MEASUREMENT OF TECHNOLOGICAL PROGRESS IN TERMS OF LEARNING RATES
AN ANALYSIS OF THE MEXICAN MANUFACTURING INDUSTRY

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STATEMENT OF AUTHENTICITY

By virtue of submitting this thesis, I certify that except where due acknowledgement has been made, the work is of my own; and the research has not been submitted previously, in whole or in part, to qualify for any other academic award. Research work carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Gonzalez Cortez Jose Luis
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ABSTRACT

The development and advancement of a manufacturing industry encompasses specialization changes over time shifting from low tech-labor intensive industries to high tech-capital intensive industries as the ultimate stage. The stock of knowledge and technological capabilities determine the technological progress of an industry. This thesis performs an analysis of the Mexican manufacturing subsectors and estimates their progress ratios or learning coefficients through a linear and a cubic model integrated into a neoclassical production function. The study seeks to determine whether Mexico is moving from labor intensive to capital intensive industries, and identify the subsectors that the country should prioritize.

It is found that there are three main patterns of technological learning among different industries: a convex learning path with a forgetting all the time or learning at some beginning periods but forgetting afterwards, a concave learning path with forgetting after beginning periods but learning afterwards, and a concave learning path with forgetting all the time. The Machinery industry is located in a forgetting stage showing a detriment performance over time, but the Railroad and Transport Equipment subsector shows an exceptional technological learning and assimilation capacity. In order to sustain industrial and economic growth, Mexico should prioritize Mid-Low and Mid-High Tech industries that show learning potentials, and adjust its technology policy structure to reverse the High Tech industry performance. Policies should be enforced to support, and do not neglect, the Food industry which remains very competitive with a high assimilation capacity.

Keywords: Learning Curve, Progress Ratio, Technological Progress, Mexican Manufacturing Industry.

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Notations

Altex	Program for High Export Oriented Companies
A_t	Stock of technology at time *t*
c_1	unit production cost at time 1
CPI	Consumer Price Index
c_t	Unit production cost in time *t*
d	Progress ratio or learning level
FDI	Foreign Direct Investment
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
IMF	International Monetary Fund
INEGI	Mexican Statistics, Geography and Information Bureau
ISI	Import Substitution Industrialization
ISIC	International Standard Industrial Classification
K	Capital
L	Labor
MC	Marginal Cost
NAFTA	North America Free Trade Agreement
OECD	Organization for Economic Cooperation and Development
Pitex	Temporary Importation Program for Exportation
Q	Production Value Added
u_1	Direct-hours required to produce the 1st unit of a product
WB	World Bank
X_t	Cumulative Production at time *t*
y_t	Direct-hours required to produce the xth unit of a product
α	Learning elasticity

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1. Introduction

1.1. Mexican Economy Performance in the last three decades

Mexico's macroeconomic policies have changed over the last 60 years. Prior to the 1970's the Mexican economy was directly influenced by the government who had a direct control of the economic development through state owned companies and by implementing strict controls in the internal market and international trade, but early in the 1980's Mexico implemented several "neoliberal policies" following the International Monetary Fund and the World Bank recommendations (Calva, 2004).

In the last three decades (1980-2010) the Mexican Gross Domestic Product shows an overall continuous growth with drastic decreases early in the 1980's due to extremely high inflation rates as a result of poor macroeconomic policies and an excessive external debt. From 1986 to 1993 Mexico's GDP showed a sustained growth as depicted in **Figure 1**. In 1994 Mexico went through a huge economic turndown that influenced South American economies and its economic effect in the region is well known as the ***tequila effect***. In 2009 the Mexican GDP decreased by 19.5 percent as shown in Figure 1 due to the recent global economic recession.

Calva (2004) argues that the Mexican economic growth during 1983-2002 is the result of short term macroeconomic policies implemented by the Mexican government: a) drastic reduction in government expenditure (from 11.9% in 1982 to 8.7% in 1988 as a percentage of GDP), and public investment (from 10.4% to 4.9% in the same period); b) good prices increase and price increases in government services that reduced the purchasing power; c) reduction in salaries by implementing salary ceilings; and d) reduction in money supply and credits (Calva, 2004).

The Mexican Gross Domestic Product shows a sustained growth after 1995 (Figure 1), with a 381 percent growth from 1980 to 1998, as a result of macroeconomic policies implemented since the 1980's and the Trade Liberalization Process that culminated in the North America Free Trade Agreement (NAFTA) in 1994. This trade liberalization process had impacted the whole Mexican economy and has forced the re-allocation of resources in different sectors and industries (Cardero & Aroche, 2008).

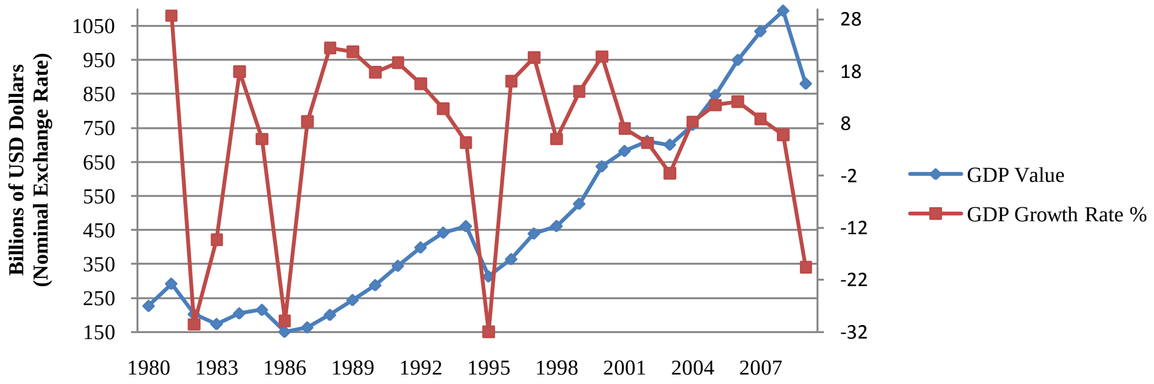


Fig. 1. Mexico GDP Value and Growth Rate.
Source: UNCTAD, UNCTADstat

1.2. Trade Liberalization and Industrialization Process

Mexico determined to grow under a closed economy after the World War II by implementing several import restrictions and trade policies early in the 1950's (Hernadez Laos, 2005), and afterwards decided to move towards an open economy throughout a trade liberalization process which began from 1985 going forward (Esquivel & Rodriguez Lopez, 2003). Mexico implemented macroeconomic policies that let the country move from a closed economy to an open economy in the last decades.

The major trade liberalization process in Mexico (initiated in 1985) can be divided into three main stages as shown in **Table 1**, a similar classification that appears in a research conducted by Esquivel and Rodriguez Lopez (2003): Economics reforms that were initiated early in the 1980's by recommendations of the International Monetary Fund (IMF) and the World Bank, Mexico's adherence to the General Agreement on Tariffs and Trade (GATT) in 1986, and the North America Free Trade Agreement that came into effect in 1994.

Table 1 Trade Liberalization in Mexico

Phase 1 1980	Phase 2 1986	Phase 3 1994
Economic reforms (IMF and WB)	General Agreement on Tariffs and Trade (GATT)	NAFTA Agreement US-Canada-Mexico
Import Substitution Industrialization (ISI). Closed Economy	Market/Export oriented policy Semi-Open Economy	Export oriented policy Open Economy
Import quotas decreased from 100% to 31%	Max tariff from 100% to 25% Maquila Program	New FDI law was enacted FDI increased 1900% from 1994-2008

1.2.1. Phase 1) Economic reforms (1980-1985)

Mexico underwent a debt crisis in the early 1980's, and international investors refused loans to the Mexican government. Mexico had no other option but to request support to the IMF and the World Bank that released financial support under strict conditions aimed to reform its macroeconomic policies, therefore, Mexico implemented several macroeconomic policies of adjustment and stabilization which created high inflation rates averaging 94.6 percent per year between 1982-1987 (Hernadez Laos, 2005).

Table 2 Mexico Total Trade in Merchandise and Services

YEAR	Exports[a]	Imports[a]	FDI[a]	GDP Percapita[b]	YEAR	Exports[a]	Imports[a]	FDI[a]	GDP Percapita[b]
1980	18,031	22,144	1,910	3,306	1995	79,542	75,858	4,405	3,423
1981	23,307	28,462	2,522	4,154	1996	96,000	93,674	10,792	3,905
1982	24,055	17,742	3,115	2,831	1997	110,431	114,847	18,993	4,628
1983	25,953	12,476	1,326	2,382	1998	117,460	130,948	28,856	4,779
1984	29,101	16,691	1,501	2,760	1999	136,391	148,648	28,578	5,371
1985	26,757	19,116	1,418	2,846	2000	166,368	182,702	32,779	6,397
1986	21,804	17,573	317	1,960	2001	158,547	176,185	22,457	6,761
1987	27,600	19,697	1,169	2,083	2002	160,682	176,607	16,590	6,969
1988	30,691	29,402	2,805	2,502	2003	165,396	178,503	10,144	6,788
1989	35,171	36,400	1,130	2,988	2004	189,084	206,623	18,146	7,273
1990	40,711	43,548	989	3,453	2005	213,891	231,821	15,066	8,014
1991	42,688	52,315	1,102	4,055	2006	250,441	268,169	18,822	8,887
1992	46,196	65,050	2,061	4,600	2007	272,055	296,578	34,585	9,484
1993	51,886	68,439	1,291	5,005	2008	291,827	325,157	45,058	9,964
1994	60,882	83,075	2,150	5,126	2009	229,683	246,104	25,949	7,921

[a]US Dollars at current prices and current exchange rates in millions (exports, imports and FDI)

[b]US Dollars at current prices and current exchange rates per capita
Source: UNCTAD, UNCTADstat

Trade liberalization was part of the policies implemented during this period, dismantling the protectionism by reducing import quotas from 100 percent of imports in 1982 to 30.95 percent in 1985 (Hernadez Laos, 2005). Contrary to expectations of an increase in imports, the data shows that in fact Mexico showed a 14 percent reduction in its total imports between 1980 and 1985 as shown in **Table 2**, and on the contrary exports increased 48 percent in the same period. Foreign Direct investments decreased by 25 percent due to economic uncertainty especially because of high inflation rates and restrictions to foreign direct investments before 1984.

A new law for FDI was enacted in 1984 that allowed investments in export-oriented, capital-intensive and technologically advanced sectors that attracted FDI in the following years (Esquivel & Rodriguez Lopez, 2003).

In 1983 Mexico initiated a privatization process for the majority of the state-owned companies in order to promote competitiveness, productivity, technology transfer and eliminate the burden on non-profitable state-owned companies. The Mexican government established the bases to transition to an open economy which had an impact on its manufacturing industry in the forthcoming years.

1.2.2. Phase 2) Adherence to the GA TT (1986)

In 1986 Mexico joined the GATT and agreed to eliminate several import/export controls. Protection levels were dramatically reduced during the period of 1985-1993. Domestic product covered by import permits decreased from 92.2 percent to 16.5, maximum tariff from 100 percent to 25 percent, and imports subject to permits from 35.1 percent to 21.5 percent (Esquivel & Rodriguez Lopez, 2003).

In 1986 Mexico implemented a program that allowed companies to process temporary imports for raw materials, equipment and machinery bounded to manufacture products for exportation under the Pitex program (Temporary Importation Program for Exportation – Programa de Importacion Temporal para la Exportacion). In 1987 Mexico launched a new program for high export-oriented companies that provided additional administrative advantages under the Altex program (Program for High Export Oriented Companies – Programa para Empresas Altamente Exportadoras), and in 1993 a law that regulates the foreign trade transactions was enacted. At the end of this period, only 3 sectors kept rigorous commercial restrictions: agriculture, oil refining and transport equipment (Esquivel & Rodriguez Lopez, 2003). The FDI law was reformed in 1993 to foster a more competitive environment for foreign and domestic investments (Vazquez Galan, 2009).

Pitex and Altex programs and the new FDI scheme played an important role in promoting investments in the manufacturing industry. During this period 1986-1993, the FDI increased 300 percent as shown in Table 2; exports and imports increased 137 percent and 290 percent correspondingly. Mexico initiated its insertion into the international trade arena and became an attractive market for FDI as shown in Figure 1 and Table 2.

Table 3 Mexico's Foreign Direct Investment Distribution by Economic Sector

Definition/Year	1980	1985	1990	1995	2000	2002	2004	2005	2006	2007	2008	2009	2010
Industry	79.2	67.4	32.0	58.7	57.4	41.2	59.6	47.2	49.9	45.5	30.0	36.1	59.7
Services	8.1	25.2	59.2	28.3	27.6	49.6	34.1	40.0	44.7	43.2	44.7	49.9	22.8
Retailing	7.3	6.3	4.6	12.1	13.6	7.8	5.5	12.0	3.3	5.2	7.1	9.0	14.2
Extraction	5.3	1.0	2.5	0.9	0.9	1.1	0.8	0.8	2.0	5.6	18	4.9	3.3
Agriculture and livestock	0.1	0.0	1.6	0.1	0.5	0.4	0.1	0.0	0.1	0.5	0.1	0.1	0.0
Total Percentage	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Vazquez Galan (2009) and Mexican Economy Bureau

The implementation of policies and institutions to stimulate trade was a key factor for the attraction and allocation of FDI primarily in the Mexican industry sector as illustrated in **Figure 2**. In 1980, as shown in **Table 3,** 79.2 percent of the total FDI was concentrated in the Mexican industry sector and in 1985 67.4 percent.

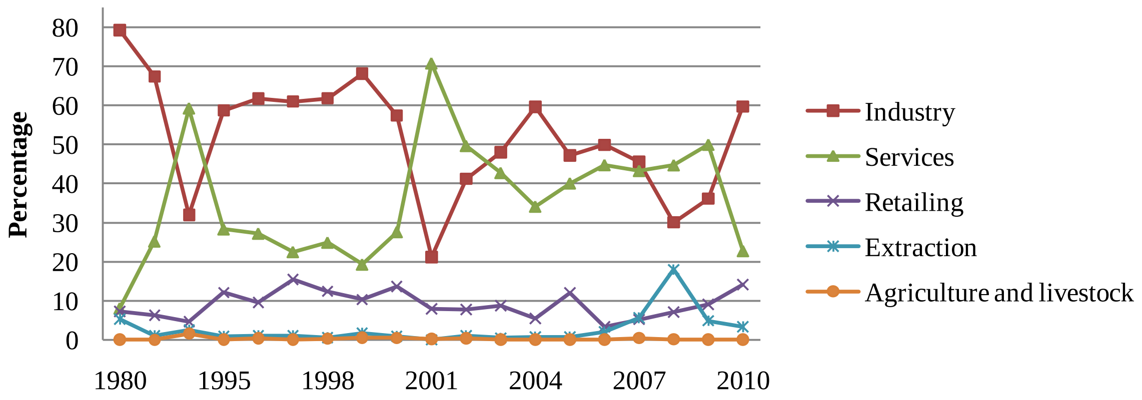


Fig. 2. FDI in Mexico by Sector "Percentage Contribution".
Source: Vazquez Galan (2009) and Mexican Economy Bureau

1.2.3. Phase 3) North American Free Trade Agreement (1994)

In 1990 Mexico initiated negotiations with Canada and the US to sign the North America Free Trade Agreement that came into effect on January 1st, 1994. During the first year of the agreement more than 80 percent of all trade restrictions were eliminated (Hernadez Laos, 2005). **Figure 3** shows a dramatic growth of trade (imports and exports) that had continued over time with a decrease in 2009 due to the worldwide financial crisis. Exports show a 379 percent growth between 1994 and 2008, imports 290 percent growth and FDI 1900 percent increase during the same period.

