]	[0.029]	[0.037]	[0.031]	[0.032]	[0.029]	[0.021]	[0.021]	[0.018]	[0.017]	[0.020]	[0.019]
male*registration	-0.078 ***	-0.070 ***	-0.077 ***	-0.057 *	-0.057 *	-0.075 ***	-0.066 **	-0.087 ***	-0.045 *	-0.053 **	-0.084 ***	-0.073 ***	-0.062 ***	-0.065 ***
	[0.024]	[0.022]	[0.028]	[0.029]	[0.033]	[0.029]	[0.031]	[0.027]	[0.023]	[0.023]	[0.018]	[0.022]	[0.022]	[0.020]
firsthead	0.132 ***	0.163 ***	0.128 ***	0.123 ***	0.152 ***	0.149 ***	0.135 ***	0.130 ***	0.140 ***	0.146 ***	0.150 ***	0.143 ***	0.151 ***	0.136 ***
	[0.015]	[0.024]	[0.023]	[0.010]	[0.015]	[0.015]	[0.015]	[0.011]	[0.016]	[0.013]	[0.014]	[0.010]	[0.014]	[0.013]
firsthead*registration	-0.040 ***	-0.062 **	-0.008	-0.021 *	-0.063 ***	-0.058 ***	-0.049 ***	-0.033 ***	-0.044 ***	-0.050 ***	-0.045 ***	-0.044 ***	-0.051 ***	-0.052 ***
	[0.015]	[0.024]	[0.027]	[0.012]	[0.019]	[0.016]	[0.019]	[0.012]	[0.016]	[0.013]	[0.017]	[0.012]	[0.014]	[0.015]
secondhead	0.052 ***	0.089 ***	0.073 ***	0.055 ***	0.071 **	0.071 ***	0.082 ***	0.072 ***	0.054 ***	0.068 ***	0.075 ***	0.064 ***	0.061 ***	0.054 ***
	[0.016]	[0.021]	[0.019]	[0.014]	[0.028]	[0.014]	[0.014]	[0.009]	[0.014]	[0.009]	[0.009]	[0.012]	0.010	0.013
secondhead*registration	-0.012	-0.055 **	-0.017	0.010	-0.017	-0.010	-0.006	-0.007	0.023	-0.001	0.003	0.0005	0.001	0.0004
	[0.018]	[0.022]	[0.023]	[0.020]	[0.028]	[0.018]	[0.018]	[0.013]	[0.016]	[0.012]	[0.012]	[0.016]	[0.013]	[0.014]
ln(population)	0.006	0.033 ***	0.163 ***	0.114 ***	0.087 ***	0.133 ***	0.126 ***	0.005	9.644	0.076 ***	0.014 ***	0.031 ***	0.043 ***	0.039 ***
	[0.011]	[0.008]	[0.016]	[0.014]	[0.020]	[0.020]	[0.011]	[0.016]	[6.184]	[0.014]	[0.002]	[0.004]	[0.004]	[0.003]
ln(population)*registration	0.040 ***	0.043 ***	0.065 ***	0.034 ***	0.041 ***	0.033 ***	0.034 ***	0.021 ***	10.883	0.025 ***	-0.011 ***	-0.013 ***	-0.018 ***	-0.020 ***
	[0.005]	[0.004]	[0.004]	[0.005]	[0.004]	[0.004]	[0.005]	[0.004]	[8.399]	[0.005]	[0.003]	[0.005]	[0.005]	[0.005]
relative distance	-0.512 ***	-0.606 ***	-0.537 ***	-0.383 ***	-0.210 ***	-0.357 ***	-0.237 ***	-0.199 ***	-43.703	-0.526 ***	-0.198 ***	-0.419 ***	-0.387 ***	-0.350 ***
	[0.035]	[0.059]	[0.032]	[0.042]	[0.030]	[0.050]	[0.029]	[0.045]	[27.920]	[0.032]	[0.025]	[0.067]	[0.031]	[0.048]
relative distance*registration	0.062	0.035	0.064	-0.103 *	-0.042	0.035	0.261 ***	0.260 ***	-180.655	0.265 ***	0.284 ***	0.243 ***	0.250 ***	0.236 ***
	[0.045]	[0.042]	[0.045]	[0.053]	[0.063]	[0.059]	[0.041]	[0.037]	[139.976]	[0.048]	[0.035]	[0.074]	[0.039]	[0.055]
high exposure	0.064 *	0.0299	0.378 ***	0.336 ***	0.341 ***	0.297 ***	0.367 ***	-0.185 ***	-16.786	0.081 ***	0.002	0.107 ***	0.185 ***	0.167 ***
	[0.036]	[0.051]	[0.043]	[0.033]	[0.060]	[0.046]	[0.040]	[0.025]	[10.913]	[0.027]	[0.019]	[0.018]	[0.017]	[0.018]
high exposure*registration	0.109 **	0.1234 ***	0.204 ***	-0.010	0.039	0.084	0.185 ***	0.137 ***	-150.909	0.061	-0.046 *	-0.052 **	-0.112 ***	-0.091 ***
	[0.047]	[0.045]	[0.043]	[0.050]	[0.055]	[0.057]	[0.044]	[0.040]	[116.869]	[0.038]	[0.025]	[0.026]	[0.031]	[0.025]
low exposure	0.097 **	0.073	0.292 ***	0.467 ***	-0.076	0.647 ***	0.611 ***	0.074	30.724	0.351 ***	0.221 ***	-0.101 ***	0.243 ***	0.155 ***
	[0.043]	[0.047]	[0.048]	[0.053]	[0.083]	[0.093]	[0.056]	[0.075]	[19.787]	[0.055]	[0.033]	[0.029]	[0.027]	[0.028]
low exposure*registration	0.028	0.263 ***	0.150 ***	0.114 **	0.376 ***	0.163 **	0.276 ***	0.055	34.766	0.184 ***	-0.109 **	0.067	-0.278 ***	-0.021
	[0.052]	[0.044]	[0.046]	[0.053]	[0.080]	[0.080]	[0.053]	[0.055]	[26.860]	[0.044]	[0.050]	[0.051]	[0.065]	[0.052]
No. Obs.	52,716	53,743	53,711	97,987	102,574	106,323	108,302	115,633	122,504	130,862	148,642	159,810	164,539	159,643

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include city dummies, industry dummies, and interactions of these with an indicator for registration. Robust standard errors clustered at the industry level are shown in brackets

Table 1.18. Effect of Trade Liberalization on Wage Differentials

		(a)	(b)	(c)
1	Mex Tariff	-0.169 [0.319]	-0.356 [0.352]	-0.074 [0.191]
	No. Obs.	3938	3710	3710
2	US Tariff	-0.695 [0.760]	-1.450 ** [0.585]	-0.949 ** [0.371]
	No. Obs.	3938	3964	3680
3	IOM Tariff	0.115 [0.108]	0.003 [0.120]	0.052 [0.065]
	No. Obs.	3968	3710	3710
4	Mex Tariff	-0.289 [0.352]	-0.334 [0.379]	-0.097 [0.209]
	US Tariff	-0.633 [0.751]	-1.399 ** [0.581]	-0.904 ** [0.370]
	IOM Tariff	0.138 [0.117]	0.022 [0.129]	0.051 [0.070]
	No. Obs.	3938	3694	3680

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include year dummies, industry dummies and industry trends. Newey-West standard errors with 1 lag are shown in brackets.

(a) Current tariffs

(b) 1-year lagged tariffs

(c) Sum of current and 1-year lagged tariffs

year- to-year correlation coefficients ranging from 0.12 to 0.70 and averaging 0.36. This suggests that the registered-unregistered wage gap could also be highly sensitive to changes in the level of import tariffs.

In the second stage the within industry registered-unregistered wage differentials are pooled over time and used as the dependent variable in the estimation of the following equation, which parallels equations (1.8) and (1.11) above:

$$\phi_{(I\times f)jt} = T_{jt}\beta_T + Y_t\gamma_Y + D_j\delta_D + (D_j \times tr_t)\eta_{(D\times tr)} + \varepsilon_{jt} \qquad (1.13)$$

Table 1.18 reports the estimates of equation (1.13). Column (a) presents the estimates obtained for the current values of the import tariffs. None of the estimates in this column is significantly different from zero. The coefficients for the Mexican and the U.S. import tariffs are negative, indicating a negative correlation with the registered-unregistered wage differentials. Column (b) explores the possibility that adjustments in the wage differentials with respect to changes in the level of import tariffs may require some time to take place. Using the 1-year lagged values, the column reports larger

effects for the Mexican and the U.S. import tariffs, but only the second one is statistically significant at a 5% level. Column (c) summarizes the dynamic effects by using the sum of the current and the 1-year lagged tariffs as regressors. Panels 2 and 4 confirm the relevance of the changes in the U.S. import tariffs for changes in the wage gap. The conclusion from the estimates in table 1.18 is that the elimination of the U.S. import tariff contributes to the increase of the wage differential, but this effect takes some time to show up. This result may also suggest that wages in Mexico are somewhat sticky, as they do not adjust to changes in the economic environment immediately after these take place. Given the insignificance and the large standard errors of the estimates of the IOM tariff, it can also be said that this result is valid for the tradable sectors only. The evidence in this subsection supports the predictions from the dynamic industry model with firm heterogeneity in section 1.2, and is also in line with the results from previous studies regarding the effect of trade liberalization on the distribution of wages.

1.8. Conclusions

This chapter has investigated the relationship between trade liberalization and informality in Mexico during the 1990s. Using the Melitz, M. J. (2003) model of heterogeneous firms to analyse the possible implications of trade liberalization on the rate of informality, it is predicted that by making more profitable to some firms to enter the formal sector, by forcing the less productive informal firms to exit the industry, and by inducing the most productive formal firms to engage in trade, trade liberalization could reduce the incidence of informality, particularly in industries characterized by higher levels of aggregate productivity. Both the exit of the least productive firms and the additional export sales gained by the more productive firms reallocate market shares towards the more productive firms and contribute to an aggregate productivity gain. The increased labour demand by the more productive firms and the new entrants tends to increase more the real wages in industries that experience larger tariff cuts.

The empirical analysis referred to the relationship between trade liberalization and the share of workers without social security registration (which is one specific type of informality that can be measured from employee data from a household survey like ENEU) to provide supporting evidence for this view. Reductions in the Mexican import tariffs are found to be significant in reducing the likelihood of unregistration in the tradable sectors. This result contrasts with the findings of Goldberg, P. K. & N. Pavcnik (2003) for Brazil and Colombia, but one has to keep in mind that liberalization of trade

in those countries has been rather different from the 1990s Mexican experience. The analysis in this chapter also indicates that for a given reduction in the Mexican import tariff, unregistration decreases less in industries with higher levels of import penetration; and that for a given reduction in the U.S. import tariff, unregistration decreases more in industries that are relatively more export oriented. It is also found that trade liberalization affects the employment shares and the composition of unregistration across industries, but it does not seem to have an impact on the size of the labour force of firms, as reported by workers when asked about the number of people in their workplaces. This chapter also presented evidence of an increase in industry wage differentials and a widening effect of trade liberalization on the registered-unregistered wage gap.

Finally, it is important to acknowledge the limitations of this results. The empirical part of the present chapter used a reduced-form approach to illustrate how, in one specific case, trade liberalization may affect informality through changes in social security payments. But, as it is clear from the model developed in section 1.2, social security unregistration is not the only characteristic of informality. Furthermore, trade liberalization may affect social security registration through a variety of channels, and given that these are not analyzed here, it is difficult if not impossible to use these results to predict how trade liberalization would affect registration and hence informality in other countries –or even in Mexico at another point in time. Some of the possible ways in which trade liberalization may affect the levels of registration could be by altering the skill mix (i.e., increasing the demand for skilled workers, who may be less likely to take a job that does not offer social or health insurance), by changing the size distribution of firms (increasing the average size of a firm's labour force, which makes it more easily monitored by the authorities and hence reduces the incentives for unregistration), by favouring investment by foreign firms with different views or objective functions regarding registration (i.e., foreign firms may face more severe consequences in their countries of origin if they employ unregistered workers abroad and are therefore perceived as exploiters), or by affecting the relative costs of the factors of production (hence generating pure rents to the firm owners and perhaps leading them to share these rents with their workers through the provision of social security benefits). The analysis of the effect of trade liberalization on social security registration through each one of these alternative channels is left as an agenda for future research.

1.9. References

ATTANASIO, O., P. K. GOLDBERG, and N. PAVCNIK (2003): "Trade Reforms and Wage Inequality in Colombia," *NBER Working Paper Series*, 9830.

BALDWIN, J., and W. GU (2006): "The Impact of Trade on Plant Scale, Production Run-Length and Diversification," *Economic Analysis Research Paper Series No. 038. Statistics Canada.*

CRAGG, M., and M. EPELBAUM (1996): "The Premium for Skills in Ldcs: Evidence from Mexico," *Journal of Development Economics*, Vol 51, pp. 99-116.

CURRIE, J., and A. HARRISON (1997): "Sharing the Costs: The Impact of Trade Reform on Capital and Labor in Morocco," *Journal of Labor Economics*, Vol. 15, pp. S44-S71.

DIXIT, A., and J. STIGLITZ (1977): "Monopolistic Competition and Optimum Product Diversity," *American Economic Review*, Vol. 67, pp.297-308.

FEENSTRA, R. C., J. ROMALIS, and P. K. SCHOTT (2002): "U.S. Imports, Exports and Tariff Data, 1989-2001," *NBER Working Paper Series.*

FERNANDES, A. M. (2003): "Trade Policy, Trade Volumes, and Plan-Level Productivity in Colombian Manufacturing Industries," *The World Bank Development Research Group. Policy Research Working Paper*, 3064.

FERREIRA, P. C., and J. L. ROSSI (2003): "New Evidence from Brazil on Trade Liberalization and Productivity Growth," *International Economic Review*, Vol. 44, pp. 1383-1405.

GOLDBERG, P. K., and N. PAVCNIK (2003): "The Response of the Informal Sector to Trade Liberalization," *Journal of Development Economics*, 72, p. 463-496.

HANSON, G. H. (1994): "Regional Adjustment to Trade Liberalisation," *National Bureau of Economic Research*, Working Paper No. 4713.

— (2003): "What Has Happened to Wages in Mexico since Nafta? Implications for Hemispheric Free Trade," *University of California, San Diego and NBER.*

— (2004): "Globalization, Labour Income, and Poverty in Mexico," *University of California, San Diego and NBER.*

HANSON, G. H., and A. HARRISON (1999): "Trade Liberalization and Wage Inequality in Mexico," *Industrial and Labor Relations Review*, Vol. 52, pp. 271-288.

HARRISON, A. (1994): "Productivity, Imperfect Competition and Trade Reform," *Journal of International Economics*, Vol. 36, p. 53-73.

KATE, A. T., C. MACARIO, and G. NIELS (2000): "Mexico: Export Promotion Policies on the Cutting Edge," in *Export Growth in Latin America: Policies and Performance*: Boulder, Colo.: L. Rienner Publishers, c2000., 183 p.

MALONEY, W. F. (1999): "Does Informality Imply Segmentation in Urban Labor Markets? Evidence from Sectoral Transitions in Mexico," *The World Bank Economic Review*, Vol. 13, p. 275-302.

MATTAR, J. (1998): "Export Promotion in Mexico," *Integration and Trade 4/5. Institute for the Integration of Latin America and the Caribbean, Inter-American Development Bank.*

MELITZ, M. J. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, Vol. 71, pp. 1695-1725.

NICITA, A. (2004): "Who Benefited from Trade Liberalization in Mexico?" *World Bank Policy Research Working Paper 3265.*

PAVCNIK, N. (2002): "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants," *The Review of Economic Studies*, Vol. 69, No. 1, p.245-276.

REVENGA, A. (1995): "Employment and Wage Effects of Trade Liberalization," *The World Bank. Latin America and the Caribbean. Human Resources Operations Division. Country Operations 1 and the Environment Division.*

ROBBINS, D. (1996): "Trade Liberalization and Income Distribution," *NBER Working Paper Series*, Working Paper 5693.

ROBERTS, B. R. (1989): "Employment Structure, Life Cycle, and Life Chances: Formal and Informal Sectors in Guadalajara," in *The Informal Economy. Studies in Advanced and Less Developed Countries*, ed. by A. Portes, M. Castells, and L. A. Breton. Baltimore & London: The John Hopkins University Press.

TIBOUT, J., and M. WESTBROOK (1995): "Trade Liberalization and the Dimensions of Efficiency Change in Mexican Manufacturing Industries," *Journal of International Economics*, Vol. 39, p.53-78.

1.10. Appendix 1A: Proof that P_0 does not change with trade liberalization

In a model like the one described in section 1.2, an equilibrium will be characterized by a mass of firms $M = M_I + M_F + M_X$ and an *ex post* distribution of productivities $\mu(\varphi)$

over a subset of $(0,\infty)$. $\mu(\varphi)$ is conditional on successful entry to the industry and is truncated at φ^*:

$$\mu(\varphi)=\begin{cases}\dfrac{g(\varphi)}{1-G(\varphi^*)} & \text{if } \varphi \geq \varphi^* \\ 0 & \text{otherwise}\end{cases} \tag{1A.1}$$

The average productivities in different sectors of the industry are determined by the *ex post* productivity distribution and the zero-profit productivity cut-offs. Let $\tilde{\varphi}$ be the weighted average productivity across all firms. Then:

$$\begin{aligned}\tilde{\varphi}(\varphi^*)&=\left[\frac{1}{1-G(\varphi^*)}\int_{\varphi^*}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi\right]^{\frac{1}{\sigma-1}}\\ \tilde{\varphi}_F(\varphi_F^*)&=\left[\frac{1}{1-G(\varphi_F^*)}\int_{\varphi_F^*}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi\right]^{\frac{1}{\sigma-1}}\\ \tilde{\varphi}_X(\varphi_X^*)&=\left[\frac{1}{1-G(\varphi_X^*)}\int_{\varphi_X^*}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi\right]^{\frac{1}{\sigma-1}}\end{aligned} \tag{1A.2}$$

The average productivity across all firms, $\tilde{\varphi}$, is based only on market share differences between firms. If some firms are formal or trading, then this average will not reflect the additional shares of more productive firms. Furthermore, neither of these averages reflect the proportions α, β, and τ of output units that are "gained" and "lost" in passing to the formal sector and to the trading sub-sector, respectively. Let $\tilde{\varphi}_t$ be the weighted productivity average that reflects these differences. $\tilde{\varphi}_t$ can be written as:

$$\tilde{\varphi}_t=\left\{\frac{1}{M}\left[M_I\tilde{\varphi}^{\sigma-1}+M_F\left[(1+\alpha)(1+\beta)^{-1}\tilde{\varphi}_F\right]^{\sigma-1}+M_X\left[(1+\alpha)(1+\beta)^{-1}\tau^{-1}\tilde{\varphi}_X\right]^{\sigma-1}\right]\right\}^{\frac{1}{\sigma-1}} \tag{1A.3}$$

$\tilde{\varphi}_t$ can then be used to obtain expressions for the aggregate prices and expenditure levels, *P* and *R* respectively. In particular:

$$P_0=Q^{\frac{1}{\sigma}}P=\frac{r(\tilde{\varphi}_t)}{q(\tilde{\varphi}_t)^{\rho}}=\frac{q(\tilde{\varphi}_t)^{1-\rho}}{\rho\tilde{\varphi}_t} \tag{1A.4}$$

This implies that the derivative of P_0 with respect to $\tilde{\varphi}_t$ is equal to:

$$\frac{\partial P_0}{\partial \tilde{\varphi}_t} = \frac{\rho \tilde{\varphi}_t (1-\rho) q(\tilde{\varphi}_t)^{-\rho} q'(\tilde{\varphi}_t) - q(\tilde{\varphi}_t)^{1-\rho} \rho}{(\rho \tilde{\varphi}_t)^2} \tag{1A.5}$$

and its sign depends on the sign of the numerator. For example, for it to be positive:

$$\tilde{\varphi}_t (1-\rho) q'(\tilde{\varphi}_t) - q(\tilde{\varphi}_t) > 0 \tag{1A.6}$$

or,

$$\frac{\tilde{\varphi}_t q'(\tilde{\varphi}_t)}{q(\tilde{\varphi}_t)} > \frac{1}{(1-\rho)} = \sigma \tag{1A.7}$$

but the left-hand side of this inequality is also equal to σ, as it is simply the elasticity of $q(\tilde{\varphi}_t)$ with respect to $\tilde{\varphi}_t$. Hence, the numerator in (1A.5) is equal to zero, implying that P_0 is not affected by changes in $\tilde{\varphi}_t$.

1.11. Appendix 1B: Proof of Proposition 1

The formal proofs for points 1 and 3 of proposition 1 are the same as in the original model in Melitz, M.J. (2003), and therefore there are not repeated here. The way in which trade liberalization works is the following: a decrease in τ to $\tau' < \tau$ will induce an increase in the industry's cut-off productivity level φ^* to $\varphi^{*\prime} > \varphi^*$, and a decrease in the cut-off productivity level for the trading sub-sector φ_X^* to $\varphi_X^{*\prime} < \varphi_X^*$. There are two potential channels through which trade can affect the distribution of surviving firms. The first one is through the increase in product market competition, which in the present model is not operative due to the assumption of monopolistic competition under C.E.S. preferences. The second channel operates through the domestic factor market where firms compete for labour. As mentioned in section 1.2.2, expanded exposure to trade offers new profit opportunities only to the more productive firms who can cover the entry cost f_X, and it also induces more entry of new firms to the industry, as prospective firms respond to the higher potential returns associated with a good productivity draw. The increased labour demand by the more productive firms and new entrants bids up the real wages and forces the least productive firms to exit. From

equation (1.6), it can be seen that φ_F^* is an increasing function of real wages, w, so that this would also translate into an increase in the cut-off productivity level for formality:

$$\frac{\partial \varphi_F^*}{\partial \tau} = \frac{1}{\rho}\left\{\frac{w^{1/(1-\rho)}\left[(1+\alpha)f_F - (1-\gamma\varepsilon)f_I\right]}{kB}\right\}^{\frac{1-2\rho}{\rho}} w^{\frac{\rho}{1-\rho}} \frac{\partial w}{\partial \tau} < 0 \qquad \text{(1B.1)}$$

because $\frac{\partial w}{\partial \tau} < 0$. The fact that both φ^* and φ_F^* increase with trade liberalization means that there will be an ambiguous effect on the size of the labour force in the informal sector. The fact that φ_X^* and τ decrease with trade liberalization translates into an increase in the labour force of the trading-formal sub-sector. To see this formally, recall that the prices and output in each one of the sectors are given by the following equations:

$$\begin{aligned}
p_I &= \frac{w}{\rho\varphi} & q_I &= Q\left[\frac{w}{P\rho\varphi}\right]^{-\sigma} \\
p_F &= \frac{(1+\alpha)w}{\rho(1+\beta)\varphi} & q_F &= Q\left[\frac{(1+\alpha)w}{P\rho(1+\beta)\varphi}\right]^{-\sigma} \\
p_X &= \frac{\tau(1+\alpha)w}{\rho(1+\beta)\varphi} & q_X &= Q\left[\frac{\tau(1+\alpha)w}{P\rho(1+\beta)\varphi}\right]^{-\sigma}
\end{aligned} \qquad \text{(1B.2)}$$

Therefore, using equation (1.2), the labour demands in each sector can be written as:

$$\begin{aligned}
\ell_I(\varphi) &= f_I + Q\left[\frac{P\rho}{w}\right]^{\sigma} \varphi^{\sigma-1} \\
\ell_F(\varphi) &= f_F + Q\left[\frac{P\rho(1+\beta)}{(1+\alpha)w}\right]^{\sigma} \varphi^{\sigma-1} \\
\ell_X(\varphi) &= f_X + Q\left[\frac{P\rho(1+\beta)}{\tau(1+\alpha)w}\right]^{\sigma} \varphi^{\sigma-1}
\end{aligned} \qquad \text{(1B.3)}$$

And total employment in the industry is given by:

$$L = L_e + \int_{\varphi^*}^{\varphi_F^*} \ell_I(\varphi)\mu(\varphi)d\varphi + \int_{\varphi_F^*}^{\infty} \ell_F(\varphi)\mu(\varphi)d\varphi + \int_{\varphi_X^*}^{\infty} \ell_X(\varphi)\mu(\varphi)d\varphi \qquad (1B.4)$$

where L_e is the labour used by new entrants for investing in the industry's fixed entry cost f_e (see Melitz, M.J (2003)), and $\mu(\varphi)$ is the *ex-post* distribution of productivities defined in equation (1A.1). In equilibrium, the market clearing condition for investment workers requires L_e to be equal to the total investment by new entrants, $M_e f_e$, where M_e is the total number of new entrants to the industry. Also, in equilibrium, stability requires that the mass of successful entrants exactly replaces the mass of incumbents who are hit with the bad shock and exit: $p_{in} M_e = \delta M$, where p_{in} is the probability of successful entry into the industry (e.g. of drawing a productivity parameter $\varphi \geq \varphi^*$) and δ is the probability of being hit by a bad shock in every period. These two equilibrium conditions together with the free entry condition to the industry $\bar{\pi} = \delta f_e / \left[1 - G(\varphi^*)\right]$ (where $\bar{\pi}$ are the average profits in the industry) imply that the labour force employed in investment by new entrants can be written as:

$$L_e = M_e f_e = \frac{\delta M}{p_{in}} f_e = M\bar{\pi} \qquad (1B.5)$$

From equation (1B.5) is easy to see that trade liberalization increases the labour demand of the new entrants: a decrease in τ increases φ^*, which in turn increases $\bar{\pi}$. Therefore, L_e increases as well. On the other hand, it is also easy to see the positive impact of trade liberalization on the employment share of the trading-formal sub-sector. Using the last equation in (1B.3) together with equation (1A.1) in the last term of the right-hand side of equation (1B.4):

$$\int_{\varphi_X^*}^{\infty} \ell_X(\varphi)\mu(\varphi)d\varphi = \frac{1}{1 - G(\varphi^*)} \int_{\varphi_X^*}^{\infty} \left[f_X + Q\left(\frac{P\rho(1+\beta)}{\tau(1+\alpha)w} \right)^{\sigma} \varphi^{\sigma-1} \right] g(\varphi)d\varphi \qquad (1B.6)$$

which is clearly negatively related to τ: when τ decreases, the term in brackets increases, φ^* increases so that $1/\left[1 - G(\varphi^*)\right]$ increases, and φ_X^* decreases so that the area of integration increases as well. Thus, the employment share of the trading-formal sub-sector increases with trade liberalization. Finally, consider the employment share of the formal sector in the domestic market. Using again equation (1A.1) together with the

second equation in (1B.3) in the second integral on the right-hand side of equation (1B.4):

$$\begin{aligned}
&\int_{\varphi_F^*}^{\infty} \ell_F(\varphi)\mu(\varphi)d\varphi = \\
&= \frac{1}{1-G(\varphi^*)} \int_{\varphi_F^*}^{\infty} \left[f_F + Q\left(\frac{P\rho(1+\beta)}{(1+\alpha)w} \right)^{\sigma} \varphi^{\sigma-1} \right] g(\varphi)d\varphi = \\
&= \frac{1-G(\varphi_F^*)}{1-G(\varphi^*)} f_F + Q\left(\frac{P\rho(1+\beta)}{(1+\alpha)w} \right)^{\sigma} \frac{1}{1-G(\varphi^*)} \int_{\varphi_F^*}^{\infty} \varphi^{\sigma-1} g(\varphi)d\varphi = \\
&= \frac{1-G(\varphi_F^*)}{1-G(\varphi^*)} f_F + Q\left(\frac{P\rho(1+\beta)}{(1+\alpha)w} \right)^{\sigma} \frac{1-G(\varphi_F^*)}{1-G(\varphi^*)} \tilde{\varphi}_F(\varphi_F^*)^{\sigma-1} = \\
&= \frac{1-G(\varphi_F^*)}{1-G(\varphi^*)} \left\{ f_F + Q\left(\frac{P\rho(1+\beta)}{(1+\alpha)w} \right)^{\sigma} \tilde{\varphi}_F(\varphi_F^*)^{\sigma-1} \right\}
\end{aligned} \tag{1B.7}$$

where $\tilde{\varphi}_F(\varphi_F^*)$ is the average productivity in the formal sector, as defined in equation (1A.2). From this last expression it can already be seen that the relationship between τ and the employment share of the formal sector (and hence of the informal sector) is ambiguous. The derivative of $\tilde{\varphi}_F(\varphi_F^*)$ with respect to τ is negative, as φ_F^* increases with a decrease in τ and $\tilde{\varphi}_F$ is increasing in φ_F^*. However, the sign of the derivative of $[1-G(\varphi_F^*)]/[1-G(\varphi^*)]$ cannot be determined, as it depends on the shape of the distribution $g(\varphi)$ and the specific values of the parameters in the model:

$$\frac{\partial}{\partial\tau} \frac{1-G(\varphi_F^*)}{1-G(\varphi^*)} = \frac{-g(\varphi_F^*)[1-G(\varphi^*)]\frac{\partial\varphi_F^*}{\partial\tau} + g(\varphi^*)[1-G(\varphi_F^*)]\frac{\partial\varphi^*}{\partial\tau}}{[1-G(\varphi^*)]^2} \tag{1B.8}$$

Looking at the numerator of (1B.8), $1-G(\varphi^*) > 1-G(\varphi_F^*)$ given that $\varphi^* < \varphi_F^*$. Using equations (1.5) and (1.6), $\left|\frac{\partial\varphi_F^*}{\partial\tau}\right| < \left|\frac{\partial\varphi^*}{\partial\tau}\right|$ whenever $\frac{f_F}{f_I} < \left[\frac{(1+\beta)^{\rho}}{1+\alpha}\right]^{\frac{1}{1-\rho}}$, and

$g(\varphi_F^*) > g(\varphi^*)$ when the distribution $g(\varphi)$ is sufficiently skewed to the left. In such a case, the share of employment in the formal sector increases with trade liberalization.

