Banco de México

Documentos de Investigación

Banco de México

Working Papers

N° 2013-10

The Effect of Trade Liberalization on Manufacturing Price Cost Margins: The Case of Mexico, 1994-2003

Gabriela López Noria
Banco de México

August 2013

Documento de Investigación 2013-10

Working Paper 2013-10

The Effect of Trade Liberalization on Manufacturing Price Cost Margins: The Case of Mexico, 1994-2003*

Gabriela López Noria†
Banco de México

Abstract: This paper analyzes the effect of the North American Free Trade Agreement (NAFTA) on Mexican manufacturing price cost margins (PCMs) for the period 1994-2003. Taking into account the sensitivity of each industry to the speed of the tariff reductions under NAFTA, the results show that PCMs immediately decreased once the second round of trade liberalization in Mexico had commenced in 1994. However, in subsequent years, no clear pattern emerges for these PCMs. Additionally, the paper accounts for the sensitivity of each industry to the initial level of its tariff and presents evidence showing that while NAFTA had an effect on the PCMs of the group of industries that liberalized in 10 years, no robust effect was found for the group of industries that liberalized in 5 years. The results on the group of industries that liberalized in 10 years suggest that NAFTA sharpened competition and exerted market discipline by forcing firms with market power to set prices closer to marginal costs. The findings on the group of industries that liberalized in 5 years suggest that additional factors may be also playing a role in the containment of their market power.
Keywords: PCMs; Trade Liberalization; NAFTA.
JEL Classification: F13, F15, L11.

Resumen: Este documento analiza el efecto del Tratado de Libre Comercio con América del Norte (TLCAN) sobre los márgenes de precios a costos marginales (MPCM) del sector manufacturero mexicano en el periodo 1994-2003. Tomando en consideración la sensibilidad de cada industria a la rapidez de la reducción en las tarifas bajo el TLCAN, los resultados muestran que los MPCM cayeron inmediatamente una vez que la segunda ronda de liberalización comercial en México hubo comenzado en 1994. Sin embargo, en años subsecuentes, no emerge un patrón claro para estos MPCM. Adicionalmente, el estudio toma en cuenta la sensibilidad de cada industria al nivel inicial de su tarifa y presenta evidencia que muestra que si bien el TLCAN tuvo un efecto sobre los MPCM del grupo de industrias que liberalizaron en 10 años, no se encontró un efecto robusto para el grupo de industrias que liberalizaron en 5 años. Los resultados sobre el grupo de industrias que liberalizaron en 10 años sugieren que el TLCAN agudizó la competencia y ejerció disciplina de mercado al forzar a las empresas con poder de mercado a establecer precios más cercanos a sus costos marginales. Los resultados sobre el grupo de industrias que liberalizaron en 5 años sugieren que factores adicionales pudieran estar jugando un rol en la contención de su poder de mercado.
Palabras Clave: MPCM; Liberalización Comercial; TLCAN.

*I would like to thank Gordon Kemp, Stephen McKnight and two anonymous referees for helpful comments and suggestions.

† Dirección General de Investigación Económica. Email: glopezn@banxico.org.mx.

I. Introduction

This paper analyzes the impact of the second round of trade liberalization in Mexico, implemented through NAFTA, on manufacturing price cost margins (PCMs) for the period 1994-2003.[1] It is generally believed that a reduction of trade barriers sharpens competition and forces domestic firms to set prices closer to marginal costs. When marginal costs and prices become equalized, an efficient allocation of resources is reached, as purchasers equate their marginal rates of substitution with the producers' marginal rates of transformation (Hall 1988). Therefore, reducing trade barriers helps diminish the inefficiency caused by monopoly power.

Empirical studies on the effect of trade on PCMs have traditionally approximated PCMs using the price average variable cost margin formula, which is equal to $\frac{sales - payroll - material\ costs}{sales}$, and have used the import penetration ratio as a proxy for trade exposure. Such studies have estimated a regression of PCMs using several explanatory variables and have typically found a negative relationship between trade and PCMs, especially when domestic concentration has been high.[2] Unfortunately, most of these studies have generated inconsistent estimates since variables such as capital costs, research and development costs, and advertising costs have generally been ignored from the approximation of PCMs, therefore leading to measurement error problems.

In contrast, in this paper, we estimate PCMs following Hall´s (1988) approach, which is based on the Solow Residual, in order to analyze the trade-PCM link for the Mexican

[1] The first round of trade liberalization in Mexico occurred in 1986, when this country became a member of the General Agreement on Tariffs and Trade (GATT).

[2] See, for example, Grether (1996) and Castañeda and Mulato (2006).

manufacturing sector.[3] This paper also distinguishes from the empirical literature on PCMs in that it uses data disaggregated at a 6 digit-level rather than the more aggregated 4 digit level data used in previous studies. Furthermore, it updates previous analysis on the impact of trade on Mexican manufacturing PCMs (i.e. Castañeda (2003)) by covering the period 1994-2003; and, rather than using a Two Stage Least Square (TSLS) approach to tackle endogeneity problems, it employs the Generalized Method of Moments (GMM), which results in a more efficient estimator.[4] Apart from the methodology, the updated data and the econometric technique used, this paper also contributes to the empirical literature on PCMs by focusing on the dynamics of Mexican markups following NAFTA's implementation, rather than on the static behavior of industries as in previous analysis.[5]

It is first shown that manufacturing PCMs immediately decreased once the second round of trade liberalization under NAFTA had commenced in 1994. However, in subsequent years, no clear pattern emerges for the PCMs. Additionally, the study presents evidence showing that NAFTA did have an effect on the PCMs of the group of industries that liberalized in 10 years, while no robust effect is observed for the PCMs of the group of industries that liberalized in 5 years. The former results, consistent with the empirical literature on PCMs, suggest that greater competition exerts market discipline by forcing firms with market power to set prices closer to cost margins. The latter results suggest that

[3] Industry markups may be also affected by factors such as the business cycle (Castañeda and Mulato (2006), Nishimura et al. (1999) and Kiyota et al. (2009)), legal or technological barriers to entry, and/or product differentiation.

[4] The GMM estimator is more efficient than the instrumental variable estimator derived from the TSLS approach since it takes into account all the moment conditions available. This leads to consider the correct weighting matrix in the quadratic function that should be minimized to estimate the parameter. The TSLS approach does not take into account all the moment conditions, so the weighting matrix considered is not the correct one. In addition, the GMM econometric technique tests for no second-order serial correlation in the first differenced disturbances to verify there is no serial correlation in the disturbances, while the TSLS approach ignores serial correlation. Due to this reasons, GMM is used in this study.

[5] Previous studies estimate a markup and by assuming it remains constant over time, this implies that competition is static.

additional factors may be playing a role in the containment of market power in the less protected group of industries, i.e. the industries that liberalized in 5 years.

The remainder of the paper is organized as follows: Section 2 presents the literature review on the impact of trade on PCMs; Section 3 briefly describes Hall's (1988) approach; Section 4 presents the data and the empirical results and; Section 5 concludes.

2. Literature Review on the Impact of Trade on PCMs

Different approaches have been used to analyze the impact of increased import competition on PCMs. First, the Structure-Conduct-Performance (SCP) paradigm had measured PCMs as $\frac{sales - payroll - material\,costs}{sales}$ and had tested the market discipline hypothesis by estimating regressions of PCMs on several explanatory variables including concentration indexes and trade variables.[6][7] Using this approach, Grether (1996) and Castañeda and Mulato (2006) provide some evidence supporting the market discipline hypothesis for the case of Mexico. Grether (1996) uses data on 2,800 Mexican manufacturing plants to investigate the impact of import license coverage and average tariff rates on PCMs for the period 1984-1990. His findings show that a decrease in import licenses or tariffs leads to lower profitability in the Mexican manufacturing sector, especially in more concentrated sectors. Castañeda and Mulato (2006) analyze the impact of the C4 concentration index, the import penetration ratio, and the capital-output ratio on PCMs, using data on the Mexican manufacturing sector for the period 1980-1998. Additionally, the unemployment

[6] The first empirical applications of the SCP paradigm were by Joe S. Bain (1951, 1956).
[7] The Market Discipline Hypothesis establishes that increased import competition induces a reduction in price cost margins in imperfectly competitive industries.

rate and a dummy variable are also included in the analysis in order to consider the impact of business cycles on PCMs. The main results show that greater import competition diminishes PCMs, and greater trade openness reduces the impact of concentration on PCMs. Furthermore, the findings also reveal that, after the trade liberalization period, the PCMs are more anti-cyclical in concentrated industries.

A second body of empirical literature making reference to the trade-PCMs link is the so called New Empirical Industrial Organization (NEIO). The NEIO literature investigates whether there is evidence of pricing above marginal costs by estimating the parameters of behavioral equations and relating them to the degree of competition within the industry. Bresnahan (1989) presents a survey of different empirical NEIO studies focused on different countries.[8]

An alternative approach follows Hall (1988). This approach permits to estimate PCMs using factor demand data (labor and capital) rather than approximating them with a formula. Siotis (2003) describes it as the derivation of an empirical specification that permits retrieval of industry price to marginal cost ratios, using the properties of the Solow Residual under perfect competition. It assumes constant returns to scale and perfect competition in factor and product markets.[9] Domowitz, et al. (1986) extend Hall's (1988) approach by incorporating intermediate inputs or materials into their analysis. This particular study uses a sample of 284 four digit industries for the US economy during the period 1958-1981 and finds that, in all US industries, prices exceed marginal costs,

[8] Appelbaum (1982) and López (1982), which study the cases of the United States and Canada, respectively, are included in this survey. Appelbaum (1982) finds that the rubber and textile industries behave competitively, while the electrical machinery and tobacco industries are characterized by an oligopolistic behavior. Lopez (1982) estimates the degree of oligopoly power in the Canadian food processing industry and finds that the price-taking behavior hypothesis is statistically rejected.