NAFTA stimulated capital inflows that have been concentrated in the industry sector; as an average over 50 percent every year has been allocated to this sector as shown in table 3. This important allocation of FDI in this sector has contributed to the increase in the Mexican manufacturing industry activity. In addition, Mexico also implemented changes in its transportation system aligned with the trade liberalization process, privatizing the seaports and the railway system in 1993 and 1997 respectively in order to promote an efficient transportation system.

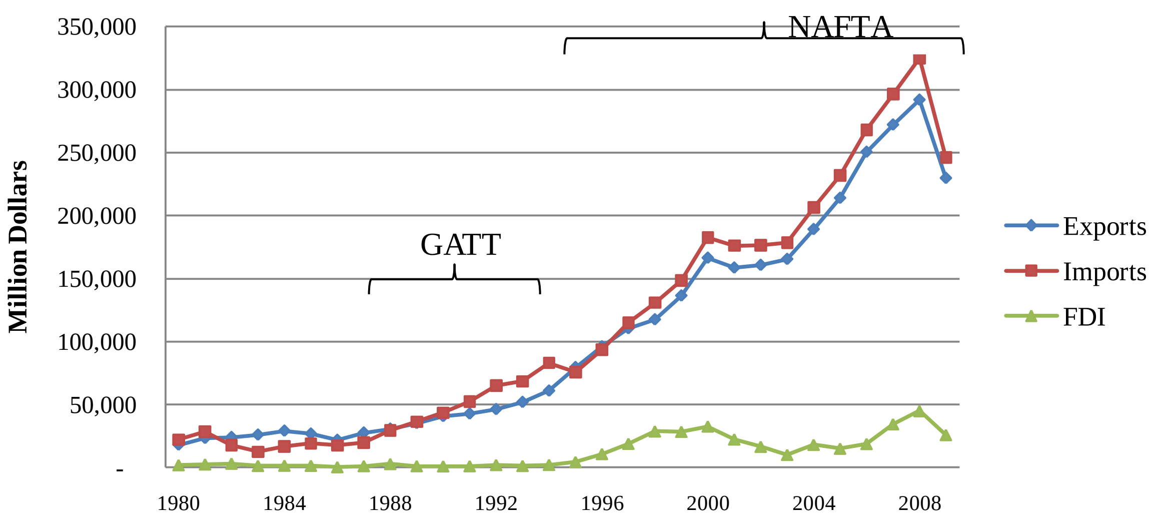


Fig. 3. Mexico: Import, Export and FDI (US Dollars at current prices and current exchange rates in millions).
Source: UNCTAD, UNCTADstat

1.3. Mexican Manufacturing Industry Development

The contribution of different sectors (Agriculture and Livestock, Mining, Electricity, Construction, Manufacturing Industry, and Commerce and services) to the Mexican GDP in the last two decades, depicted in **Figure 4**, has remain the same with a slight increase in the Mining sector. It is observed that manufacturing industry's contribution to the Mexican GDP has remained the same, yet this does not imply that the production value and total exports have remained stagnated, but it implies that the Mexican economy shows a sustainable growth in all sectors in the last two decades.

In the last two decades, especially after the intervention of the IMF and WB in the Mexican macro policies early in the 1980's, the Mexican industry and international trade policies have been aligned to the promotion of the manufacturing industry exports (CEFP, 2004).

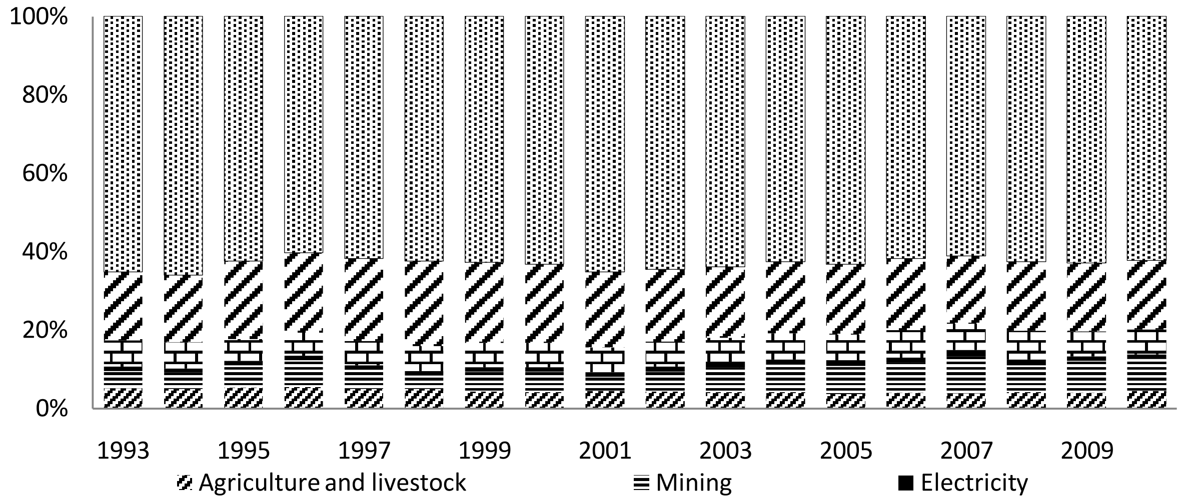


Fig. 4. GDP Contribution by Sector.
Source: INEGI

The Mexican manufacturing industry's contribution to the total exports of non oil related exports has significantly increased from around 50 percent in the 1980's to above 90 percent in the last decade as shown in **Figure 5**. The manufacturing industry has an active participation in the Mexican exports, nevertheless when analyzing its contribution to the total GDP; it is observed that its contribution has remained the same since 1993 at around 18 percent. In spite of its 18 percent contribution to the total GDP, the manufacturing industry is considered the main contributor of the economic growth and industry development in the country (CEFP, 2004).

Several studies have shown that from 1985 and predominantly after 1995, Mexico is listed among the main 10 countries with high export participation in the global market (Moreno, Santamaria, & Rivas, 2009).

Given the fact that the manufacturing industry is the main contributor to the Mexican exports and imports, it is important to analyze its evolution in order to determine its current industrial specialization. In terms of the sub-sectors' contribution to the manufacturing industry, some industries show a decreasing participation such as textiles, wood, paper and some others show an expansion such as metallic products and machinery and equipment (Cardero & Aroche, 2008).

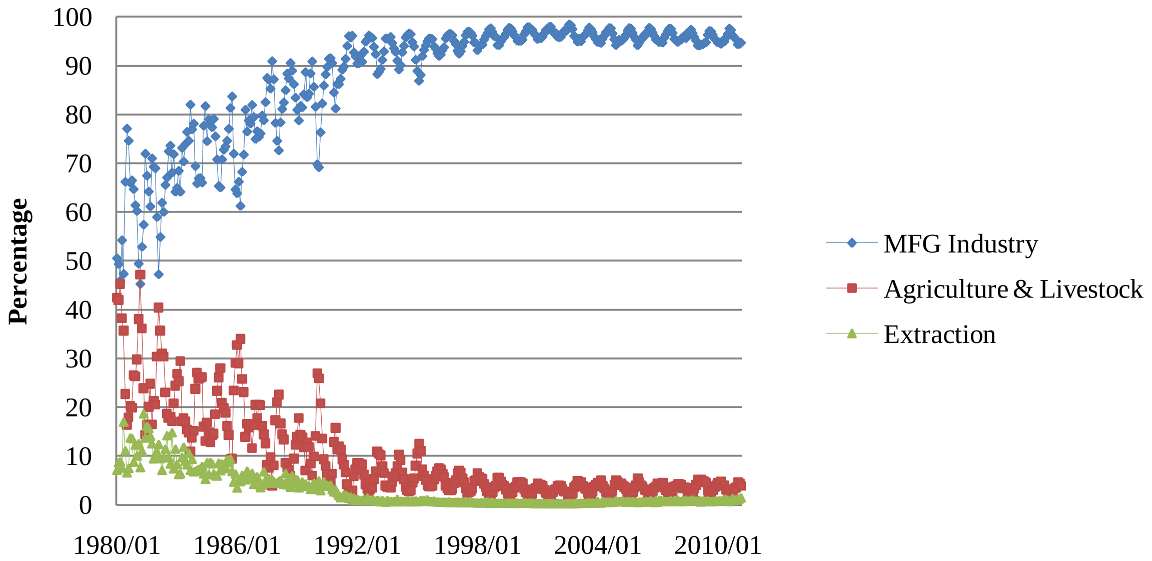


Fig. 5. Exports Participation of Non-Oil Related Sectors in Mexico.
Source: Mexican Economy Bureau

The Mexican manufacturing industry depicts a continuous growth in terms of exports with an important contribution to the GDP although its contribution level remains at around 18 percent, but the question is whether all the sub-sectors are performing well or if this continuous growth relies on some sub-sectors only.

1.4. Research Purpose and Objectives

The Mexican manufacturing sector, as reviewed, shows a continuous growth and its high contribution in the total non-oil related exports of the Mexican economy raises the concern whether different sub-sectors that integrate it are actually performing well or whether the whole good performance of the manufacturing industry relies on certain sub-sectors only.

The aim of this research is to conduct an analysis of all the sub-sectors that integrate the Mexican manufacturing industry and determine the following:

1. Which manufacturing industries should Mexico focus on?
2. Is Mexico progressing in High Tech manufacturing industries?
3. Which changes should Mexico implement in its manufacturing industry strategy to enhance its growth?

This research identifies the manufacturing subsectors with good and poor performance, and also assesses whether Mexico is moving from labor-intensive to capital-intensive sub-sectors.

This assessment is carried out by measuring the technological progress in terms of learning rates in each sub-sector, and by identifying different levels of knowledge accumulation among them.

2. Literature Review

2.1. Learning Process and its Economic Implication

Several studies have demonstrated that the increased efficiency in processes is explained by the increased familiarity with the routine of such processes. In other words, as a recurrence of a process occurs in t_1[1], there is an accumulation of knowledge that leads to a better performance of such process in t_{1+n}. This accumulation or acquisition of knowledge is what has been termed "learning" (Arrow, 1962). This particular role of knowledge accumulation in the increase of productivity was originally observed and studied by T.P Wright in 1936 in the production of airframes, concluding that the required labor-hours spent in the production of an airframe is a decreasing function of the total number of airframes of the same type previously produced.

Learning by Doing refers to the process by which production costs are reduced as experience is accumulated over time (Hornstein & Peled, 1997), and this knowledge accumulation can be depicted by a learning curve that shows the relationship of outputs and inputs, and most important how learning by doing induces improvements in the output performance over time. Different studies have termed learning curves as manufacturing progress function, cost-quality relationship, cost curve, product acceleration curve, improvement curve, performance curve, experience curve, and efficiency curve (Belkaoui, 1986).

As a person/worker becomes accustomed to, and experienced in, the process that he or she performs, the worker progressively learns how to do tasks more efficiently and quickly. The experience gained by the worker is positively correlated to the cumulated amount of output produced or activity performed (Jackson, Introduction to Economics: Theory and Data, 1982).

Arrow (1962) in his seminal work "Economic Implications of Learning-by-Doing" concluded that learning happens when attempting to solve a problem.

[1] *t* refers to time

2.2. Learning Curve Theory

The learning curve phenomenon has been of interest to researchers for the last 80 years as shown in **Table 4**. The initial observation of the learning curve is attributed to T.P Wright in 1936 when conducting a research of factors affecting the cost of airplanes finding that learning contributes to the reduction in labor-hours spent in the production of an airframe. In 1954 Andress, F.J conducted a research on the learning curve as a production tool focusing on the role of the direct labor in the learning system (Adler & Clark, 1991).

Arrow (1962) studied the economic implications of Learning-by-Doing. Baloff (1966) undertook a research to broaden the application of the learning curve in capital-intensive industries, introducing a learning model for a variety of industries and reviewed some empirical results (Baloff, 1966). Baloff and Kenelly (1967) argued that a learning model should be taken into consideration when estimating the productivity path of a start-up process, and that productivity increases have accounting implications for capital budgeting and project evaluation.

Table 4 Researchers Focusing on the Learning Curve

Year	Researcher	Publication
1936	Wright, T. P.	Factors affecting the cost of airplanes
1953	Wyer, R.	Learning curve helps figure profits, control costs
1954	Andress, F. J.	The learning curve as a production tool
1961	Taylor, M. L.	The learning curve - A basic cost prediction tool
1962	Arrow, K.	The Economic Implications of Learning by Doing
1966	Baloff, N.	The learning curve - Some controversial issues
1967	Baloff, N. and J. W. Kennelly.	Accounting implications of product and process start-ups
1972	Consulting, Boston.	Perspectives on Experience
1974	Henderson, B.	The experience curve reviewed: V. price stability
1978	Harris, L. C. and W. L Stephens.	The learning curve: A case study
1979	Yelle, L. E.	The learning curve: Historical review and comprehensive survey
1982	Ramanathan, R.	Lecture Notes in Economics and Mathematical Systems
1986	Belkaoui, A.	The Learning Curve
1989	Bailey, C. D.	Forgetting and the learning curve
1991	Adler, P. S., & Clark, K. B.	Behind the Learning Curve: A Sketch of the Learning Process
1992	Badiru, A. B.	Computational Survey of Univariate and Multivariate Learning Curve Models
1997	Hornstein, A., & Peled, D.	External vs. Internal Learning-by-Doing in an R&D Based Growth Model
2000	Pramongkit, P., Shawyun, T., & Sirinaovakul, B.	Analysis of Technological Learning for the Thai Manufacturing Industry
2001	Ruttan, V. W.	Technology, Growth, and Development. An Induced Innovation Perspective
2005	Karaoz, M., & Albeni, M.	Dynamic Technological Learning Trends in Turkish Manufacturing Industries
2009	Asgari, B., & Yen, L. W.	Accumulated Knowledge and Technological Progress in Terms of Learning Rates: A Comparative Analysis on the Manufacturing Industry and the Service Industry in Malaysia

A learning curve can be defined as a function which relates performance to experience (Jackson, 1998). Learning curves demonstrate that improvements in the output performance of any process, induced by knowledge accumulation follows an *S* shape over time, which leads to the conclusion that at some point in t_n the learning effects are bounded or that learning eventually ceases (Hornstein & Peled, 1997).

There are five main characteristics of the learning curves described in Hornstein and Peled's research that can be considered as the "stylized facts" of Learning-by-Doing

a) Learning has a significant effect on efficiency

Learning by doing has an increasing gradual effect on the performance and rapidness of a specific task. An operator in a production line performing a pad printing operation for a plastic component for the first time, needs more time to achieve this activity versus an operator that has been in this position for a week. As the operator performs the same pad printing operation repetitively, the amount of time to execute this activity decreases over time, leading to a better efficiency in this particular task. As learning happens (accumulation of knowledge) efficiency increases.

b) Learning increases as a function of production volume

Learning can be maximized with a continuous mass production of a specific component or with a continuous performance of the same process. Taking the previous example, accumulation of knowledge in the pad printing operation will be maximized if there is a continuous and interrupted pad printing operation of the same kind of plastic component and environment. If this pad printing operation happens only once a week (just 1 day), there will be knowledge accumulation but not at the same level if this pad printing operation is performed every single day of a month calendar.

c) The scope of learning is bounded

Accumulation of knowledge for a particular unchanged process cannot continue perpetually and the rate of such knowledge accumulation changes over time following the S-Curve shape. Different studies have come to the conclusion that learning does not continue indefinitely, cost improvements correlated by the accumulation of knowledge eventually stop or falls to very low rate that in practice are ignored (Hall & Howell, 1985).

d) There is an important component to learning which is firm-specific

There is an empirical regularity in manufacturing industries where the unit cost of the second unit is 80 percent of those of the n^{th} unit; however, this learning elasticity shows some variation across industries or even within the same industry, leading to the conclusion that accumulation of knowledge or the stock of knowledge achieved is firm-specific (Hornstein & Peled, 1997). According to Grubler (1998) learning varies from industry to industry, from tech to tech, and from firm to firm. High labor industries such as the manufacturing industry show high learning elasticity rates versus low labor industries such as the tourism industry.

e) The experience effect on the development of new goods is more modest than its impact on efficiency

Hornstein and Peled (1997) consider three versions of the learning process, but these can be classified as two main versions which are the following: endogenous learning in which the stock of knowledge is explained within the model and exogenous learning in which the stock of knowledge comes from the outside of the model and it is not explained by the model itself.