1.12. Appendix 1C: Proof of Proposition 2

The only difference with respect to the proof in proposition 1 in appendix 1B is that now it is not possible to determine a unique sign of the derivative of φ_F^* with respect to τ. Recall that:

$$\varphi_F^* = \left\{ \frac{w^{1/(1-\rho)}\left[(1+\alpha)f_F - (1-\gamma\varepsilon)f_I\right]}{kB} \right\}^{\frac{1-\rho}{\rho}} \tag{1C.1}$$

where $B = \left(\frac{1+\beta}{1+\alpha}\right)^{\frac{\rho}{1-\rho}} - (1-\gamma\varepsilon)$. Considering that now β is also affected by trade liberalization, so that $\frac{\partial\beta}{\partial\tau} < 0$:

$$\begin{aligned} \frac{\partial\varphi_F^*}{\partial\tau} &= \frac{w^{2\rho}}{\rho B^{1/\rho}} \left\{ \frac{(1+\alpha)f_F - (1-\gamma\varepsilon)f_I}{k} \right\}^{\frac{1-\rho}{\rho}} \left[B\frac{\partial w}{\partial\tau} - w(1-\rho)\frac{\partial B}{\partial\tau} \right] = \\ &= \frac{w^{2\rho}}{\rho B^{1/\rho}} \left\{ \frac{(1+\alpha)f_F - (1-\gamma\varepsilon)f_I}{k} \right\}^{\frac{1-\rho}{\rho}} \left\{ B\frac{\partial w}{\partial\tau} - \frac{\rho w}{1+\alpha}\left(\frac{1+\beta}{1+\alpha}\right)^{\frac{2\rho-1}{1-\rho}} \frac{\partial\beta}{\partial\tau} \right\} \end{aligned} \tag{1C.2}$$

the sign of $\frac{\partial\varphi_F^*}{\partial\tau}$ is undetermined, as $\frac{\partial w}{\partial\tau} < 0$ and $\frac{\partial\beta}{\partial\tau} < 0$. Thus, in general it is not possible to say whether φ_F^* increases or decreases, inducing less or more firms to enter the formal sector after trade liberalization. However, using the results for market share reallocations, it is possible to find cases in which the sign of $\frac{\partial\varphi_F^*}{\partial\tau}$ is uniquely determined. To begin, recall that revenues from sales to the foreign market increase after trade liberalization, so that $\frac{\partial r_X(\varphi)}{\partial\tau} < 0$. Using the last pair of equations in (1B.2):

$$\frac{\partial r_X(\varphi)}{\partial \tau} = \frac{\partial}{\partial \tau} QP^{\sigma}\varphi^{\sigma-1}\left[\frac{\rho(1+\beta)}{\tau(1+\alpha)w}\right]^{\sigma-1} =$$

$$= (\sigma-1)QP^{\sigma}\varphi^{\sigma-1}\left[\frac{\rho(1+\beta)}{\tau(1+\alpha)w}\right]^{\sigma-2}\left\{\frac{\tau w\rho\frac{\partial\beta}{\partial\tau} - \rho\tau(1+\beta)\frac{\partial w}{\partial\tau} - \rho(1+\beta)w}{\tau^2(1+\alpha)w^2}\right\} < 0 \qquad (1C.3)$$

For this inequality to hold, the numerator of the last term in the right-hand side has to negative:

$$\tau w\rho\frac{\partial\beta}{\partial\tau} - \rho\tau(1+\beta)\frac{\partial w}{\partial\tau} - \rho(1+\beta)w < 0$$

$$\Leftrightarrow \quad \eta_{1+\beta,\tau} - \eta_{w,\tau} < 1 \qquad (1C.4)$$

On the other hand, total revenues in the trading-formal sub-sector, $\left(1+\tau^{1-\sigma}\right)r_F(\varphi)$, also increase after trade liberalization, as there is a market share reallocation towards these firms. Thus, using the second pair of equations in (1B.2):

$$\frac{\partial}{\partial\tau}\left(1+\tau^{1-\sigma}\right)r_F(\varphi) = \frac{\partial}{\partial\varphi}\left(1+\tau^{1-\sigma}\right)QP^{\sigma}\varphi^{\sigma-1}\left[\frac{\rho(1+\beta)}{(1+\alpha)w}\right]^{\sigma-1} =$$

$$= (\sigma-1)QP^{\sigma}\varphi^{\sigma-1}\left[\frac{\rho(1+\beta)}{(1+\alpha)w}\right]^{\sigma-1}\left\{-\tau^{-\sigma} + \frac{\left(1+\tau^{1-\sigma}\right)\left[w\frac{\partial\beta}{\partial\tau} - (1+\beta)\frac{\partial w}{\partial\tau}\right]}{(1+\beta)w}\right\} < 0 \qquad (1C.5)$$

As before, for this inequality to hold, the last term in the right-hand side has to be negative, or:

$$\left(1+\tau^{1-\sigma}\right)\left[w\frac{\partial\beta}{\partial\tau} - (1+\beta)\frac{\partial w}{\partial\tau}\right] < \frac{(1+\beta)w}{\tau^{\sigma}}$$

$$\Leftrightarrow \quad \eta_{1+\beta,\tau} - \eta_{w,\tau} < \frac{1}{\tau^{\sigma-1}+1} \qquad (1C.6)$$

Since $\tau > 1$, then $\frac{1}{\tau^{\sigma-1}+1} < 1$. Therefore, equations (1C.4) and (1C.6) together imply that:

$$\eta_{1+\beta,\tau} - \eta_{w,\tau} < \frac{1}{\tau^{\sigma-1}+1} \tag{1C.7}$$

Now, rewrite revenues $r_X(\varphi)$ as a function of φ_F^*, using expressions in (1B.2):

$$\frac{r_X(\varphi)}{r_F(\varphi_F^*)} = \left[\frac{\varphi}{\tau\varphi_F^*}\right]^{\sigma-1} \Leftrightarrow r_X(\varphi) = \left[\frac{\varphi}{\tau\varphi_F^*}\right]^{\sigma-1} r_F(\varphi_F^*) = QP^{\sigma}\varphi^{\sigma-1}\left[\frac{(1+\alpha)w}{\rho(1+\beta)\varphi_F^*}\right]^{\sigma-1} \tag{1C.8}$$

The derivative of (1C.8) with respect to τ is equal to:

$$\frac{\partial r_X(\varphi)}{\partial\tau} =$$

$$= (\sigma-1)QP^{\sigma}\varphi^{\sigma-1}\left[\frac{(1+\alpha w)}{\rho(1+\beta)\varphi_F^*}\right]^{\sigma-2}\left\{\frac{(1+\alpha)\left[(1+\beta)\frac{\partial w}{\partial\tau} - \frac{w(1+\beta)}{\varphi_F^*}\frac{\partial\varphi_F^*}{\partial\tau} - w\frac{\partial\beta}{\partial\tau}\right]}{(1+\beta)^2\varphi_F^*}\right\} \tag{1C.9}$$

and it is negative because of (1C.3). Thus, it has to be the case that:

$$(1+\beta)\frac{\partial w}{\partial\tau} - \frac{w(1+\beta)}{\varphi_F^*}\frac{\partial\varphi_F^*}{\partial\tau} - w\frac{\partial\beta}{\partial\tau} < 0 \Leftrightarrow \eta_{w,\tau} - \eta_{\varphi_F^*,\tau} - \eta_{1+\beta,\tau} < 0 \tag{1C.10}$$

Now, (1C.7) can be used to determine the possible signs of $\eta_{\varphi_F^*,\tau}$. Consider first the case when $\eta_{1+\beta,\tau} - \eta_{w,\tau} = 0$. Then it must be that $\eta_{\varphi_F^*,\tau} > 0$ for (1C.10) to hold. Therefore, when the elasticity of productivity in the formal sector with respect to τ is equal to the elasticity of wages, $\frac{\partial\varphi_F^*}{\partial\tau} > 0$ and more firms are induced to leave the informal sector. In this case, using (1B.8) it can be seen that the share of employment in the formal sector will increase.

Consider now the case when $\eta_{1+\beta,\tau} - \eta_{w,\tau} < 0$. This implies that $\eta_{\varphi_F^*,\tau} > 0$ and sufficiently large for (1C.10) to hold. Thus, when the elasticity of productivity in the formal sector with respect to τ is larger than the elasticity of wages (in absolute terms), $\frac{\partial\varphi_F^*}{\partial\tau} > 0$ and more firms are induced to leave the informal sector. In this case, (1B.8) implies that the share of employment in the formal sector will also increase.

Finally, consider the case in which $0 < \eta_{1+\beta,\tau} - \eta_{w,\tau} < \frac{1}{\tau^{\sigma-1}+1}$. For (1C.10) to hold, it is required that: (a) $\eta_{\varphi_F^*,\tau} \geq 0$ or (b) $0 > \eta_{\varphi_F^*,\tau} > \eta_{w,\tau} - \eta_{1+\beta,\tau} > -\frac{1}{\tau^{\sigma-1}+1}$. If (a) holds, then $\frac{\partial \varphi_F^*}{\partial \tau} \geq 0$ and the share of employment in the formal sector increases or stays the same after trade liberalization. On the other hand, if (b) holds, then the share of employment in the formal sector will decrease with reductions in τ.

Chapter 2. Informality and Taxes in Mexico

2.1. Introduction

In the recent theoretical literature, when modelling the informal sector it is generally assumed that there exists a direct relationship between the tax burden and regulations faced by firms and workers, and the likelihood of informal employment in the economy. For example, Boeri, T. and P. Garibaldi (2001) use a matching model where shadow employment emerges in equilibrium as the endogenous response of firms and workers who fell overburdened by taxes and regulations. Rauch, J. E. (1989) develops a model in which the decision of formality and informality is endogenously determined as a function of the minimum wage imposed by the government. Fortin, B., N. Marceau and L. Savard (1997) build a model with firm heterogeneity in which an increase in either corporate taxes, taxes on wages paid to the employees, or the minimum wage imposed by the government lead to a larger informal sector. Ihrig, J. and K. S. Moe (2001) develop a dynamic model that shows how tax rates and enforcement policies influence the size of the informal sector. Other models with similar implications can be found in Albrecht, J., L. Navarro and S. Vroman (2006), Azuma, Y. and H. I. Grossman (2002), Loayza, N. V. (1996), and Marcouiller, D. and L. Young (1995).

However, the related empirical literature available to date indicates that there is still mixed evidence on this issue[20]. For example, Cebula, R. J. (1997) examines the impact of federal income tax rates, IRS penalties on unpaid tax liabilities, and audit rates of the Internal Revenue Service on the size of the underground economy in the United States. He finds that the maximum marginal personal income tax rate raises the size of the underground economy, which is also a decreasing function of both the percentage of tax returns audited and the penalties imposed by the IRS on unpaid taxes. In contrast, Dabla-Norris, E., M. Gradstein and G. Inchauste (2005) analyze the determinants of informality on a cross-section of countries using data from the World Business Environment Survey (WBES) compiled by the World Bank. They find that the quality of the legal framework is crucially important in determining the size of the informal sector, whereas the significance of taxes, regulations, and financial constraints is

[20] A comprehensive review of empirical studies in this topic can be found in SCHNEIDER, F. (2004): "Shadow Economies around the World: What Do We Really Know?" *European Journal of Political Economy*, Vol. 21, pp. 598-642., and SCHNEIDER, F., and D. H. ENSTE (2000): "Shadow Economies: Size, Causes, and Consequences," *Journal of Economic Literature*, Vol. XXXVIII, pp. 77-114.

reduced in the context of a well functioning legal system. Other studies, such as Auriol, E. and M. Warlters (2004), Friedman, E., S. Johnson, D. Kaufmann and P. Zoido-Lobaton (2000), and Straub, S. (2005) find that the size of the informal sector also depends on other factors, like the fixed costs of entry to the formal economy, the burden of bureaucracy and corruption from the authorities, or the financial development of the economy. Finally, the literature on the elasticity of the income tax base also provides some indirect evidence. Gruber, J. and J. Rauh (2005) study the relationship between corporate taxable income and the corporate tax rate. They find strong evidence that the corporate tax base is elastic with respect to the marginal effective tax rate, but that this elasticity is fairly small compared to the one normally found for individual income taxation. Other related contributions are Gruber, J. and E. Saez (2002), and Cowell, F. A. and J. P. F. Gordon (1988).

Thus, in order to shed more light on the nature of the relationship between taxes and the informal sector, this chapter contributes to the existing literature by studying the effect of two controversial tax policies that took place in Mexico between 1989 and 2002. The first one is the introduction of a 2% asset tax, which affected both firms and individuals with entrepreneurial activities in all sectors of the economy, apart from the financial sector. Its objective was to protect the fiscal revenue from two important sources of distortion: the 2-digit inflation rates experienced in Mexico during the 1980s, and which severely affected the income tax base; and the frequent manipulation of transfer prices by firms with subsidiaries, particularly the multinational companies. The asset tax became effectively a minimum tax for firms and individuals that attempted to evade taxes by declaring lower profits or even net losses, but on the other hand it also represented an important disincentive for foreign investment. Its fairness and efficiency have been the subject of an intense debate since its introduction in 1989. A recent example of this came in January 2007, when the Asset Tax Law was modified in order to eliminate the possibility of deducting any kind of debt from the calculation of its tax base, which some analysts estimate will increase by approximately 400%[21]. This new scenario has generated a wave of appeals for legal protection against the reform, particularly from multinational firms in the Automobiles industries[22].

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[21] According to *El Economista* –a renowned Mexican business newspaper, Price Waterhouse Coopers has estimated that the companies with assets that are insufficient to generate at least a 4.4% profit margin are the ones that are going to be more severely affected by the reform. Approximately 4.8% out of the 4,007,000 small and medium sized formal firms in the country are in this situation, and these firms represent 5.2% of the Mexican GDP.

[22] See for example the article "Comienzan amparos contra impuesto al activo" by Susana Gonzalez G., in the Mexican newspaper *La Jornada*, www.jornada.unam.mx, on the 18th of January, 2007.

The second policy is the elimination of the optional accelerated depreciation (OAD) scheme during the years 1999 to 2001, which affected firms that had investments in regions other than the three main metropolitan areas in Mexico (i.e., Mexico City, Guadalajara, and Monterrey). For many years, the OAD represented an effective system used by the federal government to promote decentralization through the stimulation of investment and the creation of formal employment. The 1999-2001 reforms were essentially changes in the real discount rate allowed by the government to calculate the present value of depreciation allowances. Originally aimed at overcoming a shortfall in government revenue caused by low international oil prices, the elimination of the OAD scheme in 1999 generated a significant increase in the cost of investment undertaken by firms outside the above mentioned cities. Verdugo, A. R. (2006) estimates the elasticity of business investment with respect to this policy at -2.0 approximately, a very large figure compared to the -0.7 consensus value for the U.S. case. Furthermore, he shows that in industries such as the Automobile Parts the user cost of capital -or the firm's "subjective" value of a unit of capital in units of contemporaneous output- increased drammatically by almost 40%.

Using an industry model with heterogeneous firms to study the possible implications of these tax reforms for the labour markets, it is predicted that both the introduction of an asset tax and the elimination of the optional accelerated depreciation scheme would be expected to raise the rate of informality in the steady state. Intuitively, regarding the asset tax, its implementation raised unambiguously the fiscal burden faced by the formal sector, and this would be expected to make less attractive for firms to step out of informality. On the other hand, the elimination of the OAD scheme translated into a higher cost of investment outside the three main cities in the country, and the expected consequence of this would be that it makes relatively more difficult for firms in this region to generate formal employment. In order to measure these effects empirically, the 1987-2002 Mexican National Survey of Urban Labour (ENEU) dataset is used to obtain estimates of the unregistration rate (i.e., the fraction of workers without any social security or health coverage) for each 4-digit industry in each city included in the sample at each point in time. As discussed in the previous chapter, unregistration is just one side of informality, and even though this implies limitations to the validity of the results, it is an effective reduced-form measure of informality that can be easily obtained from employee data collected through a household survey. These estimates are then used as the dependent variable in a differences-in-differences approach to exploit the cross-sectional variation in the effect that the tax reforms had on different sectors

and regions of the Mexican economy. In addition, for the case of the elimination of the optional accelerated depreciation scheme, the derivation in Jorgenson, D. W. (1963) is followed to see how this tax reform would have also translated into an increase in the user cost of capital, and therefore that a positive relationship between this variable and the rate of unregistration should exist. This hypothesis is tested directly, using individual level data from the April-June ENEU interviews together with the 1994-2002 Mexican Annual Industrial Survey (EIA) database, which allows constructing an estimate of the user cost of capital for each 4-digit industry by region (i.e., the three main metropolitan areas and elsewhere in the country) and by year. The econometric analysis suggests that the positive relationship between taxes and informality generally assumed in the theoretical literature not always holds, and that whenever it does the response of the likelihood of informal employment to changes in the level of taxes is rather heterogeneous, depending both on the particular economic sector and the nature of the tax policy in question. For the case of the asset taxation, the differences-in-differences estimates indicate no significant or robust effect on the unregistration rate, even when it is allowed to differ across the nonfinancial sectors, relative to the financial one (which is the control group). On the other hand, for the case of the elimination of the optional accelerated depreciation scheme, the differences-in-differences estimation yields significant effects on unregistration in some of the manufacturing industries. In particular, it is obtained that this policy translated into an average increase of 4 percentage points in unregistration for the *Food, beverages & tobacco* and the *Other manufacturing* industries. Finally, even though ordinary least squares estimation suggests that there exists a positive relationship between the user cost of capital and unregistration, instrumental variables estimation indicate that the variation in the former due to the elimination of the OAD scheme does not affect unregistration in a significant way.

The rest of the chapter is organized as follows. Section 2.2 provides a brief description of the Mexican corporate tax system and the above mentioned tax reforms. Section 2.3 develops the theoretical model used in studying their possible implications for informality. Section 2.4 gives a description of the main trends in unregistration across sectors and regions, during the periods of interest. Section 2.5 conducts the formal econometric analysis. Section 2.6 concludes.

2.2. The Mexican Corporate Tax System and the Tax Reforms

This section briefly describes the relevant aspects of the Mexican corporate tax system and the two tax reforms analysed in this chapter. The first one is the introduction of a 2% asset tax in 1989, which affected both firms and individuals with entrepreneurial activities in all sectors of the economy, apart from the financial sector. The second is the elimination of the optional accelerated depreciation scheme for the years 1999 to 2001, and which affected firms that had investments in regions other than the three main metropolitan areas in Mexico.

2.2.1. The Mexican corporate tax system

According to the Mexico 2000 Business Directory, the Mexican tax system has been subjected to comprehensive tax reform legislation during the last 25 years, in an attempt to make it continuously compatible with the tax systems of Mexico's most important trading and investment partners, such as the United States. The Mexican tax system divides tax payers into four groups: resident corporations and other associations taxable as corporations; resident individuals; non-resident corporations and individuals; and non-profit organizations. The principal taxes payable by individuals and corporations operating in Mexico are those levied by the federal government. State and municipal governments have more limitations and are not authorized to levy general corporate income taxes. The main taxes at the federal level are the income tax, the asset tax, the value-added tax, the special tax on production and services (STPS), the import and export taxes, and the payroll taxes. On the other hand, the main taxes at the local level are the tax on real property, the tax on salaries (payable by the employer), and the tax on acquisition of real property. The federal corporate income tax rate is 35%, and the personal income tax rate is progressive with a maximum rate of 35%. There is full integration of the personal and corporate tax systems in Mexico: once a corporation has paid its income tax, after-tax earnings may be distributed to the shareholders without any further tax. The asset tax is payable at the rate of 2% of the value of the assets of corporations. It is a minimum tax in the sense that it is only payable if it exceeds the regular corporate income tax due. Also, the Mexican Constitution mandates firms to distribute 10% of pre-tax income to workers and employees each fiscal year. This profit-sharing scheme increases the burden of corporate taxation. Regarding the payroll taxes, the Federal Labour Law requires corporations to make social security and other

labour related contributions, such as those made to the National Worker's Housing Institute or the Premium for Occupational Risks; which all together can amount to up to 35% of the payroll. Social security contributions must be withheld and paid by an employer and remitted to the Mexican Institute for Social Security every month. Additionally, employers are required to contribute to their employees' social security. Both contributions are based on a percentage of the employees' wages, and as with the corporate taxes described above, they also increase the tax burden on firms.

2.2.2. The asset tax reform

According to Garcia-Verdu, R. (1996), asset taxation was introduced in Mexico as a response to the decline in tax collection due to two main factors. The first one was the high inflation rates experienced by the country during the 1980's, which affected the tax base by distorting the measurement of benefits, interest payments, and the returns to capital of the firms (see for example, Feldstein, M. (1982)). The second factor was the manipulation of the prices that multinational firms set internally to carry out transactions between their different units (i.e. between the headquarters and the subsidiaries). These prices are known as transfer prices, and they are frequently used by transnational enterprises to reduce their overall fiscal burden.

Because of this reduction in fiscal revenues, the Mexican Congress passed the Asset Tax Law (Ley del Impuesto al Activo de las Empresas) on the 30th of December 1988, which came into effect on January 1st, 1989[23]. This law established a 2% tax on the average value of assets owned by firms and individuals with any entrepreneurial activity. The financial sector was exempted from this tax because the government concluded that it already had appropriate mechanisms to control taxpayers in these activities; and also because applying an asset tax to this sector would translate into double taxation, as the assets of the financial sector are at the same time means of production for the rest of the economy.

The asset tax became effectively a minimum tax for firms and individuals that attempted to evade taxes by reporting losses through the manipulation of transfer prices. Even though most of the economic agents thought of it as a measure against informality, it is important to stress that the introduction of this tax raised the burden on firms that were using legal methods to pay low taxes, and not to raise revenue from those who

[23] The Asset Tax Law was originally published in the Official Journal of the Federation (Diario Oficial de la Federacion), and was lastly modified on the 1st of December, 2004. The text can be found in the website of the Mexican Congress, at http://www.diputados.gob.mx/LeyesBiblio/pdf/76.pdf.

were illegally avoiding them (i.e., informal firms). The asset tax is complementary to the income tax, in the sense that firms and individuals reporting benefits can deduct the latter from the payment of the former. Finally, in order to avoid taxation of unproductive assets, it was not required to pay this tax during the first four years of business.

2.2.3. The reforms to the Optional Accelerated Depreciation (OAD) scheme

The second reform considered in this analysis is the one corresponding to the changes in the Mexican depreciation rules. As described in Verdugo, A. R. (2006), depreciation allowances in Mexico are based on a straight-line method of deductions for fixed assets. The specific percentage deduction for each asset is specified in the Income Tax Law (Ley del ISR). For machinery and equipment, this percentage also depends on the industry in which it is used. By 1994, depreciation rules also included the option to immediately expense the present discounted value of future depreciation allowances using a fixed real discount rate of 5%. This Optional Accelerated Depreciation (OAD) scheme was only applicable to investment expenditures undertaken outside the three main metropolitan areas of the country (i.e. Mexico City, Guadalajara and Monterrey), and for many years this system was used by the government to promote decentralization.

In the aftermath of the 1995 financial crisis, the Mexican government approved some measures designed to boost economic activity, growth and investment. These measures included a decrease in the discount rate to calculate the OAD rate from 5% to 3%, which increased considerably the value of depreciation allowances. By the end of 1998, the federal government presented to the Congress a series of reforms designed to increase government revenue collections. The approved law included the elimination of the OAD system, which was replaced with a system of differential taxation of retained earnings over distributed earnings.

During 2001, the federal government promoted the discussion of a fundamental tax reform. The discussion included the academia, tax advisors, corporations, and the government. At the end, failures in the political negotiations at the Congress resulted in a new tax law that was far from a fundamental reform. The OAD system was reinstalled with a discount rate of 6% while the preferential treatment of retained earnings was abandoned. The OAD immediate expense in the approved system, however, was not allowed to be made in the year of acquisition, but until the next one. The government

noticed that the system of OAD was considerably less effective than the one in effect in 1998, both because of the high discount rate and because of the deferral rule. For this reason, the Income Tax Law was further modified in 2003, decreasing the discount rate to 3% and allowing the immediate expense to be done partially (one third) in the year of acquisition, and the rest (two thirds) in the following year. Finally, for the fiscal year 2004 the deferral rule was two thirds in the first year and one third in the second, and for fiscal year 2005 and beyond, it was possible to expense the full present discounted value in the same year of acquisition.

2.3. A Model of Taxes and Informality

This section develops an industry model with heterogeneous firms to study the possible implications of the aforementioned tax reforms on informality. The model can be related to the Melitz, M. J. (2003) model and the Ramsey model with adjustment costs for investment (see for example Barro, R. J. and X. Sala-i-Martin (2004), pp. 152-160). To begin, assume that the preferences of the representative consumer are defined over a continuum of goods, and that there is a continuum of firms in a particular industry. Also, assume that the production function in both the formal and the informal sector is Cobb-Douglas with decreasing returns to scale:

$$\begin{aligned} F_I(L,K) &= \varphi L^{\alpha} K^{\beta} \\ F_F(L,K) &= \varphi(1+\lambda) L^{\alpha} K^{\beta} \end{aligned} \tag{2.1}$$

where the subscripts I and F refer to the informal and the formal sector, respectively, $\alpha+\beta<1$, φ is a firm-specific productivity parameter drawn from a common distribution before entering the industry, and $(1+\lambda)$ reflects the fact that firms in the formal sector are in general more productive than firms in the informal sector[24]. Each firm owns its stock of capital, which changes according to the following accumulation process equation:

$$\dot{K} = I - \delta K \tag{2.2}$$

[24] An example of this could be that, unlike firms in the informal sector, firms in the formal sector do not need to hide from the authorities and therefore can get involve in trade more easily, which could translate into a wider access to better technologies, intermediate goods, and raw materials.

where I is gross investment and δ is the economic depreciation rate. The cost of investment in each sector is given by:

$$C_I = I + \gamma \frac{I^2}{K}$$
$$C_F = I + \sigma \frac{I^2}{K} \tag{2.3}$$

where $\gamma > 0$ and $\sigma > 0$ are the adjustment costs in the informal and the formal sector, respectively, and it may be the case that $\gamma < \sigma$ due to governmental regulations in the formal sector (such as the implementation or the elimination of the OAD scheme). Firms in the informal sector pay the real competitive wage rate w to their employees, while firms in the formal sector pay taxes and worker benefits over wages, $w(1+b)$. For a partition of firms between the formal and informal sectors to exist in equilibrium, it is assumed that $\lambda > b$, so that the higher productivity in the formal sector more than compensates for the higher marginal cost of labour. Also, every period there is a fixed cost associated with production in each sector f_I and f_F, where $f_I < f_F$ as firms in the formal sector have to deal with registrations, corruption, and bureaucracy from the authorities. Furthermore, firms in the formal sector have to pay taxes on corporate profits. For every period in which a given firm reports net gains, it pays a fraction τ_c of them to the government. On the other hand, no tax is paid for the periods in which the firm reports net losses. Let ρ represent the exogenous probability of a bad economic shock leading the firm to incur in net losses. The expected value of after-tax corporate profits π in any period is then equal to:

$$\begin{aligned} E(\pi) &= (1-\rho)(1-\tau_c)\left[\varphi(1+\lambda)L^\alpha K^\beta - w(1+\mathrm{b})L\right] + \rho\left[\varphi(1+\lambda)L^\alpha K^\beta - w(1+\mathrm{b})L\right] \\ &= \left[(1-\rho)(1-\tau_c)+\rho\right]\left[\varphi(1+\lambda)L^\alpha K^\beta - w(1+\mathrm{b})L\right] \\ &= \theta\left[\varphi(1+\lambda)L^\alpha K^\beta - w(1+\mathrm{b})L\right] \end{aligned} \tag{2.4}$$

where $\theta = (1-\rho)(1-\tau_c)+\rho$. Under these considerations, a firm's net cash flow is then given by:

$$NCF_I = \varphi L^\alpha K^\beta - wL - I - \gamma \frac{I^2}{K} - f_I$$
$$NCF_F = \theta\left[\varphi(1+\lambda)L^\alpha K^\beta - w(1+b)L\right] - I - \sigma \frac{I^2}{K} - f_F \tag{2.5}$$

Thus, assuming a constant interest rate between times 0 and t, the firm's objective is to choose L and I at each date in order to maximize its present discounted value:

$$V_i = \int_0^{\infty} e^{-rt} \cdot NCF_i(t)dt \tag{2.6}$$

subject to equation (2.2) and an initial value of capital K_0. At the margin, the decision of a firm of whether to become informal or formal will be based on the comparison of the expected present discounted values of these maximized net cash flows, V_i^e. Given that firms in the informal sector evade taxes, every period they face a positive probability $0 < \varepsilon < 1$ of being caught by the government. Assume that if this happens, the government forces them to close down. Thus, a firm will be indifferent to becoming formal whenever $V_F^e - V_I^e = 0$, or equivalently:

$$\int_0^{\infty} e^{-rt} NCF_F(t)dt - \int_0^{\infty} e^{-rt}(1-\varepsilon)NCF_I(t)dt = 0 \tag{2.7}$$

Solving this last expression for φ, it is possible to obtain a cut-off productivity parameter for formality as a function of all the other parameters in the model (see appendix 2A.1): $\varphi^* = \varphi(\alpha, \beta, w, b, \lambda, r, \sigma, \gamma, \delta, \theta, f_I, f_F)$. Any firm drawing a productivity parameter $\varphi > \varphi^*$ will choose to produce in the formal sector.