[9] Hall (1986) tests the hypothesis of competition on two-digit level data for 48 US industries covering the period 1948-1978. His main results show that 42 out of 48 industries present some degree of monopoly power.

reflecting some degree of monopoly power.[10] For the specific case of Mexico, Castañeda (2003) estimates manufacturing PCMs based on Hall's (1988) approach and verifies if changes in the trade regime led to changes in this sector's market power. The study uses data on four digit manufacturing industries and non-instrumental (Ordinary Least Squares (OLS)) and instrumental (TSLS) econometric techniques to estimate markups. It focuses on the following sub-samples: the period before Mexico became a member of GATT (1975-1986), the period after GATT (1987-1998), the period before NAFTA (1975-1993), and the period after NAFTA (1994-1998). The study finds that the degree of market power decreased after NAFTA for the OLS estimates and after GATT and NAFTA for the TSLS estimates. Castañeda (2003) precedes this current analysis on Mexico.

Since endogeneity problems may emerge due to the potential correlation between the unobserved productivity shocks and the firm's input choices in Hall's (1988) approach, Roeger (1995) subtracts the Dual Solow Residual (which is price based and departs from the cost minimization problem) from the Solow Residual in order to eliminate the productivity growth rate from both residuals. By using the same data as in Hall (1988), Roeger finds evidence of prices above marginal costs and suggests that this condition of imperfect competition explains the difference between the primal and the dual productivity measures.[11]

Finally, with a slightly different hypothesis, Hoekman, et al. (2002) develop a Cournot model to exploit the idea that the effects of trade on markups depend on country size. Using a sample of 41 countries, they first estimate a country-specific average industry

[10] Some empirical studies following Hall's (1988) approach and the extension by Domowitz et al. (1986) are Konings, et al. (2001), Bottasso and Sembenelli (2001), and Siotis (2003).

[11] Examples of empirical studies based on Roeger's (1995) methodology are Konings, et al. (2005) for the case of Bulgaria and Romania; Christopoulou and Vemeulen (2008) for the case of 8 Euro area countries; Moreno and Rodríguez (2010) for the case of Spain; and Marinov (2010) for the case of 7 East European countries.

markup from a random coefficient panel regression with a heteroskedastic error term. After correcting for heteroskedasticity, they then regress the estimated average industry markup on the variables fixed cost of entry, import penetration ratio, the interacting coefficients market size - entry costs and market size - import penetration rate, and on a variable that controls for the level of financial development, for intellectual property protection law, and for the overall economic and institutional development in each country. The results show that industry markups are positively related with the fixed cost of entry, with the capitalization ratio and the intellectual property protection index, and negatively related with the import penetration rate and GDP per capita. The interacting coefficients show that country size does matter for PCMs.[12]

The empirical analysis in this paper follows Hall's (1988) approach in order to analyze the trade-PCMs link. Hall's (1988) approach distinguishes from Roeger's methodology in that it permits to estimate returns to scale directly; however, suitable instruments must be obtained in order to tackle possible endogeneity problems that may emerge due to the correlation between the unobserved productivity shocks and the input levels. Roeger's approach (1995), while avoiding the endogeneity problem, it ignores the existence of variable returns to scale. Roeger's (1995) approach is not used in this paper since his methodology is based upon a cost minimization problem which requires information, among other variables, on the rental price of capital, which is absent from the dataset for Mexico. In this study, the problem of finding suitable instruments to tackle endogeneity issues is evaded by using GMM, an instrumental variables approach based, in

[12] Similarly, Edmond et al. (2012) analize how large were the welfare gains from trade in Taiwain in the years 2000 and 2002-2004 using the Taiwan Annual Manufacturing Survey and the Atkenson-Burstein (2008) model, which assumes oligopolistic competition. Edmond et al. (2012) find that the pro-competitive gains from trade (i.e. gains due to reduced markups and reduced markup dispersion) were large only if the following conditions are satisfied: 1) extensive initial misallocation and 2) trade partners were characterized by relatively similar productivities in a given sector.

general, on appropriate lags of the endogenous regressors as instruments. Table 1 below summarizes the literature review presented in this Section.

Table 1. Literature Review on the Impact of Trade on PCMs

Author	Country, Period and Data	Method	Main findings
Grether (1996)	Mexico, 1984-1990, industry and plant level	In this study, PCMs are calculated with the price average variable cost margin formula and estimates a regression of PCMs on import licenses and tariffs.	His findigs show that lower import licenses and tariffs leads to lower PCMs, especially in more concentrated industries.
Castañeda and Mulato (2006)	Mexico, 1980-1998, manufacturing industries	In this study, PCMs are calculated with the formula ((total sales-wages-intermediate inputs)/total sales) and regressed on the C4 concentration index, the import penetration rate, and the capital output ratio.	The main results show that greater import competition diminishes PCMs and that greater openness reduces the impact of concentration on PCMS.
Appelbaum (1982)	United States, manufacturing sectors: (rubber, textiles, electrical machinery and tobacco)	This study investigates whether there is evidence of prices above marginal costs using stylized econometric models of oligopoly interaction in a single-product industry.	The findings show that the first two industries behave competitively, while the last two are characterized by an oligopolistic behavior.
López (1982)	United States, food processing industry	This study investigates whether there is evidence of prices above marginal costs using stylized econometric models of oligopoly interaction in a single-product industry.	The results show that the price-taking behavior hypothesis is statistically rejected.
Hall (1988)	United States, 1948-1978, 48 industries	This study derives an empirical specification that permits retrieval of price to marginal cost ratios, using the properties of the Solow residual under perfect competition.	The results show that 42 out of 48 industries present some degree of monopoly power.
Domowitz, Hubbard, and Petersen (1986)	United States, 1958-1981, 284 four digit industries	This study extends Hall's (1988) approach by incorporating intermediate inputs or materials into the analysis.	The results reveal that in all US industries price exceeds marginal costs and some degree of monopoly power is presented by the manufacturing industries.
Konings, Van Cayseele, and Warzynski (2001)	Belgium and the Netherlands, April 1992-March 1997, firm level data	Based on Hall's (1988) approach, this study compares markups between these two economies. Belgium introduced a competition law in 1993, while Netherlands did not.	The findings show that markups in the Netherlands are higher than those in Belgium, but markups in the latter increased rather than decresed once the competition law was introduced.
Bottasso and Sembenelli (2001)	Italy , 745 manufacturing firms	This study is based on Hall's (1988) approach but relaxes the assumptions of constant returns to scale and perfect competition in the product market. It tests whether the European Union Single Market Program has a negative and statistically significant effect on markups, while a positive and statistically significant effect on productivity.	The findings in this study show a decrease in the market power of highly sensitive firms while a positive effect on the productivity of these same firms. No clear pattern was observed in the market power or productivity of the moderately and non-sensitive firms.
Siotis (2003)	Spain, 1983-1996, firm level data	Based on Hall's (1988) approach, this study tests whether the integration of Spain to the European Union in 1986 had an effect on price cost margins.	The results show that PCMs fell in more opened sectors, while margins on more protected sectors did not.
Castañeda (2003)	Mexico, 1975-1998, four digit manufacturing industries	This study investigates the impact of trade liberalization on manufacturing price cost margins using Hall's (1998) approach. It specifically focuses on four sub-sample periods: the period before Mexico became a member of the General Agreement on Tariffs and Trade (GATT) (1975-1986) and the period after GATT (1987-1998), the period before NAFTA (1975-1993) and the period after NAFTA (1994-1998). The study uses non-instrumental (Ordinary Least Squares (OLS)) and instrumental (2SLS) techniques in the econometric analysis.	The results show that the degree of market power decreased both for the OLS estimates after NAFTA, and also for the 2SLS estimates, after GATT and NAFTA. The OLS findings additionally show that in boom periods the degree of market power diminished after NAFTA.
Roeger (1995)	United States, 1948-1978, 48 industries	Substracts the Dual Solow Residual from the Solow Residual to tackle the endogeneity problem that may emerge due to the potential correlation between the unobserved productivity shocks and the firms' input choices in Hall's (1988) approach.	The findings show evidence of prices above marginal costs and explains that this condition of imperfect competition explains the difference between the primal and the dual productivity measures.
Konings, Van Cayseele, and Warzynski (2005)	Bulgaria and Romania, 1994-1998, manufacturing companies	They investigate the impact of privatization and competitive pressure on price cost margins using Roeger's (1995) approach.	The results show that PCMs are lower in highly competitive markets and that privatized firms, foreign or domestic, experience higher PCMs than state firms.
Christopoulou and Vermeulen (2008)	United States, Germany, France, Italy, Spain, the Netherlands, Belgium, Austria and Finland, 1981-2004, 50 sectors per country	They estimate PCMs using Roeger's (1995) approach.	There is evidence of prices above marginal costs in most industries and all countries. Services have higher markups, in average, than manufacturing industries. There is not a big range change in markups if the 80s and the 90s are compared.
Moreno and Rodríguez (2010)	Spain, 1990-2005, manufacturing firms	This study analyze the impact of imports on estimated PCMs using Roeger's (1995) approach. The effect of imports on union bargaining power is also considered.	The results show that imports have a negative effect on PCMs, and this effect is larger when imports are final goods. Furthermore, union bargaining power is smaller in firms that import final goods.
Marinov (2010)	Bulgaria, the Czech Republic, Estonia, Hungary, Poland, the Slovak Republic and Solvenia, 1998-2002, manufacturing firms	Using Roeger's (1995) approach, this paper investigates the impact of trade and antritrust enforcement on PCMs.	The findings show that higher import protection leads to higher mark-ups, while antitrust enforcement to lower PCMs.
Hoekmank, Looi Kee, and Olarreaga (2002)	41 countries, industry level data	Present a Cournot model to exploit the idea that the effects of trade on markups depend on country size.	The results show that industry markups are positively related to the fixed cost of entry, the capitalization ratio and the intellectual property protection index. Thet are negatively related to the import penetration rate and the GDP per capita.
Edmond, Midrigan, and Xu (2012)	Taiwan, 2000, 2002-2004	Atkenson-Burstein (2008) model, which assumes oligopolistic competition.	The findings show that the pro-competitive gains from trade (i.e. gains due to reduced markups and reduced markup dispersion) were large when the following conditions were satisfied: 1) extensive initial misallocation and 2) a weak pattern of cross-country comparative advantage (i.e. trade partners were characterized by relatively similar productivities in a given sector).