Several papers have documented the evolution of the learning curve models, from univariate models to more complex multivariate models. Typical learning curves correlate production cost and cumulative production outputs based on the effect of learning (Badiru, 1992). T.P Wright (1936) found that a given operation is subject to a 20% productivity improvement each time the production quantity doubles.

Conventional univariate learning curves express a dependent variable (e.g, total production) in terms of a particular independent variable such as labor cost, investment, etc. According to Badiru (1992) the most famous univariate models include: the log-linear model, the S-curve, the Stanford-B model, DeJong’s learning formula, Levy’s adaptation formula, Glover’s learning formula, Pegel’s exponential function, Knecht’s upturn model, Yelle’s product model, and multiplicative Power Model.

Realistic analysis of productivity gains have enforced the extension and modifications of conventional learning curves since there are numerous factors that can influence how quickly and how distant, and how well a worker learns within a given time horizon and environment. Multivariate models have not been well studied perhaps due to the complexity of implementing the models for practical productivity assessments (Badiru, 1992).

A very simple model can be reduced to a bivariate model of the form:

$$Y = \beta_o X_1^{\beta_1} X_2^{\beta_2}$$

Where Y is a measure of cost and X_1 and X_2 are the independent variables (β_1 and β_2 learning rates). With this very simple bivariate model, it is possible to obtain accurate estimates of the effects of two variables involved. Multivariate models are more robust and help account for more of the available data (Badiru, 1992).

2.3. Emergence of the Experience Curve concept

The experience curve phenomenon was developed by the Boston Consulting Group (1960-1970’s), looking at the total cost and widening the inputs to the learning system. The experience curve, contrary to the learning curve, takes into consideration all possible inputs in a production process to find a relationship between one of many, substitutable inputs and cumulative output (OECD, Experience Curves for Energy Technology Policy, 2000).

The BCG applied to the total cost of a product, including different learning means such as research and development, economies of scale, and other cost factors. Additionally, the concept was applied not only within a single company or process, but also to entire industries (Sark Van, 2008).

2.4. S-Curve Models

a) The Log-Linear Model

Since the publication of the first article formulating the theory of learning curves in 1936, various models and geometric versions have been proposed, but the log-linear model has been and still is the most used model. The log-linear model or constant percentage model states that the improvement in productivity is fairly constant as output increases (Belkaoui, 1986).

Its mathematical function is described as follows:

$y_t = u_1 X_t^{\alpha}$ where:

y_t = the number of direct-hours required to produce the xth unit

u_1 = the number of direct-hours required to produce the 1st unit

X_t = the cumulative unit number

α = the learning elasticity

The relationship between the cumulative average direct-labor hours and the cumulative units of production plotted on a logarithmic scale follows a **straight line declining rate**, but it is extremely important to highlight that the learning elasticity (α) is a constant figure over the whole period of analysis. The calculation of the learning elasticity is straight forward when applying a logarithmic approach and linear regression analysis.

The search of other models is given the fact that the linear model does not always provide the best fit in all situations.

b) The S-Curve

The S-type function has the shape of the cumulative normal distribution function for the start-up curve and the shape of an operating characteristic function for the learning curve. According to Belkaoui (1986) the factors that appear to contribute to this pattern are:

- The early stages of production are a time of partial experimentation or learning by all employees. For instance in a launch of a new product, production operators get familiar with the production process and product in the early stages of mass production. It is also the period of mass engineering changes to adjust and improve the design of such new products.
- A rapid reduction in cost is possible for some time after corrections are made to tooling and production methods.
- Finally, the production is settled to a more routine activity which is called the slope activity. The slope of learning now proceeds to a slower growth than average.

One procedure to determine the coefficients of the S-curve is to consider it as a smooth "cubic curve". In such a case, according to Belkaoui (1986)[2], the model:
$\log MC = A + B (\log X) + C (\log X)^2 + D (\log X)^3$ represents the cubic curve in a log-log plot where: MC = Marginal Cost, A = Constant and X = Cumulative Production

[2] The cubic model described in Belkaoui's book $\log MC = A + B (\log X) + C (\log X^2) + D (\log X^3)$ appears to be incorrect and it should be in the form of $MC = A + B (\log X) + C (\log X)^2 + D (\log X)^3$ as described by Karaoz and Albeni (2005) and supported by actual data and analysis in this paper.

If applying the model $\log MC = A + B (\log X) + C (\log X^2) + D (\log X^3)$ to the data in this research, the calculated learning levels or progress ratios for the Textile sub-sector are in the range of 100 and 205. The estimated values (3 digits) are incoherent based on the theoretical values that the model should generate (for detail explanation on how to compute the progress ratio values and interpretation please refer to Chapter 3).

The fitting of a cubic curve to actual time can be accomplished by the use of any polynomial fit program (Belkaoui, 1986).

In this cubic model **MC = A + B (log X) + C (log X)** ^{2} **+ D (log X)** ^{3}, the learning elasticity is **not a straight forward calculation**, a regression analysis computes the function that best describes the data and provide the A, B, C and D coefficients that are required to calculate the learning elasticity. The function used to calculate the learning elasticity (α) is explained in the cubic model construction section.

2.5. Technological Capability and Technological Progress

Technological capability is the ability of an organization to utilize a variety of available knowledge and skills in order to acquire, assimilate, use, adapt, change and create technology (Ernst, Ganiatos, & Mytelka, 1998). Economies or organizations acquire knowledge to build up and accumulate their own technological capabilities which is achieved by engaging in a process of technological learning. This technological learning is the transformation of knowledge acquired by individuals and converted into organizational learning (Figueiredo, 2001).

Jackson (1998) describes that technological change is a process innovation relating, as a fundamental characteristic, a change to fixed capital.

Technological change or technical progress brings about production efficiencies which have a direct impact on productivity growth, and several studies have been carried out and concluded that technological change is the most important factor related with aggregate economic growth (Ruttan, 2001). In order to understand technological change, as described by Link *et al* (1987), it is important to conceptualize technology as the physical representation of knowledge. The economic and social impacts of new knowledge are realized only with its adoption and utilization (Ruttan, 2001).

It is possible to evaluate or estimate the effect of technological change on production in terms of changes in the amount of production factors, capital and labor being the most important. Technological change alters the input mix for a fixed level of output, and the simplest scheme is summarized in **Table 5** (Link, Kaufer, & Mokyr, 1987).

Table 5 Classification Scheme of Technological Change

Neutral Technological Change	Labor-Saving Technological Change	Capital-Saving Technological Change
K/L ratio remains unchanged	K/Q ratio remains unchanged	L/Q ratio remains unchanged
Marginal rate of substitution among factors remains the same	K/L ratio increases	K/L ratio decreases
	Labor increases	Capital increases

K: Capital, L: Labor and Q: Output
Source: Ruttan (2001)

Technological progress enables organizations to achieve higher output with the same amounts of limited resources (labor and capital for instance). If experience contributes to increases in productivity, the two innate candidates to explain or represent the learning process are the cumulative output and the cumulative investment. Innovations are labor-saving, capital-saving or neutral accordingly as to whether capital's share in output increases, decreases or remains unchanged as described in Table 5 (Ramanathan, 1982).

Several studies have calculated the technological learning rates, among them, Pramongkit *et al* (2000) calculated the technological learning rates for the Thai industry using a linear model; Karaoz and Albeni (2005) conducted a research for the Turkish industry, and Asgari and Yen (2009) conducted a research for the manufacturing and service industry in Malaysia, both using a cubic model.

The technological learning coefficients or learning elasticities denoted in this paper as "α" are required when computing the learning level or progress ratio. This learning level or progress ratio describes the effect of learning every time production doubles over the unit production costs or as described by Sark Van (2008) is the relative amount of cost reduction per each doubling of cumulative output.

According to Belkaoui (1986) the average time model of the log-linear model is represented by $Y = a X^{-\alpha}$ ……………..………………………………………………………….. (1)

where:

Y = average cumulative labor hours, labor dollars, material costs of X number of units, or as in this paper production value.

a = theoretical value or actual value of the first unit

X = cumulative number of units produced or as in this paper cumulative production value

α = slope coefficient, exponent or learning index

According to Belkaoui (1986) if production doubles then the formula becomes

$Y^* = a\,(2X)^{-\alpha}$ ……………………………………………………………………………… (2)

Given the fact that learning takes place when production doubles the progress ratio or learning level is denoted as d in this paper or PR in Asgari and Yen (2009):

$d = Y^*/\,Y = a\,(2X)^{-\alpha} / a\,X^{-\alpha}$ or $d = 2^{-\alpha}$ ……………………………………………………… (3)

Given the above progress ratio formula, the learning elasticity is required to compute it. In other words, to measure the level of learning, the Progress Ratio (d) is estimated from the equation $d = 2^{-\alpha}$, given an already calculated learning elasticity.

The progress ratio value interpretation is summarized in **Table 6**. A learning level below 1 indicates that learning is still taking place; therefore unit production cost decreases and efficiency increases as the total production increases. A learning level above 1 indicates forgetting; therefore unit production cost increases and efficiency decreases as the total production increases. A learning level 1 indicates that there is no improvement or worsening, implying that productivity does not change and remains constant over time (Karaoz & Albeni, 2005). Progress ratio or learning level has been found to vary between 0.5 and 1.0 for the semiconductor industry, manufacturing firms, and energy technologies (Sark Van, 2008).

Table 6 Progress Ratio Value Interpretation

d < 1	d = 1	d > 1
Learning stage	No Learning, No Forgetting	Forgetting stage
Unit production cost decreases as output increases	Unit production cost remains the same as output increases	Unit production cost increases as output increases
Efficiency Increases	No change in Efficiency	Efficiency Decreases
Productivity Increases	No change in Productivity	Productivity Decreases

This research uses a linear model and a cubic model in order to find the model that best fit the data for the Mexican manufacturing industry. These two models are identical to those used in the above mentioned papers.

The learning elasticity is traditionally considered as a constant (in a linear model); therefore the progress ratio results in a unique single value; however as postulated by Arrow (1962) and some other scholars, the learning process is cumulative and its effects are enhanced as production continues over time (Asgari & Yen, 2009). An S-curve model, as previously described, better portrays the actual trend of the learning process. Badiru (1992) proposed a cubic model that was later tested and supported by Pramongkit *et al* (2000), and Asgari and Yen (2009). This dynamic cubic model treats learning elasticity as variable; therefore, the progress ratio results in variable values over the period under analysis.

2.6. Hypothesis

The research is initiated in the premise of two main hypotheses related to development of a manufacturing industry which over time moves from labor-intensive to capital intensive industries. In this case, for the Mexican manufacturing industry analysis, the hypotheses are as follows:

a) If the Mexican manufacturing industry follows the same trend as current developed countries did in the past, the Mexican labor-intensive sub-sectors (low-Tech) should show a learning level (d) equal to or above 1.

b) Low-Tech sub-sectors participation in the total manufacturing production should be declining and mid-low tech and high-tech industries should be increasing.

3. Research Methodology

3.1. Data Collection

The data for the Mexican manufacturing industry sub-sectors at 3-digits level was collected from the Mexican Statistics, Geography and Information Bureau (INEGI). The data included: total gross production, total remunerations and total value added for the last 20 years. The data from 1988 to 1997 was collected from a special publication entitled "Sistema de Cuentas Nacionales de Mexico 1988-1997", the data from 1998 to 2002 was collected from the annual industrial surveys entitled "Encuesta Industrial Annual, 1998-1999, 2000-2001, 2002-2003", and the data from 2003 to 2008 was collected from the online INEGI database "Banco de Informacion Economica".

3.2. Data Processing

INEGI changed the sub-sectors classification from 2003 onward to follow the International Standard Industrial Classification (ISIC) according to the United Nations Statistics Division. Prior 2003, the Mexican sub-sector classification was grouped in 9 sub-sectors as follows: 1) Food, beverages and tobacco products; 2) Textiles, wearing apparel, fur, Leather, leather products and footwear; 3) Wood products including furniture; 4) Paper and paper products, printing and publishing; 5) Chemicals, petroleum products, rubber and plastics products; 6) Non-metallic mineral products; 7) Basic metals; 8) Fabricated metal products, machinery and equipment, Medical, precision and optical instruments; and 9) Other manufacturing industries (See **Appendix A**).

For consistency purposes and given the fact that the old classification cannot be re-organized following the ISIC classification, the research followed the original classification and re-grouped the 21-sub-sectors into 9 sub-sectors for data collected from 2003 to 2008, according to Appendix A. The data was converted into US dollars based on the annual average exchange rates published by the Mexican Bank (**Appendix B**), and deflated based on 2005-CPI indices published by the Organization for Economic Cooperation and Development (OECD) to reflect all data at USD dollars-2005 constant prices (**Appendix C**).

3.3. Sub-Sectors Classification According to their Technological Intensity

Sub-sectors were classified according to the "Classification of manufacturing industries based on technology" (technological intensities) published by the OECD (see **Appendix D**) as shown in **Table 7**.

Table 7 Mexican Sub-Sector Classification "Technological Intensity"

SUB-SECTOR	SHORT DESCRIPTION	TECHNOLOGICAL INTENSITY
Food, beverages and tobacco products	Food	Low Tech
Textiles, Wearing apparel, Fur, Leather, leather products and footwear	Textile	Low Tech
Wood products including furniture	Wood	Low Tech
Paper and paper products, printing and publishing	Paper	Low Tech
Chemicals, petroleum products, rubber and plastics products	Chemicals	Mid-High Tech
Non-metallic mineral products	Non-Metallic	Mid-Low Tech
Basic metals	Basic Metals	Mid-Low Tech
Fabricated metal products, Machinery and equipment, Medical, precision and optical instruments	Machinery	High Tech
Other manufacturing industries	Others	Low Tech

3.4. The Traditional Linear Model Construction

A linear model is used to calculate the learning elasticity (α) which is required to estimate the progress ratio or learning level (d) given the equation $d= 2^{-\alpha}$, which indicates that every doubling of total production reduces unit production costs by a factor of $2^{-\alpha}$…………….… (3)

The most common linear model is $c_t= c_1X_t^{-\alpha}$ or its equivalent in a logarithmic form $\ln c_t= \ln c_1- \alpha \ln X_t$. It states that unit production cost in time *t* is a function of the cumulative production powered to the learning elasticity, multiplied by the unit production cost at time 1. ………………………………………………………………………………….…… (4)

The Cobb-Douglas production function $Q_t=A_tL_t^{\beta}K_t^{\Theta}$ or its equivalent logarithmic form $\ln Q_t= \ln A_t + \beta \ln L_t+ \Theta \ln K_t$ is used; where Q is the production value added, A is the total factor productivity, L is the labor cost, K the capital, β and Θ are the elasticities for labor and capital respectively ……………………….……………….…………………………… (5)

Learning and technology spillovers along with the stock of technology enhance total factor productivity which in turn contributes to production increases leading to higher cumulative production outputs that stimulates learning (Watanabe & Asgari, 2004). The level or stock of technology, A_t in this particular case, can be written as follows: $A_t= H X_t^{\alpha}$ or its logarithmic equivalent $lnA_t= lnH + \alpha lnX_t$. It states that the level of technology at time *t* is a function of the cumulative production raised to the power of the learning elasticity, and multiplied by a constant H………….……………………………………………………..……………. (6)

The logarithmic forms of equation 5 and 6 are combined, replacing lnA_t in equation 5, accordingly the new equation is: $lnQ_t= lnH + \alpha ln X_t + \beta lnL_t+ \Theta lnK_t$ ……………………. (7)

Expressing labor in terms of the production value added (labor ratio) requires some algebraic manipulation. Labor is added to both sides of the equation and then re-arranged as follows:

