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Technological Determinants of Market Shares of Mexican Manufacturing Exports

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ABSTRACT

The aim of this paper is to estimate the determinants of export market shares for Mexican manufacturing industries to United States, in order to do this; determinants related to technology are distinguished from those nonrelated to technology. Estimations are based on a theoretical model that allowed classifying industries in function of the competition process in each industry. Regarding technological aspects four categories were identified: industries with high technology, with high and low intra-industry trade, and low technology industries with high and low intra-industry. Distinction between these groups is represented by eight major elements, namely, process or product innovation, vertical or horizontal product differentiation, price or quality differences, domestic market structure, and labor costs.

Key Words: market share, exports, technological intensity, intra-industry trade, manufacturing industries

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INTRODUCTION

The concept of competitiveness has played a leading role in the discussion about the ability of firms and countries to compete successfully in a global market. In this regard, the relationship between technology and competitiveness has been studied in the context of product cycle and technological gaps between countries literature (Dosi et al. 1990). These studies were based, explicitly or implicitly, on Schumpeterian analysis of innovation and dissemination as the driving forces of competitiveness and economic growth.

Empirically, some of these studies fit into the "Kaldor paradox", which states that exports share in markets of countries with highest growth in unit labor costs (low competitive price) often grew faster. Therefore, it is assumed that price and cost factors by themselves do not explain the failure or success in international markets (Beamish et al. 1999).

Thus, a number of studies include determinants of exports market share related to factors other than price, known as "non-price factors", in particular those related to technological efforts and more recently with elements associated with market structure of the exporting country, following the new theoretical explanations of international trade and, in particular, models that consider the intra-industry trade.

Some of the studies focused on the growth of total exports shares considering both non-price variables as well as technological and other factors (production capacity, market size, etc.). Fagerberg (1988) tested an empirical model for 15 OECD countries over the period 1961-1983. Results indicate a strong impact of technology (patents and research and development –R&D- expenditure) and other non-price factors; while price factors (approximated by relative unit labor costs – *rulc*) were less important, although significant. Amendola et al. (1993) studied the effect of technology on the dynamic competitive at the macro level for 16 OECD countries over the period 1967-1987. The variables considered were the market shares of exports in previous years, patents, R&D investment and labor costs; the dependent variable was the exports market shares. They found a significant impact of lagged patents and investment.

Also, more empirical studies include, as explanatory factors of exports and its participation in international markets, variables related to market structure. These documents are based on the new international trade theory which introduces notions of imperfect competition (Krugman 1990; Helpman and Krugman 1991) and in strategic international trade theory which states that government policies can increase market share by offering incentives for oligopolistic profits of their enterprises in the domestic market (Helpman 1984).

Thus, studies at the aggregate level allowed integrating technological and industrial organization factors in models that study export market shares, that is, that concern in determination of international competitiveness. However, they suffer from disadvantages, such as: aggregate analysis hides significant variations between industries, industry technological linkages can be very different from macroeconomic averages, and also they not allow distinguishing purely technological effects on the exports from structural changes in the economy.

To eliminate these possible biases, several studies are developed on an industrial scale. Soete (1981) explained the market shares of forty industries on the basis of the shares of patents and other variables, finding that patents have a significant impact in many industries, especially in technology-intensive ones. Magnier and Toujan-Bernate (1994) studied the shares of exports at the sectoral level of the five largest countries of the OECD in the period 1971-1987. They found important and significant effects of R&D, investment, and prices, for many industrial sectors (and not just in high-tech sectors).

Amable and Verspagen (1995) approached the technology through patents instead of R&D spending and interpret their results in terms of the taxonomy of industries proposed by Dosi et al. (1990), which distinguish between the supplier-dominated sectors, scale intensive and science based. They also find a significant impact of technology and price variables, confirming that the effect of variables differs across industries and sectors.

Moreover, since the publication of Bain's seminal paper (1951), a growing number of investigations have focused on the relationship between market structure and different dimensions of economic performance (particularly export) in advanced industrial economies. For instance, Clougherty and Zhang (2008) studied the relationship between domestic rivalry and export performance, based on the ideas of a national firm champion who enjoys government support, and national rivalry. This paper provides a theoretical framework that illustrates three different paths for exporting firms, which translates domestic rivalry into higher exports. Empirical evidence in the industry connects domestic rivalry with higher exports.

Also Glejser et al. (1980) explore how the export performance in a competitive context is related to the structure of domestic and foreign markets. It is one of the main papers that test the theoretical propositions, which link elements of international economy and industry successfully, using a large sample of data at the enterprise level. Through various statistical means, show that firm size, industry concentration, product differentiation, location, information and foreign affiliates are important in explaining the export performance (flows, levels, shares, propensity, etc.). Contrary to theoretical expectations, they concluded that to encourage domestic sales of a particular firm as well as the domestic merger or discourage direct investment from abroad represent an obstacle for exports, mainly for market share.

Finally, Donghwan and Marion (1997) study the effects, at industry level, of market structure on export market share from a perspective based on Porter (1990) hypothesis, which indicates that the degree of competition in domestic markets is positively related to performance in international markets. Hypotheses are tested using measures of business performance of manufacturing industries as proxies for international competitiveness. The empirical results are consistent with the Porter hypothesis, that is, the share of exports is negatively related to industrial concentration. The competitiveness of inputs, R&D intensity and trade barriers of other countries are also important determinants of performance of manufacturing industries in global markets.

Thus, the common conclusion of these studies is that technology and market structure are fundamental in explaining the export market shares. However, it says nothing about the reasons behind the inter-industry differences, which could be attributed to two main issues: *i*) the nature of the products (differentiated), that is, it is expected that in industries where major R&D activities take place or where product differentiation or processes, technology and industrial organization are most important in explaining the shares and *ii*) the way firms compete within a particular industry, that is, the farther the industry organization from perfect competence structure, which allows getting extraordinary profits, firms will have greater capacity to export and, ultimately, they will gain weight in international markets. For example, in a situation where there is strong competition between producers (because there are no barriers to entry or that the products are close substitutes), innovation processes are essential to improve productivity and gain temporary monopoly profits.

Thus, the aim of this paper is to examine the factors that explain export competitiveness in 20 industries according to ISIC Rev. 3 classification in the period 1987-2007. To do this, it follows a two-step methodology. First, industries are classified according to two dimensions: intra-industry trade and technology, which allows establishing common characteristics of competitiveness bases. Second, two econometric models are estimated; one in which the export shares are set as a function of changes in the R&D spending stock, intermediate goods imports, export price and in market composition effect and, the other which determines the effect of changes in different aspects such as the stock of R&D spending, the inverse of relative unit labor costs, purchases of capital and intermediate goods from abroad and intra-industry trade on export prices.