2.3.1. The effect of asset taxation on informality

As discussed in the previous section, the asset tax can be interpreted as a minimum tax for firms in the formal sector. In terms of the model described here, its introduction requires the modification of equation (2.4). Let τ_a be the asset tax rate. As before, for any given period a firm reporting net gains will pay $\tau_c \pi$ to the government as corporate income tax. If instead the firm suffers net losses, the firm will now be required to pay $\tau_a K$. Thus, the new expected value of after-tax corporate profits for any firm in the formal sector is given by:

$$E(\pi) = \theta\left[\varphi(1+\lambda)L^{\alpha}K^{\beta} - w(1+b)L\right] - \rho\tau_a K \tag{2.8}$$

Hence, the introduction of the asset tax translates into an increase in the expected taxes on corporate profits. Given that $\frac{\partial \varphi^*}{\partial \tau_a} > 0$ (see appendix 2A.2), this reform will be expected to generate an increase in the cut-off productivity level for formality, inducing less firms to exit the informal sector.

2.3.2. The effect of the OAD reforms on informality

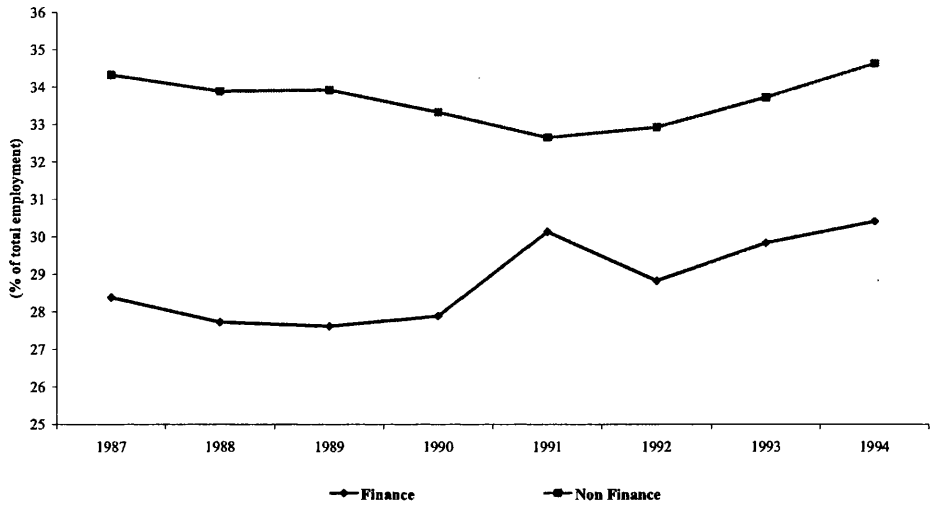
As discussed in Verdugo, A. R. (2006), the reforms to the depreciation rules conducted by the Mexican government in the 1990's are essentially changes in the real discount rate allowed by the government to calculate the present value of depreciation allowances. Following the well known derivation in Jorgenson, D. W. (1963), the user cost of capital (COC) can be shown to be a decreasing function of this present value[25]. Eliminating the OAD scheme translates into an increase in the real discount rate of depreciation allowances, and consequently into a reduction of their present value, followed by an increase in the COC. In the present context, such policies are captured by changes in the parameters σ and γ. Thus, given that the informal sector does not comply with governmental regulations, the effect of the OAD reforms in our model can be summarized as an increase in σ only. As shown in appendix 2A.3, $\frac{\partial \varphi^*}{\partial \sigma} > 0$, implying that an increase in the real discount rate of depreciation allowances in the formal sector due to the elimination of the OAD scheme generates an increase in the cut-off productivity for formality, inducing less firms to exit the informal sector.

2.4. Main Trends in Unregistration

The model developed in the previous section, together with the nature of the tax reforms exposed in section 2.2, implies that the effect of introducing an asset tax in Mexico at the end of the 1980's would have generated an increase in the rate of informality in all industries, compared to the financial sector. On the other hand, the model also suggests that the governmental decision of eliminating the OAD scheme during the years 1999 to 2001 would have contributed to an increase in the rate of informality for all the regions

[25] The user cost of capital is the firm's subjective value of a unit of capital in units of output. In terms of the Ramsey model with adjustment costs for investment, it corresponds to the current-value shadow price of installed capital in units of contemporaneous output. See Barro, J. R. and X. Sala-i-Martin (2004), p. 153 for more detail.

Figure 2.1. Annual Unregistration Rate in the Financial and Non Financial Sectors 1987-1994



other than the three main metropolitan areas of the country. It is important to note that these predictions refer to the effects of the tax policies on the steady state level of informality, and that a different relationship between the policies and the level of social security registration may arise during the transition towards the new equilibrium, given that registration is just one of the many sides of informality. In order to study these effects empirically, the Mexican National Survey of Urban Labour (ENEU) dataset is used to obtain an estimate of the unregistration rate for each 4-digit industry in each city at each point in time[26]. The ENEU survey is conducted by the National Institute of Statistics, Geography and Computing (INEGI) since 1983. It provides information about the state of the Mexican labour market, the main socio demographic characteristics of the household members aged 12 and above, and housing in the principal urban areas of the country. It is carried out on a quarterly basis. From 1983 to 1984 the ENEU survey covered only the three main cities in Mexico (Mexico City, Guadalajara and Monterrey). Between 1985 and 1991 its geographical coverage was expanded to 16 cities, within which the main cities at the Mexico-U.S. border were included (Ciudad Juarez, Matamoros, Nuevo Laredo and Tijuana). Between 1992 and 2000 another 32 cities were gradually incorporated to the sample. For the analysis of the asset taxation the 1987-1994 datasets are used, and for the analysis of the OAD reforms the 1994-2002 files are used. Also, for the latter case attention is restricted to the

[26] Following the definition used in ALEMAN-CASTILLA, B. (2006): "The Effect of Trade Liberalization on Informality and Wages: Evidence from Mexico," *CEP Discussion Papers*, No. 763, pp. 1-68., a person is classified as working in the unregistered sector if he or she runs a firm of 6 or less employees and does not have any kind of social or health insurance (unregistered self-employed), if he or she works for a firm of any size and does not have any kind of social or health insurance (unregistered salaried), and if he or she works without receiving any kind of payment (unpaid workers).

manufacturing industries, as part of the analysis developed later in this chapter will rely on information obtained from the Annual Industrial Survey (described below), a data source exclusive to this economic sector.

Looking first at the evolution of unregistration over time, and starting with the asset taxation case, figure 2.1 plots the annual unregistration rates in the financial and non financial sectors for the 1987-1994 period. The difference between both series remains basically constant during the first three years, it then decreases slightly during 1990, and it diminishes significantly in 1991 due to a marked increase in the unregistration rate of the "non treated" financial sector. This latter effect may be mainly related to the privatization process of the Mexican banks, conducted by the federal government between 1991 and 1992[27]. The graph apparently suggests that the introduction of the tax in 1989 may not have had an important effect on unregistration. At a higher level of disaggregation, the graphs in figure 2.2 plot the difference in rates of unregistration between the financial sector and each one of the non financial sectors separately. A negative differential indicates that the rate of unregistration was higher in the financial sector than in the corresponding non financial one. The graphs show a temporary increase in unregistration for the *Farms, forestry & fishing*; *Mining*; *Hotels, restaurants & trade*; and *Services* sectors, relative to the financial sector between 1988 and 1990, and which could be related to the introduction of the asset tax. However, most of the sectors show a decline in unregistration relative to the financial sector after 1991, indicating that other more important factors (such as the privatization of the banking system) are taking place during the same period and that they could be affecting the social security payment decisions of the economic agents in a more strong way.

In order to get an idea of the relevance of the asset tax from the authorities' point of view, table 2.1 presents some statistics on the Mexican fiscal revenue decomposed by the most important taxes. The data comes from the Secretariat of Finance, which is the most reliable and complete source for this kind of information. However, it has two disadvantages: first, there is no public data for the years before 1990; and second, there is no specific disaggregation for the asset tax, which is included in the *Other taxes*

[27] In 1982, as a response to the financial crisis that affected the country, the administration of President Jose Lopez Portillo decided to nationalize all the Mexican banking system. The financial sector remained under absolute control by the government until 1991, when the administration of President Carlos Salinas de Gortari decided to return the control of the banks to private investors, in order to achieve a higher level of efficiency in the Mexican economy. For more detail, see MURILLO, J. A. (2002): "La Banca En Mexico: Privatizacion, Crisis Y Reordenamiento," Direccion de Estudios Economicos de Banco de Mexico, pp. 1-55.

Figure 2.2. Unregistration Differentials between the Financial and Non Financial Sectors

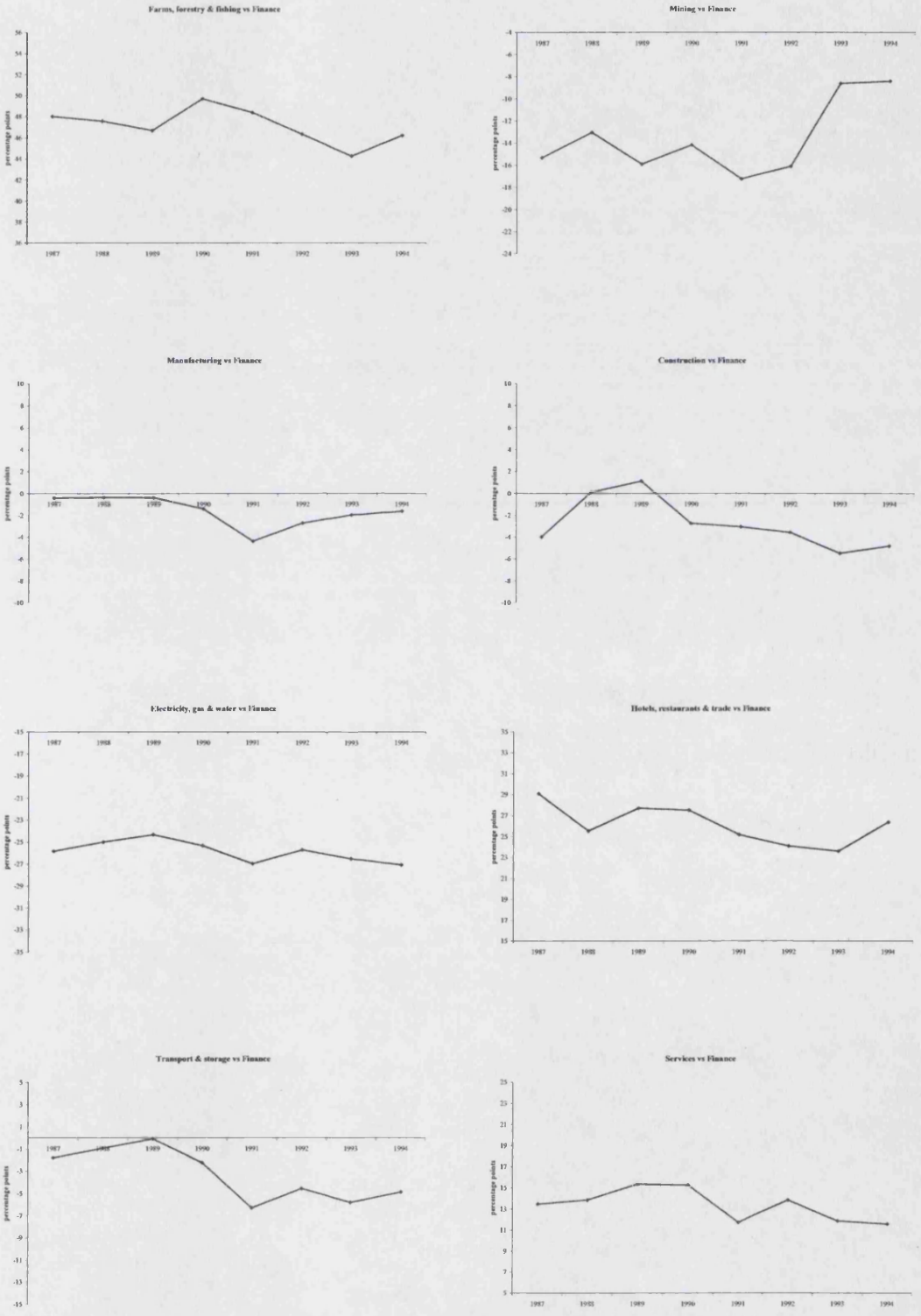


Table 2.1. Mexico's Total Fiscal Revenue by Main Taxes, 1990-2002 (Millions of current USD)

	Total	Income Tax	% of Total	VAT	% of Total	IEPS	% of Total	Imports	% of Total	Other Taxes (including asset tax)	% of Total
1990	26,388	10,979	42%	8,869	34%	3,730	14%	2,125	8%	686	3%
1991	33,089	13,995	42%	10,591	32%	4,138	13%	3,228	10%	1,137	3%
1992	40,689	18,599	46%	9,775	24%	5,839	14%	4,136	10%	2,341	6%
1993	46,072	22,278	48%	10,661	23%	6,217	13%	4,082	9%	2,835	6%
1994	39,023	17,745	45%	9,380	24%	6,802	17%	3,093	8%	2,003	5%
1995	22,199	9,607	43%	6,750	30%	3,221	15%	1,453	7%	1,168	5%
1996	28,731	12,352	43%	9,167	32%	3,775	13%	1,888	7%	1,549	5%
1997	38,428	16,634	43%	12,034	31%	5,584	15%	2,229	6%	1,948	5%
1998	40,846	17,125	42%	12,113	30%	7,740	19%	2,171	5%	1,697	4%
1999	55,322	22,919	41%	16,032	29%	11,315	20%	2,895	5%	2,160	4%
2000	61,473	27,344	44%	20,037	33%	8,617	14%	3,473	6%	2,001	3%
2001	71,488	31,169	44%	22,751	32%	12,083	17%	3,155	4%	2,330	3%
2002	71,187	31,120	44%	21,352	30%	13,319	19%	2,662	4%	2,553	4%
Total	574,934	251,866	44%	169,511	29%	92,380	16%	36,590	6%	24,407	4%
Average	44,226	19,374	44%	13,039	29%	7,106	16%	2,815	6%	1,877	4%
Maximum	71,488	31,169	44%	22,751	32%	13,319	19%	4,136	6%	2,835	4%
Minimum	22,199	9,607	43%	6,750	30%	3,221	15%	1,453	7%	686	3%

Source: Subsecretaria de Hacienda y Credito Publico, Direccion General de Planeacion Hacendaria. Consulta de Series y Datos Historicos (1990-2007) VAT stands for Value Added Tax, and IEPS stands for Special Tax on Production and Services

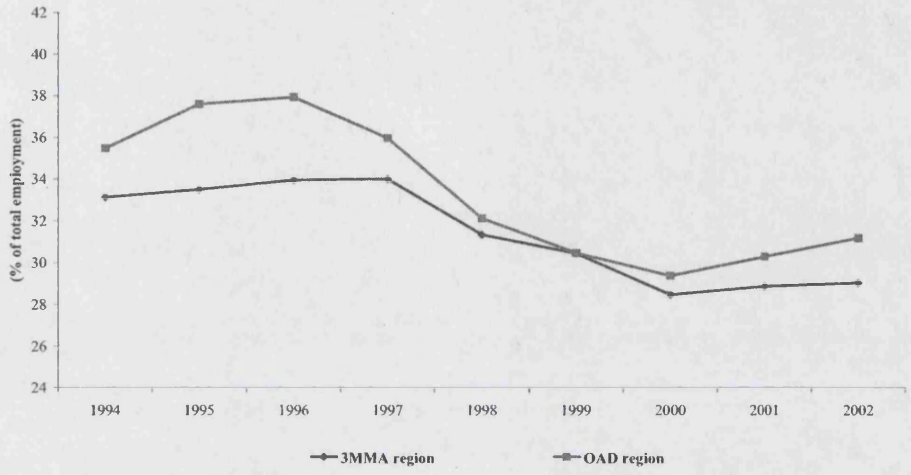
category. Nevertheless, the fact that the aforementioned category represented about 4% of total fiscal revenue between 1990 and 2002, indicates that asset taxation is not a very important component of fiscal revenue[28].

On the other hand, regarding the elimination of the OAD scheme, figure 2.3 shows the annual unregistration rates in the three main metropolitan areas (3MMA region) and the rest of the country (OAD region) for the 1994-2002 period. It can be seen that the response of unregistration to the 1994-1995 financial crisis was more severe in the latter region. The elimination of the optional accelerated depreciation scheme in 1999 does not seem to have an immediate effect on the negative trend of unregistration in the OAD region; but looking at the year 2000, the policy may not be allowing it to decrease as much as in the 3MMA region either.

Finally, figure 2.4 plots the differences in unregistration rates between the OAD and the 3MMA regions, for each manufacturing industry separately. Apart from the *Textiles, apparel & leather* and the *Other manufacturing* cases, none of the graphs seems to contain clear evidence of an effect of the elimination of the OAD scheme on unregistration. However, there is a clear temporary shock in some of these figures in the year 2000, which could be indicative of a heterogeneous response of unregistration to the fiscal policies across sectors. But also, given that this effect is only present in one year, it could very well be a consequence of different factors.

[28] TRILLO, F. H., A. ZAMUDIO, and J. P. G. AMPARAN (2000): "Los Impuestos En Mexico: Quien Los Paga Y Como?" Programa de Presupuesto y Gasto Publico, CIDE, pp. 1-18. suggest that the share of asset tax on total fiscal revenue was approximately 2% in 1998.

Figure 2.3. Annual Unregistration Rate in the 3MMA and OAD regions, 1994-2002
(manufacturing industries only)



Thus, the trends presented in this section suggest that there is no evident and homogeneous response of unregistration to either of the tax policies across sectors and regions. The next section carries out the estimation of formal econometric models in order to obtain more precise results regarding these possible relationships.

2.5. Econometric Analysis

This section proceeds to the formal empirical estimation of the effect of these two tax reforms on unregistration. To do this we first use a differences-in-differences approach, and later on for the case of the OAD reform, the estimation of a more sophisticated model that allows exploiting the variation at the 4-digit industry level introduced by the referred policy on the user cost of capital is also attempted.

2.5.1. Differences-in-differences approach

Let us begin by looking at the effect of the introduction of the asset tax in 1989. In order to avoid picking up the effect that the privatization of the banking system may have had on unregistration, the analysis here will be focused to the 1987-1990 period. The variation across sectors introduced by this tax is exploited in order to estimate the following equation:

$$\phi_{ict} = \alpha_i + \beta_1 Tax_{ict}^{period} + \beta_2 Tax_{ict}^{sector} + \beta_3 \left(Tax_{ict}^{period} \times Tax_{ict}^{sector} \right) + \eta_t + \varepsilon_{ict} \qquad (2.9)$$

Figure 2.4. Unregistration Differentials between the OAD and 3MMA Regions by Industry

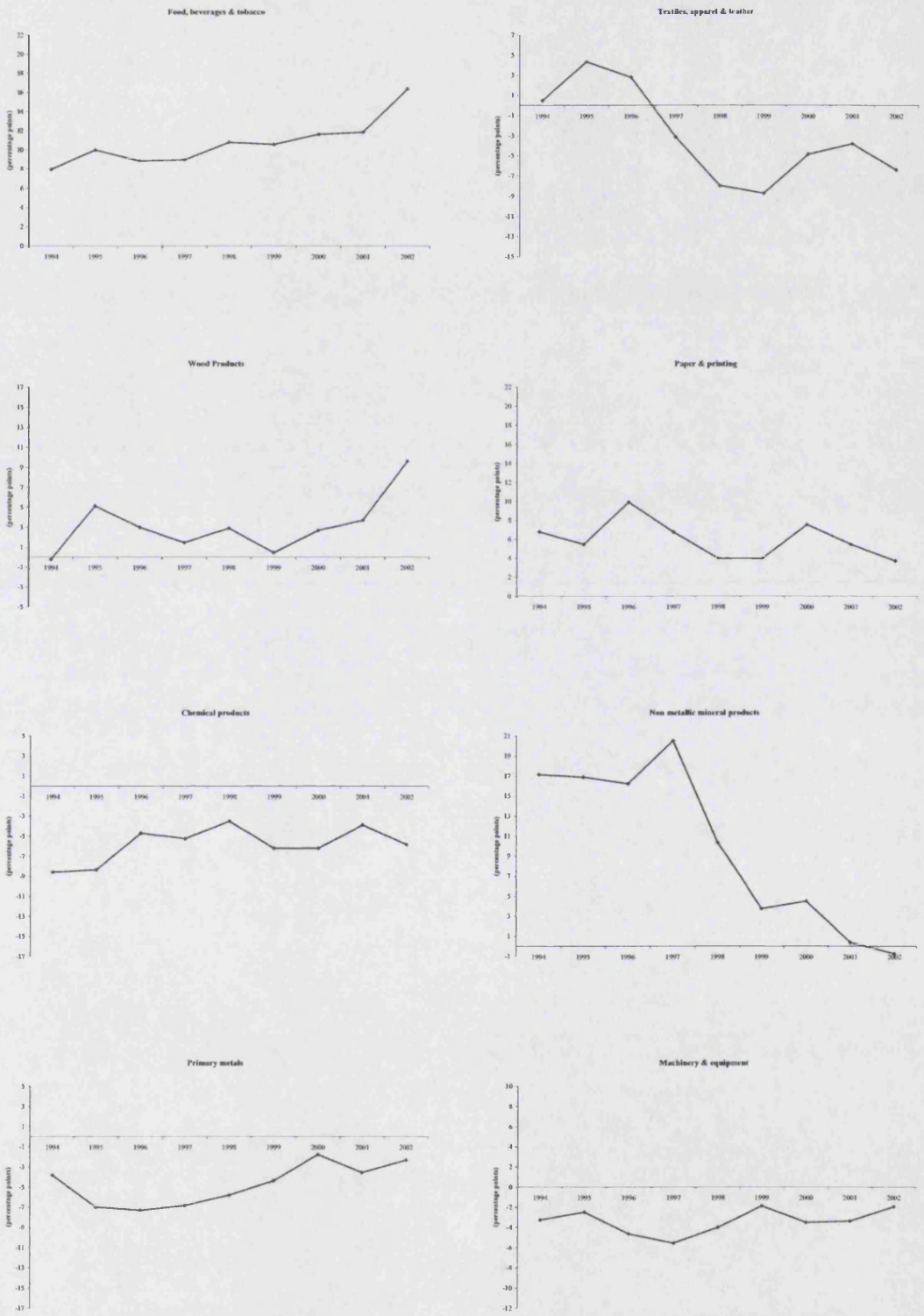
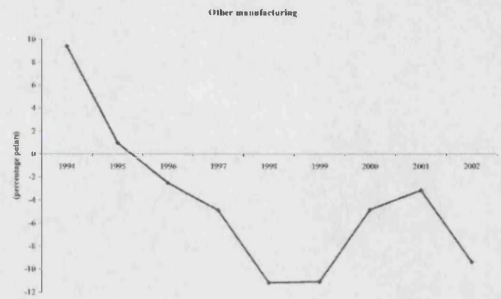


Figure 2.4 (continued)



where ϕ_{ict} is the unregistration rate of industry i in city c at time t; α_i is a set of 4-digit industry dummies; Tax_{ict}^{period} is a dummy variable equal to 0 for all quarters between 1987 and 1988, and is equal to 1 for all quarters between 1989 and 1990; Tax_{ict}^{sector} is a dummy variable equal to 0 for all the industries in the financial sector and equal to 1 otherwise; η_t is a set of quarter dummies; and ε_{ict} is the error term. Equation (2.9) is fitted using ordinary least squares, and robust standard errors clustered at the city level are calculated. The results are reported in table 2.2. Column 1 presents the basic estimation of the equation. There is no significant effect of the introduction of the asset tax on unregistration. In column 2 the Tax_{ict}^{period} dummy is substituted for a group of quarter dummies; and column 3 further adds city dummies and some labour force controls (i.e., means at the industry-city level of years of experience, years of schooling, fraction of married workers, fraction of males in the industry, and fraction of heads of households). Nevertheless, the insignificance of the effect of the tax policy on unregistration remains unchanged.

We then explore the possibility of a heterogeneous response of unregistration to the introduction of the asset tax by allowing the coefficients $\beta_1, \beta_2,$ and β_3 to differ across all the non financial sectors. This is done by interacting the Tax_{ict}^{period}, Tax_{ict}^{sector}, and $\left(Tax_{ict}^{period} \times Tax_{ict}^{sector}\right)$ variables in equation (2.9) with a set of dummy variables for the sectors listed in figure 2.2. The main results are reported in table 2.3, and the *Manufacturing* sector is left as the reference category. There are now some significant and opposite-signed effects for some of the sectors, which may provide some weak evidence of heterogeneity. However none of these results is robust to all the three specifications reported in the table.

Table 2.2. Differences-in-Differences Estimates for the Effect of Asset Taxation on Unregistration

	(1)	(2)	(3)
Tax^{period}	0.004		
	[0.016]		
Tax^{sector}	0.763 ***	0.763 ***	0.637 ***
	[0.030]	[0.030]	[0.030]
$Tax^{period} \times Tax^{sector}$	-0.003	-0.003	-0.006
	[0.015]	[0.015]	[0.015]
Constant	0.104 ***	0.093 ***	0.181 ***
	[0.026]	[0.032]	[0.033]
No. Observations	46,751	46,751	46,742
R-squared	0.472	0.473	0.499
Labour force controls & city dummies	NO	NO	YES
Quarter FE	NO	YES	YES
Industry FE	YES	YES	YES

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Robust standard errors clustered at the city level are shown in brackets. Labour force controls include means at the industry-city level of years of experience, schooling, fraction of married workers, fraction of males, and fraction of heads of households.

Next, a similar differences-in-differences analysis is done for the effect of the OAD scheme on unregistration in the manufacturing sector. The basic econometric specification is given by the following equation:

$$\phi_{ict} = \alpha_i + \beta_1 OAD_{ict}^{period} + \beta_2 OAD_{ict}^{region} + \beta_3 \left(OAD_{ict}^{period} \times OAD_{ict}^{region} \right) + \eta_t + \varepsilon_{ict} \qquad (2.10)$$

in which OAD_{ict}^{period} is a dummy variable equal to 1 for all quarters in the years 1994 to 1998, and 2002 (i.e., for the period in which the OAD scheme applied); OAD_{ict}^{region} is a dummy variable equal to 1 for all cities other than the three main metropolitan areas of Mexico City, Guadalajara, and Monterrey (i.e., the region in which the OAD scheme applied); and the rest of the variables are as defined for the previous case. Equation (2.10) is also estimated using ordinary least squares and the estimated standard errors are again clustered at the city level. The results are reported in table 2.4. There is no evidence of a significant effect of the optional accelerated depreciation scheme on overall unregistration, and the results are the same regardless of the inclusion of quarter dummies (column 2) or city dummies and labour force controls (column 3)[29].