$lnQ_t - lnL_t = lnH + \alpha ln X_t + \beta lnL_t + \Theta lnK_t - lnL_t$

$-1(lnQ_t - lnL_t = lnH + \alpha ln X_t + \beta lnL_t + \Theta lnK_t - lnL_t)$

$lnL_t - lnQ_t = - lnH - \alpha ln X_t - \beta lnL_t - \Theta lnK_t + lnL_t$

$ln(L/Q)_t= -lnH-\alpha ln X_t+(1-\beta)lnL_t-\Theta lnK_t$ ………………………………………………. (8)

Given the fact that capital can be expressed as a function of labor, when output expands the relationship between capital and labor can be expressed as $K_t=\mu L_t^{\lambda}$ or its equivalent logarithmic form $lnK_t = ln\mu + \lambda lnL_t$. λ express the type of technological bias as production expands, and μ is constant, when λ is greater than 1, capital intensity as measured by capital-labor ratio increases as output increases (Pramongkit, Shawyun, & Sirinaovakul, 2000)… (9)

Substituting $lnK_t = ln\mu + \lambda lnL_t$ in the previous equation

$ln(L/Q)_t= -lnH-\alpha ln X_t+(1-\beta)lnL_t-\Theta lnK_t$, the final equation is calculated as described below after some algebraic re-arrangements:

$ln(L/Q)_t= -lnH-\alpha lnX_t+(1-\beta)lnL_t-\Theta ln\mu -\Theta\lambda lnL_t$

$ln(L/Q)_t= -lnH-\Theta ln\mu -\alpha lnX_t+(1-\beta-\Theta\lambda)lnL_t$ …………………………………………... (10)

If we consider $\sigma_1 = -lnH -\Theta ln\mu$, $\sigma_2 = -\alpha$ and $\sigma_3 = 1-\beta-\Theta\lambda$ then the equation is:

$\mathbf{ln(L/Q)_t= \sigma_1 + \sigma_1 lnX_t + \sigma_3 lnL_t}$ This is the final equation to compute and through a regression analysis, the value of α is obtained and used to calculate the progress ratio or learning level of every sub-sector in the Mexican manufacturing industry………………………………………………………………………...... (11)

3.5. The Cubic Model Construction

A cubic model is used to calculate the learning elasticity (α) which is required to estimate the progress ratio or learning level (d) given the equation $d = 2^{-\alpha}$, which indicates that every doubling of total production reduces unit production costs by a factor of $2^{-\alpha}$ (Karaoz & Albeni, 2005)………………………………………..……………………...……...... (3)

The dynamic cubic model proposed by Belkaoui (1986) and Badiru (1992), and later tested by Asgari and Yen (2009) among other researchers is:
$\ln c_t = \ln c_1 + B \ln X_t + C (\ln X_t)^2 + D (\ln X_t)^3$. Where c_t is the unit production cost in time *t*; c_1 is the unit production cost at the beginning of the period; and X_t is the cumulative production at time *t*. This function states that per unit cost of output at time *t* is a function of cumulative production (Karaoz & Albeni, 2005) …………………………………………….…....... (12)

Given the most common function $c_t = c_1 X_t^{-\alpha}$ or its equivalent in a logarithmic form $\ln c_t = \ln c_1 - \alpha \ln X_t$ which states that unit production cost in time *t* is a function of the cumulative production powered to the learning elasticity, multiplied by the unit production cost at time 1…………………...…………………………………………………..……….. (13)

The Cobb-Douglas production function $Q_t = A_t L_t^{\beta} K_t^{\Theta}$ or its equivalent logarithmic form $\ln Q_t = \ln A_t + \beta \ln L_t + \Theta \ln K_t$ is used; where Q is the Production Value Added, A is the total factor productivity, L is the labor cost, K the capital, β and ϴ are the elasticities for Labor and Capital respectively…………………………………………….…………………..……. (14)

Learning and technology spillovers along with the stock of technology enhance total factor productivity which in turn contributes to production increases leading to higher cumulative production outputs that stimulates learning (Watanabe & Asgari, 2004). The level or stock of technology, A_t in this particular case, can be written as follows: $A_t = HX_t^{\alpha}$ or its logarithmic equivalent $\ln A_t = \ln H + \alpha \ln X_t$. It states that the level of technology at time *t* is a function of the cumulative production raised to the power of the learning elasticity, and multiplied by a constant H………………………………………………………………………………... (15)

From equation 13 we have that $X_t^{\alpha} = c_1/c_t$ and after combining 13 and 15 we have $A_t = H\, c_1/c_t$ or its logarithmic form $\ln A_t = \ln H + \ln c_1/c_t$. It implies that the stock of technology at time *t* is a function of the ratio between the unit production cost in time 1 and the unit production cost in time *t*, multiplied by a constant…………..…………………………………….…….. (16)

To transform equation 12 to represent the ratio between the unit production cost in time 1 and the unit production cost in time *t*, ln c_1 is subtracted from both sides of the equation and then re-arranged, resulting in the following equation $\ln c_1/c_t=-[B\ln X_t + C(\ln X_t)^2 + D(\ln X_t)^3]$ …(17)

After replacing equation 16 into equation 17, the resulting equation is:

$\ln A_t= \ln H-B\ln X_t - C(\ln X_t)^2 - D(\ln X_t)^3$………………………………...………………. (18)

Given the fact that Capital can be expressed as a function of Labor, when output expands the relationship between capital and labor can be expressed as $K_t=\mu L_t^{\lambda}$ or its equivalent logarithmic form $\ln K_t = \ln\mu + \lambda \ln L_t$. λ express the type of technological bias as production expands, and μ is constant, when λ is greater than 1, capital intensity as measured by capital-labor ratio increases as output increases (Pramongkit, Shawyun, & Sirinaovakul, 2000)…………………………………………………………………..………………. (19)

Equation 18 is inserted into the Cobb-Douglas production function described in equation 16, resulting in equation $\ln Q_t= \ln H-B\ln X_t - C(\ln X_t)^2 - D(\ln X_t)^3 + \beta \ln L_t+ \Theta \ln K_t$ ………….… (20)

After replacing equation 19 into equation 20, the resulting equation is:

$\ln Q_t= \ln H- B\ln X_t - C(\ln X_t)^2 -D(\ln X_t)^3 +\beta \ln L_t +\Theta \ln\mu +\Theta\lambda \ln L_t$ …………………………..… (21)

Expressing labor in terms of the production value added (labor ratio) requires some algebraic manipulation. Labor is added to both sides of the equation and then re-arranged resulting in the final equation:

$\ln(L/Q)_t= -\ln H -\Theta\ln\mu + B\ln X_t + C(\ln X_t)^2 + D(\ln X_t)^3 + (1-\beta-\Theta\lambda)\ln L_t$ …………………..… (22)

If we consider $\sigma_1 = -\ln H-\Theta\ln\mu$ and $\sigma_2 = 1-\beta-\Theta\lambda$ then the equation is:

$\mathbf{\ln(L/Q)_t= \sigma_1 + B\ln X_t + C(\ln X_t)^2 + D(\ln X_t)^3 + \sigma_2 \ln L_t}$ This is the final equation to compute and through a regression analysis, the A, B, C and D coefficients are calculated and then used to compute the value of learning elasticity α, and finally the progress ratio or learning level of every sub-sector in the Mexican manufacturing industry is estimated…………………… (23)

3.5.1. Learning elasticity estimation

According to Karaoz and Albeni (2005) the first derivative of equation:

$\ln(L/Q)_t = \sigma_1 + B\ln X_t + C(\ln X_t)^2 + D(\ln X_t)^3 + \sigma_2 \ln L_t$ gives the learning elasticity. Given the fact that $\ln c_t = \ln(L/Q)_t$ where unit production cost at time *t* is a function of the difference between unit labor cost and the unit value added; the above equation can be re-written as $\ln c_t = \sigma_1 + B\ln X_t + C(\ln X_t)^2 + D(\ln X_t)^3 + \sigma_2 \ln L_t$ or its equivalent:

$$c_t = e^{\sigma 1 + B\ln Xt + C(\ln Xt)2 + D(\ln Xt)3 + \sigma 2 \ln Lt} \quad \ldots\ldots \quad (24)$$

And after applying derivation

$$\partial c_t / \partial X_t = e^{\sigma 1 + B\ln Xt + C(\ln Xt)2 + D(\ln Xt)3 + \sigma 2 \ln Lt} [B/X_t + (2C/X_t) \ln X_t + (3D/X_t) \ln X_t^2] \quad \ldots\ldots \quad (25)$$

Substituting c_t with $c_t = e^{\sigma 1 + B\ln Xt + C(\ln Xt)2 + D(\ln Xt)3 + \sigma 2 \ln Lt}$

$$\partial c_t / \partial X_t = c_t / X_t [B + 2C \ln X_t + 3D \ln X_t^2] \quad \ldots\ldots \quad (26)$$

And the learning elasticity $-\boldsymbol{\alpha}$ is:

$$(\partial c_t / \partial X_t)(X_t / c_t) = B + 2C \ln X_t + 3D \ln X_t^2 \quad \ldots\ldots \quad (27)$$

The equation to calculate the learning elasticity will be $\boldsymbol{\alpha = -[B + 2C\ln X_t + 3D(\ln X_t)^2]}$, and as the equation indicates, there is a learning elasticity value for every year of the period under analysis, therefore the cubic model generates also a progress ratio value ($d = 2^{-\alpha}$) for every year.

3.6. The Model Computation

a) The Linear Model Computation

The model $\boldsymbol{\ln(L/Q)_t = \sigma_1 - \sigma_2 \ln X_t + \sigma_3 \ln L_t}$ was computed using the total remunerations (L), value added (Q), and cumulative production (X), and applying natural logarithm following the model structure as indicated in **Table 8** (for the rest of the sub-sectors, please refer to **Appendix E**).

The data was processed [Ln (L/Q), Ln (X) and Ln (L)] in a regression analysis to obtain the coefficients (σ_1, σ_2 and σ_3) which values are summarized in **Table 9**, and α values were used to estimate the progress ratio indices per the previous described formula $d = 2^{-\alpha}$. The learning level (progress ratio) indices were calculated for every single sub-sector in the Mexican manufacturing industry as shown in **Table 10**. The sub-sectors are ranked based on the observed level learning for the period under analysis.

Table 8 Data Processing (Linear Model) Sub-Sector: Wood

Wood products including furniture
(Thousands of USD Dollars at 2005 constant prices)

Year	Total Gross Production	Total remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	41,013,553	3,692,894	16,692,612	41,013,553	0.221	(1.51)	17.53	15.12
1989	39,226,617	3,621,073	15,522,498	80,240,170	0.233	(1.46)	18.20	15.10
1990	32,088,915	3,192,935	12,641,915	112,329,085	0.253	(1.38)	18.54	14.98
1991	29,482,300	3,037,836	11,337,378	141,811,385	0.268	(1.32)	18.77	14.93
1992	27,893,756	3,075,957	10,693,315	169,705,142	0.288	(1.25)	18.95	14.94
1993	26,921,311	2,868,060	10,101,602	196,626,453	0.284	(1.26)	19.10	14.87
1994	25,406,077	2,706,130	9,185,572	222,032,530	0.295	(1.22)	19.22	14.81
1995	12,516,608	1,092,095	4,264,817	234,549,137	0.256	(1.36)	19.27	13.90
1996	1,561,027	228,448	501,169	236,110,164	0.456	(0.79)	19.28	12.34
1997	1,580,837	205,962	506,848	237,691,001	0.406	(0.90)	19.29	12.24
1998	1,454,667	185,679	453,718	239,145,668	0.409	(0.89)	19.29	12.13
1999	1,360,823	177,172	433,444	240,506,491	0.409	(0.89)	19.30	12.08
2000	1,337,367	198,817	417,034	241,843,859	0.477	(0.74)	19.30	12.20
2001	1,182,103	197,527	365,293	243,025,962	0.541	(0.61)	19.31	12.19
2002	1,117,831	183,070	358,740	244,143,794	0.510	(0.67)	19.31	12.12
2003	1,776,844	266,883	531,071	245,920,638	0.503	(0.69)	19.32	12.49
2004	1,817,488	259,831	549,717	247,738,126	0.473	(0.75)	19.33	12.47
2005	1,915,607	260,121	572,830	249,653,732	0.454	(0.79)	19.34	12.47
2006	1,946,443	268,186	575,096	251,600,175	0.466	(0.76)	19.34	12.50
2007	1,861,797	262,878	546,215	253,461,972	0.481	(0.73)	19.35	12.48
2008	1,730,755	241,073	498,206	255,192,727	0.484	(0.73)	19.36	12.39

Source: INEGI (Production, Remunerations and Value Added)

Table 9 Linear Model Regression Results and Progress Ratio Value

Manufacturing Industry	R^2	F	σ_1	σ_2	σ_3	d
Food	0.11	1.1	-4.64	0.09	0.08	1.061
Textile	0.51	9.24	-3.15	0.13	-0.02	1.096
Wood	0.89	70.73	-0.66	0.12	-0.19	1.083
Paper	0.81	37.68	-7.97	0.19	0.21	1.144
Chemicals	0.40	5.88	-7.79	0.10	0.29	1.068
Non-Metallic	0.81	38.70	-6.25	0.08	0.21	1.060
Basic Metals	0.60	13.74	-10.31	0.18	0.35	1.136
Machinery	0.95	166.98	-8.63	0.09	0.34	1.064
Others	0.86	53.85	-3.80	0.19	-0.06	1.142

Table 10 Progress Ratio Estimates by Sub-Sector (1988-2008)

Sub-Sector	Progress Ratio	Rank
Non Metallic	1.060	1
Food	1.061	2
Machinery	1.064	3
Chemicals	1.068	4
Wood	1.083	5
Textile	1.096	6
Basic Metals	1.136	7
Others	1.142	8
Paper	1.144	9
Total Mexican Manufacturing Industry	1.061	

b) The Cubic Model Computation

As in the previous model, in this cubic model:

$$\mathbf{ln(L/Q)_t = \sigma_1 + BlnX_t + C(lnX_t)^2 + D(lnX_t)^3 + \sigma_2\, lnL_t}$$

Total remunerations (L), value added (Q), and cumulative production (X) were used, and natural logarithm was applied following the model structure as detailed in **Table 11** (For the rest of the sub-sectors, please referrer to appendix E).

The data was processed [Ln (L/Q), Ln (X), $(LnX)^2$, $(LnX)^3$ and Ln (L)] in a regression analysis to obtain the coefficients ($\sigma_{1,}$ B, C, D and σ_2) which values are summarized in **Table 12**, and these coefficients were afterward used to estimate the learning elasticites according to the above described formula $\alpha = - [B + 2C \ln X_t + 3D \ln X_t^2]$.

The learning level (progress ratio) indices were calculated for every single sub-sector in the Mexican manufacturing industry as shown in **Table 13**.