This allows determining which group of variables, price or no-price, has a greater effect on the growth of export market shares. The latter, are associated with product attributes like quality or functionality, in turn, are linked to technology and market structure. However, strictly speaking these two factors affect the price and ultimately, the competitiveness of exports, hence is not directly possible to distinguish between price or no-price competition. Accordingly, this study follows an approach that distinguishes between technological and non-technological variables that impact on prices. In this sense, it is expected that technological variables have a significant and broader effect than non-technological variables.

The econometric analysis is done by panel data methodology with 21 industries in 22 years. Industries are grouped, by a taxonomy proposed ahead, in four groups depending on two key aspects, technology and intra-industry trade. For industries within the same category parameters of a given variable depends on the results of the others. The advantage of this procedure is that it increases degrees of freedom. In this regard, an aspect of interest should be considered when export market shares will be estimated in this way. The results do not necessarily reflect the true effect on each industry, and only highlights the average weight of the determinants for all industries in each group, introducing a bias since it implicitly assumes that industries have identical coefficients.

Finally, characterizing export competitiveness of industries explicitly combining two elements (intra-industry trade and technology), important industrial policy considerations for promoting their competitiveness emerged. The paper is structured as follows. The next section identifies some theoretical considerations that sustain econometric specification and provides the basis for industries classification to identify common features and differences of industries; section three defines the variables used and specifies the model to estimate. Fourth section presents the results and discusses some highlights of the group estimations. Finally, conclusions and references are presented.

THEORETICAL ASPECTS

This section sets a model that reflects the competitiveness of Mexican exports to United States (US) market. In this sense, several aspects related to technology, prices, labor costs, composition of demand and intra-industry trade are considered.

First, to explain variations in market shares the idea of perfect competition must be removed, that is, a model that allows competitors may have some market power, which implies a certain asymmetry between producers (different prices and amounts of producers) should be considered. The asymmetry arises, as indicated by the explanations of intra-industry trade, when consumer preferences are heterogeneous and when the producers differentiate their products vertically or horizontally.

However, to model asymmetric competition with product differentiation increases the complexity of the models (Roberts 1999). In particular, it is difficult to obtain results of long-term equilibrium prices and market shares of individual producers as they depend on consumer preferences and technological level, as well as on strategic interaction between producers (Shaked and Sutton 1987). To avoid this complexity a strategy of two elements is followed. First, analysis is limited to short-term firms' behavior, and second, intra-industry trade index is included, assuming that indirectly measures the effect of product differentiation and industrial organizational factors such as scale economies and competition monopoly, among others.

Also, this model assumes that technology decisions are made in advance. Thus, after agents invest in R&D that can produce differentiated goods producers compete via price (vertical differentiation by quality) or quantities (horizontal differentiation by attributes). For a given level of technological knowledge, firms maximize their current profits given the demand and production costs functions. Empirically, this implies that technological variables can be considered as exogenous, along with other explanatory variables which are not determined by the producer, in particular, wages, exchange rate and those that affect the overall market performance.

Innovation, market structure and demand

One of the basic assumptions of this model is that Mexican exporters in a given industry offer differentiated goods (vertically or horizontally) in export markets. The degree of horizontal differentiation is the number of varieties offered, while the degree of vertical differentiation is associated with the quality of a particular variety. The degree of differentiation is determined primarily by investment decisions (the producers decide whether to enter a market, which influences the degree of horizontal differentiation, and decide about the quality of its products, impacting the degree of differentiation vertical).

There are two types of technology, one based on process innovation (*inproc*) and the other in product innovation (*inprod*). The first refers to the ability to produce a given good more efficiently, which reduces unit costs of production and is a basic aspect in the decision of producers to enter (or exit) the market. Product innovation, on the other hand, allows changing product quality. As technology decisions are made at an early stage of the competitive process, they are predetermined in a second stage where firms set prices and quantities, given a certain stock of accumulated knowledge and innovations.

Formally, consumers in foreign market (m) spend a total amount (G_m) on imports of certain type within a given industry.[1] The demand for variety in the foreign market (q_m) depends on the price charged by Mexican exporters (p_{im}), the price charged by competitors in that market (p_{jm}, j = 1,2, ..., N); the quality of Mexican products (captured by the term of innovation $inprod_{im}$) and on the quality of competing products ($inprod_{jm}$). Denoting average prices and quantities in the market as p_m and $inprod_m$, the demand for Mexican exports in market m is defined as:[2]

$$q_{im} = f\left(p_m, p_{im}, inprod_{im}, inprod_m, pib_m\right) \tag{1}$$

where $p_m = \sum_j^N s_{jm} \times p_{jm}$ is the average price in the US market (m), a weighted average of prices for each exporter. The market shares at the current price of each producer provided the relevant weights (s_{jm}). Similarly, $inprod_m = \sum_j^N s_{jm} \times inprod_{jm}$ is the average quality in market m. Only product innovation enters the demand function since process innovation acts on the costs and prices but not directly on the demand.

1 This implies that consumers maximize a neoclassical utility function with constant elasticities and therefore, with constant expenditure ratios for various types of differentiated goods.

2 The general model includes third countries (competitors of both domestic producers and of Mexican exports in market m); but given the limited access to data sets, it is only considered data for Mexico and the United States. This can be interpreted as a model of only two countries (N=1), where competition is implicitly reflected in the US variables.

Innovation, market structure and supply

It is assumed that the cost function of producer *i* consists of variable costs (v_i) and fixed (F_i). Variable costs depend positively on product level (q_i, in this case the volume of exports) and wages (w_i) and negatively on the innovation process ($inproc_i$) and on links between firms in the same group (parent and subsidiaries), since the stronger are the ties, the lower the transaction costs between them and other costs, this effect is reflected by the indicator of intra-industry trade (IIT). In other words, export shares in a market at any given time depends on the level of business that it has with its trading partners, at least in the earlier moment. Thus, to the extent that links of the bilateral trade relationship will be stronger, the level of exports will increase and, ultimately, the export shares. Both product innovation and process enter the cost function through the term F_i under the assumption that product innovation increases the fixed costs while process innovation reduces them. Thus, total costs are given by:

$$C_i = v_i(q_i, w_i, inproc_i, cii_i) + F_i(inprod_i, inproc_i) \tag{2}$$

The model includes the effect of intra-industry trade, theoretically derived from non-competitive market structures and in particular, from monopolistic competition; producers set up export prices through a markup above marginal cost, considering the demand functions in market *m*. The profit margin depends on the price-demand elasticity for firm on market *m* (ε_{im}):

$$p_{im} = \frac{1}{1 + \frac{1}{\varepsilon_{im}}} \times \frac{\partial C_i}{\partial q_i} \tag{3}$$

p_{im} depends on the price of producer *i*, the price of their competitors and on product quality, except if ε_{im} is constant; therefore the above equation can be rewritten as:

$$p_{im} = h_i\left(p_m, inprod_i, inprod_m, \frac{\partial C_i}{\partial q_i}, iit_i \right) \tag{4}$$

For estimation purposes, marginal costs are replaced by unit labor costs of industry *i*. Marginal and labor costs are linked by various terms, particularly by the elasticity of variable costs with regard to product and wages. In general, none of these two terms is constant and both depend on *inproc*. As a result, *inproc* is included in the above equation with negative expected sign. However, process innovation also operates through the unit labor costs by increasing labor productivity.