[29] One possibility for the insignificance of the difference-in-difference estimates in this case is that, as shown in figure 2.3, the unregistration rates for the 3MMA and the OAD regions seem to follow somewhat different trends before the treatment in 1999 (mainly due to a stronger impact of the 1995 crisis in the latter region). In order to account for this, the model was also estimated (a) excluding the 1994-1996 years, and (b) using only the seven biggest cities in the OAD region as the treatment group (so as to

Table 2.3. Differences-in-Differences Estimates for the Effect of Asset Taxation on Unregistration by Sectors

	(1)	(2)	(3)
Tax^{period} x Tax^{sector} (A)	-0.008	-0.041	-0.042
	[0.015]	[0.046]	[0.045]
(A)*Farms, forestry & fishing	0.021	0.003	0.003
	[0.017]	[0.050]	[0.050]
(A)*Mining	-0.066 **	-0.091	-0.073
	[0.032]	[0.078]	[0.080]
(A)*Petroleoum & coal extraction	0.013	0.004	-0.004
	[0.019]	[0.025]	[0.031]
(A)*Construction	0.002	0.007	0.014
	[0.016]	[0.043]	[0.040]
(A)*Electricity, gas & water	-0.002	0.029	0.032
	[0.013]	[0.035]	[0.035]
(A)*Hotels, restaurants & trade	0.006	0.019	0.023
	[0.008]	[0.026]	[0.023]
(A)*Transport & storage	0.0004	0.041	0.041
	[0.013]	[0.039]	[0.035]
(A)*Personal, professional ans social services	0.016 **	0.007	0.011
	[0.008]	[0.026]	[0.024]
Constant	0.104 ***	0.121 ***	0.184 ***
	[0.026]	[0.042]	[0.043]
No. Observations	46,751	46,751	46,742
R-squared	0.472	0.474	0.501
Labour force controls & city dummies	NO	NO	YES
Quarter FE	NO	YES	YES
Industry FE	YES	YES	YES

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Robust standard errors clustered at the city level are shown in brackets. In all the regressions the reference category is the *Manufacturing* sector. Labour force controls include means at the industry-city level of years of experience, schooling, fraction of married workers, fraction of males, and fraction of heads of households.

As in the case of the asset tax, we also explore the possibility of a heterogeneous response to this tax policy across different manufacturing industries, by including the interactions of the OAD_{ict}^{period}, the OAD_{ict}^{region}, and the $\left(OAD_{ict}^{period} \times OAD_{ict}^{region}\right)$ variables with a set of dummies for the 2-digit manufacturing industries listed in figure 2.4. The reference category is the *Machinery & equipment* group, and the results are reported in table 2.5. There are significant effects for the *Food, beverages & tobacco* and the *Other manufacturing* industries, with the signs of the coefficients as predicted by the model in

make it more similar to the control group. These cities are Puebla, Toluca, San Luis Potosí, Tijuana, León, Ciudad Juárez, and Torreón). In both cases the results of these non-reported regressions where very similar to the ones shown in this section.

Table 2.4. Differences-in-Differences Estimates for the Effect of the OAD Scheme on Unregistration

	(1)	(2)	(3)
OAD^{period}	0.024 *		
	[0.013]		
OAD^{region}	0.053 ***	0.053 ***	
	[0.012]	[0.012]	
OAD^{period} x OAD^{region}	-0.009	-0.008	-0.009
	[0.014]	[0.014]	[0.006]
Constant	-0.064 ***	-0.067 ***	0.185 **
	[0.011]	[0.018]	[0.080]
No. Observations	91,198	91,198	91,191
R-squared	0.399	0.400	0.477
Labour force controls & city dummies	NO	NO	YES
Quarter FE	NO	YES	YES
Industry FE	YES	YES	YES

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Robust standard errors clustered at the city level are shown in brackets. ODA stands for the region outside the three main metropolitan areas (Mexico City, Guadalajara, and Monterrey), where the optional accelerated depreciation scheme applied in 1994-1998 and 2002. Labour force controls include means at the industry-city level of years of experience, schooling, fraction of married workers, fraction of males, and fraction of heads of households.

section 2.3. The estimates suggest that the rate of unregistration in the aforementioned manufacturing industries was significantly lower outside the three main metropolitan areas during the years in which the optional accelerated depreciation scheme was in place. These effects are robust to both the inclusion of quarter dummies in column 2, and the inclusion of city dummies and labour force characteristics in column 3.

Thus, the differences-in-differences estimates presented here suggest two main results: first, that the introduction of the asset tax in 1989 may have not had important implications for the levels of unregistration in Mexico; and second, as predicted by the theory, the elimination of the OAD scheme during the years 1999 to 2001 may have had derived in an increase in unregistration, but only for some manufacturing industries.

2.5.2. The OAD reforms, the user cost of capital, and unregistration

In the last part of section 2.2 it was suggested that the elimination of the OAD scheme would be expected to translate into an increase in the user cost of capital (i.e., the firm's subjective value of a unit of capital in units of output), and eventually into an increase in unregistration. We will now try to estimate the direct relationship between these two variables, in order to see whether changes in the COC due to changes in the OAD scheme are directly related to changes in the rate of informality.

Table 2.5. Differences-in-Differences Estimates for the Effect of the OAD Scheme on Unregistration by Sectors

	(1)	(2)	(3)
OAD^{period} x OAD^{region} (A)	0.014	0.014	0.013
	[0.015]	[0.015]	[0.010]
(A)*Food, beverages & tobacco	-0.040 **	-0.040 **	-0.034 **
	[0.016]	[0.016]	[0.015]
(A)*Textiles, apparel & leather	-0.047 **	-0.048 **	-0.038 *
	[0.021]	[0.020]	[0.020]
(A)*Wood products	-0.026	-0.027	-0.024
	[0.032]	[0.032]	[0.032]
(A)*Paper & printing	-0.029	-0.029	-0.034 *
	[0.021]	[0.021]	[0.020]
(A)*Chemical products	-0.010	-0.010	-0.012
	[0.015]	[0.015]	[0.015]
(A)*Nonmetallic mineral products	0.005	0.003	-0.005
	[0.026]	[0.027]	[0.026]
(A)*Primary metals	-0.040	-0.042	-0.049 *
	[0.029]	[0.028]	[0.027]
(A)*Other manufacturing	-0.067 **	-0.068 **	-0.068 **
	[0.030]	[0.031]	[0.029]
Constant	-0.108 ***	-0.064 *	0.016
	[0.020]	[0.033]	[0.077]
No. Observations	91,198	91,198	91,191
R-squared	0.401	0.403	0.479
Labour force controls & city dummies	NO	NO	YES
Quarter FE	NO	YES	YES
Industry FE	YES	YES	YES

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Robust standard errors clustered at the city level are shown in brackets. In all the regressions the reference category is the *Machinery & equipment* sector. ODA stands for the region outside the three main metropolitan areas (Mexico City, Guadalajara, and Monterrey), where the optional accelerated depreciation scheme applied in 1994-1998 and 2002. Labour force controls include means at the industry-city level of years of experience, schooling, fraction of married workers, fraction of males, and fraction of heads of households.

The 1994-2002 Mexican Annual Industrial Survey (EIA) is used to obtain an estimate of the COC. The EIA survey is conducted by INEGI and it is housed at its headquarters in Aguascalientes, Mexico. Its objective is to generate information about the trends of the main economic variables of the national manufacturing sector. INEGI follows a non-random sampling procedure to determine the group of manufacturing plants to be surveyed. It excludes maquiladoras, basic petrochemical plants, refineries, and also micro-industry plants (i.e., plants with less than 15 employees). A small random sample of new plants is added every year. Among other things, this source contains annual measures of total employment, remunerations, operating costs, output, sales, income, assets, and depreciation. Due to confidentiality reasons, it was not possible to know the

city in which each plant in the sample was located, but only whether they were in the 3MMA region or the OAD region. Thus, the COC can only be estimated for each 4-digit industry by region and by year. The analysis in this section considers the user cost of capital related to machinery and equipment assets. Other types of assets, such as construction, land, and transportation equipment were used in non-reported analysis with very similar results. This is available from the authors upon request. Following Jorgenson, D. W. (1963), the user cost of capital is calculated as[30]:

$$COC = \frac{p^K}{p^Y} \times \frac{(r+\delta)\times(1-\Gamma)}{(1-\tau)} \tag{2.11}$$

where p^K is the price of capital, p^Y is the price of output, r is the required rate of return, δ is the economic depreciation rate, and Γ is given by:

$$\Gamma = ITC + \tau z \tag{2.12}$$

where ITC refers to the investment tax credits and z is the present value of depreciation allowances:

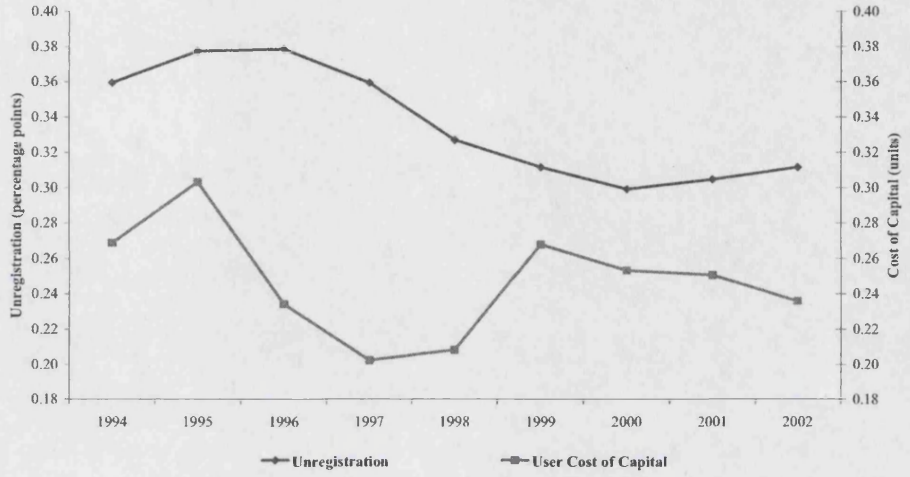
$$z = \sum_{t=0}^{T} \frac{NDR \times V}{(1+\rho)^t} \tag{2.13}$$

with NDR equal to the Normal Depreciation Rate (i.e. the percentage of the purchase value of an asset that the government allows to deduct each year), V is the purchase value of an asset, and ρ is the real discount rate, which for a plant in the OAD region is equal to the rate allowed by the government to calculate the accelerated depreciation; while for a plant in the 3MMA region it is equal to the riskless long term interest rate.

Figure 2.5 plots the average unregistration rate and user cost of capital for the period of analysis. The series for unregistration increases approximately 2 percentage points to 38% of total employment in 1995, as a consequence of the Mexican financial crisis. It then decreases gradually to 30% in 2000, year in which it experiences a new change in trend. On the other hand, the decrease in the cost of capital between 1995 and 1996 is mostly due to the fact that during this period the Mexican government reduced the discount rate to calculate the OAD rate from 5% to 3% so as to boost economic activity.

[30] For a more detailed description of the construction of this variable, see Appendix 2B.

Figure 2.5. Average Annual Unregistration Rate and User Cost of Capital in the Manufacturing Sectors



Finally, the effect of the elimination of the OAD scheme on this variable is also very clear from the graph, as the series increases by about 0.06 units from 1998 to 1999.

We now exploit the cross-sectional variation in the user cost of capital and proceed to estimate its relationship with unregistration. The baseline econometric specification is the following:

$$y_{ijt} = \alpha + \beta COC_{jrt} + \eta_t + \theta_c + \mu_j + \varepsilon_{ijt} \tag{2.14}$$

where y_{ijt} is a dummy variable equal to 1 if individual *i* in industry *j* at time *t* works in the unregistered sector, and is equal to 0 otherwise; COC_{jrt} is the natural logarithm of the user cost of capital for industry *j* in region *r* at time *t*; η_t is a set of quarter dummies; θ_c is a set of city dummies; μ_j is a set of industry dummies; and ε_{ijt} is the error term. Given that the ENEU survey has a panel structure and a quarterly frequency, and given that the cost of capital can only be constructed on a yearly basis, only the April-June interviews are used in the estimation of the model, so as to avoid autocorrelation problems and further complications with individual effects. Table 2.6 shows the results of fitting equation (2.14) by ordinary least squares, with the standard errors clustered at the industry level. The estimates in the first column suggest a positive and significant relationship between the user cost of capital and the rate of unregistration when the full 1994-2002 sample is used. The second column shows that the results are robust to the inclusion of labour force controls, such as years of experience, years of schooling,

Table 2.6. OLS Estimation of the Effect of the User Cost of Capital on Unregistration

	1994-2002	1994-2002	1996-2002
COC	0.050 **	0.052 **	0.044 *
	[0.023]	[0.022]	[0.025]
Constant	-0.008	0.160 ***	0.108
	[0.062]	[0.059]	[0.068]
No. Observations	140,761	140,741	120,006
R-squared	0.343	0.364	0.365
Labour force controls	NO	YES	YES
City FE	YES	YES	YES
Quarter FE	YES	YES	YES
Industry FE	YES	YES	YES

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Robust standard errors clustered at the industry level are shown in brackets. Labour force controls include years of experience, schooling, marital status, gender, and household position (i.e. whether the individual is head of household or not).

marital status, gender, and household position (i.e., whether the individual is head of household or not). Lastly, the third column shows the results when excluding the Mexican crisis years of 1994 and 1995, which is done in order to control for a possible correlation between the user cost of capital and the error term due to the aforementioned governmental decision of reducing the discount rate to calculate the OAD rate. Thus, the OLS estimates suggest a positive and significant relationship between unregistration and the user cost of capital, as predicted by the theoretical model discussed in section 2.3. The next step is to see whether changes in the COC due to the elimination of the OAD scheme affect the rate of unregistration or not. This is done using instrumental variables estimation, with the OAD policy variables as instruments for the cost of capital. That is, an equation like the following is first estimated:

$$COC_{jrt} = \alpha + \beta_1 OAD_{jrt}^{period} + \beta_2 OAD_{jrt}^{region} + \beta_3 \left(OAD_{jrt}^{period} \times OAD_{jrt}^{region} \right) + \varepsilon_{jrt} \qquad (2.15)$$

where all the variables are as define before. The results of this first stage are reported in table 2.7. The coefficients in column 1 refer to the estimation of the basic equation (2.15), and they indicate a negative and highly significant effect of the OAD scheme on the user cost of capital, as expected. It means that whenever the optional accelerated depreciation policy is in place, the user cost of capital tends to be significantly lower. Column 2 reports the results when industry dummies are added to the model. This is done to account for the fact that the COC varies significantly across industries, due to the different levels of capital intensity between them. Finally, column 3 shows the

Table 2.7. Instrumenting the User Cost of Capital with the OAD Policy

	(1)	(2)	(3)
OAD^{period}	-0.013	-0.012	
	[0.015]	[0.012]	
OAD^{region}	-0.003	0.002	
	[0.005]	[0.004]	
$OAD^{period} \times OAD^{region}$	-0.100 ***	-0.101 ***	-0.098 ***
	[0.010]	[0.008]	[0.004]
Constant	-1.362 ***	-1.498 ***	-1.317 ***
	[0.008]	[0.008]	[0.023]
No. Observations	140,761	140,761	140,761
R-squared	0.110	0.450	0.892
City FE	NO	NO	YES
Quarter FE	NO	NO	YES
Industry FE	NO	YES	YES

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Robust standard errors clustered at the industry level are shown in brackets. ODA stands for the region outside the three main metropolitan areas (Mexico City, Guadalajara, and Monterrey), where the optional accelerated depreciation scheme applied in 1994-1998 and 2002.

results when the OAD^{period} and the OAD^{region} variables are substituted with quarter and city dummies. For the reasons explained above, the specification in column 2 is considered to be the best one and its predicted value of COC is used in the second stage re-estimation of equation (2.14) reported here[31]. The corresponding results are shown in table 2.8, which has the same structure as table 2.6 above. There is now no significant effect of the instrumented user cost of capital on unregistration, and the result does not change with the inclusion of labour force controls, nor with the elimination of the Mexican crisis years from the sample.

Thus, the results from the instrumental variables estimation of the relationship between the user cost of capital and the rate of unregistration suggest that the variation in the former due to the elimination of the OAD scheme does not affect the latter in a significant way. This seems to confirm the differences-in-differences results reported in tables 2.4 and 2.5 above, regarding the weakness of the effect of this tax policy on informality.

[31] The results are virtually the same when using the predicted value of the user cost of capital from the specifications in either column 1 or column 3 of table 2.7. The corresponding tables are available from the authors upon request.

Table 2.8. IV Estimation of the Effect of the User Cost of Capital on Unregistration

	1994-2002	1994-2002	1996-2002
COC	0.015	0.018	0.074
	[0.105]	[0.102]	[0.105]
Constant	-0.053	0.118	0.157
	[0.172]	[0.167]	[0.175]
No. Observations	140,761	140,741	120,006
R-squared	0.343	0.364	0.365
Labour force controls	NO	YES	YES
City FE	YES	YES	YES
Quarter FE	YES	YES	YES
Industry FE	YES	YES	YES

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Robust standard errors clustered at the industry level are shown in brackets. Labour force controls include years of experience, schooling, marital status, gender, and household position (i.e. whether the individual is head of household or not).

2.6. Conclusions

In the recent theoretical literature, when modelling the informal sector it is generally assumed that there exists a direct relationship between the tax burden and regulations faced by firms and workers, and the likelihood of informal employment in the economy. However, the related empirical literature available to date indicates that there is still mixed evidence on this issue and only a few studies have been able to link corporate and individual decisions. To fill this gap in the literature, this chapter studied the effect of two important and controversial tax policies that took place in Mexico between 1989 and 2002: the introduction of a 2% asset tax in 1989, and the elimination of the OAD scheme during the years 1999 to 2001, which affected firms with investments in regions other than the three main metropolitan areas in Mexico. Using an industry model with heterogeneous firms, it was predicted that both reforms would have been expected to generate an increase in the rate of informality in the steady state. The econometric analysis developed in the present work suggests that the response of the likelihood of unregistered employment (which is one of the many characteristics of informality) to changes in the level of corporate taxes is rather heterogeneous, depending both on the particular economic sector and the nature of the tax policy in question. For the case of the asset taxation, there is no evidence of a significant effect on unregistration, even when allowing for different relationships across different economic sectors. This is an important result in itself, given that the objective of introducing such a tax was the reduction of tax evasion, and most of the people saw it as a measure against informality.

For the case of the elimination of the OAD scheme, differences-in-differences estimation yields significant effects on unregistration in some of the manufacturing industries. It is obtained that this policy translated into an average increase of 4 percentage points in unregistration for the *Food, beverages & tobacco* and the *Other manufacturing* industries. Finally, this chapter explored the possibility that this tax reform would have produced an increase in the user cost of capital and therefore that a positive relationship between this variable and the rate of unregistration should exist. This hypothesis allows exploiting an alternative source of variation to estimate the effect of the OAD reforms on unregistration. Even though ordinary least squares estimation suggested that there exists a positive and significant relationship between the user cost of capital and unregistration, instrumental variables estimation indicates that the variation in the former due to the elimination of the OAD scheme does not affect unregistration in a significant way.

2.7. References

ALBRECHT, J., L. NAVARRO, and S. VROMAN (2006): "The Effects of Labour Market Policies in an Economy with an Informal Sector," *IZA Discussion Paper Series*, No. 2141, pp. 1-31.

ALEMAN-CASTILLA, B. (2006): "The Effect of Trade Liberalization on Informality and Wages: Evidence from Mexico," *CEP Discussion Papers*, No. 763, pp. 1-68.

AURIOL, E., and M. WARLTERS (2004): "Taxation Base in Developing Countries," *Journal of Public Economics*, Vol. 89, pp. 625-646.

AZUMA, Y., and H. I. GROSSMAN (2002): "A Theory of the Informal Sector," *NBER Working Paper Series*, 8823, pp. 1-23.

BARRO, R. J., and X. SALA-I-MARTIN (2004): *Economic Growth.* Cambridge, Massachusetts: The MIT Press, Massachusetts Institute of Technology.

BOERI, T., and P. GARIBALDI (2001): "Shadow Activity and Unemployment in a Depressed Labour Market," Bocconi University, CEPR, and IGIER, pp. 1-35.

CEBULA, R. J. (1997): "An Empirical Analysis of the Impact of Government Tax and Auditing Policies on the Size of the Underground Economy: The Case of the United States, 1973-94," *The American Journal of Economics and Sociology*, Vol. 56, pp. 173-185.

COWELL, F. A., and J. P. F. GORDON (1988): "Unwillingness to Pay," *Journal of Public Economics*, Vol. 36, pp. 305-321.

DABLA-NORRIS, E., M. GRADSTEIN, and G. INCHAUSTE (2005): "What Causes Firms to Hide Output? The Determinants of Informality," *IMF Working Papers*, WP/05/160, pp. 1-33.

FELDSTEIN, M. (1982): "Inflation, Capital Taxation, and Monetary Policy," in *Inflation: Causes and Consequences*, ed. by R. E. Hall. Chicago, IL: The University of Chicago Press.

FORTIN, B., N. MARCEAU, and L. SAVARD (1997): "Taxation, Wage Controls and the Informal Sector," *Journal of Public Economics*, Vol. 66, pp. 293-312.

FRIEDMAN, E., S. JOHNSON, D. KAUFMANN, and P. ZOIDO-LOBATON (2000): "Dodging the Grabbing Hand: The Determinants of Unofficial Activity in 69 Countries," *Journal of Public Economics*, Vol. 76, pp. 459-493.

GARCIA-VERDU, R. (1996): "Un Modelo De Equilibrio General Dinamico Del Impuesto Al Activo," *Gaceta de Economia*, Year 2, pp. 65-94.

GRUBER, J., and J. RAUH (2005): "How Elastic Is the Corporate Income Tax Base?" NBER, MIT, and University of Chicago, pp. 1-31.

GRUBER, J., and E. SAEZ (2002): "The Elasticity of Taxable Income: Evidence and Implications," *Journal of Public Economics*, Vol. 84, pp. 1-32.

IHRIG, J., and K. S. MOE (2001): "Lurking in the Shadows: The Informal Sector and Government Policy," *International Finance Discussion Papers*, 664, pp. 1-22.

JORGENSON, D. W. (1963): "Capital Theory and Investment Behavior," *American Economic Review*, Vol. 53, pp. 247-259.

LOAYZA, N. V. (1996): "The Economics of the Informal Sector: A Simple Model and Some Empirical Evidence from Latin America," *Carnegie-Rochester Conference Series on Public Policy*, 45, pp. 129-162.

MARCOUILLER, D., and L. YOUNG (1995): "The Black Hole of Graft: The Predatory State and the Informal Sector," *American Economic Review*, Vol. 85, pp. 630-646.

MELITZ, M. J. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, Vol. 71, pp. 1695-1725.

MURILLO, J. A. (2002): "La Banca En Mexico: Privatizacion, Crisis Y Reordenamiento," Direccion de Estudios Economicos de Banco de Mexico, pp. 1-55.

RAUCH, J. E. (1989): "Modelling the Informal Sector Formally," *Journal of Development Economics*, Vol. 35, pp. 33-47.

SCHNEIDER, F. (2004): "Shadow Economies around the World: What Do We Really Know?" *European Journal of Political Economy*, Vol. 21, pp. 598-642.

SCHNEIDER, F., and D. H. ENSTE (2000): "Shadow Economies: Size, Causes, and Consequences," *Journal of Economic Literature*, Vol. XXXVIII, pp. 77-114.

STRAUB, S. (2005): "Informal Sector: The Credit Market Channel," *Journal of Development Economics*, Vol. 78, pp. 299-321.

TRILLO, F. H., A. ZAMUDIO, and J. P. G. AMPARAN (2000): "Los Impuestos En Mexico: Quien Los Paga Y Como?" Programa de Presupuesto y Gasto Publico, CIDE, pp. 1-18.

VERDUGO, A. R. (2006): "Tax Incentives and Business Investment: New Evidence from Mexico," Massachusetts Institute of Technology, pp. 1-56.

2.8. Appendix 2A

2A.1. The solution for φ^*.

In this section we solve the model for the case in which the asset taxation is already in place. The steady state solution to the maximization problem in the informal sector is characterized by:

$$L_I = \left[\frac{\alpha^{1-\beta}\beta^{\beta}\varphi}{w^{1-\beta}\left(r+\delta+\gamma\delta^2+2r\gamma\delta\right)^{\beta}} \right]^{\frac{1}{1-\alpha-\beta}}$$

$$K_I = \left[\frac{\alpha^{\alpha}\beta^{1-\alpha}\varphi}{w^{\alpha}\left(r+\delta+\gamma\delta^2+2r\gamma\delta\right)^{1-\alpha}} \right]^{\frac{1}{1-\alpha-\beta}} \qquad \text{(2A.1)}$$

$$I_I = \delta K_I$$

Similarly, the solution to the maximization problem in the formal sector is given by:

$$L_F = \left\{ \frac{\theta^{\beta}\alpha^{1-\beta}\beta^{\beta}\varphi(1+\lambda)}{w^{1-\beta}(1+b)^{1-\beta}\left[(1+2\sigma\delta)r+(1+\sigma\delta)\delta+\rho\tau_a\right]^{\beta}} \right\}^{\frac{1}{1-\alpha-\beta}}$$

$$K_F = \left[\frac{\theta^{1-\alpha}\alpha^{\alpha}\beta^{1-\alpha}\varphi(1+\lambda)}{w^{\alpha}(1+b)^{\alpha}\left[(1+2\sigma\delta)r+(1+\sigma\delta)\delta+\rho\tau_a\right]^{\beta^{1-\alpha}}} \right]^{\frac{1}{1-\alpha-\beta}} \qquad \text{(2A.2)}$$

$$I_F = \delta K_F$$

Equations 2A.1 and 2A.2 can then be used to obtain an expression for the maximized net cash flows in the formal and the informal sectors. The net cash flow for a firm in the informal sector can be written as:

$$NCF_I = \left[\frac{\alpha^{\alpha}\beta^{\beta}\varphi}{w^{\alpha}} \right]^{g} \left[\frac{\left(\delta+\gamma\delta^2\right)+g(r+2r\gamma\delta)(1-\alpha)}{gN^{(1-\alpha)g}} \right] - f_I \qquad \text{(2A.3)}$$

where $g = 1/(1-\alpha-\beta)$ and $N = r+\delta+\gamma\delta^2+2r\gamma\delta$. Similarly, the net cash flow in the formal sector is:

$$NCF_F = \left[\frac{\theta^{1-\alpha}\alpha^{\alpha}\beta^{\beta}\varphi(1+\lambda)}{w^{\alpha}(1+b)^{\alpha}} \right]^{g} \left[\frac{\rho\tau_a+\delta+\sigma\delta^2+g(r+2r\sigma\delta)(1-\alpha)}{gM^{(1-\alpha)g}} \right] - f_F \qquad \text{(2A.4)}$$

where $M = r+2r\sigma\delta+\delta+\sigma\delta^2+\rho\tau_a$. Now, since the limits of integration for the present discounted value of a firm in the formal sector are the same as those in the informal sector, equation (2.7) can be written as:

$$\int_0^{\infty} e^{-rt}\left[NCF_F(t)-(1-\varepsilon)NCF_I(t)\right]dt = 0 \qquad \text{(2A.5)}$$

Therefore, a firm will be indifferent between the formal and the informal sectors whenever $NCF_F(t)-(1-\varepsilon)NCF_I(t)=0$. Using equations A.3 and A.4, this implies:

$$\left[\frac{\theta^{1-\alpha}\alpha^{\alpha}\beta^{\beta}\varphi(1+\lambda)}{w^{\alpha}(1+b)^{\alpha}}\right]^{g}\left[\frac{\left(\rho\tau_a+\delta+\sigma\delta^2\right)\frac{1}{g}+(r+2r\sigma\delta)(1-\alpha)}{M^{(1-\alpha)g}}\right]-$$

$$-(1-\varepsilon)\left[\frac{\alpha^{\alpha}\beta^{\beta}\varphi}{w^{\alpha}}\right]^{g}\left[\frac{\left(\delta+\gamma\delta^2\right)\frac{1}{g}+(r+2r\gamma\delta)(1-\alpha)}{N^{(1-\alpha)g}}\right]=f_F-(1-\varepsilon)f_I \tag{2A.6}$$

And solving for φ:

$$\varphi^{*}=\frac{\left[f_F-(1-\varepsilon)f_I\right]^{\frac{1}{g}}w^{\alpha}(1+b)^{\alpha}}{\alpha^{\alpha}\beta^{\beta}\left\{\theta^{(1-\alpha)g}(1+\lambda)^{g}(1-\alpha)M^{-\beta g}-\beta\theta^{(1-\alpha)g}(1+\lambda)^{g}\left(\rho\tau_a+\delta+\sigma\delta^2\right)M^{-(1-\alpha)g}-C\right\}^{\frac{1}{g}}} \tag{2A.7}$$

where $C=(1+b)^{\alpha g}(1-\varepsilon)N^{-(1-\alpha)g}\left[N(1-\alpha)-\left(\delta+\gamma\delta^2\right)\beta\right]$ is independent of σ and τ_a.