3. Theoretical Model

This section briefly presents Hall's (1988) approach and it is based on Siotis (2003) and Bottasso and Sembenelli (2001).

3.1 Hall's (1988) Approach

A Cobb-Douglas production function with constant returns to scale is assumed:

$$Q = \Theta F(\cdot) \tag{1}$$

where Q is the production function and Θ denotes technological progress. Time and industry indices are dropped for simplicity. The inputs used in the production process are labor L, materials M, and capital K. Following Siotis (2003), the capital input, which depreciates over time, is chosen before the realization of demand, while labor and materials are obtained in competitive factor markets once the demand is realized.

Marginal cost c can be expressed as:

$$c = \frac{w\Delta L + p_M \Delta M + r\Delta K}{\Delta Q - \vartheta Q} \tag{2}$$

where w, p_M, and r represent the prices of labor, materials and capital, respectively. $\Delta Q - \vartheta Q$ stands for the increase in output generated by the increase in inputs in the absence of technological progress, where ϑ is the rate of the Hicks-neutral technological progress.[13] Dividing equation (2) through by Q and rearranging yields:

$$\frac{\Delta Q}{Q} = \frac{p}{c}\frac{wL}{pQ}\frac{\Delta L}{L} + \frac{p}{c}\frac{p_M M}{pQ}\frac{\Delta M}{M} + \frac{p}{c}\frac{rK}{pQ}\frac{\Delta K}{K} + \vartheta \tag{3}$$

where p represents the market price of output. Under the assumption of perfect competition in factor markets, the shares of labor, material, and capital in output, valued at

[13] A Hicks-neutral technological progress takes place if the ratio of capital's marginal product to labor's marginal product is unchanged for a given capital to labor ratio.

marginal costs, measure the elasticity of output with respect to inputs, and under constant returns to scale these shares sum to one. Therefore, the following expression can be obtained:

$$\frac{rK}{cQ} = 1 - \frac{wL}{cQ} - \frac{p_M M}{cQ}. \tag{4}$$

Multiplying equation (4) by $\frac{\Delta K}{K}$ and substituting it into equation (3) yields:

$$\frac{\Delta Q}{Q} - \frac{\Delta K}{K} = \frac{p}{c}\frac{wL}{pQ}\left(\frac{\Delta L}{L} - \frac{\Delta K}{K}\right) + \frac{p}{c}\frac{p_M M}{pQ}\left(\frac{\Delta M}{M} - \frac{\Delta K}{K}\right) + \vartheta. \tag{5}$$

Furthermore, if the labor's share in total revenue is $s^L = \frac{wL}{pQ}$; the materials' share in total revenue is $s^M = \frac{p_M M}{pQ}$, and; $q = \log\left(\frac{Q}{K}\right)$; $l = \log\left(\frac{L}{K}\right)$; $m = \log\left(\frac{M}{K}\right)$, the following equation is obtained:

$$\Delta q = \frac{p}{c}\left[s^L \Delta l + s^M \Delta m\right] + \vartheta \tag{6}$$

where $\frac{p}{c}$ is the price over marginal costs. This equation suggests that if $\frac{p}{c}$ is equal to 1 (i.e. there is perfect competition), then the logarithmic difference of the value of production-capital ratio is equated to the logarithmic difference of the labor-value of capital ratio weighted by the labor's share in revenue plus the logarithmic difference of the value of materials-capital ratio weighted by the material's share in revenue plus the rate of technological progress.

Finally, if it is assumed that the Lerner index is equal to $\delta = \left(\frac{p-c}{p}\right) = 1 - \frac{1}{\left(\frac{p}{c}\right)}$, equation (6) can be expressed as:

$$\Delta q - s^L \Delta l - s^M \Delta m = \delta \Delta q + (1-\delta)\vartheta . \quad (7)$$

The left hand side of equation (7) represents the Solow Residual (the part of output growth not explained by the inputs' growth), while the right hand side is formed by the Lerner Index δ multiplied by the increment in output plus $(1-\delta)$ multiplied by the rate of technological progress, ϑ.

Considering time t and j, an index for industries, ϑ can be expressed as:

$$\vartheta_{jt} = \sum_{j=1}^{J} \vartheta_j d_j + \sum_{t=1}^{T} \vartheta_t d_t + \Delta u_{jt} \quad (8)$$

where ϑ_j denotes the component of Hicks-neutral technological progress, ϑ_t represents a time specific productivity shock common to all industries, d_j stands for industry dummies, and d_t, for time dummies. u_{jt} is assumed to be a serially uncorrelated measurement error with mean zero in the levels equation, which implies Δu_{jt} follows a MA(1) process. By substituting equation (8) into (7), the final equation to be estimated is obtained:

$$\Delta q_{jt} - s_{jt}^L \Delta l_{jt} - s_{jt}^M \Delta m_{jt} = \delta_{jt} \Delta q_{jt} + (1-\delta_{jt}) \left(\sum_{j=1}^{J} \vartheta_j d_j + \sum_{t=1}^{T} \vartheta_t d_t \right) + (1-\delta_{jt}) \Delta u_{jt} . \quad (9)$$

Equation (9) shows that under perfect competition ($\delta = 0$), the Solow Residual, the part of output growth not explained by input growth, is then identical to the unknown rate of technical progress.

Following Bottasso and Sembenelli (2001), under variable returns to scale, the shares of labor, material and capital in output, valued at marginal costs, are equal to $1+\gamma$:

$$\frac{wL}{cQ} + \frac{p_M M}{cQ} + \frac{rK}{cQ} = 1 + \gamma \quad (10)$$

where $\gamma \geq 0$.

Therefore, equation (5) becomes:

$$\frac{\Delta Q}{Q}-\frac{\Delta K}{K}=\frac{p}{c}\frac{wL}{pQ}\left[\frac{\Delta L}{L}-\frac{\Delta K}{K}\right]+\frac{p}{c}\frac{p_M M}{pQ}\left[\frac{\Delta M}{M}-\frac{\Delta K}{K}\right]+\gamma\frac{\Delta K}{K}+\vartheta \tag{11}$$

which after considering the sub-indexes t and j becomes:

$$\Delta q_{jt}=\frac{p}{c}_{jt}\left[s_{jt}^{L}\Delta l_{jt}+s_{jt}^{M}\Delta m_{jt}\right]+\gamma_{jt}\Delta k_{jt}+\vartheta_{jt}. \tag{12}$$

Finally, equation (12) can also be expressed as:

$$\Delta q_{jt}-s_{jt}^{L}\Delta l_{jt}-s_{jt}^{M}\Delta m_{jt}=\delta_{jt}\Delta q_{jt}+(1-\delta_{jt})\gamma_{jt}\Delta k_{jt}+(1-\delta_{jt})\left(\sum_{j=1}^{J}\vartheta_j d_j+\sum_{t=1}^{T}\vartheta_t d_t\right)+(1-\delta_{jt})\Delta u_{jt} \tag{13}$$

if $\frac{p}{c}=\frac{1}{1-\delta}$.

An econometric concern that should be considered when estimating equation (9) and equation (13) is that the variable Δq_{jt} on the right hand side of the equations is endogenous and, therefore, the assumption of the classical model that stipulates that the error term and the explanatory variable should be contemporaneously uncorrelated is no longer satisfied. This problem of endogeneity leads to inconsistent and biased OLS estimates of the unknown parameters and should be corrected by estimating equations (9) and (13) with an instrumental variables (IV) approach such as the Generalized Method of Moments (GMM). This method estimates the unknown parameters directly from the moment conditions (conditions in terms of expectations which are often derived directly from economic theory) that are imposed by the model.[14] This econometric technique chooses an estimator for the unknown parameters such that the vector of sample moment conditions is as close as possible to zero, in the sense that a quadratic form in the sample moment conditions is

[14] To enable identification, the number of moment conditions should be at least as large as the number of unknown parameters.

minimized. The solution to this problem results in the GMM estimator, which is consistent and asymptotically efficient. In particular, following Arellano and Bover (1995) and Blundell and Bond (1998), equations (9) and (13) are estimated by System GMM using STATA's xtabond2 command written by David Roodman (2006).[15]

3.2 Hypotheses to be Tested

This study has two main objectives: 1) to verify if PCMs across industries decreased once NAFTA had commenced and, 2) to investigate if this effect on PCMs was due to NAFTA and/or to other macro or micro-economic factors occurring in the period under analysis.

In the first exercise, equation (9) is estimated to compare the PCM in 1994 with the the PCM in each of the following years once NAFTA was implemented. The null hypothesis to be tested is $PCM_{1994} > PCM_t$; while the alternative hypothesis is $PC_{1994} \leq PCM_t$. In this case, the analysis takes into account the sensitivity of each industry to the speed of the tariff reduction under NAFTA (explained in section 4.1 below).

In the second exercise, the study assumes that NAFTA had an asymmetric impact on the industries in the sample as in Bottasso and Sembenelli (2001), in order to control for the fact that changes in market power may also depend on other macro or microeconomic variables which have nothing to do with policy reform. This assumption permits to split the sample into industries that were more likely to be affected by NAFTA, industries moderately sensitive to this reform and non-sensitive industries. The criterion used to split the sample in these categories is the initial level of the tariff (also explained in section 4.1

[15] System GMM consists on adding the original equations in levels to a system of equations in first differences. In this sense, the endogenous variables in first differences are instrumented with lags of their own levels, while the endogenous regressors in levels in the second set of equations are instrumented with lags of their own first differences. This method not only improves the precision of the estimator given it uses a higher number of moment conditions, but it also reduces the finite sample bias that emerges with the First Differenced GMM estimator, when the lagged levels of the series are only weakly correlated with subsequent first differences.

below). The highly sensitive firms are those with the highest level of tariffs. Equations (6) and (12) under the assumption of constant returns to scale and variable returns to scale, respectively, are then estimated for each sub-group of industries to recover mark-ups. Consequently, if a significant fall in market power is observed only for those industries which are ex-ante expected to be more affected by NAFTA according to their level of tariff (the highly sensitive industries), then this result is interpreted as evidence showing that NAFTA, and not other macro or micro economic factors, did have an effect on PCMs.