Table 11 Data Processing (Cubic Model) Sub-Sector: Wood

Wood products including furniture
(Thousands of USD Dollars at 2005 constant prices)

Year	Total Gross Production	Total Remunera-tions	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(LnX)^3	ln (L)	Annual Learning estimates Eq 27	d=2^-a
1988	41,013,553	3,692,894	16,692,612	41,013,553	0.221	(1.51)	17.53	307.28	5,386.44	15.12	0.19	1.14
1989	39,226,617	3,621,073	15,522,498	80,240,170	0.233	(1.46)	18.20	331.26	6,029.10	15.10	0.09	1.06
1990	32,088,915	3,192,935	12,641,915	112,329,085	0.253	(1.38)	18.54	343.62	6,369.63	14.98	0.09	1.06
1991	29,482,300	3,037,836	11,337,378	141,811,385	0.268	(1.32)	18.77	352.31	6,612.92	14.93	0.11	1.08
1992	27,893,756	3,075,957	10,693,315	169,705,142	0.288	(1.25)	18.95	359.09	6,804.53	14.94	0.14	1.10
1993	26,921,311	2,868,060	10,101,602	196,626,453	0.284	(1.26)	19.10	364.69	6,964.39	14.87	0.16	1.12
1994	25,406,077	2,706,130	9,185,572	222,032,530	0.295	(1.22)	19.22	369.34	7,098.18	14.81	0.19	1.14
1995	12,516,608	1,092,095	4,264,817	234,549,137	0.256	(1.36)	19.27	371.46	7,159.12	13.90	0.21	1.16
1996	1,561,027	228,448	501,169	236,110,164	0.456	(0.79)	19.28	371.71	7,166.52	12.34	0.21	1.16
1997	1,580,837	205,962	506,848	237,691,001	0.406	(0.90)	19.29	371.97	7,173.96	12.24	0.21	1.16
1998	1,454,667	185,679	453,718	239,145,668	0.409	(0.89)	19.29	372.20	7,180.77	12.13	0.21	1.16
1999	1,360,823	177,172	433,444	240,506,491	0.409	(0.89)	19.30	372.42	7,187.11	12.08	0.22	1.16
2000	1,337,367	198,817	417,034	241,843,859	0.477	(0.74)	19.30	372.64	7,193.31	12.20	0.22	1.16
2001	1,182,103	197,527	365,293	243,025,962	0.541	(0.61)	19.31	372.83	7,198.76	12.19	0.22	1.16
2002	1,117,831	183,070	358,740	244,143,794	0.510	(0.67)	19.31	373.00	7,203.89	12.12	0.22	1.17
2003	1,776,844	266,883	531,071	245,920,638	0.503	(0.69)	19.32	373.28	7,212.01	12.49	0.22	1.17
2004	1,817,488	259,831	549,717	247,738,126	0.473	(0.75)	19.33	373.57	7,220.26	12.47	0.22	1.17
2005	1,915,607	260,121	572,830	249,653,732	0.454	(0.79)	19.34	373.86	7,228.90	12.47	0.23	1.17
2006	1,946,443	268,186	575,096	251,600,175	0.466	(0.76)	19.34	374.17	7,237.61	12.50	0.23	1.17
2007	1,861,797	262,878	546,215	253,461,972	0.481	(0.73)	19.35	374.45	7,245.89	12.48	0.23	1.17
2008	1,730,755	241,073	498,206	255,192,727	0.484	(0.73)	19.36	374.71	7,253.54	12.39	0.23	1.18

Source: INEGI (Production, Remunerations and Value Added)

Table 12 Cubic Model Regression Results

Manufacturing Industry	R^2	F	σ_1	B	C	D	σ_2
Food	0.31	1.79	2034.67	-299.79	14.71	-0.24	-0.05
Textile	0.57	5.25	-2338.33	362.17	-18.71	0.32	0.05
Wood	0.89	31.50	-315.37	51.58	-2.80	0.05	-0.18
Paper	0.81	17.16	-24.22	3.66	-0.23	0.01	0.24
Chemicals	0.86	25.38	4115.65	-617.25	30.81	-0.51	0.07
Non-Metallic	0.91	41.39	984.53	-160.73	8.71	-0.16	0.09
Basic Metals	0.66	7.73	1549.23	-244.92	12.85	-0.22	0.22
Machinery	0.95	77.04	-378.64	54.45	-2.66	0.04	0.37
Others	0.86	24.29	-105.86	16.75	-0.89	0.02	-0.06

Table 13 Progress Ratio Estimates by Manufacturing Sub-Sector

Year	Total MFG	Food	Textile	Wood	Paper	Chemicals	Non Metallic	Basic Metals	Machinery	Others
1988	0.83	0.80	1.60	1.14	1.09	0.67	1.03	0.94	1.12	1.23
1989	1.20	1.17	0.99	1.06	1.13	1.37	1.18	1.21	1.04	1.15
1990	1.21	1.20	0.97	1.06	1.15	1.41	1.13	1.19	1.04	1.13
1991	1.12	1.11	1.06	1.08	1.17	1.25	1.03	1.12	1.06	1.12
1992	1.01	1.00	1.19	1.10	1.19	1.07	0.93	1.05	1.08	1.12
1993	0.91	0.89	1.35	1.12	1.21	0.89	0.84	0.98	1.10	1.12
1994	0.81	0.79	1.53	1.14	1.22	0.74	0.76	0.91	1.13	1.12
1995	0.75	0.75	1.65	1.16	1.23	0.66	0.72	0.87	1.15	1.12
1996	0.72	0.72	1.69	1.16	1.23	0.61	0.71	0.83	1.16	1.12
1997	0.70	0.70	1.74	1.16	1.23	0.57	0.69	0.79	1.16	1.12
1998	0.68	0.68	1.77	1.16	1.24	0.54	0.67	0.76	1.17	1.12
1999	0.66	0.66	1.81	1.16	1.24	0.51	0.66	0.74	1.18	1.12
2000	0.64	0.65	1.84	1.16	1.24	0.48	0.65	0.71	1.19	1.12
2001	0.62	0.63	1.87	1.16	1.24	0.45	0.63	0.70	1.20	1.12
2002	0.61	0.61	1.90	1.17	1.25	0.43	0.62	0.68	1.20	1.12
2003	0.59	0.60	1.93	1.17	1.25	0.39	0.61	0.66	1.21	1.12
2004	0.57	0.58	1.96	1.17	1.25	0.35	0.59	0.64	1.22	1.12
2005	0.55	0.57	1.99	1.17	1.25	0.31	0.58	0.62	1.22	1.12
2006	0.53	0.55	2.03	1.17	1.25	0.27	0.57	0.60	1.23	1.12
2007	0.51	0.54	2.06	1.17	1.26	0.24	0.55	0.57	1.24	1.12
2008	0.49	0.52	2.09	1.18	1.26	0.21	0.54	0.55	1.25	1.12

4. Results and Discussion

4.1. The Linear Model versus the Cubic Model

The calculated progress ratio values under the linear model result in a single value over the entire period of analysis for each manufacturing sub-sector, compared to the cubic model, the linear model does not reveal whether the industries have had changes in their learning level over the period under analysis or not. The linear model outcomes could be strong in a situation where there are no drastic macro-economic changes within a country, but in the Mexican manufacturing industry this is not the case.

The regression analysis and estimation, in both scenarios, reveals that the best-fit model for the Mexican manufacturing industries is the cubic model given the fact that shows stronger R^2 values, although these values are low for the Food and Textile industries.

The estimated progress ratio values shown in Table 10 under the linear model reveal that all the Mexican manufacturing sub-sectors, during the period 1988-2008, are located in a forgetting stage. This means that unit production cost are actually increasing when production increases, therefore productivity levels are not improving but worsening. For example the Basic Metals subsector progress ratio is 1.136 which implies that the unit production cost increases by 13.6 percent every time production doubles.

The linear model outcomes do not provide the best insight of the learning trend in the sub-sectors under analysis, but it is a good indicator of the overall performance of the industries over certain period under study. When compared to a different model, as in this paper, it is a good indicator of the technological capability and technological change within an industry.

The calculated progress ratios through the cubic model can be analyzed yearly and compared against different policies implemented in Mexico for instance the impact of NAFTA on the learning level trends over the period between 1995 and 2008. Through the outcomes under this model it is determined whether the industry is stagnated or whether the industry is actively engaged in innovations and technology assimilation that contributes to increases in productivity levels.

Table 14 summarizes the progress ratio average values before and after the NAFTA, and it highlights the impact of NAFTA on the different manufacturing subsectors. The overall learning level performance of the manufacturing industry was stagnated from 1988 to 1994[3], indicating that the industry did not experience any productivity gaining during this period. NAFTA stimulated technological change in the industry, with an average overall learning level of 0.62 from 1995 to 2008, indicating that productivity levels had remarkable improvements after new policies were implemented under the NAFTA agreement.

Table 14 Average Progress Ratio Values Before and After NAFTA

	Total MFG	Food	Textile	Wood	Paper	Chemicals	Non Metallic	Basic Metals	Machinery
Before NAFTA	1.01	1.00	1.24	1.10	1.17	1.06	0.98	1.06	1.08
After NAFTA	0.62	0.63	1.88	1.17	1.24	0.43	0.63	0.69	1.20
21 Years Average	0.75	0.75	1.67	1.14	1.22	0.64	0.75	0.81	1.16

When performing the analysis (1998-2008), the linear model indicates that all Mexican subsectors (refer to Table 10) are located in a forgetting stage, but when the analysis is performed by the cubic model and divided by before and after NAFTA, it is observed that almost all subsectors were forgetting before NAFTA with the exception of the Non-Metallic industry. The NAFTA has had a positive impact on the Food, Chemicals, Non-Metallic and Basic Metals industries as observed in Table 14, but it has had a negative impact on the Textile, Wood, Paper (labor intensive subsectors), and Machinery industry. The Chemical industry has been the most benefited subsector during the NAFTA period and the Textile industry has been the industry with the most detriment performance.

In the analysis of the sub-sectors in a “Learning and Forgetting” stage the cubic model outcomes are used as the base line and the linear model outcomes are used for comparison and validation purposes. The progress ratio levels in the linear model must be in between the results obtained through the cubic model, otherwise there is an error in one of the models.

[3] Although NAFTA came into effect on January 1st, 1994, the analysis considers year 1994 as before the NAFTA period given the fact that its impact on the industry cannot be observed immediately but after a year of the new policies’ implementation.

4.2. Sub-Sectors in Learning Situations

The expected results for capital intensive industries; classified as Mid-Low Tech, Mid-High Tech and High Tech according to their technological intensity, were progress ratio values below 1. It is interesting, however, that the estimated values depicted in **Figure 6** show the Food industry in a learning stage although this industry is a Low Tech or labor intensive industry.

The Food industry suffered productivity issues during 1989, 1990 and 1991; where unit production cost increased 17 percent, 20 percent and 11 percent corresponding to each doubling the production. This unit production cost increase was stabilized in 1992 (progress ratio d= 1.0) and from 1993 onward the Food industry has exhibited a sustained decrease in the unit production cost as production doubles, reaching 51 percent decrease in 2008. According to the results it can be inferred that the Food industry has been engaged in innovation activities and technological assimilation that have contributed to its outstanding performance between 1994 and 2008.

The Food industry which comprises food, beverages and tobacco products; is the only Low Tech sub-sector that is still accumulating knowledge leading to a more competitive industry, but its contribution to the total manufacturing industry in terms of production value, however, has decreased from 24.50 percent to 21.85 percent during the period of analysis as summarized in **Table 15.**

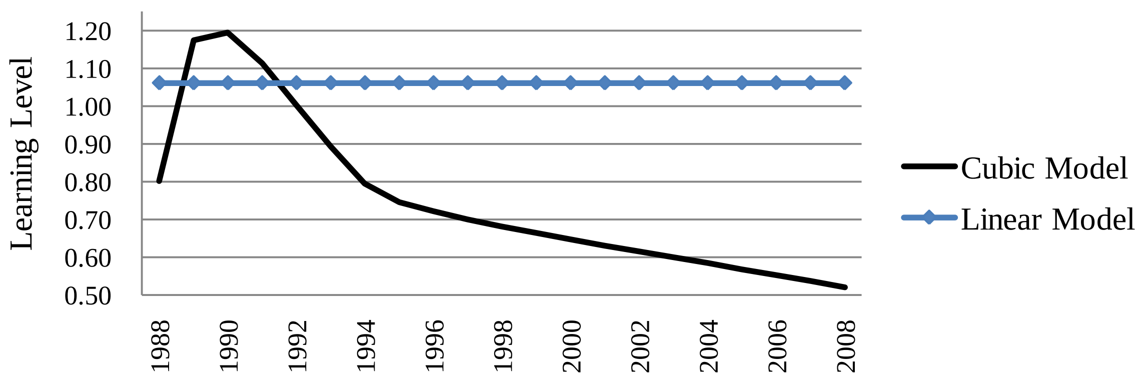


Fig. 6. Progress Ratio Values for the Food Industry (Low Tech).

The Chemical industry classified as Mid-High Tech according to its technological intensity, has the most remarkable performance in terms of technological change by the estimated progress ratio values as shown in **Figure 7**. The industry which includes chemicals, petroleum products, rubber, and plastic products had productivity issues from 1989 to 1992 with a level of 41 percent increase in its unit production cost when doubling production in 1991. This unit production cost increase tendency was reversed from 1994, and the industry achieved around 50 percent unit production cost reduction between 1998 and 2001. The Chemical industry has continued its learning trend in the last decade reaching a more than outstanding learning level of 0.21 in 2008. This industry has been the most benefited during NAFTA with an average progress ratio of 0.43 which indicates that in average the unit production cost has decreased 57% when doubling production.

The Chemical industry's contribution to the total manufacturing value has increased from 18.20 percent in 1988 to 32.85 percent in 2008 as shown in Table 15, an exceptional growth level in line with its observed learning performance during this period.

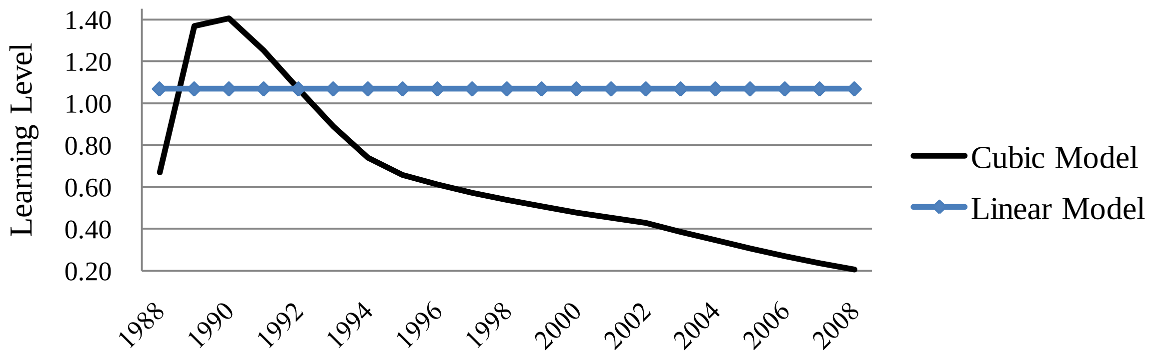


Fig. 7. Progress Ratio Values for the Chemical Industry (Mid-High Tech).

The Non-Metallic and Basic Metal industries, classified as Mid-Low Tech, show similar trend in the period under analysis. Both industries, as shown in **Figure 8** and **Figure 9**, overcame their productivity problems early in the 1990's and have achieved good learning levels from 1993 onward. The Non-Metallic industry achieved better improvement levels from 1995 to 2002 compared to the Basic Metals industry. In 1995 the unit production cost, in the Non-Metallic industry, decreased by 28 percent when doubling production, while in the Basic Metal industry this cost decreased by only 13 percent.

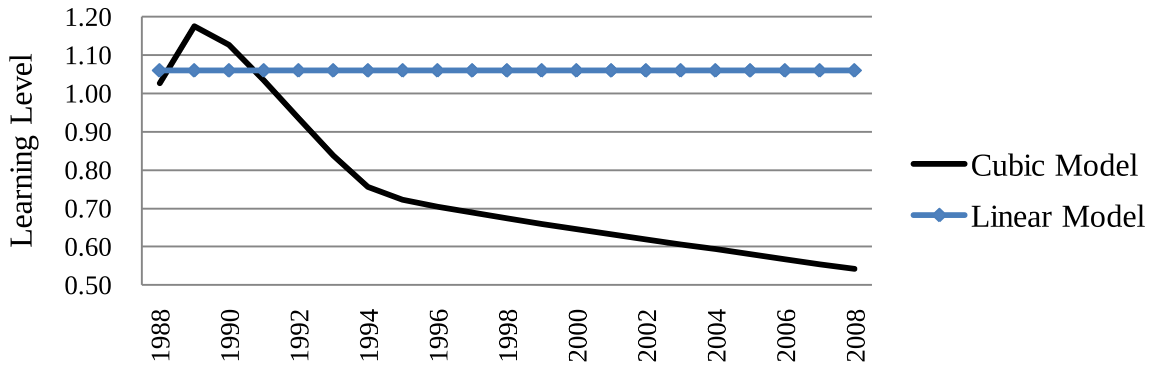


Fig. 8. Progress Ratio Values for the Non-Metallic Industry (Mid-Low Tech).