Product innovation of firm i ($inprod_i$) enters the price equation with positive sign; product innovation of competitors ($inprod_m$) appears with negative sign. Equations (1) and (4) form the basis for empirical estimation. Thus, both equations are linearized and expressed in first differences of their logarithms. This produces expressions for $\Delta\ln(q_{im})$ and $\Delta\ln(p_{im})$ that can be used to generate weighted means $\Delta(q_m)$ and $\Delta(p_m)$, changes in the total export volume in market m and changes in the average market price. Then, changes in market shares of exporter i in market m are given by:

$$\Delta\ln(XMS_{im}) = \Delta\ln(q_{im}) - \Delta\ln(q_m) = \alpha\cdot\Delta\ln\left(\frac{inprod_{im}}{inprod_m}\right) - \beta\cdot\Delta\ln\left(\frac{p_{im}}{p_m}\right) \tag{5}$$

$$\Delta\ln\left(\frac{p_{im}}{p_m}\right) = \Delta\ln(p_{im}) - \Delta\ln(p_m) =$$

$$= \gamma\cdot\Delta\ln\left(\frac{inprod_{im}}{inprod_m}\right) - \gamma\cdot\Delta\ln\left(\frac{inproc_{im}}{inproc_m}\right) + \varphi\cdot\Delta\ln\left(\frac{ULC_{im}}{ULC_m}\right) - \phi\cdot\Delta\ln\left(\frac{IIT_{im}}{IIT_m}\right) \tag{6}$$

Considering a particular market, the variable of expenditure G_m is removed since only affects total demand but not its distribution among exporters. To analyze changes in export market shares of an industry it should be considered two components: the first is purely referred to changes in exports in market m (market share effect-MSE) and the second is associated with changes in market (market composition effect-MCE), as indicated in equation (7), where the change in export share of industry i is the sum of market share effect (the weights, s_{im}, reflect the share of each market on total exports of producer i) and market composition effect:

$$\Delta\ln(XMS_i) = \Delta\ln(q_i/q) = \sum_m s_{im}\Delta\ln(XMS_{im}) + MCE_i \tag{7}$$

Thus, empirical analysis requires estimating this expression, which includes two equations, one which relates growth of total export share to relative prices, product innovation and market composition effect (relative structure of demand), and second, which explains movements in relative prices through changes in directly or indirectly technology, in unit labor costs and in intra-industry trade.

Taxonomy of industries

Markets can be characterized by some variant of imperfect competition (monopolistic competition or oligopoly, for instance) which, in a context of international trade, is reflected in some grade in intra-industry trade index. *A priori*, little can be said about the degree of competition although it has been shown that interaction of consumer preferences and cost structure are important elements in shaping the degree of competition and changing market structures (Klemp 1995).

Moreover, it is possible that importance of various determinants of market share vary with these conditions. For example, it could be argued that in an industry with a fragmented market structure (low concentration and therefore low levels of intra-industry trade), costs or exchange rates play a more important role in explaining the gains or losses in market shares, than in segmented industries with high profit margins and a tendency to concentration (which involves high levels of intra-industry trade). Thus, this study distinguishes between industries with low intra-industry trade (fragmented) and industries with high intra-industry trade (segmented) under the assumption that industries in these groups share core characteristics.

A second feature, in line with the theoretical discussion, is the importance of technology. If market shares are investigated under the assumption that technology is a determining factor, it is reasonable to expect that variables that affect market shares differ between the industries of high technological intensity and low intensity. Combination of these two criteria (high/low technological intensity, high/low intra-industry trade, associated with a segmented structure/fragmented), form an industrial taxonomy similar to that adopted by Oliveira et al. (1996).[3] Empirically, to group industries such as high or low technology it is used OECD taxonomy that classifies industrial activities according to the ratio of expenditure on research and development of each activity to the value of production.

Thus, Table 1 sets the four different combinations and associates each "box" the features of exports competitive process.[4] In the first

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3 This classification uses the same technology criterion (technological strengths in R&D) than that used here, however, the purpose of this document is more extensive in the sense that instead of only considering the market concentration ratio it uses intra-industry trade indicator, which includes more aspects than the former.

4 To classify industries in this way means that certain factors have, *a priori*, a more impor-

box (right and top), industries are technology-intensive and the majority trade is on intra-industry nature. The way they compete is mainly by technological activities that lead to product innovation which, in turn, implies higher qualities and different (higher) prices, that is, vertical product differentiation is a central element for exports; domestic markets tend to be oligopolistic (relatively few firms with market power derived from the high segmentation of them) and are mostly large multinational companies (Mexican and foreign); target markets are very dynamic with high incomes and different tastes.

Table 1. Industry classification: technology and intra-industry trade

Characteristics of export competition

	LIIT		HIIT	
HTI	-process innovation -prices -horizontal product differentation -capital use intensity -fragmented markets -many medium and small firms -relatively dynamic export markets -high incomes and differentiated preferences	II	-product innovation -qualities -segmented markets (oligopoly) -vertical product differentation -large multinational firms -dynamic export markets -high incomes and differentiated preferences	I
LTI	-costs (labor) -low product differentation -low levels of technology use -standardized qualities -fragmented markets -many small firms in traditional industries -specialization in some export market segments -export markets with low dynamism -standardized preferences and relatively low income	III	-product differentiation in some good ranges -economies of scale -segmented markets (monopolistic competence) -large firms (multinationals) and medium firms -many small firms in traditional industries -dynamic export markets -standardized preferences and relatively low income	IV

HTI: high technology industries (high and medium-high technology); LTI: low technology industries (low and medium-low technology);
HIIT: high intra-industry trade industries (more than 0.8); LIIT: low intra-industry trade industries (less than 0.8).
Source: own elaboration

In the box on the left and top (box II), with technology intensive industries and low IIT, export competition occurs notably through process innovation, price differential (reduced), factor endowments particularly the high capital intensity, product differentiation essentially horizontal (generated by differences in the characteristics of the goods); national markets are fragmented and dominated by many midsized or small companies with certain barriers to entry; international markets where they participate are relatively dynamic and also show different tastes and high income.

In the third box (left and down), the industries are of low technological intensity and with low levels of intra-industry trade. They compete trough costs, particularly labor costs which tend to be small; product differentiation is limited and qualities are relatively low or

tant role than other factors as determinants of export success in a particular industry.

standardized; the firms within this category are characterized by low use of technological factors (in addition to low levels of R&D investment); market structure is fragmented, which means many small firms compete in traditional industries without capacity to influence prices, and there are no barriers to entry. Their export markets are not dynamic that leads to specialization in certain segments with "normalized" tastes.