4. Empirical Analyses

This section describes the data set used in the empirical analyses and presents the results.

4.1 Data

The data comes from the Annual Industrial Survey of the National Institute of Statistics and Geography in Mexico (*INEGI* in Spanish) and covers the period 1994-2003.[16] The codes used by this statistical agency to identify the economic activities considered in this Survey correspond to the Mexican Classification of Activities and Products (*CMAP* in Spanish).[17] The Survey is a balanced panel of 205 industries from the Mexican manufacturing sector

[16] The data used in this paper are part of the series the National Institute of Statistics and Geography in Mexico no longer updated after 2003.

[17] *CMAP* is a list of economic activities ordered in a logical way and associated to codes or identification numbers, based on the International Standard Industrial Classification elaborated by the United Nations Organization (ISIC in English). It was developed in Mexico in 1981 to classify industries according to the economic activities in which they were engaged. In 1993, once NAFTA was signed, the statistical agencies of Mexico, the United States and Canada agreed on generating a new economic classification so that users from the three countries could obtain internationally comparable data and business statistics. This classification is knows as North American Industry Classification System (NAICS) and it was adopted in 1997. In the United States, NAICS replaced the Standard Industrial Classification (SIC) system; while in Mexico, it replaced *CMAP*. NAICS industries are identified by a 6-digit code; while SIC, by a 4-digit code. In this document I used the Annual Industrial Survey with 205 economic activities from the manufacturing sector, which are identified under *CMAP* and can be obtained at a 2, 4 and 6-digit level.

and it is disaggregated at a 6 digit level. Two of the industries, publishing of newspaper and magazines and publishing of books, were dropped from the panel since they were already duty free prior to NAFTA. Two more industries, tobacco processing and production of cigarettes, were also eliminated since their initial level of tariff was higher (50 percent) than that of the rest of the industries in the sample (20 percent, 15 percent and 10 percent).[18] Finally, seventeen industries were dropped due to inconsistencies in the data. The elimination of 21 industries led to a panel of 184 industries and 1,840 industry-year observations in total. This survey covers topics such as employment, wages, operating costs, repairing and maintenance costs, some other costs, value of production, sales, exports, stocks, concentration ratios and fixed assets. Labor in the empirical analyses is measured by the number of workers in each industry. Wages include salaries, social benefits, compensations, and loans. The value of materials is equal to the sum of the value of raw materials, fuel and containers. The value of the capital stock is equal to the sum of the value of machinery and equipment, buildings, land, transport equipment and other fixed assets. Wages, the value of materials, the value of the capital stock and the value of production are given in thousands of pesos. The value of the capital stock is deflated using an index of capital formation with base year 2003; while wages, the value of materials and the value of production are deflated using a producer price index with base year 2003.[19]

Data on tariffs comes from the document "*Tratado de Libre Comercio de América del Norte",* particularly from *Sección B-Aranceles*, *Artículo 302, Anexo 302.2,* where one can find the following two texts: *Eliminación Arancelaria* and *Lista de Desgravación de*

[18] The sample did not contain any industry with an initial level of tariff equal to 5 per cent.
[19] The index used to deflate the value of the capital stock is an index of capital formation, obtained from the National Institute of Statistics and Geography in Mexico, it is yearly and 2003 is its base year. The producer price index used to deflate the wages, the value of materials and the value of production was also obtained from the National Institute of Statistics and Geography and it has the same base year as the capital index.

México. The first text, *Eliminación Arancelaria*, presents the tariff phase out schedule under NAFTA for different levels of tariffs, while the text *Lista de Desgravación de México* shows the tariff level in each Mexican industry before the implementation of NAFTA and, the tariff phase out schedule assigned to each of them. Under NAFTA, trade barriers have been eliminated gradually and the trans-border movement of goods facilitated. Table 1 in Appendix 1 shows the tariff phase out schedule followed by the Mexican manufacturing industry under this Free Trade Agreement. Textile goods follow the same tariff phase out schedule as that described in Table 1 in Appendix 1, except for a group of textiles, namely, those classified as B6. The tariff phase out schedule for this specific group of textiles is shown in Table 2 of Appendix 1. Both tables show that the tariff levels in 1993 ranged between 5% and 20% in the manufacturing sector, but, by 1999, for the case of the textiles classified as B6, and 2003, for the rest of the manufacturing industry, tariffs became 0%. Table 3 in Appendix 1 shows the industries considered in the analysis, as well as the tariff phase out schedule each of them followed.

This information on tariffs permits us to split the sample as follows:

1) It is first divided into three groups taking into account the time (years) it took for each industry to eliminate its tariff: group A, comprised by the industries that eliminated tariffs immediately; group B, comprised by the industries that eliminated tariffs in 5 years; and group C, comprised by the industries that eliminated tariffs in 10 years.[20] Given this categorization, the impact of NAFTA on Mexican manufacturing PCMs across industries is just analysed for the industries in groups B (those that liberalized in 5 years) and C (those

[20] For example, if a manufacturing industry had an initial tariff equal to 10 percent and it was classified as B, this means that it had 5 years to eliminate its tariff. According to Table 1 in Appendix 1, by 1994, this tariff had to drop to 8; by 1995, to 6 per cent; by 1996, to 4 percent; by 1997, to 2 percent; and by 1998, to 0 percent.

that liberalized in 10 years). These two sub-samples are used in the first empirical analysis. The industries in group A are not considered since by eliminating tariffs immediately it is not possible to verify NAFTA's impact on PCMs.

2) The industries in groups B and C were then subdivided according to the initial level of tariffs (before NAFTA was implemented) in each industry. Those industries with the highest level of tariffs (those with a tariff of 20 percent) were classified as highly sensitive industries. Those industries with a medium level of tariff (those with a tariff of 15 percent) were classified as moderately sensitive, while those with the lowest level of tariff (those with a tariff of 10 percent), as non-sensitive industries. This sub-division in highly, moderately and non-sensitive industries is used in the second empirical analysis (see section 4.3.2 below), and focuses on disentangling the effect of NAFTA on PCMs from other macro or microeconomic effects occurring in the same period. Table 4 in Appendix 1 provides some summary statistics of the data used in this paper.

Overall, the classifications of the sample in those industries that liberalized in 5 and 10 years and then, within these sub-samples, in those industries that are highly, moderately or non-sensitive to the initial level of their tariff, allow for greater flexibility in the analysis. The first classification accounts for the sensitivity of each group of industries to the speed of the tariff reductions under NAFTA, while the second one accounts for the sensitivity of each group of industries to the initial level of its tariff, before it is eliminated.

4.2 Variable Description

This section describes the variables used in the estimation of equations (9) (first empirical exercise) and (12) (second empirical exercise).

For convenience, equation (9) is reproduced below:

$$\Delta q_{jt} - s_{jt}^{L}\Delta l_{jt} - s_{jt}^{M}\Delta m_{jt} = \delta_{jt}\Delta q_{jt} + (1-\delta_{jt})\left(\sum_{j=1}^{J}\vartheta_j d_j + \sum_{t=1}^{T}\vartheta_t d_t\right) + (1-\delta_{jt})\Delta u_{jt}$$

where:

Table 2. Variables used in the First Empirical Exercise

Logarithmic difference of the Solow residual: $\Delta q_{jt} - s_{jt}^{L}\Delta l_{jt} - s_{jt}^{M}\Delta m_{jt}$.	This variable is located on the left hand side of equation (9). It is obtained as a residual from regressions, by fixed effects, of the logarithmic difference of the value of production – capital ratio on the labor share $s_{jt}^{L} = \frac{wL}{pQ}$ multiplied by the logarithmic difference of the labor – value of capital ratio and, on the material share $s_{jt}^{M} = \frac{p_M M}{pQ}$ multiplied by the logarithmic difference of the value of materials – capital ratio. The value of production and the value of materials were deflated with a producer price index with 2003 as base year. The value of capital in the ratios mentioned was

	deflated with an index of capital formation with 2003 as base year.
Logarithmic difference of the value of production – capital ratio: Δq_{jt} .	This variable is located on the right hand side of equation (9). Its coefficient is the Lerner index, which can be transformed in order to get the corresponding PCM. The value of production in this ratio was deflated with a producer price index with 2003 as base year. The value of capital in the ratio was deflated with an index of capital formation with 2003 as base year.

Equation (12) is also shown in this sub-section:

$$\Delta q_{jt} = \frac{p}{c}_{jt} \left[s_{jt}^{L} \Delta l_{jt} + s_{jt}^{M} \Delta m_{jt} \right] + \gamma_{jt} \Delta k_{jt} + \vartheta_{jt}$$

where:

Table 3. Variables used in the Second Empirical Exercise

Logarithmic difference of the value of production – capital ratio: Δq_{jt}	This variable is located on the left hand side of equation (12). The value of production in this ratio was deflated with a producer price index with 2003 as base year. The value of capital was deflated with an index of capital formation with 2003 as base year.

The labor share in total revenue: $s_{jt}^{L} = \frac{wL}{pQ}$	It is equal to the value of labor over the value of production.
The logarithmic difference of the labor – value of capital ratio: Δl_{jt}	The value of capital in the denominator of this ratio was deflated with an index of capital formation with 2003 as base year.
The material share in total revenue: $s_{jt}^{M} = \frac{p_M M}{pQ}$	It is equal to the value of materials over the value of production.
The logarithmic difference of the value of materials – capital ratio: Δm_{jt}	The value of materials in this ratio was deflated with a producer price index with 2003 as base year. The value of capital was deflated with an index of capital formation with 2003 as base year.
The logarithmic difference of the value of capital: Δk_{jt}	The value of capital, as mentioned before, was deflated with an index of capital formation with 2003 as base year.
The rate of technological progress: ϑ_{jt}	It is described in Section 3.1.

Equation (6) is not presented in this section since it represents the constant returns to scale case and it is similar to Equation (12) when the logarithmic difference of the value of capital is equal to zero.