2A.2. The effect of asset taxation on informality.

In the model of section 2.3, the introduction of an asset tax translates into an increase in τ_a. Therefore, the effect of this tax on the rate of informality is given by the derivative of φ^{*} with respect to τ_a. From equation 2A.7, and after some algebraic manipulation:

$$\frac{\partial\varphi^{*}}{\partial\tau_a}=\frac{1}{g}\left\{\frac{\varphi^{*(2-\alpha-\beta)}\alpha^{\alpha}\theta^{1-\alpha}(1+\lambda)}{\left[f_F-(1-\varepsilon)f_I\right]^{\frac{1}{g}}w^{\alpha}(1+b)^{\alpha}M^{2-2\alpha-\beta}}\right\}^{g}\beta^{\beta g+1}\rho G>0 \tag{2A.8}$$

where $G=g(1-\alpha)(1+2\sigma\delta)r+M$. Hence, an increase in τ_a increases the equilibrium cut-off productivity level for formality, which leads to a higher rate of informality in the steady state.

2A.3. The effect of the OAD reforms on informality.

Also as discussed in section 2.3, the reforms to the OAD scheme imply a change in the adjustment cost of investment for the formal sector, captured by the parameter σ. Thus,

the effect of these reforms on informality is given by the derivative of φ^* with respect to σ. Using equation 2A.7:

$$\frac{\partial \varphi^*}{\partial \sigma} = \frac{1}{g}\left\{\frac{\varphi^{*(2-\alpha-\beta)}\,\alpha^{\alpha}\theta^{1-\alpha}(1+\lambda)}{\left[f_F-(1-\varepsilon)f_I\right]^{\frac{1}{g}} w^{\alpha}(1+b)^{\alpha} M^{2-2\alpha-\beta}}\right\}^{g} \beta^{\beta g+1}\delta D > 0 \qquad (2A.9)$$

where $D = g(1-\alpha)(\delta+2r)(1+2\sigma\delta)r+\delta M$. Hence, an increase in σ increases the equilibrium cut-off productivity level for formality, inducing more firms to produce in the informal sector.

2.9. Appendix 2B

Estimation of the user cost of capital (COC).

The user cost of capital is estimated at the 4-digit industry level for the two different regions (3MMA or OAD) using equation 11 and the following inputs:

- The capital-output price ratio (p_K/p_Y): is the output deflator for each 2-digit industry divided by the price index for fixed capital accumulation.[32] It was set equal to 1 in 2002.
- Corporate Tax Rate (τ): comes from Income Laws, and was adjusted to include the burden of the profit sharing rate.
- Real required rate of return (r): was assumed equal to the real riskless interest rate, plus a time varying risk premium equal to the difference between the short term nominal interest rate on private and government bonds.[33]
- Present discounted value of depreciation allowances (z): calculated based on equation 13, using normal depreciation rates or the optional accelerated depreciation rates according to each plant location (OAD or 3MMA), from Income Tax Laws.

Economic depreciation (δ): estimated at the 6-digit industry level using data from the 1984-1994 EIA panel, and assigned at the 4-digit industry level for each plant in the 1994-2002 EIA panel.

[32] The first comes from the Mexican National Income and Product Accounts and the second from the Mexican Central Bank.

[33] The real riskless rate is the rate on UDIBONOS (inflation indexed long term government bonds). The risk premium is the difference between the rate on private commercial paper and CETES (short term government bonds).

Chapter 3. The Returns to Temporary Migration to the U.S.: Evidence from the Mexican Urban Employment Survey.

3.1. Introduction

Mexican migration to the United States has become a very important issue during the twentieth century. Many authors trace the beginning of this socio-economic phenomenon back to the late 1880s, linking it to the construction of the railroad between the two countries, just a few decades after the U.S. took Texas, New Mexico and California from Mexico. According to Martin, P. (1998), there have been three major phases of recruitment of Mexican workers authorized by the U.S. government, each one associated with a war-time emergency. The first one occurred in 1917, as a response to the labour force shortage due to World War I, and it is estimated that between 1917 and 1920 some 50,000 Mexican workers where admitted legally, most of them as farm workers. The second stage initiated in 1942 with the *Bracero Program*, when the U.S. and the Mexican governments concluded an agreement that permitted Mexican workers to enter the U.S. as emergency farm workers whenever the U.S. workers where not available. According to Craig, R. B. (1971), this program can then be divided in two phases: from 1942 to 1951, when the labour shortages in the U.S. where mainly due to the participation in the World War II and the U.S. government was the direct supervisor of the program; and then from 1951 to 1964, when U.S. growers where allowed to participate directly in the recruitment of Mexican workers to cover for the shortages generated by the Korean war. Nevertheless, it is believed that the main reasons for extending the program to 1964 were both the pressure coming from the Mexican government and the belief that the *Bracero Program* was the only way to control the increasing illegal immigration. Overall, between 1942 and 1964 approximately 4.6 million Mexicans were admitted in the United States as temporary farm workers, and for some authors (see for example, Hanson, G. H. (2006) or Epstein, G. S., A. L. Hillman and A. Weiss (1999)), the end of this program marked the beginning of large-scale illegal immigration.

The relevance of Mexican migration to the United States has reached unprecedented levels during the last two decades. Apart from being the hottest topic in the bilateral agenda, it has also become a very important component of the economic relation between the two countries. To the south of the border, and according to data published

by the Mexican Central Bank and the Mexican Institute of Statistics, Geography and Computing (INEGI)[34], remittances of Mexican workers accounted for approximately 2.3% of the GDP between 2003 and 2006, which makes it one of the most important sources of income for the economy. Woodruff, C. and R. Zenteno (2001) estimate that remittances are responsible for 20% of the capital invested in micro enterprises throughout urban Mexico. On the other hand, to the north of the border, the Bureau of Labor Statistics of the U.S. Department of Labor estimates that 8.3% of the employed people in the United States during 2004 and 2005 were from Mexican origin[35], and the increasing presence of Mexican illegal immigrants in the United States has been constantly generating debates among different groups of the population and the government, up to the point that in September 2006 the U.S. Congress approved a budget of 1,200 million dollars in order to build a 1,120 kilometers fence along the U.S.-Mexico border.

So, even though Mexican migration to the U.S. is almost as old as the countries themselves (as we know them today), its increasing complexity contributes to make it an even more attractive topic for research with the passing of time. To date, there is a huge body of literature that analyses many different aspects of this phenomenon, such as the characteristics of the migrants (Bustamante, J. A. et. al. (1998a); Durand, J. and D. S. Massey (1992)), the factors that influence migration (Massey, D. S. and K. E. Espinosa (1997); Latapi, A, E. et. al. (1998); Markusen, J. R. and S. Zahniser (1997); Papail, J. (1998)), the quantification of legal and illegal migrants (Woodrow-Lafield, K. A. (1998); Hanson, G. H. (2006); Bean, F. D. et. al. (1998); Bean, F. D., R. Corona, R. Tuiran, K. A. Woodrow-Lafield and J. V. Hook (2001)), the interconnectedness between international and regional migration in Mexico (Lozano-Ascencio, F., B. R. Roberts, and F. D. Bean (1996)), or the economic performance of Mexican migrants with respect to the U.S. labour market (Borjas, G. J. (1982), (1987) and (1989); Borjas, G. J., and L. F. Katz (2006); Chiquiar, D. and G. H. Hanson (2005)). Interestingly though, it seems that the economic performance of migrants with respect to the Mexican labour markets has received far less attention, and this is precisely the area in which the present chapter attempts to contribute on.

The main objective of this chapter is to present new evidence on the effect that migration to the United States has on the earnings of Mexican workers. It adds to the

[34] See http://www.banxico.org.mx/polmoneinflacion/estadisticas/balanzaPagos/balanzaPagos.html, and http://dgcnesyp.inegi.gob.mx/cgi-win/bdieintsi.exe/Consultar, for some data on family remittances and quarterly GDP.

[35] Estimated using data from the Current Population Survey. See http://www.bls.gov/cps/cpsaat13.pdf and http://www.bls.gov/cps/cpsaat9.pdf for more detail.

existing literature by comparing the economic performance of these workers during their stay in the U.S. to their situation when they are back in Mexico. In order to do this, the present study focuses on temporary migration, and it uses data from the Mexican National Survey of Urban Labour (ENEU), for the period between 1994 and 2002. To my knowledge, the information on temporary migration collected by the ENEU has not been used in this type of studies before, even though it offers some noticeable advantages, like its quarterly coverage or its panel structure (which allows minimizing the problems of self-selection biases). Additionally, unlike other sources, the ENEU survey frequently contains information about the migrants even when they are not present, given that the informant is allowed to be different from the subject in these cases. Finally, the survey collects measures of different variables that may affect the migration decision at different levels, such as individual, household, geographic, or workplace characteristics.

To preview the most important results, fixed-effects estimates of the effect of temporary migration on real hourly earnings indicate that a Mexican worker earns on average 112% more in the U.S. labour market than in Mexico during the period of migration. Temporary migrants also work on average 6.5% more hours per week during their stay abroad, a result that is consistent with the standard theory of the response of the labour supply to temporary positive shocks to real wages. Additionally, it is found that temporary migrant workers have a generally higher likelihood of non employment during the period of return migration. Lastly, the estimates of the interactions between migration and individual characteristics indicate that the effect of temporary migration on earnings is lower for more skilled workers and for those migrating from the most distant regions in Mexico, relative to the United States.

The rest of the chapter is organized as follows: Section 3.2 describes the data used in the analysis and provides a discussion about their representativeness and validity. Section 3.3 presents a preliminary analysis of the characteristics and the determinants of temporary migration from the ENEU data, in order to compare them with the results obtained by other researchers. Section 3.4 develops the econometric estimation of the effect of temporary migration on hourly earnings, weekly hours worked, and the likelihood of employment. Section 3.5 concludes.

3.2. Description and Representativeness of the Data

The present study uses data from the Mexican National Survey of Urban Labour (ENEU) to study temporary migration from Mexico to the United States. The period covered here goes from 1994 to 2002. The ENEU survey is carried out by the National Institute of Statistics, Geography and Computing (INEGI) since 1983. It provides information about the state of the Mexican labour market, the main socio-demographic characteristics of the household members aged 12 and above, and housing in the principal urban areas of the country. The survey is carried out on a quarterly basis, and the sample is divided in five independent panels, each one staying in it for five consecutive quarters (i.e. it is a rotative panel that allows following individuals for 1.25 years). From 1983 to 1984 the ENEU survey covered only the three main cities in Mexico (Mexico City, Guadalajara and Monterrey). Between 1985 and 1991 its geographical coverage was expanded to 16 cities, within which the main cities at the Mexico-U.S. border were included (Ciudad Juarez, Matamoros, Nuevo Laredo and Tijuana). Between 1992 and 2000 another 32 cities were gradually incorporated to the sample.

Regarding migration, the ENEU survey asks for the residential status of each person in the household. A person is then classified as *temporarily absent emigrant* if he or she was reported as absent from the household at the time of the interview, temporarily residing in a place outside the city where the household is, but still reported by the other members of the household as being part of it. The survey also asks for the temporary place of residence of the absent member, allowing the classification of the migratory movements as internal (i.e. between two Mexican states) and international migration. If the migration movement is internal, the informant is asked for the state to which the referred individual moved. If the migration movement is international, the informant is asked to report the country (if Guatemala, Belize, or the United States) or the region of the world (if some other country in the American continent or any other country of the world) in which the migrant is currently residing. If the person moved to the United States, the informant is further asked whether he or she moved to a state in the U.S.-Mexico border or to some other place. Finally, the ENEU survey also has some information regarding the reason for migrating, which allows for the classification of migrants as those migrating for *work reasons*, those migrating for *study reasons*, and those migrating for *other reasons*. In order to reduce the problem of selectivity bias, the present study excludes migration for study reasons from the analysis.

There are several advantages in using the ENEU data to study Mexico-U.S. migration. The first one is that, unlike the population censuses and some other data sources, it is a survey carried out quarterly every year and not only every 5 or 10 years. This allows for example to make a more detailed analysis of the response of migration to different macroeconomic events, such as the Mexican crisis, NAFTA, or the different changes in the U.S. migratory policy. Second, because of its panel structure, it is possible to follow individuals through time, making it easier to control for self-selection biases when studying certain aspects of the phenomenon, such as the economic returns to migration and to circular migration. Third, when possible, the ENEU dataset contains information about the migrants even when they are not in the household for the interview (i.e. when they are in the U.S.). This is so because when an individual is absent for an interview, the information is frequently collected from another member of the family. Therefore, in some cases the ENEU contains valuable information of the migrants while in the U.S. Finally, given that it is a labour markets survey, the survey collects measures of different variables that may affect the migration decision at different levels, such as individual characteristics (age, schooling, gender, marital status), household characteristics (number of children, head of household, number of family members, number of providers of income), geographic characteristics (metropolitan area, proximity to the U.S.-Mexico border, whether the individual lives in a state or region with traditionally high rates of migration), and workplace characteristics (industry affiliation in Mexico and in the U.S., employment status in Mexico and in the U.S., informality status in Mexico and in the U.S., etc.).

On the other hand, there may also be some concerns about using the ENEU survey to analyse migration, and perhaps the most important one could be regarding its representativeness. First, as the survey covers only the 48 main cities in the country, any estimation based on these data may be irrelevant if an insignificant fraction of the migrants comes from urban places. However, previous evidence indicates that this is not the case. Table 3.1 reports data on migration to the U.S. estimated by INEGI from the Mexican population census. According to these numbers, between 1990 and 1995 a total of 1,737,520 Mexicans moved (both temporarily and permanently) to the United States[36]. Of these, 59% came from places with more than 2,500 inhabitants. Similar

[36] This estimate is corroborated by the U.S. Immigration and Naturalization Service, which reports that 1,490,040 Mexicans arrived to the United States between 1991 and 1995. See Table 4 in BEAN, F. D., R. CORONA, R. TUIRAN, and K. A. WOODROW-LAFIELD (1998): "The Quantification of Migration between

Table 3.1. Distribution of Migrants to the U.S. by Size of the Locality of Origin

	1990-1995	1995-2000
Total population	91,158,290	97,483,412
Total migrants	1,737,520	1,500,321
From places with less than 2,500 ha	712,383	600,128
% of total migrants	*41%*	*40%*
From places with 2,500+ ha	1,025,137	900,193
% of total migrants	*59%*	*60%*

Source: Censos de Población y Vivienda, 1950 a 2000, and Conteos de Población y Vivienda, 1995 y 2005 (INEGI). Base de datos de la muestra censal.

results are obtained for the 1995-2000 period. The relevance of urban places as places of origin for international migration seems to be confirmed by other studies and data sources. Bustamante, J. A., G. Jasso, J. E. Taylor and P. T. Legarreta (1998a) report that 58.49% of the interviewed migrants in the Mexican Survey of Migration of the North Border (EMIF) came from places with 15,000 or more inhabitants, and Bustamante, J. A., G. Jasso, J. E. Taylor and P. T. Legarreta (1998b) indicate that 47.4% of the migrants interviewed in the Mexican National Survey of Demographic Indicators (ENADID) came from urban places. Also, in analyzing the evidence on the characteristics of Mexican migrants to the U.S., Cornelius, W. A. (1992) concludes that during the 1970's and 1980's the flow of migrants became more geographically diverse, originating more in non-traditional sending states and large cities.

The second reason why the representativeness of the ENEU data on migration might be questionable is that it captures mainly temporary migration. To see this, table 3.2 presents some data on the frequency of migration to the United States, calculated from the sample of individuals interviewed between 1994 and 2002. All the individuals in this database have five consecutive, quarterly interviews. The first column of data presents the results for all the individuals that migrated both for *work reasons* and for *other reasons*. The first panel indicates that 2,052 out of 1,274,225 individuals migrated to the United States at some point in time during the period in question, which yields and estimated migration rate of 0.16%. The second panel shows that of all these migrants 78.4% where reported as *temporarily absent emigrants* in one of their five interviews, while only 0.58% of them stayed in the United States during all the

Mexico and the United States," *Migration Between Mexico and the United States: Binational Study*, Volume 1: Thematic Chapters, pp. 1-89. for more detail.

Table 3.2. Number of Migrants and Frequency of Migration to the U.S. 1994 Q2 to 2002 Q4

	All Migrants (AM)	Migrant Workers (MW)	MW as % of AM
No. Individuals in sample	1,274,225	1,274,225	100%
No. Migrants[1] *rate of migration*	2,052 *0.16%*	953 *0.07%*	46%
No. Migrants absent for all interviews *share of No. Migrants*	12 *0.58%*	12 *1.26%*	100%
No. Migrants absent for 4 interviews *share of No. Migrants*	34 *1.66%*	32 *3.36%*	94%
No. Migrants absent for 3 interviews *share of No. Migrants*	105 *5.1%*	82 *8.6%*	78%
No. Migrants absent for 2 interviews *share of No. Migrants*	292 *14.2%*	195 *20.5%*	67%
No. Migrants absent for 1 interview *share of No. Migrants*	1,609 *78.4%*	632 *66.3%*	39%
No. Migrants that migrated 1 time *share of No. Migrants*	1,937 *94.4%*	874 *91.7%*	45%
No. Migrants that migrated 2 times *share of No. Migrants*	112 *5.5%*	76 *8.0%*	68%
No. Migrants that migrated 3 times *share of No. Migrants*	3 *0.1%*	3 *0.3%*	100%

Source: author's calculations based on the Nation Survey of Urban Employment (ENEU). Excludes people that moved to the U.S. for study reasons. [1]For the "All Migrants (AM)" column: number of people that was reported as temporarily absent from the household because they migrated to the U.S. for reasons other than studying at the time of one or more of the five quarterly interviews. For the "Migrant Workers (MW)" column: Number of people that was reported as temporarily absent from the household because they migrated to the U.S. for work reasons only, at the time of one or more of the five quarterly interviews.

interviews. This implies that the majority of the migration episodes captured by the ENEU lasted at most 6 months. The third panel in the table summarizes the distribution of migrants according to the number of times that they migrated to the United States. It indicates that 94.4% of them migrated only once. The results are very similar when only the people that migrated for *work reasons* are considered.

The problem in this case would be that if temporary migration is not an important component of the overall migratory movements to the United States, then the estimates based on the ENEU survey would be irrelevant. Nonetheless, as with the previous argument, there exists historical evidence indicating the contrary. According to the Mexican Embassy in the United States, "until the second half of the eighties the

traditional pattern of migration from Mexico to the United States was circular"[37]. Griswold, D. T. (2002) mentions that between 1942 and 1964, 4.6 million Mexicans entered the United States on a temporary basis to fill the gaps in the labour market caused by the World War II. Between 1965 and 1986, even though per-country legal immigration quotas were in place, the "Texas Proviso" prohibited the U.S. authorities from prosecuting employers that hired undocumented workers. Massey, D. S., J. Durand and N. J. Malone (2002) argue that this situation derived in a *de facto* guest-worker program. To get an idea of the numbers, in the opening line of their analysis of the profiles of temporary Mexican labour migrants to the United States in 1978, Ranney, S. and S. Kossoudji (1983) state that "the flow of temporary Mexican labour migration to the United States is known to be substantial (estimates range from 500,000 to 2 million persons per year)"[38].

In 1986 the United States Congress passed the Immigration Reform and Control Act (IRCA), which required U.S. companies to check documentation of all prospective employees, authorized fines against firms that knowingly hired illegal immigrants, increased the spending in the Border Patrol, but at the same time granted permanent legal status to almost 3 million illegal immigrants[39]. Even though some authors argue that Mexican temporary migration has decreased during the post-IRCA period (see for example Cornelius, W. A. (1992) and Marcelli, E. A. and W. A. Cornelius (2001)[40]), there is also empirical evidence that supports the continuity of its importance. To mention one example, Durand, J., D. S. Massey and R. M. Zenteno (2001) use data from the ENADID survey, the U.S. census, and the Mexican Migration Project (MMP) to analyse the profile of Mexican immigrants to the United States. They conclude that there is basically no evidence of a trend away from the dominance of working-age males or of a greater family migration, but that instead there has been an increase in the propensity towards return migration in the early 1990's. On the other hand, according to the U.S. Department of Homeland Security, between 1998 and 2005 928,399 Mexicans

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[37] MEXICAN_EMBASSY_IN_THE_UNITED_STATES (2006): "Mexico's Public Policies to Foster Circular Migration," Mexico-U.S.: Migration and Border Security www.embassyofmexico.org, pp. 1-24. p. 4.

[38] Ranney, S. and S. Kossoudji (1983), p. 475.

[39] For more detail, see for example DUNN, T. J. (1996): *The Militarization of the U.S.-Mexico Border, 1978-1992: Low-Intensity Conflict Doctrine Comes Home.* University of Texas at Austin..

[40] Cornelius, W. A. (1992) and Marcelli, E. A. and W. A. Cornelius (2001) find that the increase in permanent migration is not only related to the legalization programs introduced by IRCA in 1986, but also to the changing composition of U.S. demand for migrant labour, the economic crisis in Mexico during the 1980's, and the maturing of transnational migrant networks that altered the demographic composition of migration flows and strengthened incentives for permanent settlement in the United States.

Table 3.3. Mexican Nonimmigrants Admitted as Temporary Workers, Exchange Visitors, and Intracompany Trainees

	Total Nonmigrants	Workers with Specialty Occupations	Seasonal Workers	Intra-company Transferees	Workers with Extraordinary Ability or Achievement	Athletes, Artists and Entertainers	Other	Admitted Mexican Immigrants	Nonmigrants as % of Immigrants
1998	66,197	10,079	32,321	8,987	348	7,268	7,194	131,575	50%
1999	86,424	12,257	44,996	11,387	561	8,731	8,492	147,573	59%
2000	104,155	13,507	54,927	14,516	750	10,385	10,070	173,919	60%
2001	116,157	14,423	63,421	15,723	881	10,508	11,201	206,426	56%
2002	118,835	15,867	65,818	15,283	851	10,237	10,779	219,380	54%
2003	130,327	16,290	75,802	15,794	1,472	10,375	10,594	115,864	112%
2004	136,518	17,917	73,498	16,336	1,709	8,575	18,483	173,664	79%
2005	169,786	17,063	90,466	16,279	2,216	9,478	34,284	161,445	105%
Total	**928,399**	**117,403**	**501,249**	**114,305**	**8,788**	**75,557**	**111,097**	**1,329,846**	**70%**

Source: Yearbook of Immigration Statistics 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005. U.S. Department of Homeland Security. Immigrants, as defined by U.S. immigration law, are persons lawfully admited for permanent residence in the United States. A Nonimmigrant is defined as a foreign national seeking to enter the United States temporarily for a specific purpose.

entered the United States as temporary workers, exchange visitors, or intracompany trainees (see table 3.3). Of these, almost 54% entered as seasonal workers, both agricultural and non-agricultural. Total nonmigrants between 1998 and 2005 represented a 70% of lawfully admitted permanent residents (immigrants). These estimates –which should be taken as a lower bound, given that the official statistics do not account for illegal migration, indicate that Mexican temporary migrant workers are an important proportion of the total flow of Mexican migrants every year.

Finally, it is also possible to get an idea of the relative importance of these workers with respect to the stock of Mexican immigrants in the U.S. by looking at the basic monthly data of the U.S. Current Population Survey[41]. Although the survey does not allow for the exact identification of temporary migrants, it is possible to approximate their weight in the stock of Mexican immigrants through recent immigration (i.e. those that entered the country within the referred year, for example) and citizenship status. Figure 3.1 plots the share in the U.S. population over age 15 of people born in Mexico. On average, Mexicans represented a 2.2% of the U.S. population between 1994 and 2002. Figure 3.2 shows the estimated share of Mexican immigrants that entered the country during the year. It indicates for example that 2.9% of all the Mexicans living in the United States by 1994 entered the country during that year. The average for the 1994-2002 period is 3.8%. Figure 3.3 plots the fraction of Mexican immigrants without U.S. citizenship. Even though this figure has declined through time, about 79% of all Mexican immigrants in 2002 still did not have the U.S. citizenship. The average for the 1994 to 2002 period is 81.5%. Lastly, figure 3.4 shows that the share of recent Mexican

[41] The data comes from the National Bureau of Economic Research (NBER) Data Collection, in http://www.nber.org/data/cps_index.html.

Figure 3.1. Share of Mexicans on U.S. Population
(Basic Monthly Data from the U.S. Current Population Survey)

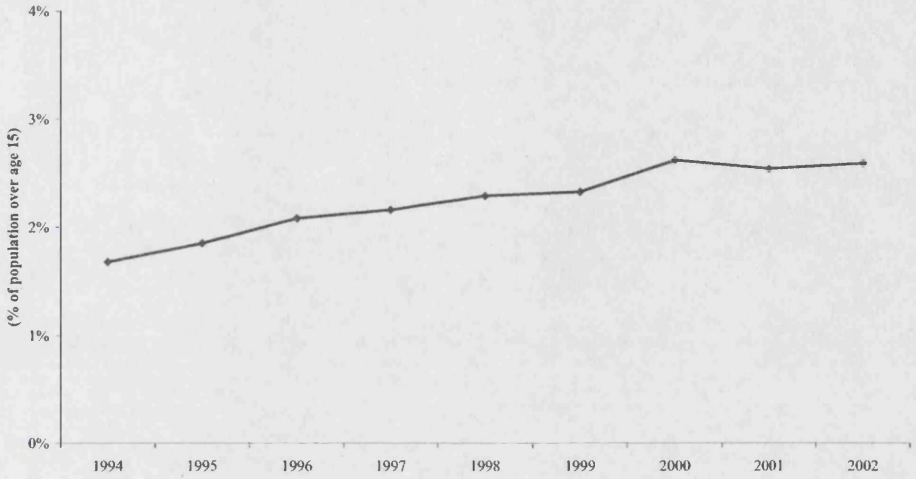
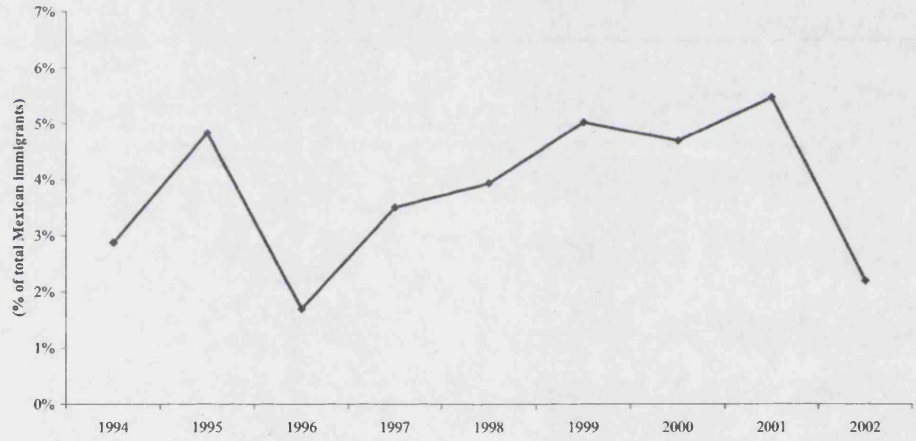


Figure 3.2. Share of Recent Mexican Immigrants in Total Mexican Immigration to the U.S.
(Basic Monthly Data from the U.S. Current Population Survey)[1]



[1] Recent immigrants are those that entered the United States during the year.