In 2002, however, the unit production cost decreased by 38 percent when doubling production in the Non-Metallic industry, while in the Basic Metal this cost decreased by only 32 percent. These observations indicate that stronger innovations activities were carried out in the Non-Metallic industry between 1993 and 1999 versus the Basic metal industry, but from 2000 to 2005 the Basic Metal industry carried out stronger innovation activities than the Non-Metallic industry. In year 2008 both industries show similar progress ratio values, 0.54 for the Non-Metallic industry and 0.55 for the Basic Metals. Both industries have achieved outstanding learning levels, reaching around 45 percent unit production cost decreases in 2008 when production doubles.

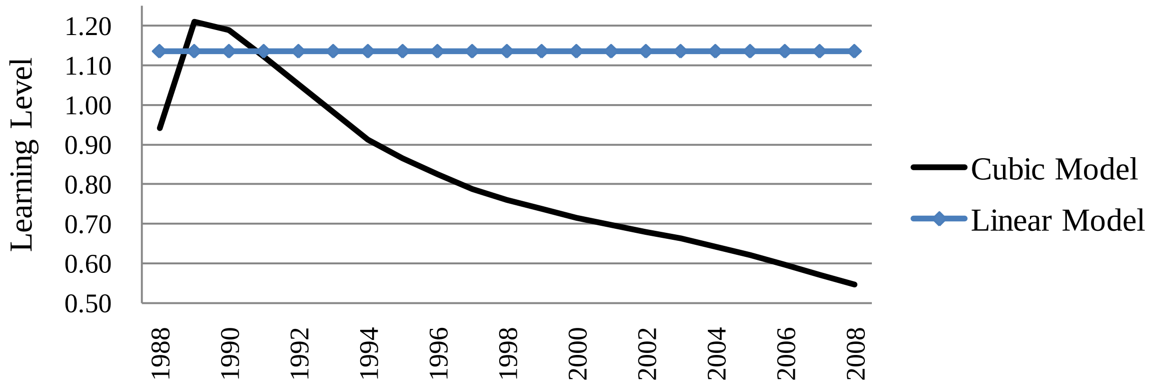


Fig. 9. Progress Ratio Values for the Basic Metals Industry (Mid-Low Tech).

4.3. Subsectors in Forgetting Situations

The expected results for labor intensive industries; classified as Low Tech according to their technological intensity, were progress ratio values equal or above 1 (d). It is important to highlight; however, that calculated values portrayed in **Figure 10** show the Machinery industry in a forgetting stage although this industry is a High Tech or capital intensive industry. This industry comprises Fabricated Metal products, Machinery and Equipment, Medical, Precision and Optical Instruments.

The Machinery industry has not overcome its productivity problems during the period under analysis, even though data shows improvements between 1988 and 1991. The unit production cost has increased in every year of analysis when doubling production. During NAFTA's new policies implementation, this situation has worsened moving from a progress ratio of 1.15 in 1994 to 1.20 in 2002 and to 1.25 in 2008. This data indicates that unit production costs increased 15 percent in 1994, 20 percent in 2002 and 25 percent in 2008 when production doubled.

The data shown in Table 5 indicates that the Machinery industry was actually expanding from 1988 until 2002, but since 2003 the industry has contracted. This finding supports the fact that in 2003 several high tech companies, especially companies engaged in the manufacturing of computer related assemblies decided to migrate to China.

Given the fact that the Machinery industry is a High Tech industry, this worsening situation in the learning level of the industry stresses a concern of the future of the manufacturing industry in the country. As a natural path of the manufacturing industry development it is expected to observe a change in the manufacturing specialization moving from labor intensive to capital intensive industries, in other words, moving from Low Tech to High Tech industries.

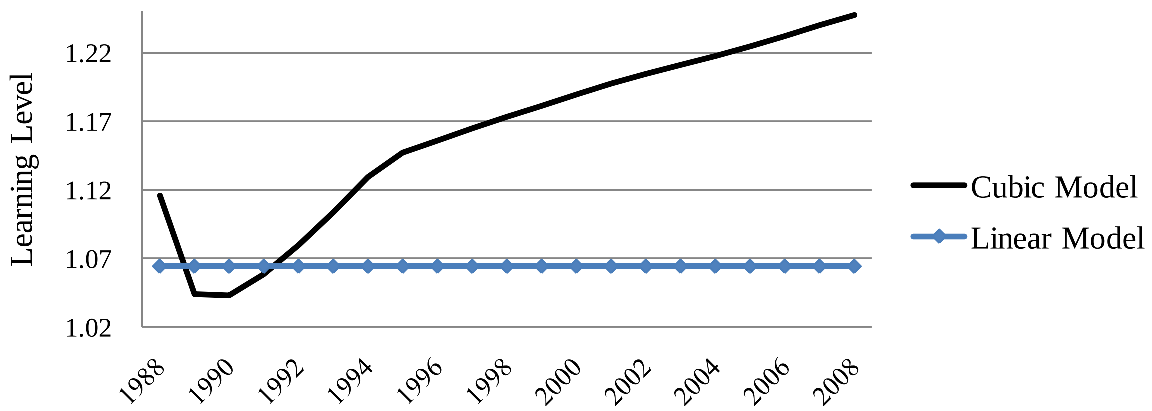


Fig. 10. Progress Ratio Values for the Machinery Industry (High Tech).

The Textile industry has the worst performance among all the Mexican manufacturing sub-sectors. The industry had two years of acceptable performance with progress ratios of 0.99 in 1989 and 0.97 in 1990. Since 1991 and before NAFTA the Textile industry suffered serious productivity issues, and the observed progress ratios moved from 1.06 in 1991 to 1.53 in 1994 indicating that unit production cost increased from 6 percent to 53 percent between the mentioned years.

The calculated progress ratio values indicate a chronic situation in the industry, reaching a deteriorated progress ratio level of 2.09 in 2008. The Textile industry is no longer competitive and no learning is taking place in this industry. Unit production cost shows an increase of 109 percent in 2008 when production doubles. NAFTA has not benefited this industry but it has worsened its performance level. It can be deducted that no new technology has been acquired and implemented in the industry; no innovations activities have been taken place, and almost none investment has reached the industry during the period of analysis 1988-2008.

This analysis supports several studies that indicate that the Textile manufacturing industry in Mexico is no competitive and that the industry has suffered from competitive markets such as China. The industry's contribution to the total manufacturing industry has decreased from 8.92 percent to 2.60 percent in 2008.

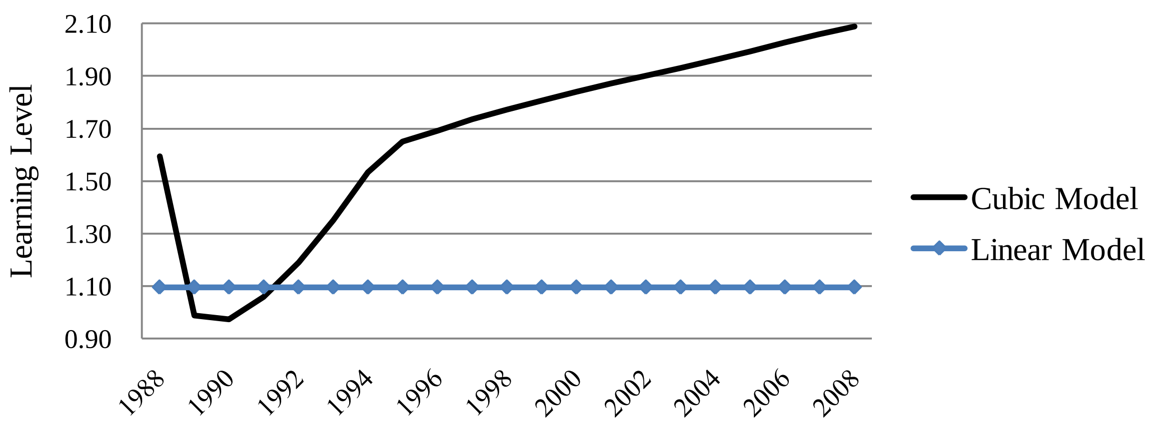


Fig. 11. Progress Ratio Values for the Textile Industry (Low Tech).

The Wood industry which includes Wood Products and Furniture, and the Paper industry which captures Paper, Paper Products, Printing and Publishing show an almost similar trend over the period of analysis as depicted **in Figure 12** and **Figure 13**. The Wood industry had some improvements in its forgetting level in 1989 and 1990, but after 1991 this situation is worsening but not as bad as the Textile subsector.

The unit product cost shows an average increase of 17 percent when doubling production between 1995 and 2008. The industry's participation in the total production value in the manufacturing industry has declined from 3.41 percent in 1998 to a poor level of 0.61 in 2008 as indicated in Table 15.

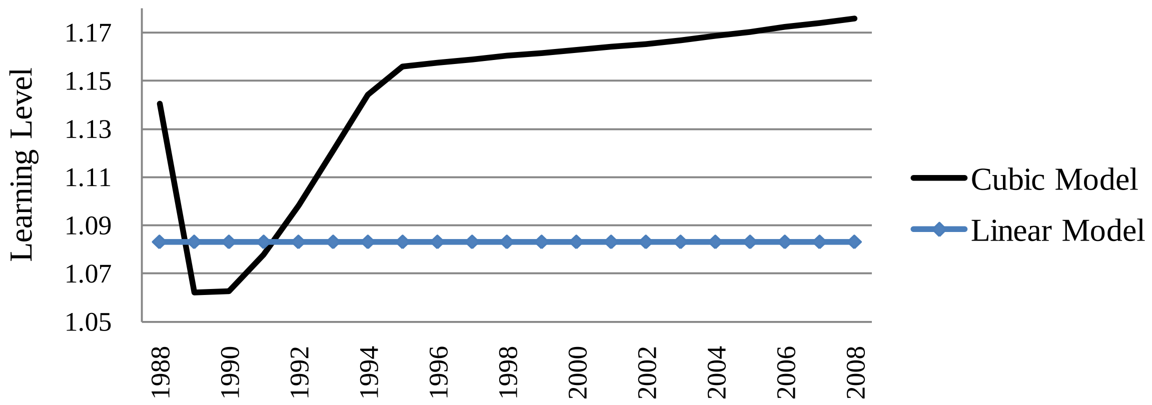


Fig. 12. Progress Ratio Values for the Wood Industry (Low Tech).

The Paper industry shows a chronic forgetting level, and it is the only manufacturing industry that does not show any improvement in any year, but a more detriment level as the time goes by. The industry's forgetting level is smaller than the Textile industry, and its progress ratio level of 1.26 in 2008 indicates that the unit production cost increases 26 percent when doubling production.

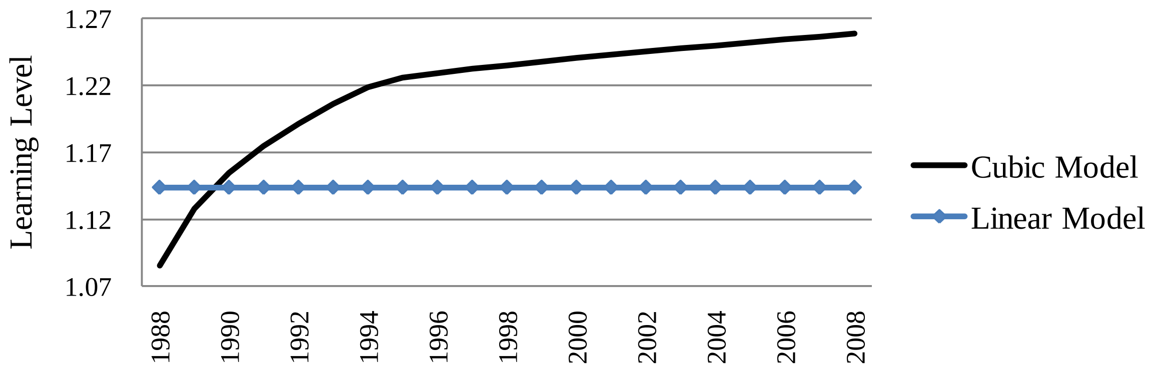


Fig. 13. Progress Ratio Values for the Paper Industry (Low Tech).

NAFTA has negatively impacted the industry and it is not a competitive industry. The industry's contribution to the total manufacturing industry has decreased from 5.43 percent in 1998 to 3.23 percent in 2008; however its current contribution to the whole industry is higher than the contribution of the Textile and Wood industry together (3.21 percent) as shown in Table 15.

Table 15 Industry Participation in the Total Manufacturing Production Value

Year	Chemical %	Machinery %	Food %	Basic Metals %	Non-Metallic %	Paper %	Textiles %	Wood %	Others %
1988	18.20	25.44	24.50	7.67	4.63	5.43	8.92	3.41	1.80
1989	17.22	26.44	24.83	7.20	4.44	5.42	8.87	3.47	2.12
1990	16.59	26.95	25.71	6.72	4.62	5.12	8.68	3.22	2.40
1991	15.48	28.28	27.01	5.52	4.88	4.89	8.54	3.12	2.27
1992	15.01	28.97	27.13	4.98	5.16	4.87	8.30	3.05	2.52
1993	14.80	28.50	27.85	4.82	5.48	4.76	8.22	3.05	2.51
1994	14.67	29.89	27.19	4.92	5.25	4.70	7.82	2.94	2.62
1995	14.90	33.75	24.17	5.94	4.00	4.54	7.46	2.44	2.80
1996	18.16	31.90	25.01	10.19	4.17	4.68	5.05	0.59	0.24
1997	17.88	33.47	23.71	10.29	4.16	4.49	5.12	0.62	0.25
1998	17.65	35.26	23.14	9.15	4.47	4.59	4.85	0.64	0.26
1999	17.43	35.73	23.61	8.18	4.70	4.78	4.66	0.65	0.26
2000	17.34	36.95	23.08	7.95	4.62	4.77	4.45	0.60	0.25
2001	17.68	36.21	24.91	6.90	4.63	4.71	4.16	0.57	0.24
2002	17.83	34.75	26.07	7.09	4.69	4.70	4.06	0.57	0.24
2003	29.79	27.34	22.99	6.29	4.56	3.83	3.79	0.80	0.62
2004	30.58	26.30	22.41	7.83	4.33	3.59	3.59	0.78	0.59
2005	32.01	26.12	21.92	7.51	4.19	3.57	3.34	0.75	0.58
2006	31.68	26.42	21.17	8.67	4.15	3.48	3.16	0.72	0.56
2007	31.27	26.75	21.67	8.78	4.14	3.31	2.88	0.67	0.54
2008	32.85	25.19	21.85	9.29	3.86	3.23	2.60	0.61	0.51

Source: INEGI

4.4. Manufacturing Subsectors by Technological Intensity

The different policies implement under the NAFTA agreement have led to a re-structuring in the whole manufacturing industry as observed in Table 15 and **Table 16**. Labor intensive industries are decreasing their contribution in the manufacturing industry with the exception of the Food industry whereas capital intensive industries are increasing their contribution with the exception of the Machinery industry.

Table 16 Industry Production Contribution Before and After NAFTA[a]

Subsector	Chemical	Machinery	Food	Basic Metals	Non-Metallic	Paper	Textiles	Wood	Others
Average Before NAFTA	16.00%	27.78%	26.32%	5.97%	4.92%	5.03%	8.48%	3.18%	2.32%
Average After NAFTA	23.36%	31.15%	23.26%	8.15%	4.33%	4.16%	4.23%	0.79%	0.57%

a The analysis considers the Before NAFTA period from 1988 to 1994, and the After period from 1995 to 2008

Source: INEGI

Figure 14 depicts the development path followed by the manufacturing industry, showing that the country is moving from a Low Tech industry with low value added production activities to a Mid-Low Mid-High Tech industry with high value added production activities.