4.3 Results

4.3.1 First Empirical Exercise

This first exercise verifies if PCMs across industries decreased once the second round of trade liberalization in Mexico had commenced. It takes into account the sensitivity of each industry to the speed of the tariff reduction. Therefore, equation (9) becomes:

$$\Delta q_{jt} - s_{jt}^{L}\Delta l_{jt} - s_{jt}^{M}\Delta m_{jt} = \delta_{jt}\Delta q_{jt} + \beta_1 Timedummy1995 * \Delta q_{jt} + \beta_2 Timedummy1996 * \Delta q_{jt} + \beta_3 Timedummy1997 * \Delta q_{jt} + ... + \beta_9 Timedummy2003 * \Delta q_{jt} + \varepsilon_{jt} \quad (14)$$

This equation shows that the logarithmic difference of the Solow Residual is regressed on the logarithmic difference of the value of production-capital ratio, whose coefficient δ gives a measure of the Lerner Index for 1994, and on interacted terms integrated by time dummies, corresponding to each and every year in the period analyzed, multiplied by the logarithmic difference of the value of production-capital ratio. The coefficient β from each interacted term shows how much does the Lerner index in a specific year differ from that in 1994.

By considering this specification, the analysis controls for the sensitivity of each industry to the speed of the tariff reductions and, at the same time, focuses on the dynamics of Mexican markups following NAFTA's implementation, rather than assuming competition is static as in previous studies.

Equation (14) is estimated by System GMM to tackle the endogeneity problem in its right hand side, as mentioned in Section 3.1. Since System GMM combines equations in first differences with equations in levels, the instruments for the first type of equations are the lagged levels of the regressors, while the instruments for the second type of equations are the first differences of these same independent variables. The results from estimating

equation (14) for the group of industries that liberalized in 5 and the group of industries that liberalized in 10 years are presented in Table 1.

Time indicators are excluded from both specifications (the first regression considers the industries that liberalized in 5 years, while the second regression, those that liberalized in 10 years) since in a first estimation that did contain year dummies the null hypothesis of the joint test for the significance of these coefficients (the estimated coefficients are equal to zero) was not rejected. Table 1, however, does present two diagnostic tests: The Hansen test and the Arellano-Bond test for no first or second order autocorrelation in the first differenced residuals. The Hansen test (two-step estimator) shows that the null for the exogeneity of the instruments is not rejected in any of the two regressions. The Arellano Bond tests for no first or second order autocorrelation in the first differenced residuals is also not rejected.

As regards the interpretation of the coefficients, the results show that PCMs immediately decreased once the second round of trade liberalization in Mexico had commenced. However, in subsequent years, no clear pattern emerged for the markups. Figure 1 shows the evolution of the PCMs for those industries that liberalized in 5 years and those industries that liberalized in 10 years.

4.3.2 Second empirical exercise

This exercise investigates if the observed market power change in the previous section was only due to NAFTA or also to other macro or micro economic factors. Following Bottasso and Sembenelli (2001), this exercise assumes that NAFTA had an asymmetric impact on the industries in the sample. This assumption enables us to split the sample into those industries that were more likely to be affected by NAFTA, in industries moderately

sensitive to this reform and in non-sensitive industries. In this sense, the industries classified according to the speed of the tariff reduction (5 or 10 years) in the previous exercise are now categorized according to the initial level of their tariff. The highly sensitive firms are those with the highest level of tariffs. The subgroups of industries resulting from this second categorization are the following: Industries that liberalized in 5 years and are highly sensitive, moderately sensitive or non-sensitive; and those that liberalized in 10 years and are highly sensitive, moderately sensitive or non-sensitive.

Equations (6) and (12) (the constant returns to scale assumption and the variable returns to scale assumption, respectively) are then estimated for each sub-group of industries to recover mark-ups and verify if the markup from the period 1995-1997 is higher than that from the period 1998-2003; and if the markup from the period 1995-1998 is higher than that from the period 1999-2003.[21] A constancy test on the markup parameters is presented in the results to analyze this situation. Consequently, if a significant fall in the market power measure is observed only in the industries which ex-ante were expected to be more affected by the program according to the initial level of their tariff (the highly sensitive firms), then this fall can be interpreted as evidence showing that NAFTA did have an effect on PCMs.

Columns 1 and 3 from Tables 2-6 present the results from estimating equation (6), which considers the assumption of constant returns to scale. Columns 2 and 4 from the same Tables present the results from estimating equation (12), which considers the assumption of variable returns to scale. Regarding the specifications that consider variable

[21] The selected periods (1995-1997) and (1998-2003) are in some sense arbitrary and the exercise is repeated twice, considering a different set of periods (1995-1998) and (1999-2003), in order to check for the robustness of the results.

returns to scale, the results show that the returns are not statistically significant in any of the estimations so, in this second exercise, only the findings considering constant returns to scale are interpreted (the first and third column from each Table).[22]

Tables 2 to 6 show a test for the joint null hypothesis that all the coefficients of the year indicators are equal to zero. In each specification, the null hypothesis is rejected which means that the time indicators in each model are jointly significant.

The Hansen test and the Arellano Bond test for no first or second order autocorrelation are also presented for each specification in the Tables mentioned. The findings show that the null hypothesis for the exogeneity of the instruments used is not rejected in the Hansen Test, while the null for no first or second order autocorrelation in the first differenced residuals in the Arellano Bond tests is also not rejected.

Regarding the coefficients of the market power measure, the findings show that, in the case of the highly sensitive industries that liberalized in 5 years (Table 2), the PCMs decreased during the period analyzed: its estimates range between 62.4 percent and 63.7 percent in the first sub-periods analyzed, while their values range between 21.7 percent and 39.3 percent in the second sub-periods. However, the constancy test presented in Table 2 shows that the markup fall is only statistically significant when the sub-periods 1995-1997 and 1998-2003 are considered in the estimation (first column), but not when the sub-periods 1995-1998 and 1999-2003 are analyzed (third column).

In the case of the moderately sensitive industries that liberalized in 5 years (Table 3), the findings also show that the PCMs decreased during the period analyzed (the estimates range between 55.4 percent and 61.1 percent in the first sub-periods, while between 21.2

[22] The variable returns to scale in all the specifications shown in Tables 2-6 are decreasing. This finding is difficult to rationalize and it is contrary to expectations, but Bottasso and Sembenelli (2001) find similar results for their sample of Italian firms.

percent and 24.6 percent percent in the second set of sub-periods) but, according to the constancy test presented, the markup's fall is not statistically significant in any of the two specifications considered (column 1 or 3). No results are presented for the non-sensitive industries that liberalized in 5 years since it was not possible to obtain consistent results.

Overall, the analysis for the industries that liberalized in 5 years show that the results for the highly sensitive industries are not robust to a different selection of sub-periods in the estimation and, therefore, it cannot be concluded that there is evidence showing that NAFTA did have an effect for this group of industries' PCMs.

As regards the highly sensitive industries that liberalized in 10 years, the results in Table 4 (column 1 and 3) show that the PCMs did decrease during the period analyzed (the estimates of the markup range between 29.1 percent and 93.4 percent in the first sub-periods, while between 2.2 percent and 53.0 percent in the second set of sub-periods) and, according to the constancy test presented, the fall was statistically significant independently of the set of sub-periods chosen.

In the case of the moderately sensitive industries that liberalized in 10 years (column 1 and 3 from Table 5), the PCMs also decreased during the period analyzed (the markup estimates range between 13.2 percent and 19.8 percent in the first sub-periods, while between 6.6 percent and 7.8 percent in the second set of sub-periods), but the constancy test presented show that the fall was not statistically significant when either the sub-periods 1995-1997 and 1998-2003 or the sub-periods 1995-1998 and 1999-2003 were considered.

Finally, in the case of the non-sensitive industries that liberalized in 10 years (column 1 and 3 from Table 6), the results were similar to those of the moderately sensitive industries. The estimated coefficients of the PCMs range between 38.7 percent and 44.6 percent in the first sub-periods, while between 33.8 percent and 40.3 percent in the second

set of sub-periods, but the fall was not statistically significant as it can be seen with the constancy test presented.

Overall, the findings for the group of industries that liberalized in 10 years show evidence that NAFTA did have an effect on PCMs. The coefficient in the constancy test for the highly sensitive industries was negative and statistically significant independently of the set of sub-periods selected, while in the cases of the moderately sensitive industries and the non-sensitive industries, that same coefficient was negative but not statistically significant.

5. Conclusions

This paper analyzes the effect of NAFTA on Mexican manufacturing PCMs during the period 1994-2003. In particular, it first verifies if PCMs across industries decreased once the second round of trade liberalization in Mexico had commenced. Then, the paper investigates if the expected change in market power was only due to NAFTA or also to other macro or micro economic factors. The analysis is based on Hall's (1988) approach and tackles endogeneity problems by using System GMM, rather than TSLS as previous empirical literature on PCMs.

The results show that PCMs immediately decreased once the second round of trade liberalization under NAFTA in Mexico had commenced in 1994. However, in subsequent years, no clear pattern emerged for the markups.

Additionally, the study presents evidence showing that NAFTA did have an effect on the PCMs of the group of industries that liberalized in 10 years, while no robust result was found on the PCMs of the group of industries that liberalized in 5 years. The fact that

NAFTA alone affected markups in the group of industries that liberalized in 10 years, while no robust effect was observed for the group that liberalized in 5 years, suggest that additional factors may be also playing a role in the containment of market power in this less sheltered and less protected group of industries.

In terms of trade policy, analyses on PCMs permit policymakers and regulators to verify whether the dismantling of trade barriers under trade agreements leads or not to greater competition in the economies and, therefore, to a more efficient allocation of resources.