Figure 3.3. Share of Mexican Immigrants without U.S. Citizenship
(Basic Monthly Data from the U.S. Current Population Survey)

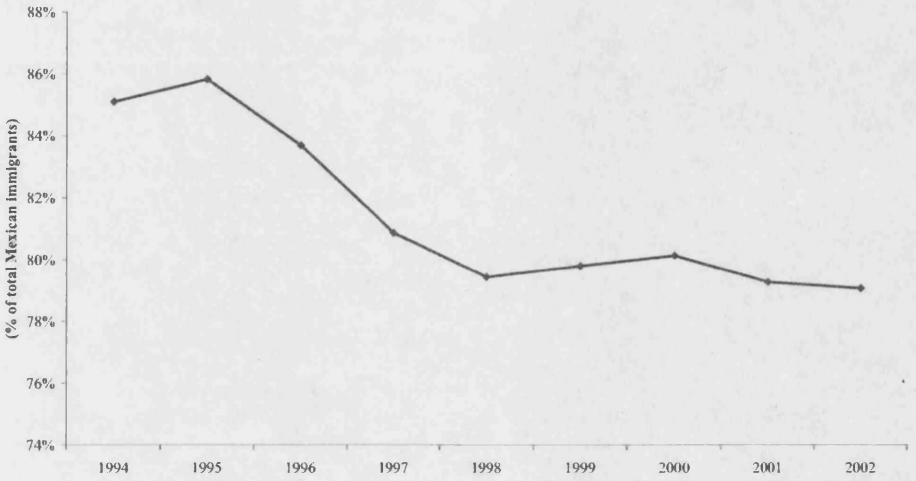
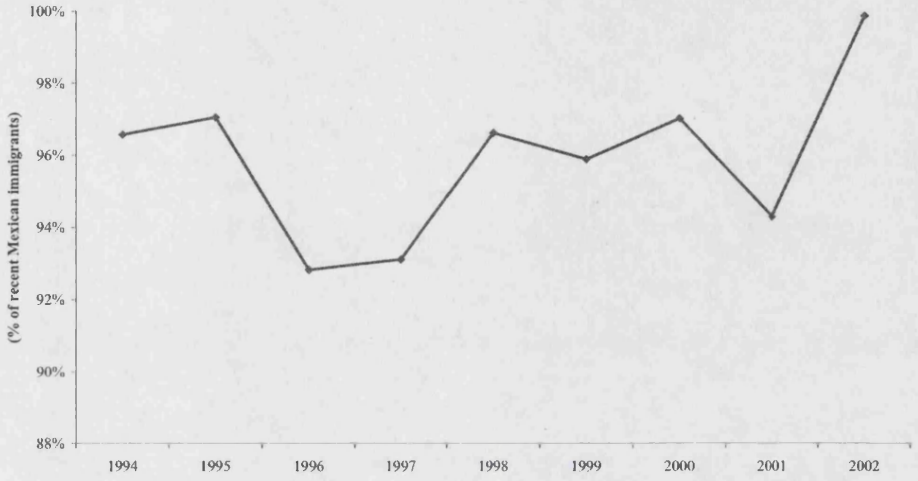


Figure 3.4. Share of Recent Mexican Immigrants without U.S. Citizenship
(Basic Monthly Data from the U.S. Current Population Survey)



immigrants without citizenship was always around 96% between 1994 and 2002, which could be indicating that most of them do not intend or are not allowed to stay in the United States for long periods.

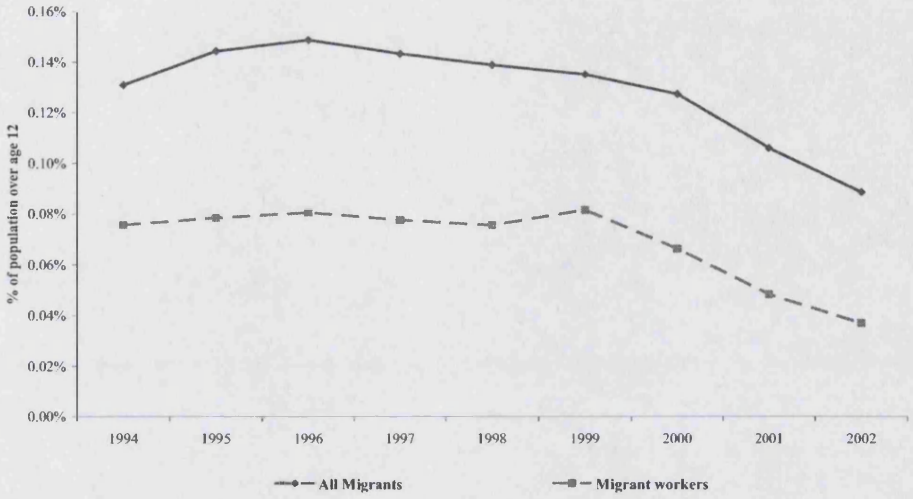
In conclusion, the discussion in this section suggests that temporary migration has been a historically important component of the Mexico-U.S. relationship, and that even though it represents a small fraction of the total stock of Mexicans in the U.S., it is still a very important component of the annual flows. Thus, even though the ENEU captures mainly temporary migration, and even though these data refer only to urban places, it seems that the survey is in principle able to measure a relevant part of the Mexico-U.S. migratory phenomenon. This, together with the aforementioned advantages regarding its structure, makes it a valuable data source worth using.

3.3. The Characteristics of Temporary Migration

This section presents new evidence on the determinants of temporary migration to the United States, stemming from the main urban places in Mexico. As in table 3.2 in the previous section, the results are shown for *all migrants* and *work migrants* separately. Also, as mentioned before, migration for *study reasons* is left outside the analysis in order to minimize any possible self-selection bias problems.

To begin, figure 3.5 depicts the estimated annual Mexican temporary migration rate to the U.S. among the population aged 12 and more. The average annual rate for *all*

Figure 3.5: Estimated Temporary Migration Rate to the U.S.



migrants is 0.13% while for *work migrants* is equal to 0.07%. For the case of *all migrants*, there is a negative trend in this rate starting in 1996, while for the *work migrants* it starts to decrease just after 1999. It is interesting to note that in the first case this change of trend coincides with the Illegal Immigration Reform and Immigrant Responsibility Act of 1996, "which addressed border enforcement and the use of social services by immigrants. It increased the number of border patrol agents, introduced new border control measures, reduced government benefits available to immigrants, and established a pilot program in which employers and social services agencies could check by telephone or electronically to verify the eligibility of immigrants applying for work or social services benefits"[42]. Also, the acceleration in the decline of the temporary migration rate between 2000 and 2002 for both groups in the figure may be partially reflecting the tighter immigration enforcement and border controls that came into place after the September 11 terrorist attacks[43].

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[42] CALDERA, S., and P. PIPER/BACH (2006): "Immigration Policy in the United States," The Congress of the United States - Congressional Budget Office. p. 14.

[43] On the 26th of October, 2001, President George W. Bush signed into law the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001, known as the USA Patriot Act of 2001. According to the Centre for Immigration Studies, the act contains provisions that improve the ability of U.S. authorities to identify and either exclude or prosecute aliens with terrorist ties. Among other things, it authorizes the exclusion of the spouses and children of aliens who have committed acts linking them to terrorist organizations within the past five years and makes inadmissible any alien determined by the Attorney General and the Secretary of State to have been associated with a terrorist organization. It also mandates the implementation of an integrated entry and exit data system at airports, seaports, and land border ports; as well as the creation of a student database with information on the date and port of entry. See JENKS, R. (2001): "The USA Patriot Act of 2001: A Summary of the Anti-Terrorism Law's Immigration-Related Provisions," *Backgrounder. Center for Immigration Studies*, pp. 1-4. for more detail.

Apart from its variation over time, migration to the U.S. has also been historically diverse among sending regions in Mexico. Even though migrants originate from all over the country nowadays, traditionally it has been the west-central region the one with the highest levels of migration. According to Chiquiar, D. and G. H. Hanson (2005), this is partially an historical accident: "In the early 1900s, Texas farmers began to recruit laborers in Mexico. Given the small populations on the Texas-Mexico border, recruiters followed the main rail line into Mexico, which ran southwest to Guadalajara, a major city in the center west of the country"[44]. According to estimates based on the ENADID and the EMIF data, the border and northern states follow the west-central region in importance (Bustamante, J. A., et. al. (1998b)), and the relevance of the border states has been increasing in recent years, acting now as a link between internal migration from the southern states and international migration to the U.S. (Lozano-Ascencio, F., B. R. Roberts and F. D. Bean (1996)).

To see what the ENEU survey has to say about this, the panels in figure 3.6 depict the evolution of each region's share of total temporary migration to the United States, and the map in figure 3.7 identifies the states that belong to each region. The graphs confirm the importance of the west-central, the border, and the northern regions. They also show a decline in the relative weight of the west-central states (from 46% to 29% of *all migrants* and from 55% to 17% of *work migrants* only, between 1994 and 2002), and a strong increase in the share of the border region (from 27% to 37% of *all migrants* and from 16% to 44% of *work migrants* only). Finally, the data seem to partially support the findings by Marcelli, E. A. and W. A. Cornelius (2001), in the sense that the Mexican migratory flow is becoming more geographically diversified, and that there has been an increase in the likelihood of migration originating in the southern states (in figure 3.2, the share of the southern states in *work migrants* increased from 4% to 9% between 1994 and 2002).

Another well-known result obtained in previous empirical studies is that migrants and nonmigrants have different individual characteristics. As an example, in their revision of the pre-IRCA Mexican studies, Bustamante, J. A., G. Jasso, J. E. Taylor and P. T. Legarreta (1998c) indicate that, on average, about 70% of the migrants were below age 30, approximately 85% were males, and roughly 50% were married. A very similar

[44] Chiquiar, D. and G. H. Hanson (2005), p.258. According to the authors, the following states belong to the west-central region: Aguascalientes, Colima, Guerrero, Hidalgo, Jalisco, Guanajuato, Michoacán, Morelos, Nayarit, Oaxaca, Querétaro, San Luis Potosí, and Zacatecas. They also mention that in the year 2000, 9% of the households in these states had sent migrants to the U.S. within the last five years, compared to 2.6% of households in the rest of the country.

Figure 3.6. Regional Shares in Migration to the U.S.

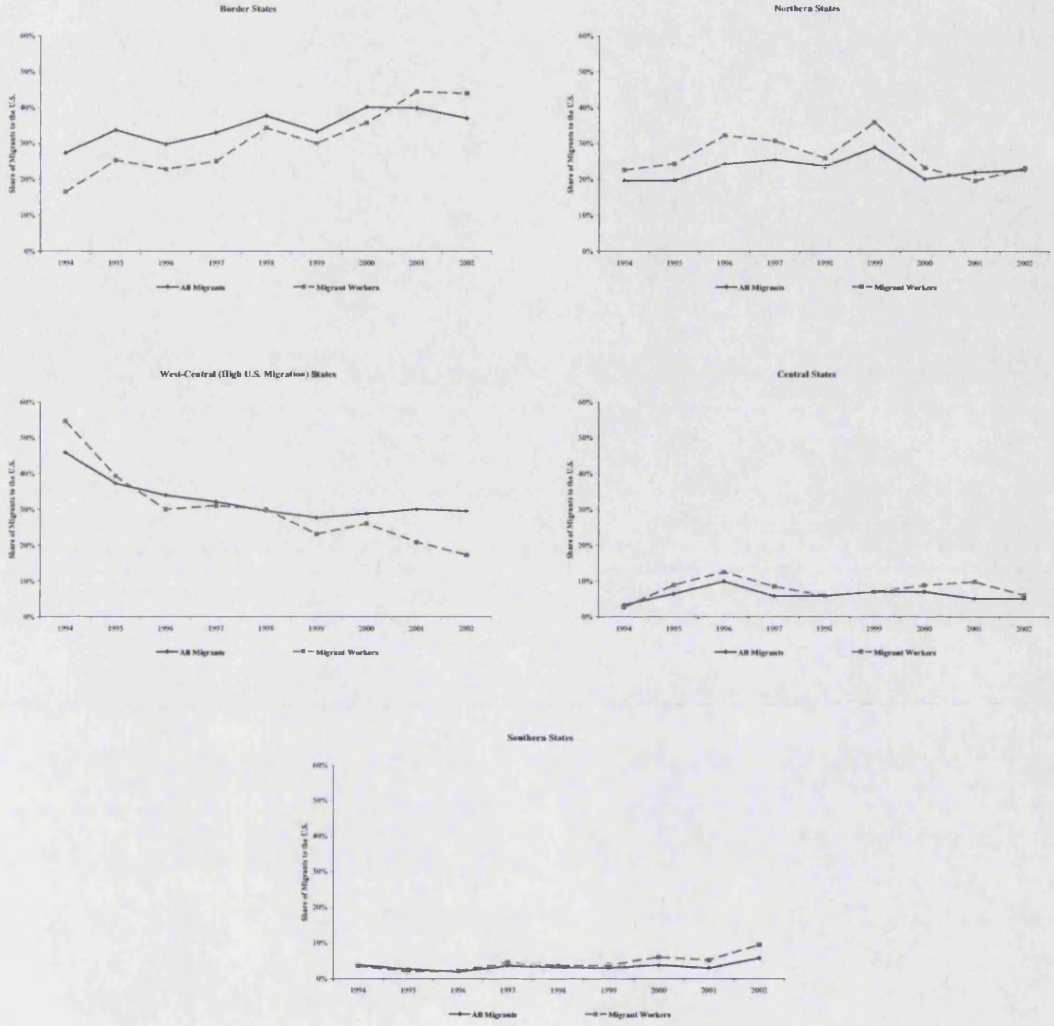
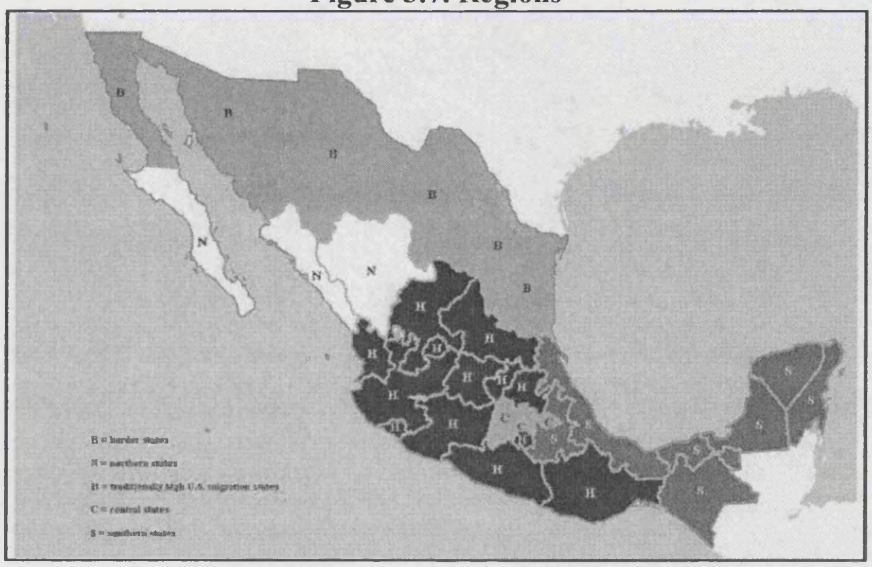


Figure 3.7. Regions



pattern is found in more recent studies and data sources (see Bustamante, J. A. et. al. (1998a), Durand, J. et. al. (2001), and Durand, J. and D. S. Massey (1992)). Also, regarding educational attainment, the profile of the migrants has changed through time. Gamio, M. (1969) found that years of schooling among Mexican migrants to the United States were very low in the early years: around 5. But more recent studies have documented a change towards a higher skilled sector of the population. Using the 1990 and 2000 Mexican and U.S. population censuses, Chiquiar, D. and G. H. Hanson (2005) find that Mexican immigrants in the United States are more educated than nonmigrants in Mexico. Cuecuecha, A. (2005) and Mishra, P. (2003) find that the likelihood of emigration to the United States is higher for more educated Mexicans. These findings contradict the hypothesis of negative selection originally proposed by Borjas, G. J. (1987), which stated that in countries with high returns to education and higher wage dispersion, such as Mexico, individuals in the lower part of the skills distribution are those with the greatest incentives to migrate to the United States. Finally, regarding wages, there is also some evidence suggesting that, compared to the Mexican distribution, migrants to the U.S. would be concentrated in the middle part of it if they were paid according to Mexican prices (Chiquiar, D. and G. H. Hanson (2005)); whereas when compared to the United States distribution, the economic performance of the Mexican migrants has historically lagged behind with respect to both the U.S. natives and other groups of immigrants (Borjas, G. J. and L. F. Katz (2006), Feliciano, Z. M. (2001), and Borjas, G. J. (1982)), with a very weak convergence rate throughout the twentieth century.

Table 3.4 presents estimates of the average individual characteristics for temporary migrants and nonmigrants obtained from the ENEU survey. The first panel shows that in general migrants tend to be older and more experienced than nonmigrants, but the differences become minimal when comparing only *work migrants* with nonmigrants, and they are reversed when comparing the former with employed nonmigrants. Also, the average years of schooling for migrants are very similar to those of the nonmigrants, while the fractions of married and male individuals are greater for the first group. The estimates also seem to indicate that the likelihood of becoming a migrant is greater for the heads of households and for individuals with more children, compared to nonmigrants. Finally, average hourly earnings for migrants are significantly higher than for nonmigrants, as suggested by the literature discussed above.

Table 3.4. Mean Sample Characteristics of Migrants and Non-migrants 1994 Q2 to 2002 Q4

	All Migrants	Migrant Workers	Non-Migrants	Employed Non-Migrants
Age	40.61	34.28	34.74	35.65
Experience	26.87	19.84	20.41	20.61
Schooling	7.75	8.45	8.35	9.04
Married	0.57	0.62	0.48	0.54
Male	0.57	0.88	0.47	0.63
Head of household	0.48	0.63	0.32	0.48
No. children in household	4.08	2.34	2.34	2.00
Hourly earnings[1]	22.55	24.83	15.50	15.50
When in Mexico, lives in:				
a border state	0.38	0.35	0.26	0.26
a northern state	0.23	0.27	0.07	0.07
a west-central state	0.31	0.27	0.37	0.38
a central state	0.05	0.08	0.10	0.10
a southern state	0.02	0.03	0.20	0.19
Employment status[2]:				
employed	0.55	0.80	0.53	1.00
unemployed	0.05	0.07	0.02	0.00
out of the labour force	0.41	0.12	0.45	0.00
If employed[3]:				
works in the formal sector	0.66	0.49	0.73	0.49
works in the informal sector	0.34	0.51	0.27	0.51

Source: author's calculations based on the National Survey of Urban Employment (ENEU). Excludes people that moved to the U.S. for study reasons. "All Migrants" refers to people that was reported as temporarily absent from the household because they migrated to the U.S. for reasons other than studying at the time of one or more of the five quarterly interviews "Migrant Workers" refers to people that was reported as temporarily absent from the household because they migrated to the U.S. for work reasons only, at the time of one or more of the five quarterly interviews.

[1]Nominal hourly earnings in current pesos, obtained during the week before the interview.

[2] For each column, this panel shows the fractions of individual-quarter cells that where employed, unemployed, and out of the labour force throughout the 1994Q2-2002Q4 sample.

[3] For each column, this panel shows the fraction of employed individual-quarter cells that where working in the informal and the formal sector throughout the 1994Q2-2002Q4 sample

The second panel of table 3.4 summarizes the sample share of each one of the Mexican regions described above. It indicates that around 90% of the temporary migrants live in a border, a northern, or a west-central state whenever they are residing in Mexico; compared to a 70% of the nonmigrants. The third panel of the table contains information about the employment status of both migrants and nonmigrants. While the figures for *all migrants* and nonmigrants are very similar to each other, the employment

Table 3.5. Some Sample Characteristics of Mexican Immigrants from the U.S. Current Population Survey Compared to Temporary Migrants from ENEU

	All Mexicans CPS	Recent Mexican Immigrants CPS[1]	All Migrants ENEU	Work Migrants ENEU
Age	35.93	28.41	40.61	34.28
Schooling	8.75	8.61	7.75	8.45
Married	0.64	0.49	0.57	0.62
Male	0.53	0.57	0.57	0.88
Hourly earnings[2]	9.02	7.86	5.42	5.46
Employment status:				
employed	0.62	0.58	0.55	0.80
unemployed	0.06	0.07	0.05	0.07
out of labour force	0.32	0.35	0.41	0.12

Source: author's calculations based on the Basic Monthly Data of U.S. Current Population Survey (National Bureau of Economic Research) and the Mexican National Survey of Urban Labour (ENEU).

[1] Recent immigration by year, as available from the CPS: for 1994 those people entering the U.S. during 1992-1994; for 1995 those entering during 1992-1995; for 1996 those entering during 1994-1996; for 1997 those entering during 1994-1997; for 1998 those entering during 1996-1998; for 1999 those entering during 1996-1999; for 2000 those entering during 1998-2000; for 2001 those entering during 1998-2001; and for 2002 those entering during 2000-2002.

[2] Nominal hourly earnings in current U.S. dollars. For the ENEU migrants, average hourly earnings during the periods of migration only.

and out-of-the-labour-force rates for *work migrants* are notoriously higher and lower, respectively. Finally, the last panel summarizes the formality/informality status for each one of the groups[45]. The shares of formality and informality for *work migrants* are the same as for employed nonmigrants, but they are markedly different from those of *all migrants* and nonmigrants: while formality and informality basically have an equal share in the first group, formality is more common than informality in the other two groups.

In sum, the statistics presented in table 3.4 seem to confirm the findings of previous studies regarding the individual characteristics of the migrants, particularly for the *work migrants*. This is also an indicator of the good quality of the data collected by the ENEU survey. The table also displays one of the advantages of this survey by presenting evidence on the employment and the formality/informality status of the migrants, two characteristics that were rarely reported in previous studies and that could certainly be very important determinants of the migration decision. Table 3.5 contains some of the

[45] Following the definition used in ALEMAN-CASTILLA, B. (2006): "The Effect of Trade Liberalization on Informality and Wages: Evidence from Mexico," *CEP Discussion Papers*, pp. 1-71., a person is classified as working in the informal sector if he or she runs a firm of 6 or less employees and does not have any kind of social or health insurance (*informal self-employed*), if he or she works for a firm of any size and does not have any kind of social or health insurance (*informal salaried*), and if he or she works without receiving any kind of payment (*unpaid workers*).

average individual characteristics for Mexican immigrants obtained from the basic monthly data of the U.S. Current Population Survey, and compares them to those of Mexican migrants in the ENEU survey. The characteristics of the ENEU work migrants are in general closer to those of the *all Mexicans CPS* category.

Finally, another interesting characteristic of the Mexican migrants is the economic sector to which they belong, both when they are still in Mexico and when they are already in the United States. For the pre-IRCA period, Bustamante, J. A. et. al. (1998c) identified the agricultural, transport, services, and commerce as some of the most common economic sectors to which migrants were affiliated before leaving Mexico; whereas the agricultural, construction, and transport sectors were the preferred ones once they were already in the United States. Regarding their occupation, the authors mention that most of the migrants were working as labourers, self-employed, and peasants before migrating; and most of them worked as peasants, construction workers, industrial labourers, and services employees during their stay in the United States. Papail, J. (1998) presents data on the economic activity of Mexican migrants from medium-sized cities in the state of Jalisco, for the period between 1980 and 1995. Regarding the economic sector affiliation before migration, he finds evidence of a progressive diversification of activities in detriment of agriculture (which used to provide around 50% of the migratory flows before 1980) and favouring the industrial and the services sector, principally. Papail finds a similar pattern regarding economic sector affiliation of Mexican immigrants in the United States, with more migrants moving from the agricultural to the industrial, construction, restaurants & hotels, and services sectors. Finally, Latapi, A. E., P. Martin, P. S. Davies, G. L. Castro and K. Donato (1998) and Borjas, G. J. and L. F. Katz (2006) also report some data on the participation of Mexican immigrants in the U.S. labour markets. Both studies identify janitors and cleaners, food preparation workers, private household workers, farm workers, gardeners and nursery workers, sewing machine operators, garment, construction workers, and vehicle washers and cleaners as some of the major occupations in which Mexican-born workers were a majority of all workers during 1994 and 2000, respectively.

Table 3.6 summarizes the information on economic sector affiliation of temporary migrants contained in the ENEU sample. It presents data for people that migrated for other reasons (*non-work migrants*) and people that migrated for work reasons, separately. For each one of these groups, the table reports the economic sector shares of

Table 3.6. Distribution of Migrants to the U.S. by Economic Sector

Economic Sector	Non-Work Migrant		Work Migrant	
	in Mexico	in the U.S	in Mexico	in the U.S.
Farms, forestry & fishing	0.68%	0.59%	6.92%	13.36%
Mining, Petroleoum & coal extraction	0.00%	0.00%	0.47%	0.12%
Petroleoum & coal extraction	0.00%	0.00%	0.12%	0.12%
Manufacturing industries	7.81%	7.13%	18.87%	20.63%
Construction	2.44%	2.93%	12.43%	14.30%
Electricity, gas & water	0.00%	0.10%	0.23%	0.12%
Hotels, restaurants & trade	13.77%	12.89%	16.88%	3.99%
Transport & storage	1.76%	1.66%	8.44%	3.75%
Financial services & real estate	0.20%	0.10%	0.82%	0.00%
Personal, professional and social services	15.82%	13.77%	24.38%	39.62%
Not available/unemployed/out of the labour force	57.62%	60.94%	10.55%	4.10%
No. Observations (individual-quarter cells)	1,024	1,024	853	853

Source: author's calculations based on the National Survey of Urban Labour (ENEU). Percentages are calculated as the fraction of individual-quarter cells that declared to be in a particular economic sector, divided by the total number of individual-quarter cells in each one of the four categories listed in the columns of the table.

migrants both before and during migration to the United States. To understand where the numbers are coming from, recall that the sample used here is a balanced panel with 5 quarterly observations for each individual, covering the period between 1994 and 2002. The percentages in table 3.6 are therefore calculated from the individual-quarter cells that fall in each one of the four categories included in it. For example, according to table 2 there are 953 *work migrants* in the sample, each one with 5 quarterly observations. Following the last row in table 3.6, only in 853 migration episodes of these people it is possible to see what they where doing before leaving (i.e. only in these 853 cases migration did not occur during the first interview). Thus, for the case of *non-work migrants*, apart from being unemployed or out of the labour force, the main economic sectors of origin are the *Personal, professional & social services* and the *Hotels, restaurants & trade* sectors, followed by the *Manufacturing industries; Construction;* and *Transport & storage* sectors. Not surprisingly, roughly the same economic sector affiliation preferences are observed for the periods when these migrants are in the United States, confirming that in most of these cases people are effectively travelling for reasons other than joining the U.S. labour force. In other words, it is very likely that in most of the *non-work migrant* cases the economic sector

Table 3.7. Main Occupations of Non-Worker Migrants Before and During Migration

	Before Migration	During Migration	Absoulte Change	% Change
Agents, sales representatives, wholesalers, suppliers	**61**	**39**	***-22***	***-36%***
Clerks and cashiers	**45**	**39**	***-6***	***-13%***
Other services employees	30	31	*1*	*3%*
Construction workers	30	26	*-4*	*-13%*
Food, Beverages & Tobacco labourers	**29**	**23**	***-6***	***-21%***
Other manufacturing labourers	25	26	*1*	*4%*
Secretaries	**22**	**16**	***-6***	***-27%***
Domestic servants	21	18	*-3*	*-14%*
Street vendors and cash washers	**18**	**29**	***11***	***61%***
M&E, Metallurgy, Mineral Products craftsmen and labourers	18	21	*3*	*17%*
Supervisors & Inspectors	**18**	**13**	***-5***	***-28%***
Technicians	17	16	*-1*	*-6%*
Professionals	16	19	*3*	*19%*
Teachers and instructors	16	16	*0*	*0%*
Directors, managers & CEOs	16	14	*-2*	*-13%*
Machinery operators	15	19	*4*	*27%*
Drivers, pilots and sailors	13	15	*2*	*15%*
Janitors	8	11	*3*	*38%*
Nurses and nursemaids	7	6	*-1*	*-14%*
Farms, forestry & fishing labourers and peasants	7	5	*-2*	*-29%*
Gardeners	3	1	*-2*	*-67%*
Unspecified employment status	1	2	*1*	*100%*
Employed	**363**	**231**	***-132***	*-36%*
Unemployed	20	13	*-7*	*-35%*
Out of the labour force	**640**	**778**	***138***	*22%*
TOTAL (individual-quarter cells)	**1024**	**1024**		

Source: author's calculations based on the National Survey of Urban Labour (ENEU). "Before Migration" refers to the quarter immediately before being registered as temporarily absent from the household for reasons other than work or study. The rows with bold numbers refer to those occupations for which the reported values changed in 5 or more units.

reported by the ENEU in the quarters when these individuals where temporarily away is simply referring to their economic activity back in Mexico.