The last box (right and down) is composed of industries with low technological intensity and high IIT. Their exports compete through product differentiation, but only in certain ranges of products. In this sense, scale economies play a central role in reducing the average costs accordingly the production scale of that small group of differentiated goods increases. The market structure is monopolistic competition, that is, there are many firms with free entry but markets are segmented according to these ranges of differentiated goods. There is a tendency for the exporting companies are mostly multinational companies, often in traditional industries. Foreign markets are relatively dynamic with differentiated tastes and medium income levels.

VARIABLES AND MODEL SPECIFICATION

Because there is no concept of export competitiveness universally accepted, empirical studies have followed different perspectives, mainly associated with export shares, an indicator that captures the performance of a particular industry of a country in a foreign market. There are several indicators of export competitiveness, but given the availability of data for all industries, this study employs, as the dependent variable, the growth of export shares of the *i*-th Mexican manufacturing industry inside the US market as a performance measure, according to equation (7).[5] Thus, starting from expressions (5) and (6), the following equations for demand and prices, are estimated separately:

$$\begin{aligned}\Delta \ln(XMS_{it}) = \alpha_0 + \alpha_1 \cdot \Delta \ln(SR\&D_{it}) + \alpha_2 \cdot \Delta \ln(MBI_{it}) \\ + \alpha_3 \cdot \Delta \ln(P_{it}) + \alpha_4 \cdot DS_{it} + \varepsilon_{it}\end{aligned} \tag{8}$$

5 Other indicators may be mentioned, for example, the coverage rate of exports, ratios of export prices to import or measures of firm profitability.

$$\Delta \ln(P_{it}) = \beta_0 + \beta_1 \cdot \Delta \ln(SGI + D_{it}) + \beta_2 \cdot \Delta \ln(MBI_{it}) + \beta_3 \cdot \Delta \ln(MBK_{it}) + \beta_4 \cdot \Delta \ln(1/RULC_{it}) + \alpha_5 \cdot \Delta(IIT_{it}) + \mu_{it} \tag{9}$$

where:

$\Delta\ln(SR\&D_{it})$: growth of the logarithm of the stock of spending on research and development of industry *i* at time *t*;

$\Delta\ln(MBI_{it})$: growth of the logarithm of intermediate goods imports (product innovation);

$\Delta\ln(MBK_{it})$: growth of the logarithm of capital goods imports (process innovation);

$\Delta\ln(P_{it})$: growth of the logarithm of export prices;

$\Delta\ln(DS_{it})$: change of demand structure;

$\Delta\ln(1/RULC_{it})$: growth of the logarithm of (the reciprocal of) relative unit labor cost;

ΔIIT_{it}: growth of the logarithm of intra-industry trade index (marginal IIT);

$\Delta\ln(XMS_{it})$: growth of the logarithm of export shares in the US market.

For empirical purposes it is needed an expression that determines each of the variables listed above. First, the growth of knowledge stock is approximated through a measure often viewed as an input, in particular, it is used the R&D investment. The availability of data does not, in general, allow differentiating between direct efforts in product innovation and in process innovation, so that using this measure would gather the effects derived from both on export shares.

Thus, several authors (see for instance Montobbio and Ramp 2005) suggest that relevant measure to compute technology effects is accumulation because it reflects the real export potential, since technology stock is constantly depreciating. Consequently, technological capital stock of industry *i* in period *t* is given by $skt_{it} = (1-\delta)\cdot skt_{it-1} + I_{it-1}$, where δ is depreciation rate (set equals to 0.05) and *I* is investment in R&D performed in the previous period. To approximate technological capital stock in *t-1* (skt_{it-1}), it follows: $skt_{it-1} = [(1-\delta)\cdot skt_{i0} + i]/[1+g_i]$, where *i* is the investment-output ratio and *g* the growth rate of investment. The product is approximated by GDP and investment through investment in R&D, both in constant prices deflated by the implicit price index of GDP at the subsector level. The first series was obtained from national accounts statistics from INEGI and the second from the general report of the state of science and technology in Mexico of CONACYT (several copies). skt_0 is calculated as the ratio of investment in R&D, at the set initial period, to the sum of the depreciation rates and growth, that is, $skt_{i0} = I + D_{i0} / [1 + g_i]$.

Second, as proxies of the growth in product innovation and process innovation is used, respectively, imports of intermediate goods and of capital goods in industry *i*. Empirically, the distinction between these types of innovation is derived from the idea of technology indirectly acquired, derived from lasting R&D activities incorporated in such goods. It is assumed that technology embodied in intermediate inputs purchased from abroad tends to lead to improvements in products, so it is possible to approximate the theoretical variable *inprod*; while technology embodied in capital goods facilitates improvements in innovation processes, allowing approximating this variable (*inproc*). Thus, indirect technological level is constructed by linking acquired R&D in purchases from abroad (from a technologically advanced economy) of goods for capital formation and goods for intermediate consumption. The data were taken from Economic Information Bank of INEGI.[6]

Third, an indicator of (change in) marginal cost widely used in the empirical literature is the (change) relative unit labor cost, which is determined as the ratio of unit labor costs (*ULC*) of foreign country *j* compared to unit labor costs in the home country *i* in industry *k*, multiplied by the nominal exchange rate, that is, $RULC_{kti} = ULC_{ikt} / ULC_{ijkti}$. Also, *CUL* is expressed as the ratio of wages at current prices to value added in industry *k*, converted to constant pesos using the real exchange rate (2000=100), $ULC_{iikt} = W_{iikt} / VA_{ikt}$.[7] The data were taken from the Stan OECD Data Base. Two series were considered; first *ULC* indicator built by the own OECD and, second, *ULC* was calculated with the salary and value added data obtained from the Bank of Economic Information of INEGI. This study seeks to measure the ratio of labor costs, in industry *k* that exports to market *m*, to the aver-

6 There are only series for imported capital and intermediate goods for manufacturing aggregate, so that these indicators were constructed for each industry in the same way that spending on R&D, but the weighting used was the gross domestic product of each industry. The data are converted to constant pesos through real exchange rate (2000=100).

7 Nominal wages data used here are derived from the number of employees. Gross value added is the value of output less the value of intermediate consumption.

age labor costs prevailing in market *m*, so what is actually used in the model is the inverse of *RULC*.