References

- Appelbaum, E. (1982); "The Estimation of the Degree of Oligopoly Power "; Journal of Econometrics; No. 19; p. 287-299.
- Bain, J. S. (1951); "Relation of Profit Rate to Industry Concentration: American Manufacturing, 1936-1940"; Quarterly Journal of Economics; 65; p. 293-324.
- ---------- (1956); "Barriers to New Competition: Their Character and Consequences in Manufacturing Industries"; Cambridge: Harvard University Press.
- Bottasso, A. and Sembenelli, A. (2001); "Market Power, Productivity and the EU Single Market Program: Evidence from a panel of Italian firms"; European Economic Review; 45; p. 167-186.
- Bresnahan, T. F. (1989); "Empirical Studies of Industries with Market Power"; Handbook of Industrial Organization, Volume II, Chapter 17; Standford University.
- Castañeda S., A. (2003); "Mexican Manufacturing Markups: Procyclical Behavior and the Impact of Trade Liberalization"; Economía Mexicana, Nueva Época; Vol. XII; No. 2.
- Castañeda S., A. and Mulato, D. (2006); "Market Structure: Concentration and Imports as Determinants of Industry Margins"; Estudios Económicos, El Colegio de México; Vol. 21, No. 002.
- Christopoulou, R. and Vermeulen, P. (2008); "Markups in the Euro Area and the US over the Period 1981-2004: A Comparison of 50 Sectors"; European Central Bank; Working Paper Series; No. 856.
- Domowitz, I., Glenn Hubbard, R., and Petersen, B. C. (1986); "Market Structure and Cyclical Fluctuations in U.S. Manufacturing"; NBER Working Paper Series; No. 2115.
- Edmond, C., Midrigan, V. and Xu, Daniel Yi (2012); "Competition, Markups, and the Gains from International Trade"; NBER Working Paper Series; 18041.
- Grether, J. M. (1996); "Mexico, 1985-90: Trade Liberalization, Market Structure, and Manufacturing Performance" in Industrial Evolution in Developing Countries: Micro Patterns of Turnover, Productivity, and Market Structure; Oxford University Press; Ch. 11.
- Hall, R. E. (1986); "Market Structure and Macroeconomic Fluctuations"; Brookings Paper on Economic Activity; 17(2); p. 285-338.
- ---------- (1988); "The Relation Between Price and Marginal Cost in U.S. Industry"; Journal of Political Economy; 96(5); p. 921-947.
- Hoekman, B., Looi K. H., Olarreaga, M. (2001); "Markups, Entry Regulation, and Trade: Does Country Size Matter?"; The World Bank, Development Research Group, Trade; Policy Research Working Paper 2662.
- Kiyota, Kozo, Takanobu Nakajima,and Kiyohiko G. Nishimura (2009) "Measurement of the Market Power of Firms: The Japanese Case in the 1990s," Industrial and Corporate Change; 18(3); p. 381–414.
- Konings, J., Van Cayseele, P., and Warzynski, F. (2001); "The Dynamics of Industrial Mark-ups in Two Small Open Economies: Does National Competition Policy Matter?; International Journal of Industrial Organization; No. 19; p. 841-859.

- ----------(2005); "The Effects of Privatization and Competitive Pressure on Firms' Price-Cost Margins: Micro Evidence from Emerging Economies"; The Review of Economics and Statistics; 87 (1); p. 124-134.
- Lopez, R. E. (1982); "Measuring Oligopoly Power and Production Responses of the Canadian Food Processing Industry"; Journal of Agricultural Economics; No. 35; p. 219-230.
- Marinov, R. (2010); "Competitive Pressure in Transition: A Role for Trade and Competition Policies"; Journal of Industry, Competition and Trade; 10; p. 1-31.
- Mexican Ministry of Economics (1993); *"Eliminación Arancelaria*" and "*Lista de Desgravación de México"*; *Tratado de Libre Comercio con América del Norte (TLCAN)*; *Sección B-Aranceles, Artículo 302, Anexo 302.2*; http://www.economia.gob.mx/swb/es/economia/p_TLC_AN
- Moreno, R. and Rodríguez, D. (2010); "Markups, Bargaining and Offshoring: An Empirical Assessment"; Working Papers On International Economics and Finance; DEFI 10-05.
- Nishimura, Kiyohiko G., Yasushi Ohkusa, and Kenn Ariga (1999) "Estimating the Mark-up Over Marginal Cost: A Panel Analysis of Japanese Firms 1971–1994," International Journal of Industrial Organization; 17(8); p. 1077–1111
- Roeger, W. (1995); "Can Imperfect Competition Explain the Difference between Primal and dual Productivity Measures? Estimates for U. S. Manufacturing"; Journal of Political Economy; Vol. 103; No. 2.
- Siotis, G. (2003); "Competitive Pressure and Economic Integration: An Illustration for Spain, 1983-1996"; International Journal of Industrial Organization; No. 21; p. 1435-1459.
- Verbeek, M. (2004); "A Gruide to Modern Econometrics"; John Wiley and Sons, Ltd.; 2nd. Edition; Ch. 5 Endogeneity, Instrumental Variables and GMM.; p. 121-159.

Table 1. Industries that Liberalized in 5 and 10 Years

Regression by System GMM: Two-Step Dependent Variable: log. Solow Residual		
Independent Variables	**Industries that liberalized in 5 years**	**Industries that liberalized in 10 years**
log. Q/K	0.168606**	0.4081721**
	[0.0758504]	[0.1840969]
Time Dummy 1995 * log. Q/K	-0.0454075**	-0.124425**
	[0 .0212982]	[0.0605556]
Time Dummy 1996 * log. Q/K	-0.0449933**	-0.1031909*
	[0.0191742]	[0.0564924]
Time Dummy 1997 * log. Q/K	-0.0512123**	-0.0933037*
	[0.0205901]	[0.0515794]
Time Dummy 1998 * log. Q/K	-0.0429044*	-0.0941763*
	[0.0223118]	[0.0508348]
Time Dummy 1999 * log. Q/K	-0.0400897*	-0.105053*
	[0.0214209]	[0.0552039]
Time Dummy 2000 * log. Q/K	-0.0439045*	-0.119377**
	[0 .023099]	[0.0596707]
Time Dummy 2001 * log. Q/K	-0.0663325**	-0.1121922*
	[0.0256684]	[0.0585706]
Time Dummy 2002 * log. Q/K	-0.0702356**	-0.1252005*
	[0.0291225]	[0.0679356]
Time Dummy 2003 * log. Q/K	-0.0722697**	-0.1404862*
	[0.0310017]	[0.0788228]
Constant	-0.350098*	-1.105717**
	[0.20615]	[0.4778516]
Observations	386	910
Number of industry	39	91
Diagnostics		
Arellano-Bond test for AR(1) in first differences:	-1.63	-1.62
	(0.103)	(0.105)
Arellano-Bond test for AR(2) in first differences:	-0.61	-0.62
	(0.540)	(0.532)
Hansen test of overid. Restrictions:	11.83	6.95
	(0.541)	(0.326)

Notes:
1.) Robust standard errors in brackets:
*** p<0.01, ** p<0.05, * p<0.1
2.) p-value in parenthesis.

Figure 1. PCM: Industries that Liberalized in 5 and 10 Years

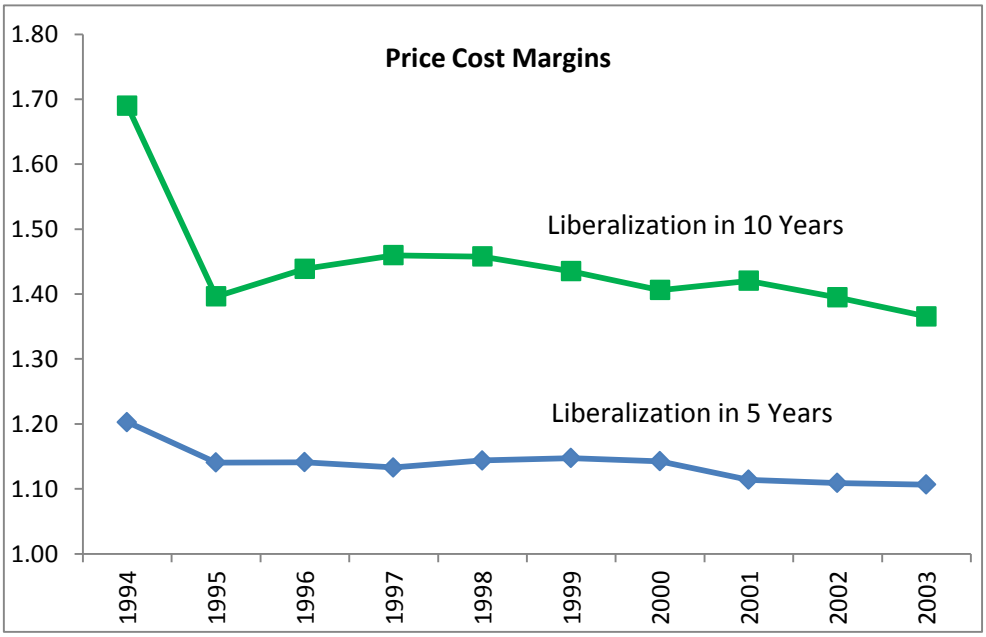

Table 2. Highly Sensitive Industries
Liberalization in 5 Years

Regression by System GMM: Two-Step

Dependent Variable: log. Q/K

	(1)	(2)	(3)	(4)
Independent Variables				
Time Dummy 1995 -1997 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.6366***	1.3787***		
	[0.178]	[0.450]		
Time Dummy 1998 - 2003* ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.2170***	1.1532***		
	[0.212]	[0.370]		
Time Dummy 1995 -1998 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.6239***	1.4587***
			[0.643]	[0.452]
Time Dummy 1999 - 2003 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.3931***	1.2052***
			[0.313]	[0.407]
Log. Capital		-0.1706		-0.1675
		[0.156]		[0.137]
Constant	3.7700***	4.6178***	3.7404***	4.6138***
	[0.214]	[0.998]	[0.248]	[0.864]
Observations	190	190	190	190
Number of industry	19	19	19	19
Year Indicators	Yes	Yes	Yes	Yes
Joint Sig. Test Year Indicators	52.39	17.82	17.09	23.10
	(0.000)	(0.000)	(0.000)	0.000
Constancy test on mark-up parameters	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$
	-0.420*	-0.226	-0.231	-0.253**
	(0.056)	(0.170)	(0.277)	(0.038)
Diagnostics				
Arellano-Bond test for AR(1) in first differences:	-0.96	-0.96	-0.96	-0.94
	(0.339)	(0.335)	(0.337)	(0.346)
Arellano-Bond test for AR(2) in first differences:	1.24	1.31	1.44	1.41
	(0.214)	(0.192)	(0.150)	(0.158)
Hansen test of overid. Restrictions:	2.19	3.05	3.54	1.79
	(0.701)	(0.881)	(0.471)	(0.970)