Regarding *work migrants*, the main economic sectors of origin are the *Personal, professional & social services* and *Manufacturing industries*, followed by the *Hotels, restaurants & trade; Construction;* and *Transport & storage* sectors. The relatively low importance of agriculture as a sector of origin is obviated by the fact that, as described in the previous section, the ENEU survey is an urban employment survey. Compared to the case of *non-work migrants*, a much smaller fraction of *work migrants* come from unemployment or economic inactivity. On the other hand, the last column of the table indicates that there is a strong preference of this type of migrants to work in the *Personal, professional & social services; Manufacturing industries; Construction;* and *Farms, forestry & fishing* sectors. The fact that the unemployment and out-of-the-labour-force shares are substantially lower for these migrants when they are in the U.S. than when they are in Mexico confirms that the reason for leaving in the first place was to work abroad.

Finally, tables 3.7 and 3.8 tabulate the occupations of employed *non-work* and *work* migrants, both for the interview just before migrating and for the interview during migration to the United States. In table 3.7 the rows with bold numbers refer to those

Table 3.8. Main Occupations of Migrant Workers Before and During Migration

	Before Migration	During Migration	Absoulte Change	% Change
Construction workers	129	124	-5	-4%
Drivers, pilots and sailors	**82**	**45**	**-37**	**-45%**
Other services employees	**59**	**127**	**68**	**115%**
M&E, Metallurgy, Mineral Products craftsmen and labourers	**57**	**41**	**-16**	**-28%**
Farms, forestry & fishing labourers and peasants	**52**	**113**	**61**	**117%**
Agents, sales representatives, wholesalers, suppliers	**49**	**12**	**-37**	**-76%**
Machinery operators	**41**	**26**	**-15**	**-37%**
Clerks and cashiers	**37**	**20**	**-17**	**-46%**
Food, Beverages & Tobacco labourers	**36**	**57**	**21**	**58%**
Supervisors & Inspectors	**28**	**14**	**-14**	**-50%**
Professionals	25	25	0	0%
Wood, Paper & Printing craftsmen and labourers	**23**	**50**	**27**	**117%**
Electrical & Telecommunications equipment labourers	**22**	**11**	**-11**	**-50%**
Other manufacturing labourers	21	25	4	19%
Technicians	19	12	-7	-37%
Janitors	**18**	**39**	**21**	**117%**
Directors, managers & CEOs	18	11	-7	-39%
Street vendors and cash washers	15	9	-6	-40%
Gardeners	**9**	**22**	**13**	**144%**
Secretaries	8	5	-3	-38%
Domestic servants	8	11	3	38%
Teachers and instructors	6	7	1	17%
Nurses and nursemaids	**3**	**18**	**15**	**500%**
Unspecified employment status	1	5	4	400%
Employment	**647**	**696**	**49**	**8%**
Unemployed	**67**	**109**	**42**	**63%**
Out of the labour force	**138**	**43**	**-95**	**-69%**
TOTAL (individual-quarter cells)	**853**	**853**		

Source: author's calculations based on the National Survey of Urban Labour (ENEU). "Before Migration" refers to the quarter immediately before being registered as temporarily absent from the household for work reasons. The rows with bold numbers refer to those occupations for which the reported values changed in 10 or more units.

occupations for which the reported values changed in 5 or more units. 138 out of the 1,024 (13.5% approximately) *non-work* migrants dropped out of the labour force during their migratory experience. The most common occupations both before and during migration are *Agents and sales representatives; Clerks and cashiers; Construction workers; Other services employees* and *Food, beverages & tobacco labourers*. The occupations in which the labour force increased the most both in absolute and relative terms were *Street vendors and cash washers*; *Machinery operators;* and *Janitors*. The occupations in which the labour force decreased the most were *Agents and sales representatives; Secretaries; Food, beverages & tobacco labourers; Clerks and cashiers;* and *Supervisors and Inspectors*. On the other hand, for the case of the *work migrants*, table 3.8 presents the data for the *work migrants* group. Given that there are more dramatic changes than in the previous group, the rows with bold numbers now refer to those occupations for which the reported values changed in 10 or more units. The most common occupations before migration are *Construction workers; Drivers, pilots and sailors; Other services employees; M&E, Metallurgy and Mineral Products craftsmen and labourers;* and *Farms, forestry & fishing labourers and peasants*. The most common ones during the stay in the United States are *Other services employees; Construction workers; Farms, forestry & fishing labourers and peasants; Food,*

Table 3.9. Most Common Industries and Occupations Among Employed Recent Mexican Immigrants from the U.S. Current Population Survey

Industries	Fraction of Employed Recent Mexican Immigrants	Occupations	Fraction of Employed Recent Mexican Immigrants
Eating and drinking places	19.8%	Cooks	9.3%
All construction	17.0%	Farm workers	7.7%
Agricultural production, crops	6.1%	Groundskeepers and Gardeners	7.0%
Landscape and horticultural services	5.9%	Construction labourers	6.3%
Private household	3.0%	Misc. food preparation occupations	5.9%
Hotels and motels	2.9%	Janitors and cleaners	4.9%
Meat products	2.8%	Labourers, except construction	3.0%
Services to dwellings and other buildings	2.5%	Maids and housemen	2.3%
Apparel and accessories	2.4%	Waiters/waitresses assistants	2.3%
Grocery stores	2.4%	Stock handlers and baggers	2.3%
Other	35.2%	Other	49.1%

Source: author's calculations based on the Basic Monthly Data of the U.S. Current Population Survey (NBER). Recent immigration by year, as available from the CPS: for 1994 those people entering the U.S. during 1992-1994; for 1995 those entering during 1992-1995; for 1996 those entering during 1994-1996; for 1997 those entering during 1994-1997; for 1998 those entering during 1996-1998; for 1999 those entering during 1996-1999; for 2000 those entering during 1998-2000; for 2001 those entering during 1998-2001; and for 2002 those entering during 2000-2002.

beverages & tobacco labourers; and *Wood, Paper & Printing craftsmen and labourers.* Among the occupations with the largest labour force increases, both in absolute and relative terms, were *Other Services employees; Farms, forestry & fishing labourers and peasants; Wood, Paper & Printing labourers; Food, beverages & tobacco labourers; Janitors;* and *nurses and nursemaids.* The occupations in which the labour force decreased the most were *Drivers, pilots and sailors; Agents and sales representatives; Clerks and cashiers; M&E, Metallurgy and Mineral Products craftsmen and labourers;* and *Machinery operators.* And lastly, for the sake of comparison, table 3.9 reports the 10 most common industries and occupations among employed recent Mexican immigrants, according to the CPS.

To conclude, the statistics for temporary *work migrants* presented in tables 3.7 and 3.8 seem to support the findings of previous studies regarding the economic sector affiliation and the occupation of Mexican migrants to the United States. The results presented in these tables also seem to indicate that in most of the cases there is no misreporting of the reasons for migration of the *non-work migrants*, and that for the majority of these individuals, the data collected by the ENEU during their periods of absence from the household refers to their occupation back in Mexico. In other words, the majority of the people reported as *non-work migrant* may be travelling to the U.S. for holidays or perhaps for business reasons; but not with the purpose of getting a job there.

3.4. The Returns to Temporary Migration

Most of the literature on the economic performance of migrants available to date has dealt with how well they do in the host country, compared both to the native population and to other immigrants from different countries of origin. For example, apart from the studies by Chiquiar, D. and G. H. Hanson (2005), Borjas, G. J. and L. F. Katz (2006), Feliciano, Z. M. (2001), and Borjas, G. J. (1982) mentioned in the previous section, Borjas, G. J. (1989) analyzes the relationship between earnings and the extent of assimilation, cohort quality change, and return migration experienced by the foreign-born population in the United States. Using longitudinal data from the 1972-1978 Survey of Natural and Social Scientists and Engineers, he finds that the rate of convergence between the age/earnings profiles of immigrants and natives is relatively small, and that there had been a sizable drop in the skills of immigrant scientists and engineering cohorts in the 1960s and the 1970s. In addition, return migration was more likely among immigrants who did not perform well in the U.S. labour market. Also, Dustmann, C. (1991) studies the optimal investment decision of European temporary migrants into country specific human capital, and its implications for the evolution of the earnings gap between migrants and natives. Using the first wave of the German Socioeconomic Panel of 1984 to analyze temporary migration to West Germany, he finds that foreign workers in the German labour market receive lower wages than their native counterparts throughout their working history, and that the earnings gap between these two groups is not closing over time.

On the other hand, there is considerably less evidence on the economic performance of migrants relative to when they are in their home country or after return migration. Dustmann, C. and O. Kirchkamp (2002) use a survey dataset of Turkish immigrants to Germany that returned to Turkey in 1984, and they find that about half of the returning population of immigrants becomes active as an entrepreneur after return, and that the capital for starting off a business stems from savings and capital acquired abroad. Another study is the one by Paulson, A. and A. Singer (2000). Using variation in the probability that Mexican immigrants to the U.S. will return and work in Mexico, they test the predictions of the permanent income model for savings (i.e. that the higher the probability of returning and working in Mexico, the more temporary is the increase in wages that the migrant experiences by crossing the border, and therefore his savings rate should be higher than for migrants with a lower probability of returning to Mexico). Using data from the Mexican Migration Project, they find that a higher probability of

return is associated with a lower savings rate, but that the interaction between the probability of returning and migrant income increases the savings rate significantly.

Thus, the analysis in this section aims at presenting new evidence from the Mexican National Survey of Urban Labour on the effect of temporary migration to the United States on earnings, both during and after migration. As in the previous section, work and non-work migrants are considered separately and compared to the nonmigrants. Given that most of the migrants in the sample where reported as absent from the household once and just for one of the interviews (see table 3.2), the analysis is based only on this group whenever it is necessary, in order to simplify the exposition of the results. To begin, recall that the dynamic labour supply theory (see, for example MaCurdy, T. E. (1981)) suggests that the marginal disutility of work is proportional to the real wage rate. Therefore, given that real wages are higher in the United States than in Mexico, a migrant worker would be expected to earn more and work longer hours during his stay in the former country. Figures 3.8 and 3.9 show the average hourly earnings for work and non-work migrants grouped by quarter of migration and compared to the average hourly earnings for nonmigrants in the ENEU data. Two things are evident from figure 3.8: first, the increase in earnings during the period of migration; and second, the fact that average earnings for work migrants tend to be above that of nonmigrants. Less evident is whether earnings after migration are higher than earnings before migration, which may be partially due to the length of the observable period, and partially due to the length of the migration period. In other words, the observable period may be too short to capture any possible change in earnings obtained in Mexico that could be attributable to the effect of migration; or alternatively, the duration of migration may be too short as to have such an effect. For the case of non-work migrants, there is basically no generalized pattern through time. Figure 3.10 plots the average hourly earnings for work and non-work migrants that apparently move seasonally to the United States (i.e. those that migrate during the first and the fifth quarters), against those for nonmigrants. As before, earnings of work migrants are clearly higher during these two periods.

Figures 3.11 and 3.12 show the average weekly hours worked by work and non-work migrants, also grouped by quarter of migration and compared to the average weekly hours for nonmigrants. As with earnings, weekly hours for work migrants increase during the period of migration and tend to be always above those of nonmigrants. In contrast, average weekly hours for non-work migrants decrease during the period of

Figure 3.8. Average Hourly Earnings for Migrant Workers by Quarter of Migration

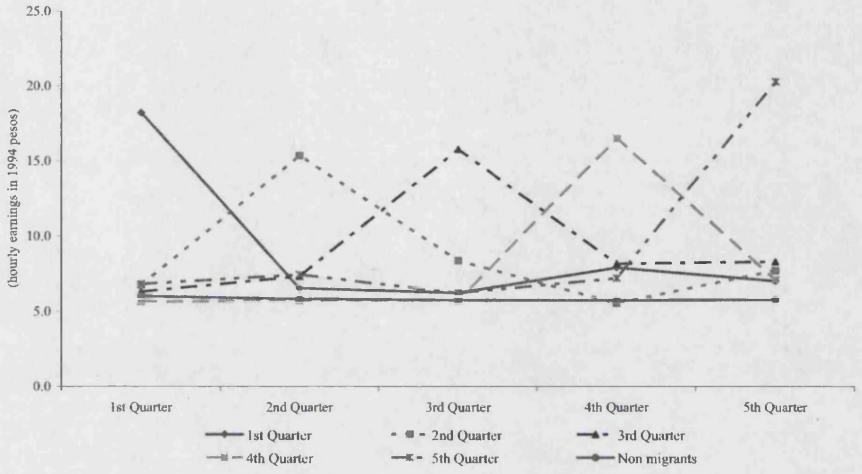


Figure 3.9. Average Hourly Earnings for Non-Work Migrants by Quarter of Migration

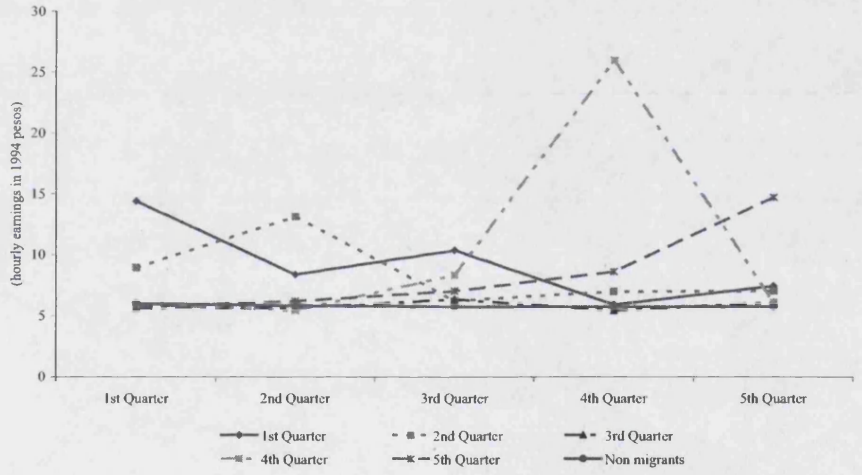


Figure 3.10. Average Hourly Earnings for People that Migrated in the 1st and the 5th Quarters

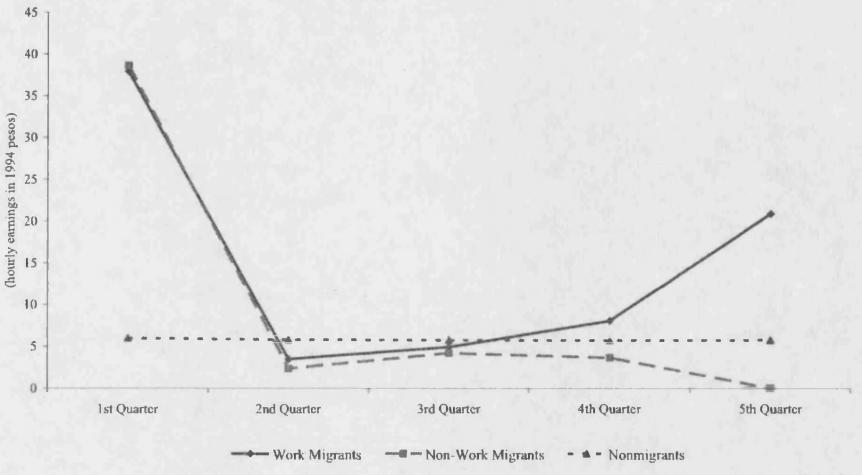


Figure 3.11. Average Weekly Hours Worked by Migrant Workers by Quarter of Migration

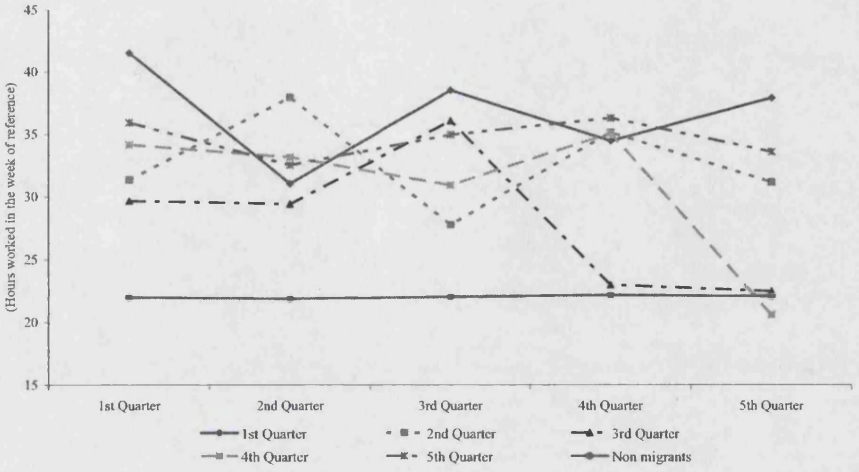


Figure 3.12. Average Weekly Hours Worked by Non-Work Migrants by Quarter of Migration

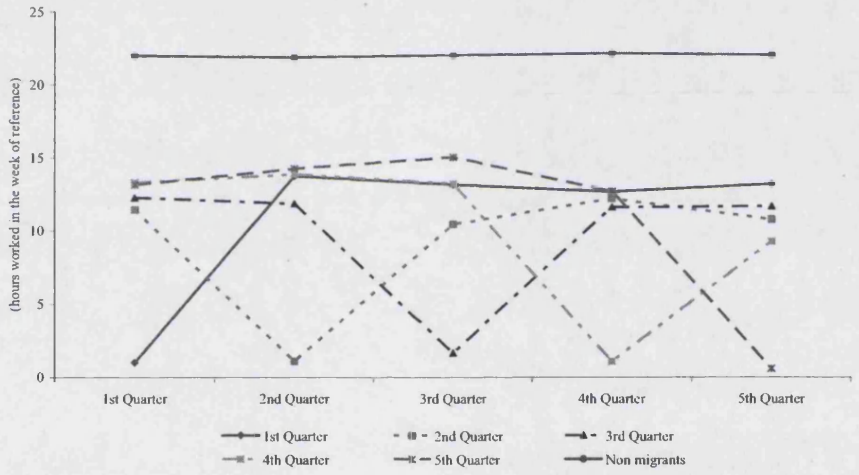
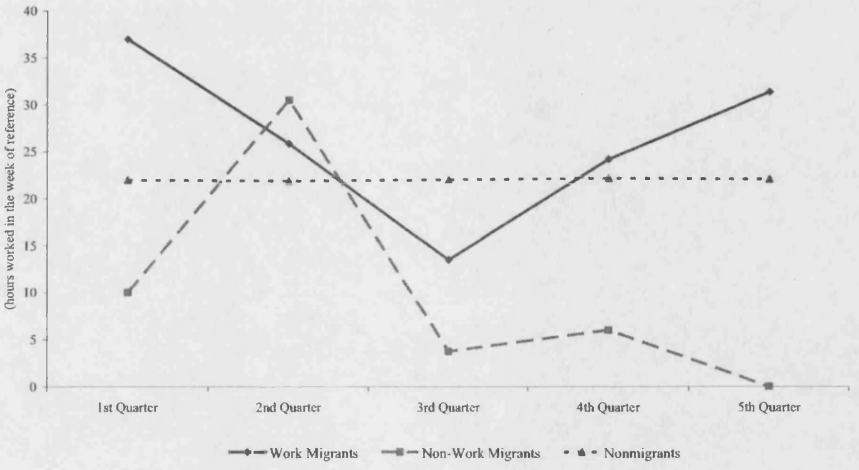


Figure 3.13. Average Weekly Hours Worked by People that Migrated in the 1st and the 5th Quarters



migration and tend to be always below those of nonmigrants. Figure 3.13 shows that the average weekly hours worked by seasonal migrants have a very similar pattern.

Finally, figures 3.14 to 3.16 plot the quarterly employment shares for work and non-work migrants against those for nonmigrants. In both cases these shares follow closely the behaviour of the average weekly hours worked, as may be expected. The fraction of employed work migrants tends to increase by about 5 to 10 percentage points during the quarter of migration, while the fraction of employed non-work migrants tends to decrease by about 10 to 15 percentage points during the referred quarter. For the case of nonmigrants, the share of employment remains constant throughout the five quarters, at approximately 53%.

Overall, the graphs suggest that temporary migration should affect both the earnings and the labour supply of work migrants. To estimate the effects on earnings, the following equation is fitted using fixed effects:

$$y_{it} = X_{it}\beta_X + M_{it}\delta_M + B_{it}\varphi_B + A_{it}\theta_A + \varepsilon_i + \varepsilon_t + \varepsilon_{it} \qquad (3.1)$$

where y_{it} is the natural logarithm of hourly earnings for individual i at time t, X_{it} is a matrix of time variant individual characteristics (e.g. a quadratic term on potential experience, years of schooling, a dummy variable for marriage, and an indicator for informality), and M_{it} is an dummy variable equal to 1 if individual i migrated to the United States at time t and 0 otherwise. B_{it} and A_{it} are vectors of dummy variables included to see whether there is a relationship between migration at quarter t and earnings in a quarter other than the quarter of migration. B_{it} is a vector of dummy variables for the periods before the period of migration, and A_{it} is a vector of dummy variables for the periods after the period of migration. The time-specific effect ε_t is captured by a set of dummy variables for all the quarters included in the sample (from the third quarter of 1994 to the fourth quarter of 2002). Given that equation (3.1) is fitted using the fixed effects method, all the time invariant individual characteristics (e.g. gender or region of origin) and the individual effects ε_i are removed from the estimation. The estimated φ_B, δ_M, and θ_A's and their standard errors (clustered at the individual level) for work and non-work migrants are reported in panel A of table 3.10. Column (1) shows that during the quarter of migration, a work migrant earns on average 112% more than when he is in Mexico, and this effect is significant at the 1%

Figure 3.14. Employment Share for Migrant Workers by Quarter of Migration

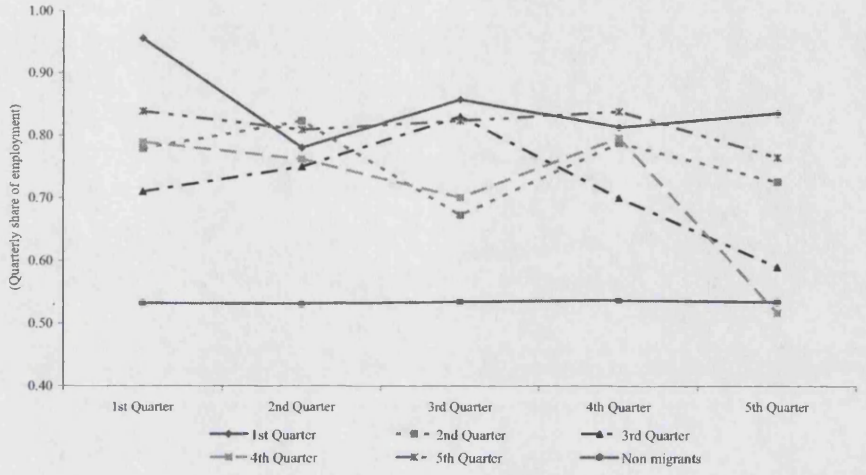


Figure 3.15. Employment Share for Non-Work Migrants by Quarter of Migration

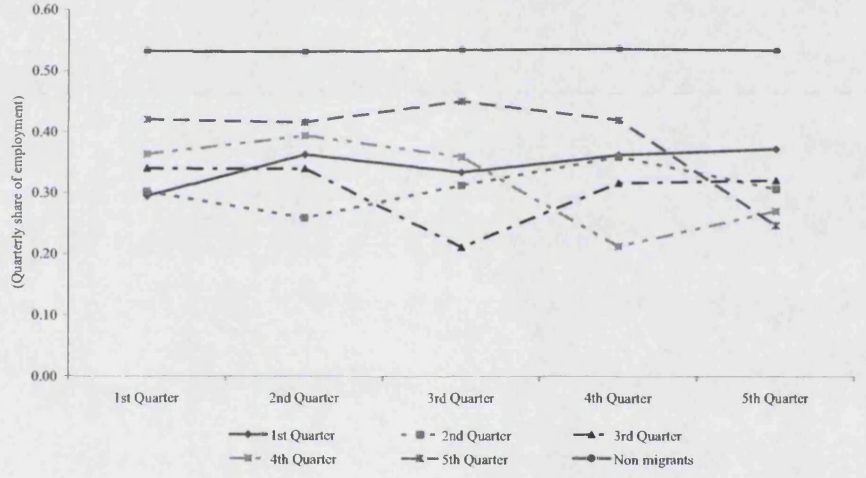


Figure 3.16. Employment Share for People that Migrated in the 1st and the 5th Quarters

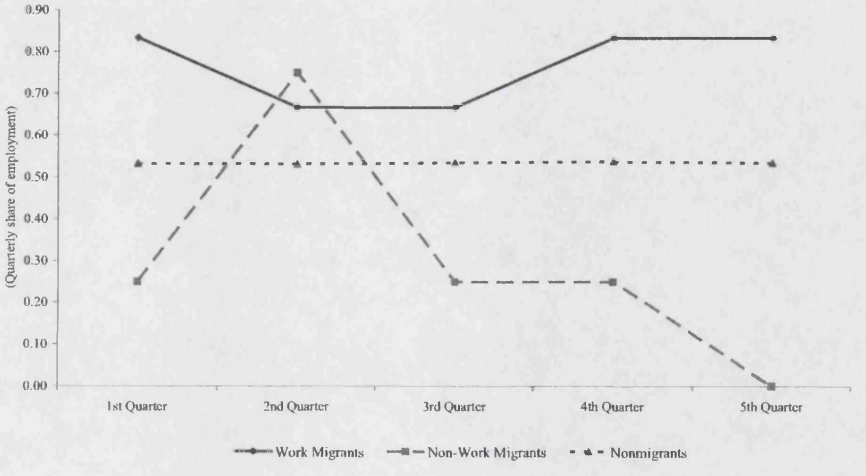


Table 3.10: Fixed Effects Estimates of the Effect of Temporary Migration on ln(hourly earnings), ln(weekly hours), and Employment

	Work Migrants			Non-Work Migrants		
	(1) ln(hourly earnings)	(2) ln(weekly hours)	(3) Employment	(4) ln(hourly earnings)	(5) ln(weekly hours)	(6) Employment
Panel A. Including Individual Observable Characteristics						
4 quarters before being in U.S.	-0.129	0.104	0.015	0.044	-0.006	-0.004
	[0.175]	[0.078]	[0.048]	[0.340]	[0.096]	[0.029]
3 quarters before being in U.S.	-0.111	0.120	-0.016	0.079	-0.029	-0.004
	[0.172]	[0.074]	[0.046]	[0.330]	[0.087]	[0.027]
2 quarters before being in U.S.	-0.184	0.108	-0.047	0.140	-0.039	-0.003
	[0.171]	[0.072]	[0.044]	[0.326]	[0.083]	[0.026]
1 quarter before being in U.S.	-0.183	0.095	-0.054	0.164	-0.040	-0.020
	[0.165]	[0.069]	[0.042]	[0.324]	[0.082]	[0.025]
During stay in U.S.	0.753 ***	0.177 **	-0.073	0.529	-0.119	-0.103 ***
	[0.176]	[0.072]	[0.046]	[0.393]	[0.146]	[0.026]
1 quarter after being in U.S.	-0.061	0.114 *	-0.115 ***	0.146	-0.031	-0.051 **
	[0.160]	[0.067]	[0.042]	[0.317]	[0.076]	[0.025]
2 quarters after being in U.S.	-0.170	0.123 *	-0.074	0.152	0.010	-0.035
	[0.166]	[0.070]	[0.045]	[0.324]	[0.084]	[0.025]
3 quarters after being in U.S.	0.003	0.104	-0.070	0.182	-0.058	-0.040
	[0.168]	[0.071]	[0.048]	[0.327]	[0.093]	[0.027]
4 quarters after being in U.S.	0.008	0.171 **	-0.089 *	0.100	0.048	-0.035
	[0.172]	[0.074]	[0.052]	[0.344]	[0.117]	[0.034]
No. of observations	2,826,450	3,182,119	6,271,852	2,824,869	3,180,262	6,272,752
No. of groups	782,995	834,179	1,257,181	782,612	833,816	1,257,356
Panel B. Excluding Individual Observable Characteristics						
4 quarters before being in U.S.	-0.114	0.099	-0.012	0.049	-0.012	0.012
	[0.174]	[0.078]	[0.057]	[0.343]	[0.094]	[0.058]
3 quarters before being in U.S.	-0.111	0.118	-0.029	0.089	-0.040	0.016
	[0.170]	[0.074]	[0.055]	[0.333]	[0.085]	[0.054]
2 quarters before being in U.S.	-0.182	0.107	-0.061	0.143	-0.046	0.019
	[0.170]	[0.073]	[0.054]	[0.328]	[0.082]	[0.053]
1 quarter before being in U.S.	-0.183	0.093	-0.072	0.163	-0.042	-0.015
	[0.164]	[0.069]	[0.051]	[0.326]	[0.080]	[0.052]
During stay in U.S.	0.737 ***	0.162 **	-0.012	0.530	-0.136	-0.139 ***
	[0.175]	[0.072]	[0.056]	[0.395]	[0.144]	[0.054]
1 quarter after being in U.S.	-0.068	0.107	-0.133 ***	0.144	-0.040	-0.051
	[0.159]	[0.068]	[0.050]	[0.319]	[0.075]	[0.052]
2 quarters after being in U.S.	-0.175	0.119 *	-0.093 *	0.149	-0.004	-0.030
	[0.165]	[0.071]	[0.055]	[0.327]	[0.083]	[0.053]
3 quarters after being in U.S.	-0.001	0.101	-0.092	0.183	-0.068	-0.045
	[0.167]	[0.072]	[0.057]	[0.330]	[0.092]	[0.055]
4 quarters after being in U.S.	0.003	0.166 **	-0.084	0.099	0.039	-0.031
	[0.171]	[0.075]	[0.063]	[0.347]	[0.115]	[0.062]
No. of observations	2,877,459	3,236,549	6,352,933	2,875,879	3,234,698	6,353,830
No. of groups	795,711	847,178	1,273,093	795,328	846,815	1,273,267
Panel C. Including Individual Observable Characteristics and Excluding B_{it} and A_{it} Dummy Variables						
During stay in U.S.	0.886 ***	0.063 ***	-0.007	0.390 *	-0.088	-0.077 ***
	[0.046]	[0.015]	[0.012]	[0.232]	[0.106]	[0.008]
No. of observations	2,876,865	3,235,811	6,351,164	2,875,285	3,233,960	6,352,060
No. of groups	795,675	847,144	1,273,081	795,292	846,781	1,273,255

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include quarter dummies. Individual controls include a quadratic term on experience, years of schooling, marital status, and an informality indicator. Robust standard errors clustered at the individual level are shown in brackets.

level. Column (4) indicates that the effect in the case of non-work migrants is much smaller and not significant.