Fourth, the intra-industry trade index is used to estimate the effect of improving on the structure of other export costs faced by domestic firms. However, what matters is the change in this indicator over time, thus the index used is the marginal intra-industry trade Brülhart A (IBA_{it}) for industry *i* at time *t*, which in formal terms is defined as:

$$IBA_{it} = \frac{\left[\left(|\Delta X_{it}| + |\Delta M_{it}|\right) - \left(|\Delta X_{it} - \Delta M_{it}|\right)\right]}{\left(|\Delta X_{it}| + |\Delta M_{it}|\right)}$$

With $|\Delta X_{it}|$ y $|\Delta M_{it}|$ as the net change of exports and imports for *i* at *t*, respectively. $|\Delta X_{it}\text{-}\Delta M_{it}|$ represents the net change of trade balance and $|\Delta X_{it}|+|\Delta M_{it}|$ is the net change of total trade. The data of exports and imports by industry used come from OECD Stan Bilateral Trade Database expressed in Mexican constant pesos through real exchange rate with base year 2000. Fifth, the variable that approximates the effect of changes in market composition, DS_{kit} measures the weighted average importance of exports of industry *k* of country *i* (Mexico) to changes in total demanded amount from overseas by country *m* at time *t*. The weights represent the difference between the importance of market *m* for country *i* and the importance of this market for all countries (world). The weights will be zero if market *m* has the same importance to all countries. In other words, the market composition effect shall be greater and positive (negative) if country *I*'s exports are concentrated in the market with higher (lower) growth. Formally, DS_{kit} is defined as:[8]

$$DS_{kit} = \left\{ \frac{p_{im} \cdot q_{im}}{p_i \cdot q_i} - \frac{p_m \cdot q_m}{p \cdot q} \right\} \Delta \ln(q_m)$$

Where:

$p_{im} \cdot q_{im}$: country *i*´s exports to market *m* (US) at current prices;
q_{im}: volumen of country *i*´s exports to market *m*;
p_{im}: price of country *i*´s exports to market *m*;

8 Indeed, if a multi-market context is considered, the above expression can be rewritten as:
$$DS_{kit} = \sum_{m}^{M} \left\{ \frac{p_{im} \cdot q_{im}}{p_i \cdot q_i} - \frac{p_m \cdot q_m}{p \cdot q} \right\} \Delta \ln(q_m) \cdot$$

$p_m \cdot q_m = \Sigma_j\, p_{jm} \cdot q_{jm}$: total exports to market m;
$p_i \cdot q_i = \Sigma_m\, p_{im} \cdot q_{im}$: country i´s to all markets (world);
$p \cdot q = \Sigma_j\, p_j \cdot q_j$: total exports to all markets (world).

Sixth, since there are no available data of prices, ΔP_{it} is proxy in equations (8) and (9) by the unit value, which is simply obtained by dividing the value of exports in industry i at time t, by quantities sold abroad, that is, $PriceX_{it}=ValueX_{it}/QuantitieX_{it}$. The series are obtained from the same source of trade data noted above. Seventh, the dependent variable ΔXMS_{it}, represents changes in market share of Mexican exports of industry i at time t in market m (US), that is, the changes in demanded quantities of Mexican products in US, regarding changes in the demanded quantities of all goods in that market. In formal terms:

$$\Delta \ln(q_{im}) - \Delta \ln(q_m) = \Delta \ln(q_{im}) - \sum_j^N \frac{p_{jm} \cdot q_{jm}}{p_m \cdot q_m} \Delta \ln(q_{jm})$$

For DS, ΔP and ΔXMS data were taken from the *United Nations Commodity Trade Statistics Database* (UN Comtrade). The considered industries are shown in Table 2. Thus, to the extent that independent variables generate significant empirical effects of the change in exports share of each industry, it might be thought they are good approximation of Mexican manufacturing exports' competitiveness.

Table 2. Industries

	ISIC Rev. 3	Description	Short name
1	15-16	Food products, beverages and tobacco	Foods
2	17-19	Textiles, manufactures of textiles, leather and footwear	Textiles
3	20	Wood and its manufactures	Wood
4	21-22	Paper and its manufactures, publishing and printing	Paper
5	23	Manufacture of coke, refined petroleum products and nuclear fuels	Petroleum
6	24-2423	Manufacture of chemicals and chemical products*	Chemicals
7	2423	Pharmaceutical products	Pharmaceutical
8	25	Manufacture of rubber and plastic products	Rubber
9	26	Manufacture of other non-metallic mineral products	Non-metallic minerals
10	27	Manufacture of basic metals	Basic metals
11	28	Manufacture of fabricated metal products, except machinery and equipment	Metalic products
12	29	Manufacture of machinery and equipment	Machinery and equipment
13	30	Manufacture of office, accounting and computing machinery	Computers
14	31	Manufacture of electrical machinery and apparatus	Electrical machinery
15	32	Manufacture of radio, television and communicaion equipments	Electronic equipment
16	33	Manufacture of medical, precision and optical instruments, watches and clocks	Medical equipment
17	34	Manufacture of motor vehicles, trailers and semi-trailers	Motor vehicles
18	351	Building and repairing of ships and boats	Ships
19	353	Manufacture of aircraft and spacecraft	Aircraft
20	352+359	Other transport equipments and railway	Other transport equipment
21	36-37	Other manufactures	Other manufactures

* Except Pharmaceutical
Source: own elaboration based on OECD, STAN Bilateral Trade Database (BTD)

On the other hand, equations (8) and (9) are estimated using panel data techniques; in this case, includes 21 years and 21 industries, with a total of 441 observations. The sample consists of data from two-digit industries of ISIC Rev. 3 in the period 1987-2007. These equations are a panel regression model derived from a general structure with form:

$$y_{it} = \alpha + \beta \cdot X_{it} + u_{it} \tag{10}$$

Where *i* denotes industries (*i*=1,2,…, *N*); and *t* which represents time (*t*=1,2,…, *T*), meanwhile the error term is:

$$u_{it} = \mu_{it} + \upsilon_{it} \tag{11}$$

$$u_{it} = \lambda_i + \upsilon_{it} \tag{12}$$

Where u_i denotes the unobserved individual specific effect and υ_{it} is the rest of the error which is identically and independently distributed, that is, iid~(0, σ^2_υ). This model is known in the empirical literature as a one-way model as it considers the individual effects in the industries but not the effects of time. The model considers the heterogeneity in the error term at the level of specific individual units (industries) or at time level. It also implies an intercept coefficient for each industry (equation 11) or an intercept for each time period (equation 12). In this paper, although it is considered a relatively large period, it is accepted that differences among industries are generated mainly by the structural features specific to each industry, so it is only estimated the one-way model.

It can be set different assumptions about μ_i and λ_t. That is, panel data analysis requires choosing the appropriate specification between models of pooled data, fixed effects or random effects. First, if errors, u_{it}, are independent between time and individual units with $E(u)=0$ and $var(u)=\sigma^2$, then traditional regression model can be estimated by OLS. This restrictive and unrealistic model is known as pooled regression.