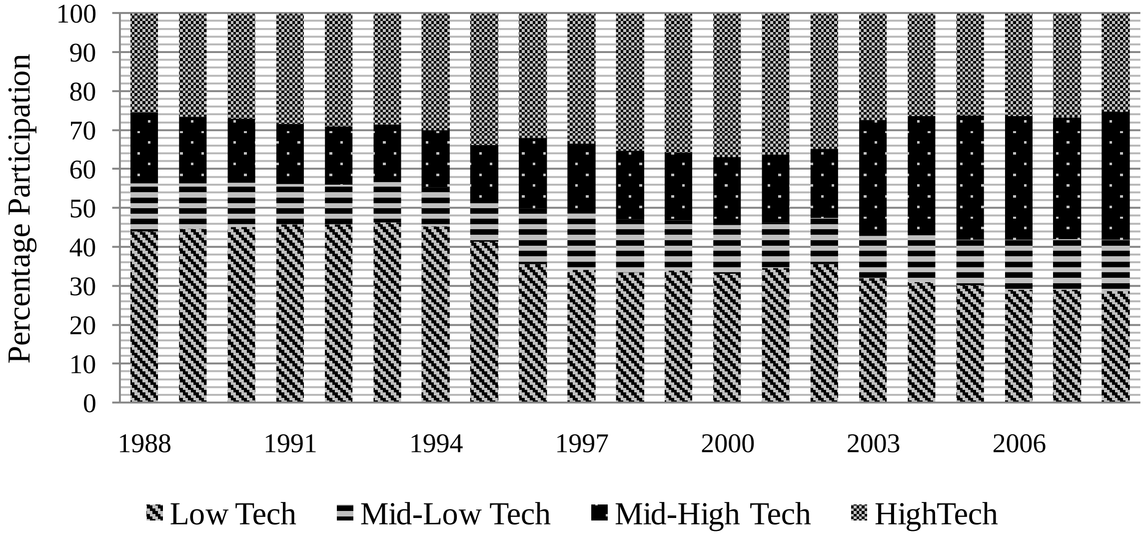


Fig. 14. Manufacturing Production Contribution by Technological Intensity.
Source: INEGI

Mexico's manufacturing industry is moving to more specialized production industries that require skilled workers and better organized institutions to support the whole industry requirements.

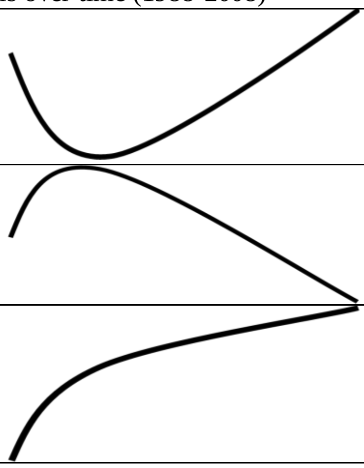
The Low Tech industry contribution to the manufacturing sector has decreased from 44.6 percent in 1988 to 28.81 percent in 2008, whereas the Mid High Tech industry has increased its contribution from 18.20 percent to 32.85 percent from 1988 to 2008 respectively. The Mid-Low industry's contribution, however, has almost remained the same during this period under analysis, moving from 12.30 percent in 1988 to 13.15 percent in 2008.

The High Tech industry participation in the manufacturing industry shows an expansion from 1998 to 2002, but its contribution level in 2008 is similar to the 1988 level, 25.19 percent in 2008 versus 25.44 percent in 1988.

4.5. Patterns of Technological Learning Level

The learning path followed by each industry depends on different internal and external factors. The Mexican subsectors were analyzed and grouped depending upon the observed learning path during the period under analysis 1988-2008. **Table 17** shows that the Mexican manufacturing industry can be grouped into three main patterns of learning, two of them with a concave shape and one with a convex shape, but the convex shape was subdivided into two learning paths depending on the estimated progress ratio values.

Table 17 Patterns of Technological Learning Over Time



Patterns of Learning Levels over time (1988-2008)	**Learning Path**	**Industry**
Convex learning path with a minimum	Forgetting at all time	Machinery
	Learning at some beginning periods, but forgetting afterwards	Textile Wood
Concave learning path with a maximum	Forgetting after beginning periods, but learning afterwards	Food Chemical Non-Metallic Basic Metals
Concave learning path with no maximum	Forgetting at all time	Paper

In general, a convex learning path moves towards a forgetting stage while a concave learning path moves towards a learning stage.

4.5.1. Convex Learning Path with Minimum

Three industries follow this convex learning path; however the calculated progress ratios over time among these three industries show some differences during the period under analysis. The Machinery industry shows no learning but forgetting at all time, nevertheless a deeper analysis described in **Chapter 5** reveals an interesting finding of the actual progress ratio values in the different sub-sectors included in the Machinery industry.

The Textile and Wood industry follow the same convex learning path, but with some learning at the beginning of the period but forgetting afterwards. This is mainly due to the nature of these two industries which are labor intensive, low technological intensity; and both industries face high competition levels in the global market from cheaper labor countries.

4.5.2. Concave Learning Path with Maximum

Four industries follow a concave learning path with a maximum learning level. The Food, Chemical, Non-Metallic and Basic Metals industries show a forgetting level after the beginning periods, but this tendency is reversed and the industries move towards a learning stage which indicates that productivity issues were overcome and the industries engaged in innovations activities that contributed in the achievement of production cost downs as production increased. This trend in the Progress Ratio level is most likely the result of structural changes for instance the FDI law enacted in 1993 and the NAFTA.

4.5.3. Concave Learning Path with No maximum

The Paper industry follows a concave learning path with no maximum. The industry shows forgetting at all time, indicating that its performance is worsening over time.

4.6. The Contributing Factors of Technological Learning

The dynamism of technological learning is influenced by different factors that could be either internal or external. This dynamism directly affects the changes in the Progress Ratio path over time at firm, industry or national level. The achieved learning level is also different even at different manufacturing locations of a given company, therefore progress ratio ranges from firms to industries and to national economies.

Mexico's economy underwent through several structural changes in the last decades, but the main changes that inserted the Mexican economy in the global arena initiated early in the 1980's. The manufacturing industry has been directly influenced by three main drastic structural changes in the country.

a) Globalization

Mexico implemented several neoliberal policies early in the 1980's that set the basis for its globalization process. The country gradually opened its economy to the world through different mechanisms for instance its adherence to the GATT in 1986. This globalization process has contributed to the development of the manufacturing industry in Mexico as a whole, but it has negatively impacted the labor intensive industries.

b) Foreign Direct Investment

Mexico re-designed its policy for FDI and eliminated several restrictions in the new FDI law enacted in 1984. The FDI inflows, however, did not increase as expected and Mexico reformed its FDI law in 1993. This reform was in line with the NAFTA agreement that came into effect in 1994.

The 1993 reforms had an immediate effect in the FDI inflows in the country as shown in table 2, and around 50 percent of these inflows have been allocated to the Industry sector. The manufacturing industry has been benefited of this structural change that has directly been impacting the technological learning in the industry.

c) North America Free Trade Agreement

The NAFTA has been the major contributor of the current structure of the Mexican manufacturing industry, and has influenced the allocation of internal and external resources in the country.

The NAFTA, as observed in Table 14, has shape the technological learning levels in the different industries in the country. Through the NAFTA Mexico has been able to consolidate its manufacturing industry and the country has been benefited from technological spillovers.

d) Other Free Trade Agreements

Mexico has been actively engaged in different Free Trade Agreement not only in the region but with the whole world, and besides the NAFTA the most important free trade agreements are: the Free Trade Agreement between Mexico and the European Union (2007) and the Free Trade Agreement between Mexico and Japan (2011). The different trade agreements have and will influence the technological learning in the manufacturing industry, contributing to the re-structuring of the whole manufacturing industry.

5. The Case of Machinery Sub-Sectors

The analysis of the Machinery subsector was performed following the old Mexican manufacturing classification which groups the manufacturing production activities into 9 clusters, but as explained in **Chapter 3** Mexico followed the ISIC classification and the whole Mexican manufacturing industry was re-grouped into 21 sub-sectors. The research attempted to reclassify the old classification into the new classification without success.

The fact that the analysis locates the Machinery industry in a forgetting stage and given the importance of the industry for the Mexican long term manufacturing development, a deep analysis is performed for the industries (under the new classification) that fall into the old industry classification.

A further analysis was carried out in the five industries that the research grouped (in the previous chapters) into the Machinery subsector as shown in **Table 18**: Railroad and Transport Equipment; Electrical Machinery and Apparatus; Fabricated Metal Products; Machinery and Equipment; and Computing Machinery, Communications Equipment, Medical, Precision and Optical. Information for new ISIC classification is only available from 2003, therefore this additional analysis only comprises data from 2003 to 2008 (six years period). This section considers an analysis of the five mentioned industries in terms of the observed performance of the total Machinery subsector; and percentages and ranks are based on the whole Machinery subsector itself and given figures do not represent information related to the Mexican Manufacturing industry as a total.

This further analysis reveals that three industries are in a forgetting level and two in a learning level as depicted in **Figure 15, 16, 17, and 19**.

Table 18 Subsectors under ISIC that fall into the Old Machinery Classification

INDUSTRY	SHORT DESCRIPTION	SUBSECTORS UNDER ISIC
Fabricated metal products, Machinery and equipment, Medical, precision and optical instruments.	**Machinery**	332: Fabricated Metal Products 333: Machinery and Equipment 334: Computing Machinery, Communications Equipment, Medical, Precision and Optical 335: Electrical Machinery and Apparatus 336: Railroad and Transport Equipment

Source: INEGI

The Machinery and Equipment subsector classified as Medium-High Tech according to its technological intensity, shows Progress Ratio values below 1 in 2004, 2005 and 2006, but its competitiveness has deteriorated in the last years. The industry reached a detriment level of 2.43 progress ratio in 2008; however its production contribution value to the whole Machinery industry has increased during the period under analysis from 5.12 percent in 2003 to 7.05 percent in 2008 as shown in **Figure 20**.

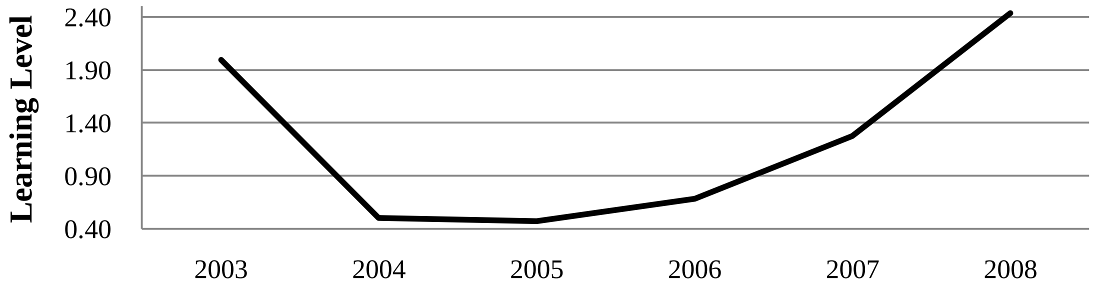


Fig. 15. Progress Ratio Values for the Machinery and Equipment Industry (Medium-High Tech).

The Computing Machinery, Communications Equipment, Medical, Precision and Optical Industry trend depicted in Figure 16 indicates that the industry shows a chronic issue in its learning level or knowledge accumulation reaching an unwanted level of 2.46 in 2008. Mexico faced a massive withdrawal of FDI in the IT industry from 2003 to 2005, and this particular situation is contributing to the detriment learning levels of the whole industry. This subsector has decreased its contribution to the Machinery industry from 6.59 percent in 2003 to 2.73 percent in 2008.

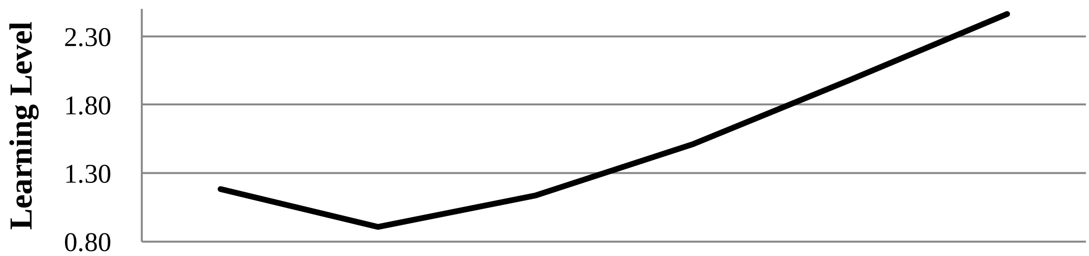


Fig. 16. Progress Ratio Values for the Computing Machinery, Communications Equipment, Medical, Precision and Optical Industry (Medium-High Tech).

The Electrical Machinery and Apparatus industry had a good performance from 2008 to 2006, but its progress ratio moved from 0.96 in 2007 to 1.06 in 2008. These data indicates that the industry is facing productivity issues. In 2008 unit production cost increased 6 percent when doubling production. The Electrical Machinery and Apparatus contribution to the total manufacturing activity in the whole Machinery industry shows and increase between 2003 to 2008, moving from 9.25 percent to 11.70 percent respectively.

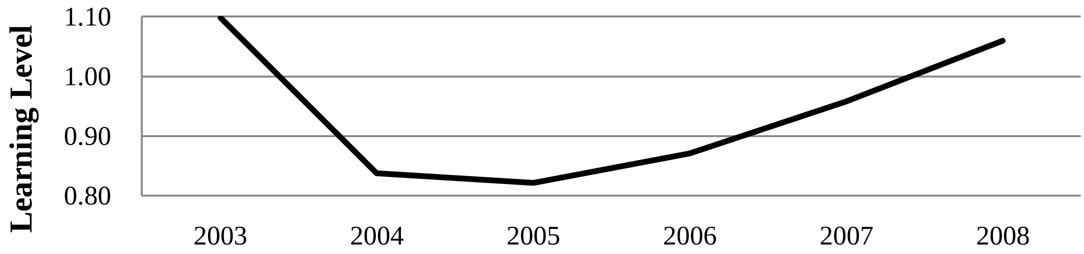


Fig. 17. Progress Ratio Values for the Electrical Machinery and Apparatus Industry (Medium-High Tech).

The Fabricated Metal Products industry is in a learning level, showing a progress ratio of 0.9411 in 2003 and 0.9455 in 2008. The industry has been able to keep its productivity level at almost the same level during the 6 years under analysis. Overall, the industry has been able to manage unit production cost reductions, achieving around 6 percent cost decreases when production doubles. The industry contribution to the total Machinery industry has slightly increased from 10.4 percent in 2003 to 11.3 in 2008, only 0.9 percent during six years.

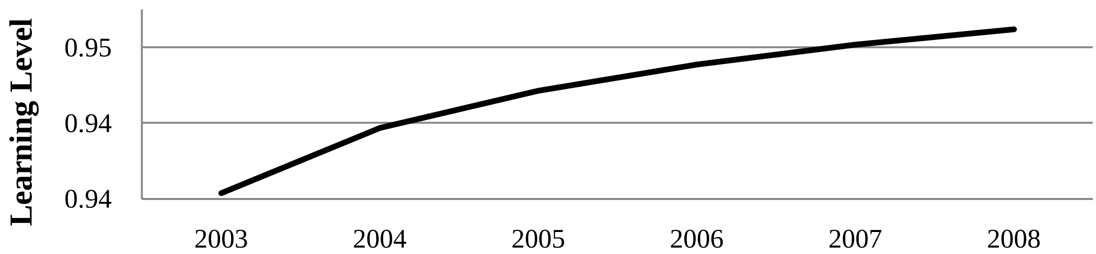


Fig. 18. Progress Ratio Values for the Fabricated Metal Products Industry (Medium-Low Tech).