The semi-logarithmic model in equation (3.1) can also be used to estimate the effect of temporary migration on weekly hours worked. The corresponding results are reported in columns (2) and (5) of table 3.10. Column (2) shows that during the quarter of migration, a work migrant works on average 19% more hours per week than when he is Mexico, and as with earnings, this effect is significant at a 1% level. In contrast, column (5) indicates that migrating to the United States does not affect the weekly hours worked by non-work migrants.

Finally, in order to estimate the effect of temporary migration on the likelihood of employment, equation (3.1) is also fitted for a binary variable which is equal to 1 if individual i is employed at time t, and equal to 0 otherwise. The corresponding estimates are shown in columns (3) and (6) of table 3.10. Column (3) shows that the likelihood of employment for a work migrant is lower than for non migrants during the period immediately after migration, indicating that these people face an adjustment process when they return from the U.S. and try to join the Mexican labour force again. Alternatively, it could also be indicating that migrant workers tend to substitute their labour supply in Mexico with their labour supply in the U.S. On the other hand, for non-work migrants column (6) indicates that their likelihood of employment is significantly lower only during the quarter of migration and the quarter immediately after it.

Panel B in table 3.10 repeats the estimations excluding the time variant individual characteristics. The results are very similar to those in panel A, indicating that observable characteristics do not play a very important role. Also, F-tests for the joint significance of the B_{it} and A_{it} variables in panel A were carried out. The null hypothesis of no significance could not be rejected for the regressions in columns (2), (4), and (5). For this reason, panel C shows the estimation results excluding these variables. The effect of temporary migration on earnings for work migrants is now larger, and the effect on hours is smaller, indicating that Mexican workers increase their weekly hours worked by about 6.5% when they are in the United States. For the case of non-work migrants, there is now an increase of 48% in earnings, significant at the 10% level, and a smaller effect on the likelihood of employment.

The coefficients reported in table 3.10 are estimates of the effects of temporary migration within individuals. In order to measure these effects between individuals, equation 1 is also fitted using random effects. The results are reported in table 3.11, and

Table 3.11: Random Effects Estimates of the Effect of Temporary Migration on ln(hourly earnings), ln(weekly hours), and Employment

	Work Migrants			Non-Work Migrants		
	(1) ln(hourly earnings)	(2) ln(weekly hours)	(3) Employment	(4) ln(hourly earnings)	(5) ln(weekly hours)	(6) Employment
Panel A. Including Individual Observable Characteristics						
nonmigrant dummy	-0.089	0.058	-0.014	-0.117	0.083	0.074 ***
	[0.146]	[0.065]	[0.044]	[0.225]	[0.088]	[0.027]
4 quarters before being in U.S.	-0.020	0.112	0.010	-0.127	-0.003	-0.012
	[0.152]	[0.072]	[0.047]	[0.238]	[0.101]	[0.030]
3 quarters before being in U.S.	0.004	0.126 *	-0.018	-0.126	0.012	-0.013
	[0.149]	[0.067]	[0.045]	[0.227]	[0.090]	[0.027]
2 quarters before being in U.S.	-0.055	0.116 *	-0.047	-0.071	0.003	-0.010
	[0.148]	[0.066]	[0.043]	[0.224]	[0.088]	[0.026]
1 quarter before being in U.S.	-0.046	0.101	-0.053	-0.024	-0.003	-0.026
	[0.143]	[0.063]	[0.042]	[0.223]	[0.087]	[0.026]
During stay in U.S.	0.941 ***	0.201 ***	-0.068	0.379	-0.063	-0.108 ***
	[0.151]	[0.065]	[0.045]	[0.291]	[0.134]	[0.027]
1 quarter after being in U.S.	0.076	0.119 *	-0.110 ***	-0.030	0.006	-0.055 **
	[0.140]	[0.061]	[0.041]	[0.217]	[0.084]	[0.026]
2 quarters after being in U.S.	-0.046	0.128 **	-0.068	-0.011	0.025	-0.036
	[0.144]	[0.065]	[0.044]	[0.226]	[0.090]	[0.026]
3 quarters after being in U.S.	0.119	0.108 *	-0.063	0.017	-0.027	-0.040
	[0.147]	[0.066]	[0.048]	[0.228]	[0.098]	[0.028]
4 quarters after being in U.S.	0.105	0.178 ***	-0.081	-0.028	0.017	-0.027
	[0.152]	[0.069]	[0.051]	[0.243]	[0.124]	[0.034]
No. of observations	2,826,450	3,182,119	6,271,852	2,824,869	3,180,262	6,272,752
No. of groups	782,995	834,179	1,257,181	782,612	833,816	1,257,356
Panel B. Excluding Individual Observable Characteristics						
nonmigrant dummy	-0.196	-0.032	-0.329 ***	-0.140	0.137 *	0.164 ***
	[0.154]	[0.067]	[0.053]	[0.300]	[0.079]	[0.053]
4 quarters before being in U.S.	-0.038	0.110	-0.012	-0.165	-0.025	0.009
	[0.159]	[0.073]	[0.057]	[0.311]	[0.091]	[0.056]
3 quarters before being in U.S.	-0.039	0.126 *	-0.030	-0.134	-0.022	0.012
	[0.156]	[0.069]	[0.055]	[0.302]	[0.080]	[0.053]
2 quarters before being in U.S.	-0.103	0.117 *	-0.061	-0.087	-0.027	0.015
	[0.155]	[0.068]	[0.053]	[0.299]	[0.079]	[0.051]
1 quarter before being in U.S.	-0.100	0.101	-0.070	-0.035	-0.022	-0.019
	[0.150]	[0.065]	[0.050]	[0.299]	[0.077]	[0.050]
During stay in U.S.	0.856 ***	0.173 ***	-0.006	0.354	-0.111	-0.142 ***
	[0.159]	[0.067]	[0.055]	[0.354]	[0.127]	[0.052]
1 quarter after being in U.S.	0.024	0.110 *	-0.127 **	-0.039	-0.020	-0.054
	[0.146]	[0.063]	[0.050]	[0.292]	[0.072]	[0.050]
2 quarters after being in U.S.	-0.086	0.126 *	-0.085	-0.016	-0.007	-0.032
	[0.151]	[0.066]	[0.055]	[0.301]	[0.081]	[0.051]
3 quarters after being in U.S.	0.093	0.109	-0.082	0.027	-0.056	-0.045
	[0.153]	[0.067]	[0.057]	[0.302]	[0.089]	[0.054]
4 quarters after being in U.S.	0.084	0.178 **	-0.069	-0.025	-0.003	-0.028
	[0.158]	[0.070]	[0.063]	[0.315]	[0.116]	[0.060]
No. of observations	2,877,459	3,236,549	6,352,933	2,875,879	3,234,698	6,353,830
No. of groups	795,711	847,178	1,273,093	795,328	846,815	1,273,267
Panel C. Including Individual Observable Characteristics and Excluding B_{it} and A_{it} Dummy Variables						
nonmigrant dummy	-0.083 ***	-0.062 ***	0.046 ***	-0.067 **	0.078 ***	0.104 ***
	[0.021]	[0.011]	[0.009]	[0.030]	[0.024]	[0.008]
During stay in U.S.	0.946 ***	0.079 ***	-0.006	0.425 **	-0.066	-0.078 ***
	[0.041]	[0.014]	[0.012]	[0.191]	[0.094]	[0.008]
No. of observations	2,826,450	3,182,119	6,271,852	2,824,869	3,180,262	6,272,752
No. of groups	782,995	834,179	1,257,181	782,612	833,816	1,257,356

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include quarter dummies. Individual controls include a quadratic term on experience, years of schooling, marital status, gender, a head-of-household indicator, regional dummies, and an informality indicator. Robust standard errors clustered at the individual level are shown in brackets.

they are all very similar to the ones obtained under fixed effects. However, across most of the specifications, Hausman, J. A. (1978) tests reject the null hypothesis that fixed and random effects coefficients are not systematically different, implying that random effects are inconsistent and that the individual effects should not be treated as independent of the other regressors in the model. Therefore, fixed effects estimation is effectively controlling for possible self-selection biases.

To conclude the econometric analysis, equation (3.1) is modified in order to allow for interactions between the dummy variable for migration M_{it} and some of the individual characteristics X_{it} that could have an effect on the returns to temporary migration to United States. For example, more experienced and more skilled people may perform better in the U.S. labour market, or perhaps people migrating from regions other than the traditional sending region (see section 3.3) perform worse due to the lack of well-established networks abroad. To see this, the equation becomes:

$$y_{it} = X_{it}\beta_X + M_{it}\delta_M + (X_{it} \times M_{it})\mu_{(X \times M)} + \varepsilon_i + \varepsilon_t + \varepsilon_{it} \qquad (3.2)$$

Equation (3.2) is fitted using fixed effects, and the estimated coefficients δ_M and $\mu_{(X \times M)}$ are reported in table 3.12. The results for hourly earnings indicate that the returns to temporary migration decrease with years of potential experience and years of schooling, particularly for the case of work migrants. It seems to imply that more skilled workers can do better also in the Mexican labour market, and therefore the benefits from moving to the U.S. are lower for them. Regarding the regions of origin, people migrating from the northern states have higher returns, while people migrating from the southern states have lower returns. This could be due to either of three factors: first, people form the north have more developed networks in the United States than people from the south; second, people from the south face higher migration costs due to the distance from the border; or third, economic activities and availability of technology in the north may be closer to that in the U.S., translating into a comparative advantage of this region with respect to the south.

The estimates for weekly hours worked show that, while there are basically no differences among work migrants, non-work migrants tend to work more time the more educated they are. They also work significantly less hours during the quarter of migration if they come from the centre states, and significantly more hours if they come from the southern states.

Table 3.12: Fixed Effects Estimates of the Interactions Between the Temporary Migration Dummy and the Individual Characteristics

	Work Migrants			Non-Work Migrants		
	(1) ln(hourly earnings)	(2) ln(weekly hours)	(3) Employment	(4) ln(hourly earnings)	(5) ln(weekly hours)	(6) Employment
migration	1.460 ***	0.029	-0.079	1.691 *	-0.728 *	-0.197 ***
	[0.271]	[0.078]	[0.066]	[0.983]	[0.414]	[0.038]
experience*migration	-0.015 ***	0.002	0.006 ***	-0.018	0.006	0.002 ***
	[0.005]	[0.002]	[0.001]	[0.024]	[0.007]	[0.001]
school*migration	-0.042 ***	0.005	0.010 ***	-0.161 **	0.073 **	0.001
	[0.015]	[0.004]	[0.004]	[0.075]	[0.033]	[0.003]
married*migration	-0.024	0.017	-0.061 *	0.302	-0.330	0.050 ***
	[0.118]	[0.042]	[0.033]	[0.735]	[0.241]	[0.016]
male*migration	0.021	-0.048	-0.042	0.492	0.142	-0.034
	[0.175]	[0.065]	[0.048]	[0.501]	[0.168]	[0.021]
head household*migration	0.075	-0.019	-0.131 ***	-0.170	-0.201	0.018
	[0.135]	[0.047]	[0.036]	[0.553]	[0.189]	[0.019]
border*migration	-0.116	0.004	-0.018	0.437	-0.136	0.039 ***
	[0.122]	[0.038]	[0.030]	[0.504]	[0.276]	[0.017]
northern*migration	0.282 **	-0.024	0.062 *	1.011 **	-0.044	0.011
	[0.127]	[0.040]	[0.032]	[0.477]	[0.165]	[0.021]
centre*migration	0.216	0.048	0.070	(dropped)	-1.046 ***	-0.002
	[0.235]	[0.061]	[0.047]		[0.261]	[0.038]
southern*migration	-0.440 **	0.037	-0.028	(dropped)	1.401 ***	0.117 ***
	[0.186]	[0.068]	[0.055]		[0.340]	[0.048]
No. of observations	2,826,450	3,182,119	6,351,164	2,824,869	3,180,262	6,352,060
No. of groups	782,995	834,179	1,273,081	782,612	833,816	1,273,255

***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. All regressions include quarter dummies. The missing coefficients correspond to variables dropped due to multicollinearity. Robust standard errors clustered at the individual level are shown in brackets.

Finally, the likelihood of employment for work migrants increases with years of potential experience and schooling, and it is lower for married workers and heads of households. It is also a bit higher for people migrating from the northern states. For non-work migrants, the likelihood of employment is higher for married people and for those coming from the border and the southern states.

In sum, the evidence in this section indicates that the Mexicans that migrate temporarily to the United States for work reasons get significantly higher earnings in the U.S. labour market than in the Mexican one during the period of migration. They also tend to work longer hours, as suggested by the standard theory on the response of the labour supply to temporary positive shocks to real wages. It is also found that this group of workers have a higher likelihood of non employment after return migration. Lastly, the effect of temporary migration on earnings seems to be lower for more skilled workers and for those migrating from the most distant regions in Mexico, relative to the United States.

3.5. Conclusions

Mexican migration to the United States has been a very important issue throughout the twentieth century, and its relevance has reached unprecedented levels during the last

two decades. From the Mexican side, remittances of Mexican workers account for approximately 2.3% of the GDP. From the United States side, about 8.3% of the employed people in that country are from Mexican origin, and the increasing problem of illegal immigration has derived in the approval by the U.S. Congress of the construction of a 1,120 kilometers fence along the U.S.-Mexico border.

Even though there is a huge body of literature that analyzes many different aspects of this phenomenon, the economic performance of migrants with respect to the Mexican labour markets has received very little attention. Thus, the objective of this chapter was to fill this gap in the literature by presenting new evidence on the effect that temporary migration to the United States has on the earnings of Mexican workers.

The present work used a balanced panel data from the Mexican National Survey of Urban Labour (ENEU) for the period between 1994 and 2002, a source that has not been used before to answer this question regardless of some noticeable advantages, such as its quarterly coverage, its panel structure, and the fact that it contains information about migrants during their periods abroad. On the other hand, there may also be some concerns about the representativeness of the ENEU survey in analyzing migration. First, as the survey covers only the 48 main cities in the country, any estimation based on these data may be irrelevant if an insignificant fraction of the migrants comes from urban places; and second, the survey captures mainly temporary migration. However, the discussion in sections 3.2 and 3.3 provided evidence supporting the importance of both the share of migration originating in urban places and the share of temporary migration in total Mexican migration to the United States, leading to the conclusion that the ENEU is a valuable data source worth using. Thus, the econometric analysis developed in section 3.4 indicates that Mexicans that migrate temporarily to the United States for work reasons get significantly higher earnings in the U.S. labour market than in the Mexican one during the period of migration. They also tend to work longer hours and face a higher likelihood of non employment during the period immediately after returning to Mexico. Finally, the gains from temporary migration are lower for more skilled workers and for those migrating from the most distant regions in Mexico, relative to the United States.

It is important to mention some caveats regarding the estimates obtained in the present exercise. First, as mentioned above, by using longitudinal data it is possible to control for time-invariant unobserved heterogeneity. But this leaves the analysis open to other sources of bias, namely time-varying unobserved heterogeneity. For instance, it is possible that the Mexican earnings of migrants fall prior to migration as migrants get

ready for the trip to the U.S. If this is in fact the case, then the returns to temporary migration calculated in this chapter are an overestimate of the real effect. Alternatively, it is possible that the likelihood of migration increases with Mexican income in case migrants need to accumulate the cash needed to finance the illegal border crossing. In this case the present exercise would be underestimating the returns to temporary migration. Secondly, there are also some concerns regarding possible sample selection biases. Mexican workers who would earn little in the U.S. do not migrate, and hence we do not observe migration episodes for this type of workers. This leads to an overestimate of the returns to migration: only those who benefit strongly migrate. Another possible source of sample selection bias has to do with attrition. Since the estimation in this chapter is done using a balanced panel, it does not include all those individuals in the sample that do not return within a quarter. But migrants who earn much more in the U.S. than in Mexico are unlikely to return, and given that there is no information on U.S. earnings for non-returning migrants, we do not observe migrants whose gain in earnings is particularly large. This leads to an underestimate of the returns to migration: only those who do not benefit too much are observed. The net effect of migration estimated in this chapter could thus be a combination of these biases. Since their respective magnitude is unknown, it is impossible to know whether the estimated migration effect is an over or under-estimate of the true average gain.

3.6. References

ALEMAN-CASTILLA, B. (2006): "The Effect of Trade Liberalization on Informality and Wages: Evidence from Mexico," *CEP Discussion Papers*, pp. 1-71.

BEAN, F. D., R. CORONA, R. TUIRAN, and K. A. WOODROW-LAFIELD (1998): "The Quantification of Migration between Mexico and the United States," *Migration Between Mexico and the United States: Binational Study*, Volume 1: Thematic Chapters, pp. 1-89.

BEAN, F. D., R. CORONA, R. TUIRAN, K. A. WOODROW-LAFIELD, and J. V. HOOK (2001): "Circular, Invisible, and Ambiguous Migrants: Components of Difference in Estimates of the Number of Unauthorized Mexican Migrants in the United States," *Demography*, Vol. 38, pp. 411-422.

BORJAS, G. J. (1982): "The Earnings of Male Hispanic Immigrants in the United States," *Industrial and Labour Relations Review*, Vol. 35, pp. 343-353.

— (1987): "Self-Selection and the Earnings of Immigrants," *The American Economic Review*, Vol. 77, pp. 531-553.

— (1989): "Immigrant and Emmigrant Earnings: A Longitudinal Study," *Economic Inquiry*, Vol. XXVII, pp. 21-37.

BORJAS, G. J., and L. F. KATZ (2006): "The Evolution of the Mexican-Born Workforce in the United States," *NBER Working Papers*, pp. 1-66.

BUSTAMANTE, J. A., G. JASSO, J. E. TAYLOR, and P. T. LEGARRETA (1998a): "Mexico-to-U.S. Migrant Characteristics from Surveys Involving Samples Drawn in Mexico," *Migration Between Mexico and the United States: Binational Study*, Volume 2: Research Reports and Background Materials, pp. 769-778.

— (1998b): "Characteristics of Migrants: Mexicans in the United States," *Migration Between Mexico and the United States: Binational Study*, Volume 1: Thematic Chapters, pp. 91-160.

— (1998c): "Mexico-to-U.S. Migrant Characteristics from Mexican Data Sources," *Migration Between Mexico and the United States: Binational Study*, Vol. 2: Research Reports and Background Materials, pp. 779-818.

CALDERA, S., and P. PIPER/BACH (2006): "Immigration Policy in the United States," The Congress of the United States - Congressional Budget Office.

CHIQUIAR, D., and G. H. HANSON (2005): "International Migration, Self-Selection, and the Distribution of Wages: Evidence from Mexico and the United States," *Journal of Political Economy*, Vol. 113, pp. 239-281.

CORNELIUS, W. A. (1992): "From Sojourners to Settlers: The Changing Profile of Mexican Immigration to the United States," *U.S.-Mexico Relations: Labour Markets Interdependence*, pp. 155-195.

CRAIG, R. B. (1971): *The Bracero Program: Interest Groups and Foreign Policy.* Austin: University of Texas Press.

CUECUECHA, A. (2005): "Choice Based Sample Techniques, Undercounting and the Study of the Characteristics of Mexican Immigrants to the Us," Instituto Tecnologico Autonomo de Mexico. Centro de Investigacion y Estudios de Posgrado. Working paper, pp. 1-49.

DUNN, T. J. (1996): *The Militarization of the U.S.-Mexico Border, 1978-1992: Low-Intensity Conflict Doctrine Comes Home.* University of Texas at Austin.

DURAND, J., and D. S. MASSEY (1992): "Mexican Migration to the United States: A Critical Review," *Latin American Research Review*, Vol. 27, pp. 3-42.

DURAND, J., D. S. MASSEY, and R. M. ZENTENO (2001): "Mexican Immigration to the United States: Continuities and Changes," *Latin American Research Review*, Vol. 36, pp. 107-126.

DUSTMANN, C. (1991): "Earnings Adjustment of Temporary Migrants," *Journal of Population Economics*, Vol. 6, pp. 153-168.

DUSTMANN, C., and O. KIRCHKAMP (2002): "The Optimal Migration Duration and Activity Choice after Re-Migration," *Journal of Development Economics*, Vol. 67, pp. 351-372.

EPSTEIN, G. S., A. L. HILLMAN, and A. WEISS (1999): "Creating Illegal Immigrants," *Journal of Population Economics*, Vol. 12, pp. 3-21.

FELICIANO, Z. M. (2001): "The Skill and Economic Performance of Mexican Immigrants from 1910 to 1990," *Explorations in Economic History*, Vol. 38, pp. 386-409.

GAMIO, M. (1969): *El Emigrante Mexicano. La Historia De Su Vida.* Mexico. UNAM.

GRISWOLD, D. T. (2002): "Willing Workers: Fixing the Problem of Illegal Mexican Migration to the United States," *Trade Policy Analysis*, pp. 1-28.

HANSON, G. H. (2006): "Illegal Migration from Mexico to the United States," University of California, San Diego and National Bureau of Economic Research, pp. 1-71.

HAUSMAN, J. A. (1978): "Specification Tests in Econometrics," *Econometrica*, Vol. 46, pp. 1251-1271.

JENKS, R. (2001): "The USA Patriot Act of 2001: A Summary of the Anti-Terrorism Law's Immigration-Related Provisions," *Backgrounder. Center for Immigration Studies*, pp. 1-4.

LATAPI, A. E., P. MARTIN, P. S. DAVIES, G. L. CASTRO, and K. DONATO (1998): "Factors That Influence Migration," *Migration Between Mexico and the United States: Binational Study*, Volume 1: Thematic Chapters, pp. 163-250.

LOZANO-ASCENCIO, F., B. R. ROBERTS, and F. D. BEAN (1996): "The Interconectedness of Internal and International Migration: The Case of the United States and Mexico," *Texas Population Research Center Papers*, pp. 1-30.

MACURDY, T. E. (1981): "An Empirical Model of Labor Supply in a Life-Cycle Setting," *Journal of Political Economy*, Vol. 86, pp. 1059-1085.

MARCELLI, E. A., and W. A. CORNELIUS (2001): "The Changing Profile of Mexican Migrants to the United States: New Evidence from California and Mexico," *Latin American Research Review*, Vol. 36, pp. 105-131.

MARKUSEN, J. R., and S. ZAHNISER (1997): "Liberalization and Incentives for Labour Migration: Theory with Applications to Nafta," *NBER Working Paper Series*, Working Paper 6232, pp. 1-48.

MARTIN, P. (1998): "Guest Workers: Past and Present," *Migration Between Mexico and the United States: Binational Study*, Volume 3: Research Reports and Background Materials, pp. 877-895.

MASSEY, D. S., J. DURAND, and N. J. MALONE (2002): "Beyond Smoke and Mirrors: Mexican Immigration in an Era of Economic Integration," *New York. Russell Sage Foundation.*

MEXICAN_EMBASSY_IN_THE_UNITED_STATES (2006): "Mexico's Public Policies to Foster Circular Migration," Mexico-U.S.: Migration and Border Security www.embassyofmexico.org, pp. 1-24.

MISHRA, P. (2003): "Effect of Emigration on Wages in Developing Countries: Evidence from Mexico," Department of Economics. Columbia University, pp. 1-45.

PAPAIL, J. (1998): "Factores De La Migracion Y Redes Migratorias," *Migration Between Mexico and the United States: Binational Study*, Volume 3: Research Reports and Background Materials, pp. 975-1000.

PAULSON, A., and A. SINGER (2000): "Savings and Settlement: Evidence from Mexican Migrants," *mimeo*, pp. 1-37.

RANNEY, S., and S. KOSSOUDJI (1983): "Profiles of Temporary Mexican Labour Migrants to the United States," *Population and Development Review*, Vol. 9, pp. 475-493.

WOODROW-LAFIELD, K. A. (1998): "Estimating Authorized Migration," *Migration Between Mexico and the United States: Binational Study*, Volume 2: Research Reports and Background Materials, pp. 619-682.

WOODRUFF, C., and R. ZENTENO (2001): "Remittances and Micro Enterprises in Mexico," UCSD and ITESM-Guadalajara, pp. 1-40.

General Conclusions

The objective of this thesis was to make three original contributions to the existing literature on two very important characteristics of the Mexican labour markets: informality and migration to the United States. Chapter 1 investigated the relationship between trade liberalization and informality in Mexico during the 1990s. The empirical analysis found that reductions in the Mexican import tariffs are significantly related to reductions in the likelihood of unregistered labour (i.e., the fraction of workers that do not have social security or health insurance) in the tradable sectors. This result contrasts with the findings of Goldberg, P. K. & N. Pavcnik (2003) for Brazil and Colombia. The analysis also indicates that for a given reduction in the Mexican import tariff, unregistered labour decreases less in industries with higher levels of import penetration; and that for a given reduction in the U.S. import tariff, unregistered labour decreases more in industries that are relatively more export oriented. It is also found that trade liberalization affects the employment shares and the composition of unregistered labour across industries, but it does not seem to have an impact on the size of the labour force of firms. Finally, chapter 1 also presented evidence of an increase in industry wage differentials and a widening effect of trade liberalization on the registered-unregistered labour wage gap.

Chapter 2 studied the relationship between informality and taxes, by analyzing the effect of two tax reforms that took place in Mexico between 1989 and 2002: the introduction of a 2% asset tax in 1989; and the elimination of the OAD scheme during the years 1999 to 2001, which affected firms with investments in regions other than the three main metropolitan areas in Mexico. The econometric analysis suggested that the response of the likelihood of unregistered employment to changes in the level of corporate taxes is heterogeneous, depending both on the particular economic sector and the nature of the tax policy in question. For the case of the asset taxation, there was no evidence of a significant effect on unregistration, even when different relationships across different economic sectors were allowed. For the case of the elimination of the OAD scheme, the estimation yielded significant effects on unregistration in some of the manufacturing industries. Finally, it was argued that this tax reform would translate into an increase in the user cost of capital, and therefore that a positive relationship between this variable and the rate of unregistered labour should exist. This hypothesis allowed the use of an alternative source of variation to estimate the effect of the OAD reforms on unregistration. Even though ordinary least squares estimation indicated that there

exists a positive and significant relationship between the user cost of capital and unregistration, instrumental variables estimation suggested that the variation in the former due to the elimination of the OAD scheme does not affect unregistration in a significant way.

Lastly, chapter 3 presented new evidence on the effect that temporary migration to the United States has on the earnings of Mexican workers. It used data from the Mexican National Survey of Urban Labour (ENEU) for the period between 1994 and 2002, a source that has not been used before to answer this question regardless of some noticeable advantages, such as its quarterly coverage, its panel structure, and the fact that it contains information about migrants during their periods abroad. The econometric analysis carried out in this chapter indicated that Mexicans that migrate temporarily to the United States for work reasons get significantly higher earnings in the U.S. labour market than in the Mexican one during the period of migration. They also tend to work longer hours and face a higher likelihood of non employment during the period immediately after returning to Mexico. Finally, the gains from temporary migration are lower for more skilled workers and for those migrating from the most distant regions in Mexico, relative to the United States.