Aside, the fixed effects model (FEM) assumes the u_i as fixed, the parameters as time-invariant and variables, X_{it}, as independent of the terms υ_{it} for all *i* and *t*. This model also assumes that differences among industries can be captured by differences in the constant term. In the model above, these differences are included in the error term μ_i (for fixed effects in cross-section units) or λ_t (for temporal fixed effects).

The parameters can be estimated using least squares with dummy variables (LSDV) for each cross section (or time). The equations are estimated and individual effects calculated for each industry (or time).

When N, the number of industries, is large, the FEM involves too many dummies MEF, which magnifies the multicollinearity problem among regressors. Thus, the FEM suffers a considerable loss of degrees of freedom. Moreover, the FEM cannot estimate the effect of any unobserved variable on the participation (or price) of exports, for instance, government policies promoting export competitiveness and foreign direct investment.

Nevertheless, the loss of degrees of freedom as well as the need to estimate too many parameters in the FEM can be avoided if it is set the assumption that u_i are random (Baltagi 1995). That is, the random effects model (REM) stresses that X_{it} are independent of u_i and υ_{it}, for all i and t. However, it is considered that this model is only appropriate when the random process is performed by a large population ($N \rightarrow \infty$). Also, following Greene (1999) the MEA suffers from inconsistency since the individual effects are treated as uncorrelated with other regressors due to omitted variable bias.

However, the REM seems intuitively appropriate to model the effects of technology on exports, since, in the context of industries, the unobserved variables such as policies to boost exports, the ability to attract foreign investment or the internal structure of each industry, not necessarily remain constant and can be a function of other variables. Systematically, the choice between FEM and REM is made using the Hausman test. The rejection of one of these models does not imply the adoption of another.

RESULTS

The results of the regressions are shown in Tables 3 and 4. Since in all cases the F-test rejected the hypothesis that data can be pooled, and simultaneously the LM test indicated that neither model is candidate to be considered as of REM, it is accepted that the best model specification is of fixed effects. For all regressions, with the aim of assessing the robustness of the results, it was determined whether there were problems of multicollinearity, autocorrelation and heteroskedasticity, thus the displayed results include, if necessary, corrections of these problems.

Multicollinearity among explanatory variables was investigated using the correlation coefficient matrix. In most relationships, the correlation is low (the highest correlation is less than 0.5) so it is not considered as a serious problem. However, as could be expected, there are problems of this kind between MBI and MBK and, to a lesser extent between ED. Once these variables are lagged one period, the problems decrease dramatically (the highest correlation among all variables is less than 0.5), in consequence, the model to estimate incorporates a lag in these variables.

Considering it is a fixed effects model, the autocorrelation test found evidence of first-order autocorrelation AR(1) only for the regression whose dependent variable is export price in high technology industries. To solve this problem, we used the Prais-Winston transformation by period, following the method Panel Corrected Standard Errors (PCSE). After this correction, it seems to be no such problems.

Finally, LM test suggested by Greene (1999) was applied to determine heteroskedasticity. In five of the regressions there is different variances between the residues (for models that determine: the export prices of low technology industries; the export shares of high technology industries; and, the export prices of high-tech industries and high intra-industry trade). As a way of correction, these models were estimated by weighting the observations (periods) trough the method White Period Coefficient Covariance (WPCC), which corrects the standard errors.

In general, there are mixed results across industries regarding the significance and importance of the determinants of export volume and, to a lesser extent, about the determinants of export price. Considering the export price function, it can be observed from a technological perspective that for all industries, the explanatory power of the factors included in the model is low, implying that other aspects not captured in the model, prevail in those industries. By contrast, a significant proportion of the variation in market shares is captured by the proposed determinants in the model *XMS*. On average, after eliminating the problems mentioned above, technological and non-technology factors can explain between 69% and 91% of the variations in the volume exported, but only between 50% and 58% of variations in relative prices.

In addition, all variables are significant in at least one model, however, of all possible relationships between the explanatory variable and the explained (excluding the intercept), only in eight the explanatory variable is statistically significant at 99% of confidence, three at 95%, nine at 90%, and in 16 cases it is not significant. Among the most systematically significant variables, considering the percentage of estimates in where they are significant, are prices and market structure (non-technology factors) in 75% of cases and R&D stock in 63% of the estimates. In what follows it is discussed in more detail the role of the different variables in explaining for gains and losses of manufacturing exports to US market and in determining the export price of those goods. The discussion is based on tables 3 and 4.

Technology

Contrary to what might be expected, the technological variable plays a bigger role in explaining movements in market share of low-tech industries than in high technology industries. On average, elasticity of demand regarding the R&D stock in the first kind of industries is 0.1036, as long as the second industries have an average of just 0.058. In addition, a regression of these technological elasticities (using the inverse of their standard deviations as the weight) produces a negative (β =-0.015) and significant (t =-2.43) slope.[9]

Table 3. Resutls of panel data regressions (fixed effects model)

Share of export volumes

	LIIT					HIIT				
	C	$\Delta SR\&D$	ΔMBI	ΔP	ΔDS	C	$\Delta SR\&D$	ΔMBI	ΔP	ΔDS
HTI	0.1290	0.0124	-0.1679	-0.0175	0.0026	0.0044	0.1036	0.1313	-0.0975	0.0197
	(5.1345)*	(1.7109)***	(-1.9457)***	(-0.7357)	(0.9536)	(0.1952)	(4.7628)*	(1.6811)***	(-1.7492)***	(2.3967)**
	R^2 = 0.69	n = 123	F = 11.38			R^2= 0.71	n = 112	F = 18.25		
LTI	0.1069	0.1285	-0.1213	-0.1214	-0.0626	0.0531	0.0787	-0.0611	0.0870	0.0040
	(2.3155)**	(4.0209)*	(-0.7879)	(-3.3897)*	(-13.9899)*	(2.5450)**	(4.4552)*	(-0.8202)	(1.6816)***	(1.7395)***
	R^2 = 0.91	n = 72	F = 14.74			R^2= 0.79	n= 134	F = 8.41		

Export prices

	LIIT						HIIT					
	C	$\Delta SR\&D$	ΔMBI	ΔMBK	$\Delta IRULC$	ΔIBA	C	$\Delta SR\&D$	ΔMBI	ΔMBK	$\Delta IRULC$	ΔIBA
HTI	-0.1218	-0.0485	0.3885	-0.2138	-0.0639	0.0158	-0.1753	-0.0404	0.3457	-0.0782	0.0720	0.0033
	-1.3644	-0.7896	(2.7062)*	(-2.5261)**	-0.2523	(1.7152)***	(-2.4143)**	-1.2809	(2.1825)**	-0.7671	0.3149	(1.6901)***
	R^2 = 0.50	n = 123	F = 7.35				R^2= 0.58	n = 112	F = 11.35			
LTI	-0.3693	0.2017	0.3839	-0.2593	0.5683	0.0004	-0.1730	0.0306	-0.0862	-0.0462	0.6589	-0.0001
	(-2.0866)**	(5.1249)*	0.9198	-0.9237	(2.0435)*	0.0321	-1.4044	0.7317	-0.6841	-0.7407	(1.8556)***	-0.0081
	R^2 = 0.54	n = 72	F = 13.22				R^2= 0.56	n= 134	F = 7.24			