Notes:
1.) Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
2.) p-values in parenthesis

Table 3. Moderately Sensitive Industries
Liberalization in 5 Years

Regression by System GMM: Two-Step

Dependent Variable: log. Q/K

	(1)	(2)	(3)	(4)
Independent Variables				
Time Dummy 1995 -1997 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.6114***	1.2089***		
	[0.437]	[0.195]		
Time Dummy 1998 - 2003* ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.2464***	1.1999***		
	[0.243]	[0.231]		
Time Dummy 1995 -1998 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.5540***	1.2572***
			[0.201]	[0.208]
Time Dummy 1999 - 2003 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.2116***	1.1575***
			[0.108]	[0.241]
Log. Capital		-0.0693		-0.0726
		[0.092]		[0.095]
Constant	2.9129	3.4054***	2.8991***	3.4185***
	[0.246]	[0.691]	[0.236]	[0.713]
Observations	180	180	180	180
Number of industry	18	18	18	18
Year Indicators	Yes	Yes	Yes	Yes
Joint Sig. Test Year Indicators	20.63	11.08	24.77	11.65
	(0.000)	(0.000)	(0.000)	(0.000)
Constancy test on mark-up parameters	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$
	-0.365	-0.009	-0.342	-0.100
	(0.587)	(0.969)	(0.272)	(0.730)
Diagnostics				
Arellano-Bond test for AR(1) in first differences:	-0.08	0.00	-0.11	0.16
	(0.933)	(0.997)	(0.915)	(0.872)
Arellano-Bond test for AR(2) in first differences:	-0.80	-1.39	-1.18	-1.44
	(0.423)	(0.166)	(0.238)	(0.150)
Hansen test of overid. Restrictions:	0.89	5.96	2.03	5.59
	(0.344)	(0.918)	(0.730)	(0.935)

Notes:
1.) Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
2.) p-values in parenthesis

Table 4. Highly Sensitive Industries
Liberalization in 10 Years

Regression by System GMM: Two-Step

Dependent Variable: log. Q/K

	(1)	(2)	(3)	(4)
Independent Variables				
Time Dummy 1995 -1997 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.9339***	1.262829***		
	[0.3047735]	[0.363205]		
Time Dummy 1998 - 2003* ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.53021***	1.128592***		
	[0.2418973]	[0.3765196]		
Time Dummy 1995 -1998 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.291285***	1.162251**
			[0 .371416]	[0.4562877]
Time Dummy 1999 - 2003 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.022173***	1.074677**
			[0.3762484]	[0.4718388]
Log. Capital		-0.2704714		-0.4521815
		[0.2417363]		[0.2797707]
Constant	3.340799***	5.256643***	3.33891***	6.586788***
	[0.1215542]	[1.651411]	[0.1233351]	[1.935719]
Observations	378	378	378	378
Number of industry	38	38	38	38
Year Indicators	Yes	Yes	Yes	Yes
Joint Sig. Test Year Indicators	26.49	3.55	18.29	2.25
	(0.000)	(0.003)	(0.000)	(0.040)
Constancy test on mark-up parameters	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$
	-0.403691*	-0.134	-0.2691115**	-0.088
	(0.097)	(0.284)	(0.049)	(0.420)
Diagnostics				
Arellano-Bond test for AR(1) in first differences:	-1.27	-1.04	-1.63	-1.19
	(0.205)	(0.299)	(0.104)	(0.236)
Arellano-Bond test for AR(2) in first differences:	0.36	0.68	1.44	-0.68
	(0.722)	(0.494)	(0.149)	(0.499)
Hansen test of overid. Restrictions:	3.24	7.84	19.08	1.84
	(0.355)	(0.347)	(0.387)	(0.606)

Notes:
1.) Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
2.) p-values in parenthesis

Table 5. Moderately Sensitive Industries
Liberalization in 10 Years

Regression by System GMM: Two-Step

Dependent Variable: log. Q/K

	(1)	(2)	(3)	(4)
Independent Variables				
Time Dummy 1995 -1997 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.1983***	1.0847***		
	[0.228]	[0.346]		
Time Dummy 1998 - 2003* ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.0658***	1.0302***		
	[0.234]	[0.366]		
Time Dummy 1995 -1998 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.1323***	1.0627***
			[0.190]	[0.360]
Time Dummy 1999 - 2003 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.0780***	1.0203***
			[0.183]	[0.328]
Log. Capital		-0.0500		-0.0493
		[0.216]		[0.221]
Constant	3.6276***	3.9584***	3.6380***	3.9629***
	[0.168]	[1.529]	[0.142]	[1.5618]
Observations	360	360	360	360
Number of industry	36	36	36	36
Year Indicators	Yes	Yes	Yes	Yes
Joint Sig. Test Year Indicators	38.57	4.56	35.56	2.53
	(0.000)	(0.001)	(0.000)	(0.0239)
Constancy test on mark-up parameters	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$
	-0.133	-0.054	-0.054	-0.042
	(0.355)	(0.606)	(0.723)	(0.792)
Diagnostics				
Arellano-Bond test for AR(1) in first differences:	-1.44	-1.47	-1.54	-1.48
	(0.151)	(0.142)	(0.123)	(0.138)
Arellano-Bond test for AR(2) in first differences:	-0.96	-0.87	-0.98	-0.92
	(0.339)	(0.382)	(0.325)	(0.360)
Hansen test of overid. Restrictions:	19.16	21.71	21.94	21.17
	(0.382)	(0.477)	(0.524)	(0.510)

Notes:
1.) Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
2.) p-values in parenthesis

Table 6. Non-Sensitive Industries
Liberalization in 10 Years

Regression by System GMM: Two-Step

Dependent Variable: log. Q/K

	(1)	(2)	(3)	(4)
Independent Variables				
Time Dummy 1995 -1997 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.3867***	1.3225		
	[0.251]	[0.890]		
Time Dummy 1998 - 2003* ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)	1.3378**	1.2884		
	[0.328]	[1.005]		
Time Dummy 1995 -1998 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.4463***	1.4440***
			[0.284]	[0.387]
Time Dummy 1999 - 2003 * ($s_{jt}^{M} * \Delta m_{jt} + s_{jt}^{L} * \Delta l_{jt}$)			1.4031***	1.3645***
			[0.260]	[0.279]
Log. Capital		-0.2817		-0.0697
		[0.485]		[0.181]
Constant	3.3823***	5.5504	3.3888***	3.8670**
	[0.109]	[3.787]	[0.175]	[1.450]
Observations	170	170	170	170
Number of industry	17	17	17	17
Year Indicators	Yes	Yes	Yes	Yes
Joint Sig. Test Year Indicators	51.91	7.01	58.57	17.09
	(0.000)	(0.000)	(0.000)	(0.000)
Constancy test on mark-up parameters	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{98\text{-}03} - \mu_{95\text{-}97}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$	$\mu_{99\text{-}03} - \mu_{95\text{-}98}$
	-0.049	-0.034	-0.043	-0.079
	(0.673)	(0.828)	(0.811)	(0.681)
Diagnostics				
Arellano-Bond test for AR(1) in first differences:	-0.90	-0.58	-1.23	-1.21
	(0.367)	(0.562)	(0.219)	(0.226)
Arellano-Bond test for AR(2) in first differences:	-0.17	-0.62	-0.21	-0.40
	(0.863)	(0.537)	(0.832)	(0.691)
Hansen test of overid. Restrictions:	0.01	0.70	3.75	1.44
	(0.997)	(0.403)	(0.440)	(1.000)

Notes:
1.) Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
2.) p-values in parenthesis

Appendix 1

Table 1. Tariff Phase-Out Schedule

Mexican Base Rate	20%			15%			10%			5%		
	C	B	A	C	B	A	C	B	A	C	B	A
1994	18.0%	16.0%	Free	13.5%	12.0%	Free	9.0%	8.0%	Free	4.5%	4.0%	Free
1995	16.0%	12.0%		12.0%	9.0%		8.0%	6.0%		4.0%	3.0%	
1996	14.0%	8.0%		10.5%	6.0%		7.0%	4.0%		3.5%	2.0%	
1997	12.0%	4.0%		9.0%	3.0%		6.0%	2.0%		3.0%	1.0%	
1998	10.0%	Free		7.5%	Free		5.0%	Free		2.5%	Free	
1999	8.0%			6.0%			4.0%			2.0%		
2000	6.0%			4.5%			3.0%			1.5%		
2001	4.0%			3.0%			2.0%			1.0%		
2002	2.0%			1.5%			1.0%			0.5%		
2003	Free			Free			Free			Free		

Source: "*Eliminación Arancelaria, Tratado de Libre Comercio de América del Norte"*, Mexican Ministry of Economics. Note: Products classified as A experienced an immediate tariff elimination once NAFTA was implemented; products classified as B were assigned a tariff phase out schedule of five years (the tariffs were reduced in equal portions across the subsequent five years after the NAFTA implementation); while products classified as C were assigned a tariff phase out schedule of 10 years (the tariffs were reduced in equal portions across across the subsequent 10 years). Textiles are classified as A, B6 or C. A and C remained as before, while goods classified as B6 were assigned a tariff phase out schedule of 6 years.

Table 2. Tariff Phase-Out Schedule for Textiles Classified as B6

Mexican Base Rate	20%	15%	10%	5%
1994	16.0%	12.75%	9.00%	4.75%
1995	12.8%	10.20%	7.20%	3.80%
1996	9.6%	7.65%	5.40%	2.85%
1997	6.4%	5.10%	3.60%	1.90%
1998	3.2%	2.55%	1.80%	0.95%
1999	Free	Free	Free	Free

Source: "*Eliminación Arancelaria, Tratado de Libre Comercio de América del Norte*", Mexican Ministry of Economics.
Note: In the first year, the tariff experienced a reduction equal, in percentage terms, to its base rate (if the tariff base rate is 20%, the tariff elimination in the first year is 20%); in the following 5 years, the tariff was reduced in equal portions across the remaining period, with the textile becoming duty free in 1999.