HTI: high technology industries (high and medium-high technology); LTI: low technology industries (low and medium-low technology); HIIT: high intra-industry trade industries (bigger than the manufacture average in the period 0.6432); LIIT: low intra-industry trade industries (less than the manufacture average in the period 0.6432); $\Delta SR\&D$: growth of the stock of research and development spending; ΔMBI: growth of intermediate imports; ΔMBK: growth of capital imports; $\Delta IRULC$: growth of the inverse of relative unit labor cost; ΔIBA: marginal intra-industry trade. t-statistic in brackets. *,**, *** significance at 99%, 95% and 90%, respectivaley.

Source: own elaboration

Also, in high-tech industries with high intra-industry trade, the variable R&D has a significant and positive effect on the demand equation (*XMS*). This confirms the notion that both product innovation and differentiation by quality are common features of the competitive process of these industries in the US market. In high-tech and low intra-industry trade industries a similar result is obtained, but of minor effect, thus supporting the importance of process innovation and horizontal differentiation as mechanism of competition.

9 The technological intensity indicator is defined as the logarithm of the average annual expenditure on R&D in industry *i* regarding to value added in the same industry.

Simultaneously, it seems that in these two industries, R&D stock is not important in determining export prices, which is consistent with the type of competition expected in the high-tech industries. Particularly, it can be seen that in HTI-HIIT, unit labor cost, which captures the increase of productivity arising from the innovation processes, is not significant in explaining changes in prices; in consequence, it is concluded that innovation process is secondary in this group of industries. Similarly, for HTI-LIIT industries, labor costs are not significant for export prices, implying that favorable impact of process innovation is only spread through the R&D stock.

The effects of R&D stock in prices appear to be not significant within the set of technology-intensive industries. However, the estimated sign is negative, indicating that the innovation process has effects of greater magnitude in comparison of the RULC.

On the other hand, in low-tech industries, the cumulative investment in R&D has significant positive effects over movements on market share of Mexican exports in US. In fact, the effect is greater than in the HTI. This means that low levels of product differentiation (LTI-LIIT) or differentiation restricted to certain ranges of goods (LTI-HIIT) are highly efficient as sources of competitiveness of these sales in US.

The fact that the RULC and SGI&D are significant and positive in explaining relative prices in LTI-LIIT confirms the characterization in Table 1, where is stated that firms compete in this segment by wage-costs and relative standardized qualities through low levels of investment in R&D, but with significant effects. By contrast, prices seem not to respond to accumulation of R&D expenditure in LTI-HIIT; but significantly react to changes in the cost of labor, in relative terms, which confirms the relevance of production scale. That is, to the extent that wage costs are lower in Mexico relative to US, the cost of production of one additional unit will be lower, encouraging increases in production.

The indirect variables of R&D appear not to contribute in a relevant way in the development of market shares. In HTI these variables are significant only at 90% of confidence and in LTI they are not significant, confirming the taxonomy of industries proposed above. R&D activities embodied in intermediate goods purchased abroad (product innovation) is positive in HTI-HIIT, which underpins the relevance of these activities as mechanism of competition in these industries. By contrast, the negative sign of MBI in HTI-LIIT implies that the advantage of this type of industries is focused on process innovation.

Considering the effect of MBI and MBK in export prices it can be seen that regardless the technological intensity, when the analysis is focused in HIIT, imports of capital goods (process innovation) are not significant determinants. The same applies to LTI-HIIT. Again, since MBK is significant and negative, the importance of process innovation as way of competition in these industries is confirmed. That is, additional imports of capital goods tend to reduce the price of exports which, in turn, significantly impact on market shares. The same happens in these industries with MBI. In contrast, the latter variable is not important in LTI, although it is for HTI-HIIT, which allows sustaining the competitive process of these industries pointed above (through product innovation).[10]

Table 4. Industry classification: technology and intra-industry trade

Characteristics of export competition

	LIIT			HIIT		
HTI	**29**	Machinery and equipment		**2423**	Pharmaceutical	
	33	Medical equipment		**31**	Electrical machinery	
	352+359	Other transport equipment		**32**	Electronic equioments	
	24	Chemicals		**351**	Ships	
	30	Computers		**36-37**	Other manufactures	
	34	Motor vehicle				
	353	Aircfaft	HTI-LIIT (7)			HTI-HIIT (5)
LTI	**21-22**	Paper		**15-16**	Foods	
	23	Petroleum		**17-19**	Textiles	
	25	Rubber		**20**	Wood	
				26	Non-metallic minerals	
				27	Basic metals	
				28	Metalic products	
			LTI-LIIT (3)			LTI-HIIT (6)

HTI: high technology industries (high and medium-high technology); LTI: low technology industries (low and medium-low technology); HIIT: high intra-industry trade industries (bigger than the manufacture average in the period 0.6432); LIIT: low intra-industry trade industries (less than the manufacture average in the period 0.6432).
Source: own elaboration

Demand structure

After R&D stock, the most powerful variable to explain the growth of exports market, by the number of significant coefficients, is that which captures the structure and growth in demand. In three of four regressions *DS* is significant. However, the estimated coefficients are low and even negative (LTI-LIIT). In principle, this means that an increase in US demand for imports is translated in a slight increase in Mexican export share in that market for HIIT industries, which confirms the hypothesis that this variable, measures the strength of the bilateral relationship.

By contrast, for LTI-LIIT an increase in US demand leads to a lower market share of these industries, so that in the long run, ceteris paribus, it can be expected the exit of Mexican products from that market.

10 However, any interpretation of the findings regarding the technological intensity indirectly reflected in MBI and MBK must consider the problems of measuring of these variables arising from the availability of data.

This has two general implications: first, the geographical composition of export markets is crucial in the overall export performance of each industry group and, second, there is a "waste" by the lack of capacity of industries to meet this new market. The fact that industries with bigger IIT are those who have a greater effect of *DS* in *XMS* is due to large companies dominate this sector, which have made greater efforts to export, i.e. investing in production and distribution networks between the two countries. Again, confirming the role of IIT as a measure of strength in the bilateral relationship.

Price

In general, the price variable is significant for industries with HIIT. In this line, this group of industries competes through high quality that tends to be associated with high prices. The negative sign for HTI is contrary to expectations and involves a loss of market share due to higher prices even with higher qualities. In this regard, one explanation is that the quality of exported goods does not justify, from the perspective of consumers, increases in prices charged inside the US market. Therefore, the alternative for firms within this segment is to take into account market discrimination strategies, allowing them to charge a lower price in the target market that the price charged for products in the domestic market. By contrast, for LTI the advantage derived from high trade between industries in the same sector in both countries allows them to generate profits in *XMS* given small changes in prices for a range of differentiated goods.

Besides, for LTI-LIIT the expected result is obtained, ΔP is statistically significant and negative. This means that market share of firms in this traditional sector, with low technology and high labor intensity, depends on the price charged to US consumers. This result confirms the characterization of this sector which points that industries compete by costs ultimately reflected in prices. Given the standardized qualities, in the extent that many firms follow strategies of both price (cost) reduction and to specialize in market niches, their presence is not only guaranteed, but it will considerably grow.

Contrary to the above, for HTI-LIIT, which theoretically competes by prices, this variable is not a determinant of market share of this industry segment. One argument behind this result is that for these industries, the import of intermediate goods, which enables product innovation, tends to increase prices, while imports of capital goods, which affect the innovation process, reduces prices. In other words, only part of technological variables indirectly incorporated affects positively the way to compete in foreign market. Then, SR&D and MBI are the most relevant for industries of high technological intensity. Thus, loss of market share in industries such as transport equipment, computers or general machinery and equipment, may be due to they compete through process innovation that affects export price, but at the same time it not allows them charging consistently different prices to different varieties of horizontally differentiated products. This confirms the idea that process innovation directly affects *XMS*, by creating better ways of doing things that allows to differentiating goods (but with about the same price).

Relative unit labor cost

Changes in the inverse of relative unit labor cost (changes in labor costs in Mexico with respect to labor costs in US), which reflect movements in wages, nominal exchange rate and labor productivity, play a significant role in determining prices in more than the half of group of industries. In particular, RULC only has an effect on prices for LTI. Regardless of whether or not industries are concentrated, the labor costs have no effect on technology-intensive industries. In LTI-HIIT, it appears that statistical significance of wage costs is in fewer cases, but when it does, the effect of such costs in price is of greater magnitude than in the case of LTI-LIIT. Thus, it is argued that the lower the industrial concentration, the degree of product differentiation and intra-industrial trade, the stronger the relationship between export prices and labor costs.

Consequently, fluctuations in wages and exchange rates are more important in fragmented industries with LIIT than in segmented industries with HIIT. This argument is in line with the industrial taxonomy proposed in Table 1 which states that sectors with low intra-industry trade and low technological intensity are ruled by competition via cost. This is understood taking account that in industries with low fixed costs (such as traditional low-tech) the link between total average costs and labor costs is greater (i.e., variable costs outweigh the total costs).

Additionally, when estimating a model that sets cost-labor elasticities as a function of an indicator of market concentration or alternatively of the IIT indicator (using the inverse of their standard deviations as the weight) yields a negative average slope (β=-0.227) and significant (t=-3.65),[11] which highlights the systematic importance of wage costs

11 The market concentration indicator used is known as the profit margin that approximates the effect of market power through profit margin on labor costs per unit of output and is defined as the sum of *ulc* and its product with profit margin. Likewise, the

in these industries. In this regard, this group of industries has low horizontal product differentiation which represents few options for product substitution which, in turn, explains the relatively low elasticity with respect to changes in market concentration and the high response of export prices to movements in wage costs.

Intra-industry trade

Contrary to expectations, in HTI the impact of the strength of trade relations between firms within the same industry in both countries seems to be a small disadvantage for Mexican exports (coefficient low and significant only at 90% of confidence) since a positive sign in the coefficient of *IBA* was obtained. In other words, to the extent that the new trade between these two countries is largely within industries, the export prices tend to increase which could affect the participation of Mexican exports.

When the parents in one country send inputs to their subsidiaries in another country, they can charge higher prices to enable them to obtain a higher profit margin, particularly in segmented industries with HIIT, which compensates, in terms of profit, the small loss of market share resulting from higher prices. Also, for HTI-LIIT, as the higher prices are established through the relationship described by the IIT and have no effect on *XMS*, firms exploit the advantages emerged from the strong bilateral trade links. In low-technology industries, the growth of intra-industry trade has no effect on relative prices of exports.

CONCLUDING REMARKS

This paper provides empirical estimates of market share determinants of Mexican manufacturing exports to US, by industry groups classified according to two dimensions: technological intensity and intra-industry trade. Overall, it distinguishes between technology and non-technology factors. Among the former, there was a distinction between direct variables –stock of R&D expenditure- and indirect variables. It was considered that the latter incorporate technological elements and therefore have an indirect effect. Additionally, there were factors that affect the process innovation and those that impact on product innovation. The estimates were made based on a theoretical

indicator of IIT is the conventional Grubel-Loyd that measures the total trade value minus the absolute value of net trade as a proportion of total trade.

model that also allowed the classification of industries, used to present the empirical results and to characterize the competence of the industries included in each group.

In this regard, the taxonomy identified four categories: high-tech industries with high and low intra-industry trade, and low-tech industries with high and low intra-industry trade. The key distinction between these groups is given by process or product innovations, differentiation (vertical or horizontal), the price or quality differences, market structure in which they compete domestically, the importance of labor costs, etc. The following are the main conclusions of the study:

- The determinants of export performance vary significantly across industry groups. However, industries within each group share the same characteristics, i.e., on average they are affected in the same way by the proposed determinants.

- The variable of direct technology ($\Delta SR\&D$) is a major determinant of market share regardless of the technological intensity of industries. Although the relevance of this variable it is lower in the explanation of relative prices (basically only affects the price of LTI-LIIT).

- Indirect technology incorporated in imports (intermediate or capital) affects the market share of high-tech industries, indicating the importance of process innovation in HTI-LIIT and of product innovation to HTI-HIIT.

- The structure and growth of foreign demand remains as a competitive advantage for export performance in virtually all industries-except HTI-LIIT. In this sense, the development of export networks to US market seems a logical choice for exporting firms.

- The non-technological variables, approximated by relative prices (unit value) and labor costs (inverse of RULC) are important factors of export competitiveness and of export prices, respectively. Wage costs show a greater effect in industries with low concentration and low IIT. Prices seem to affect more exports from low-tech industries.

- It was explicitly tested the importance of intra-industry trade over relative prices. The conclusion is that affects only high-tech industries. The strong commercial links, based on intra-firm and intra-industry relationships, are an advantage in pricing and, ultimately, in market share through product differentiation, and firms strategies of price discrimination.

Thus, whether it is intended to increase the market share of total manufactured exports or of any group of industries, it seems the best way is through the establishment of mechanisms that stimulate the net investment in R&D activities. In particular, these policies can be supplemented with others that either boosts process innovation in HTI-LIIT, product innovation in HTI-HIIT, price reduction in LTI-LIIT, or economies of scale in LTI-HIIT.

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