Table 3. Tariff Phase-Out Schedule for the Industries in the Sample

Sector	Industries	Tariff phase-out schedule
Sector 31	**Food, drinks and tobacco**	
311101	Cattle and birds slaughtering	C
311102	Meat freezing and packing	C
311104	Meat and sausages canning	C
311201	Treatment and bottling of milk	C
311202	Cream, butter and cheese	C
311203	Condensed milk	C
311301	Fruit and vegetable canning	A
311303	Production of soups	B
311304	Freezing and packing of fresh seafood	A
311305	Seafood canning	A
311401	Rice milling	C
311402	Coffee	A
311403	Coffee toasting	C
311404	Wheat milling	C
311405	Production of maize flour	C
311501	Production of cookies and pastas	B
311503	Industrial bakeries	C
311701	Vegetable fats and oils	C
311801	Production of sugar	C
311901	Chocolate confectionery	C
311903	Production of chewing gum	C
312110	Production of soluble coffee	C
312121	Production of flavouring syrups and concentrates	C
312123	Starches and leaves	C
312126	Production of cream caramel, gelatins and desserts	C
312127	Products of maize not mentioned before	C
312129	Production of miscellaneous food products	C
312200	Animal food	C
313011	Agave distilleries	A
313012	Cane distilleries	A
313013	Grape distilleries	C
313014	Other distilleries	B
313031	Wineries	C
313040	Malt	C
313041	Breweries	C
313050	Soft drinks	C
314001	Tobacco processing	C
314002	Production of cigarettes	C
Sector 32	**Textiles, clothes and leather**	
321111	Henequen fiber preparation	C
321112	Henequen spinnning and knitting	A
321120	Natural or synthetic fiber cording	B(B6)
321202	Spinning of soft fibers	B(B6)

321203	Yarn texturing and twisting	A
321204	Production of woolen yarns	A
321205	Production of woolen fabrics	B(B6)
321206	Soft fiber knitting	B(B6)
321207	Textile and fabric finishing	B(B6)
321208	Production of laces, bands and stickers	B(B6)
321214	Production of bandages	C
321215	Production of non-woven fabrics	B(B6)
321216	Fabric coating	B(B6)
321217	Spinning, knitting and finishing of artificial fibers	B(B6)
321311	Production of sheets, table clothes and curtains	B(B6)
321312	Embroidery products	B(B6)
321321	Production of canvas and related articles	B(B6)
321332	Production and knitting of carpets and rugs	C
321401	Production of hosiery and socks	C
321402	Production of jerseys	C
321403	Underwear and nightwear knitting	A
321404	Knit fabrics	B(B6)
321405	Outwear knitting	B(B6)
322001	Men serial apparel	B(B6)
322003	Women serial apparel	A
322005	Shirts	A
322006	Uniforms	A
322009	Infants apparel	B(B6)
323001	Leather tanning and finishing	A
323003	Production of leather articles	C
324001	Production of leather footwear	A
324002	Production of plastic soles for footwear	C
Sector 33	**Wood**	
331102	Veneer, plywood	C
331103	Prefabricated wooden articles for building	B
331201	Production of wooden containers	B
332001	Production and repairing of furniture made of wood	B
332003	Production of mattresses	C
Sector 34	**Paper**	
341021	Production of paper and cellulose	B
341022	Production of cardboard	B
341031	Production of cardboard containers	C
341032	Production of paper bays and treated paper	C
341033	Production of stationery	C
341034	Production of articles made of cardboard not included above	C
342001	Publishing of newspaper and magazines	D
342002	Publishing of books	D
342003	Other printing	B
Sector 35	**Chemical substances, oil, coal, plastics and rubber**	
351211	Production of basic organic chemicals	A

351212	Production of basic inorganic chemicals	A
351213	Production of synthetic dye and pigment	A
351214	Production of industrial gases	A
351215	Production of turpentine and tar	A
351221	Production of fertilizers	A
351222	Production of pesticides	A
351231	Production of plastics and synthetic resins	A
351232	Production of synthetic rubber	C
351300	Production of synthetic fibers	A
352100	Production of pharmaceutical articles	C
352101	Production of drugs and chemicals	C
352210	Production of paints and varnishes	C
352221	Production of perfumes and cosmetics	C
352222	Production of soaps and detergents	B
352231	Production of adhesives and waterproof articles	C
352232	Production of printing inks	C
352233	Production of matches	C
352234	Production of photographic films and paper	A
352237	Production of polishes and surface active agents	A
352238	Production of essential oils	A
352240	Production of secondary chemical products	C
354001	Production of coke and coal derivatives	A
354002	Production of petroleum lubricating oils	A
354003	Production of asphalt and materials to pave	C
355001	Production of tires	B
355003	Production of articles made of natural and synthetic rubber	C
356001	Production of plastic packaging materials	C
356002	Production of plastic pipes	C
356003	Production of different PVC products (vinyl)	C
356004	Production of blown plastic packing	C
356005	Production of miscellaneous plastic articles	C
356006	Industrial pieces moulded with different resins	C
356007	Production of reinforced plastic products	C
356008	Production of decorative and industrial laminates	C
356010	Production of rubber and plastic footwear	C
356011	Production of plastic toys	C
356012	Other plastic products	C
Sector 36	**Non-metallic mineral products**	
361201	Production of plumbing fixtures	C
361202	Production of ceramic walls and floor tiles	C
361203	Clay products which are not heat resistant	C
361204	Clay bricks which are heat resistant	B
362011	Production of flat glass	C
362013	Production of fiberglass articles	C
362021	Production of glass containers	A
362022	Production of miscellaneous glass and crystal articles	C
362023	Handicraft glass products	C

369111	Production of cement	B
369112	Production of lime	A
369121	Production of ready-mix concrete	B
369122	Production of concrete blocks and bricks	B
369123	Production of concrete pipes	B
369124	Production of asbestos/cement materials	B
369133	Other mineral non-metallic derived products	A
Sector 37	**Metallic industries**	
371001	Steel and iron smelting	C
371006	Steel rolling and drawing	C
371007	Production of iron and steel pipes and tubes	C
372001	Non-ferrous metals smelting	A
372003	Copper smelting	C
372005	Aluminum smelting	C
372007	Production of non-ferrous metal solders	C
Sector 38	**Metallic products, machinery and equipment**	
381100	Smelting of metallic pieces	C
381201	Production of metallic structures for building	C
381202	Production and repairing of metal tanks	C
381203	Production and repairing of industrial boilers	A
381300	Production and repairing of metal furniture and accessories	A
381401	Production and repairing of tools used in agriculture	B
381404	Production of wire	C
381405	Production of screws, nuts and rivets	C
381407	Production of metal containers	C
381408	Electroplating, polishing, anodizing	C
381409	Production and repairing of metallic valves	C
381410	Production of power boilers and heat exchangers	C
381412	Metal pieces galvanization	C
382101	Production and repairing of machinery used in agriculture	A
382102	Production and repairing of woodworking machinery	C
382103	Production of machinery for mining and building	A
382104	Production of machinery used in the food industry	C
382106	Production of machinery used in other specific industries	A
382202	Production of machinery used to transport materials	C
382203	Production of miscellaneous purpose machinery	B
382205	Production and repairing of pumping equipment	C
382206	Production of ventilation equipment and heating	B
382207	Production of air and gas compressors	A

382301	Production and repairing of machinery used in the office	A
382302	Production and repairing of computers	A
383101	Production and repairing of power transmission equipment	C
383102	Production of welding and soldering equipment	C
383103	Production of motor vehicle electrical equipment	B
383107	Production of batteries	C
383108	Carbon and graphite products	B
383109	Production of electric materials and accessories	C
383110	Production of electric lamp bulbs	A
383201	Production of communication and transmission equipment	A
383202	Production of components for communication equipment	A
383204	Production of audio and video equipment	A
383205	Production of compact discs and tapes	A
383206	Production of audio and video equipment components	A
383301	Production of household cooking appliances	C
383302	Production of household refrigerators	B
383303	Production of household laundry equipment	C
383304	Production of small household electric appliances	B
384110	Production of motor vehicles	C
384121	Production of bodyworks for light vehicles and trailers	B
384122	Production of motor vehicle engines and parts	B
384123	Production of motor vehicle transmission parts	C
384124	Production of motor vehicle suspension components	B
384125	Production of parts for the brake system of motor vehicles	B
384126	Production of other motor vehicle parts	B
384201	Ship and boat building	C
384202	Production and repairing of railroad equipment	A
384203	Production of motorcycles and bicycles	B
384204	Production of motorcycles and bicycles components	A
385001	Production of surgical and medical instruments	A
385002	Production of dental equipment and supplies	A
385004	Production of instruments for measuring and testing	A
385005	Production of optical instruments	A
385006	Production of photographic equipment	A

Sector 39	**Other manufacturing industries**	
390001	Production of jewelry	C
390005	Production of office supplies	B
390006	Production of dolls, toys and games	C

Source: Own construction with data from INEGI and the document "*Lista de Desgravación de México, Tratado de Libre Comercio de América del Norte",* Mexican Ministry of Economics.

Table 4. Summary statistics of the data (whole sample)

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Value of production	1360	7,007,643	19,400,000	17,001	280,000,000
Number of employees	1360	7,980	9,821	162	82,331
Value of materials	1360	3,856,448	13,100,000	7,461	199,000,000
Value of capital stock	1360	277,418	694,258	96	8,522,600
Wages	1360	698,242	1,186,447	5,802	12,500,000
Tariff	1360	6.02	5.29	0	18
Producer price index	1360	68.14	23.17	25.42	97.44
Capital index	1360	68.43	22.88	28.01	98.19

Source: National Institute of Statistics and Geography (*INEGI* in Spanish) and NAFTA's document "*Tratado de Libre Comercio de América del Norte".*

Note: All variables except the number of employees and the tariffs are expressed in nominal thousands of pesos.