The most remarkable finding in this special analysis for the Machinery industry is that the Railroad and Transport Equipment industry had an outstanding performance from 2005 to 2008. It is important to highlight that this subsector comprises the **Automotive industry** which plays a very important role in the total Mexican manufacturing industry.

The Railroad and Transport Equipment industry achieved a progress ratio of 0.81 in 2006, 0.55 in 2007 and 0.37 in 2008, indicating that the industry was able to reach unit production cost reductions of 19 percent in 2006, 45 percent in 2007 and 63 percent in 2008 when doubling production. The contribution of the industry to the total Machinery subsector has remained almost the same, 68.6 percent in 2003 and 67.3 percent in 2008 as shown in Figure 20. The Railroad and Transport Equipment industry shows a very high learning potential. This industry alone contributed to 17.23 percent and 19.2 percent in 2003 and 2008 respectively to the total Mexican manufacturing production.

The Railroad and Transport Equipment represents a key industry to the Mexican manufacturing industry given its high contribution to the national manufacturing production. The fact that this industry is in a learning stage with increasing productivity levels makes this particular industry a national priority.

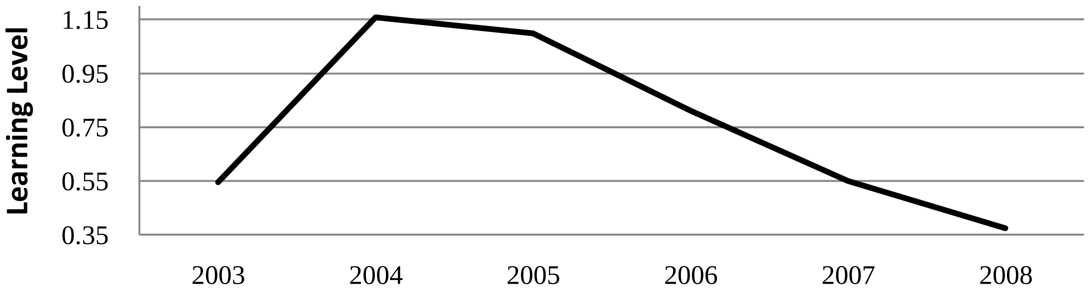


Fig. 19. Progress Ratio Values for the Railroad and Transport Equipment Industry (Medium-High Tech).

This further analysis of the Machinery industry reveals that the bad performance in the Computing Machinery, Communications Equipment, Medical, Precision and Optical; Machinery and Equipment; and Electrical Machinery and Apparatus subsectors are driving the whole industry's performance to a forgetting stage although their contributions to the total Machinery production value only accounts for around 21 percent.

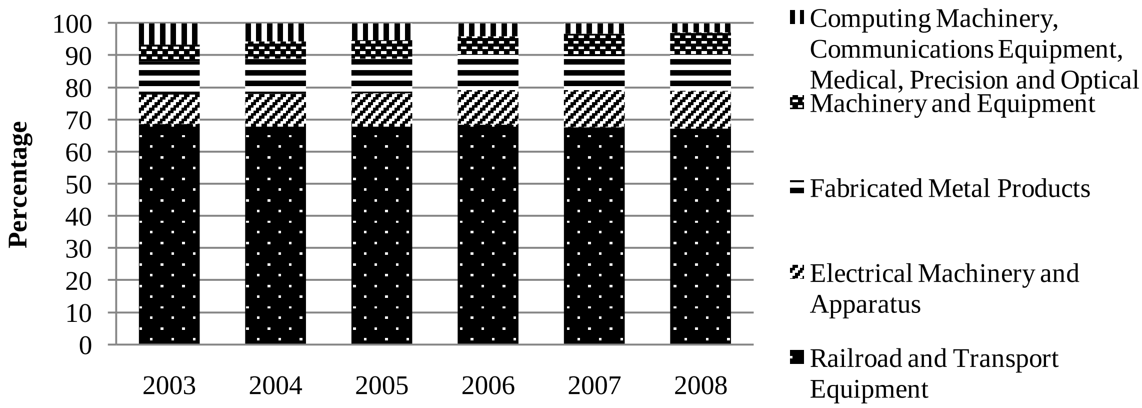


Fig. 20. Manufacturing Production Contribution of Industries grouped into the Machinery Industry.
Source: INEGI

6. Conclusions and Policy Implications

The data from the manufacturing industry was collected and analyzed using a linear and a cubic model integrated into a neoclassical production function, in order to estimate the progress ratios in each subsector over time. The research findings demonstrate that the cubic model is stronger and provides more insights of the dynamic technological progress and learning effects in the industries compared to the linear model.

The study identified three main patterns of technological learning among the different industries: 1) a convex learning path with a forgetting all the time or learning at some beginning periods but forgetting afterwards, 2) a concave learning path with forgetting after beginning periods but learning afterwards, and 3) a concave learning path with forgetting all the time.

The research found that overall the Mexican manufacturing industry is moving from labor intensive industries to capital intensive industries. The calculated progress ratios for the Textile, Wood and Paper locate these industries in a forgetting level; while the Food industry remains very competitive with a high assimilation capacity. The Chemical, Non-Metallic and Basic Metals industries show progress ratios around or below 0.5 indicating that these industries have been actively engaged in innovations activities, and these industries are highly competitive.

The paper found, however, that the Machinery industry is located in a forgetting level showing a deteriorating performance over time. Given the importance of this industry in terms of its contribution to the total manufacturing industry and its impact on the future Mexican manufacturing industry development, a further analysis was performed. It was found that the Railroad and Transport Equipment plays an important role in the Mexican manufacturing industry and shows an exceptional technological learning path. This case illustrates the need for a more detail analysis and future studies should attempt to perform an analysis at a 4 digits level.

In order to sustain industrial and economic growth, Mexico should put more emphasis on industries with learning potentials and adjust its **technology policy structure**. Overall focus should be given to Mid-Low and Mid-High Tech industries, but these policies should be adjusted to reverse the High Tech industry performance in the last two decades. Policies should also be enforced to support, and do not neglect, the Food industry.

The drastic declining of the high tech contribution in the total production reflects weak technology policies at the national level that are required for the long-run development of the Mexican manufacturing industry. The fact that the High-Tech sub-sector is in a forgetting level and reducing its contribution in the total manufacturing industry has Policy Implications. Mexico should expand its high tech national structure beyond its current national industry priority: the Railroad and Transport Equipment subsector. Mexico requires adjusting its current national policy towards high tech industries in order to improve the design of the current high tech industrial structure.

Bibliography

Adler, P. S., & Clark, K. B. (1991). Behind the Learning Curve: A Sketch of the Learning Process. *Management Science* , 267-281.

Andersen, B. (1999). The Hunt for S-Shaped Growth Paths in Technological Innovation: A Patent Study. *Evolutionary Economics* , 487-526.

Arrow, K. (1962). The Economic Implications of Learning by Doing. *The Review of Economic Studies Ltd.* , 155-173.

Asgari, B., & Yen, L. W. (2009). Accumulated Knowledge and Technological Progress in Terms of Learning Rates: A Comparative Analysis on the Manufacturing Industry and the Service Industry in Malaysia. *Asian Journal of Technology Innovation* , 71-99.

Badiru, A. B. (1992). Computational Survey of Univariate and Multivariate Learning Curve Models. *IEEE Transactions on Engineering Management* , 176-188.

Baloff, N. (1966). The Learning Curve - Some Controversial Issues. *The Journal of Industrial Economics* , 275-282.

Baloff, N., & Kennelly, J. W. (1967). Accounting implications of product and process start-ups. *Journal of Accounting Research* , 131-143.

BANXICO. (2011). *Banco de Mexico*. Retrieved May 27, 2011, from CR72 - Cuentas nacionales: http://www.banxico.org.mx/politica-monetaria-e-inflacion/estadisticas/otros-indicadores/produccion.html

Belkaoui, A. (1986). *The Learning Curve "A Management Accounting Tool".* London, England : Quorum Books.

Calva, J. L. (2004). La Economía Mexicana en Perspectiva. *EconomiaUNAM* , 63-85.

Cardero, M. E., & Aroche, F. (2008). Cambio Estructural Comandado por Apertura Comercial. El Caso de la Economia Mexicana. *Estudios Economicos* , 203-252.

CEFP. (2004). *Evolucion del Sector Manufacturero de Mexico 1980-2003.* Mexico: Centro de Estudios de las Finanzas Publicas (CEFP).

Ernst, D., Ganiatos, T., & Mytelka, L. (1998). *Technological Capabilities and Export Sucess in Asia.* London: Taylor & Francis.

Esquivel, G., & Rodriguez Lopez, J. A. (2003). Technology, Trade, and Wage Inequity in Mexico Before and After NAFTA. *Journal of Development Economics* , 543-565.

Figueiredo, P. N. (2001). *Technological Learning and Competitive Performance.* Massachusetts: Edward Elgar Publishing, Inc.

Grubler, A. (1998). *Technology and Global Change.* Cambridge: Cambridge University Press.

Hall, G., & Howell, S. (1985). The Experience Curve from the Economist's Perspective. *Strategic Management Journal* , 197-212.

Hernadez Laos, E. (2005). *Productivity Performance in Developing Countries: Mexico.* USA: UNIDO.

Hornstein, A., & Peled, D. (1997). External vs. Internal Learning-by-Doing in an R&D Based Growth Model. *Federal Reserve Bank if Richmond* , 1-38.

INEGI. (1998). *Encuesta Industrial Anual 1996-1997.* Mexico: INEGI.

INEGI. (2000). *Encuesta Industrial Anual 1998-1999.* Mexico: INEGI.

INEGI. (2002). *Encuesta Industrial Anual 2000-2001.* Mexico: INEGI.

INEGI. (2004). *Encuesta Industrial Anual 2002-2003.* Mexico: INEGI.

INEGI. (2010). *INEGI*. Retrieved December 14, 2010, from Banco de Informacion Economica: http://dgcnesyp.inegi.org.mx/cgi-win/bdieintsi.exe/NIVR250130#ARBOL

INEGI. (1998). *Sistema de Cuentas Nacionales de Mexico. Cuentas de Bienes y Servicios 1988-1997.* Mexico: INEGI.

Jackson, D. (1982). *Introduction to Economics: Theory and Data.* London: Macmillan.

Jackson, D. (1998). *Technological Change, the Learning Curve and Profitability.* Massachusetts: Edward Elgar Publishing, Inc.

Karaoz, M., & Albeni, M. (2005). Dynamic Technological Learning Trends in Turkish Manufacturing Industries. *Elsevier* , 866-885.

Link, A. N., Kaufer, E., & Mokyr, J. (1987). *Economics of Technological Change.* London: Harwood Academic Publishers GmbH.

Montes Rojas, G., & Mauricio, S. (2007). Sources of Productivity Growth: Evidence from the Mexican Manufacturing Sector. *North America Journal of Economics and Finance* , 263-278.

Moreno, J. C., Santamaria, J., & Rivas, J. C. (2009). Manufactura y TLCAN: Un Camino de Luces y Sombras. *Economia UNAM* , 95-114.

OECD. (2005). *Directorate for Science, Technology and Industry "Stan Indicators (2005 Edition)".* Paris: OECD.

OECD. (2000). *Experience Curves for Energy Technology Policy.* Paris: OECD.

Pramongkit, P., Shawyun, T., & Sirinaovakul, B. (2000). Analysis of Technological Learning for the Thai Manufacturing Industry. *Pergamon* , 189-195.

Ramanathan, R. (1982). *Lecture Notes in Economics and Mathematical Systems.* New York: Springer-Verlag.

Ruttan, V. W. (2001). *Techology, Growth, and Development. An Induced Innovation Perspective.* New York: Oxford University Press.

Sark Van, W. (2008). Introducing Errors in Progress Ratios Determined from Experience Curves. *Elsevier* , 405-415.

SecretariaDeEconomia. (2010). *Programa Nacional de Inovacion.* Mexico: Secretaria de Economia.

Towill, D. R. (1985). Management Systems Applications of Learning Curves and Progress Functions. *Elsevier* , 369-383.

Vazquez Galan, B. I. (2009). Have Liberalisation and NAFTA Had a Positive Impact on Mexico's Output Growth? *Journal of Applied Economics* , 159-180.

Watanabe, C., & Asgari, B. (2004). Impacts on Funcionality Development on Dynamism between Learning and Diffusion of Technology. *Technovation* , 651-664.

Appendix

Appendix A Manufacturing Industry Classification Before and After 2003

OLD MEXICAN CLASSIFICATION (Before 2003)	NEW MEXICAN CLASSIFICATION (ISIC) (After 2003)
31 Productos alimenticios bebidas y tabaco	311: Industria alimentaria 312: Industria de las bebidas y del tabaco
32 Textiles y prendas de vestir e industria del cuero	313: Fabricación de insumos textiles 314: Confección de productos textiles, excepto prendas de vestir 315: Fabricación de prendas de vestir 316: Fabricación de productos de cuero, piel y materiales sucedáneos, excepto prendas de vestir
33 Industria de la madera y productos de madera incluyendo muebles	321: Industria de la madera 337: Fabricación de muebles y productos relacionados
34 Papel y productos de papel, imprentas y editoriales	322: Industria del papel 323: Impresión e industrias conexas
35 Sustancias químicas, productos derivados del petróleo y del carbón, de hule y de plástico	324: Fabricación de productos derivados del petróleo y del carbón 325: Industria química 326: Industria del plástico y del hule
36 Productos minerales no metálicos. Excluye los derivados del petróleo y del carbón.	327: Fabricación de productos a base de minerales no metálicos
37 Industrias metálicas básicas	331: Industrias metálicas básicas
38 Productos metálicos, maquinaria y equipo. Incluye instrumentos quirúrgicos y de precisión.	332: Fabricación de productos metálicos 333: Fabricación de maquinaria y equipo 334: Fabricación de equipo de computación, comunicación, medición y otros equipos componentes y accesorios eléctricos 335: Fabricación de equipo de generación eléctrica y aparatos y accesorios eléctricos 336: Fabricación de equipo de transporte
39 Otras industrias manufactureras	339: Otras industrias manufactureras

Source: INEGI

Appendix B Exchange Rate "Mexican Pesos per US Dollar"

Year	Exchange Rate
1985	0.26
1986	0.61
1987	1.37
1988	2.27
1989	2.46
1990	2.81
1991	3.02
1992	3.09
1993	3.12
1994	3.38
1995	6.42
1996	7.60
1997	7.92

Source: Banco de Mexico

Year	Exchange Rate
1998	9.14
1999	9.56
2000	9.46
2001	9.34
2002	9.66
2003	10.79
2004	11.29
2005	10.90
2006	10.90
2007	10.93
2008	11.13
2009	13.51
2010	12.64

Appendix C Mexico Consumer Price Index 2005=100

Year	Consumer Price Index	Year	Consumer Price Index
1988	9.61	1999	71.83
1989	11.53	2000	78.65
1990	14.60	2001	83.65
1991	17.91	2002	87.86
1992	20.69	2003	91.86
1993	22.70	2004	96.16
1994	24.29	2005	100.00
1995	32.79	2006	103.63
1996	44.06	2007	107.74
1997	53.15	2008	113.26
1998	61.61	2009	119.26

Source: OECD Stat

Appendix D Classification of Industries based on Technology Intensity (OECD)

Classification of manufacturing industries based on technology

High-technology industries Aircraft and spacecraft Pharmaceuticals Office, accounting and computing machinery Radio, TV and communications equipment Medical, precision and optical instruments	**Medium-high-technology industries** Electrical machinery and apparatus, n.e.c. Motor vehicles, trailers and semi-trailers Chemicals excluding pharmaceuticals 24 excl. Railroad equipment and transport equipment, n.e.c. Machinery and equipment, n.e.c.
Medium-low-technology industries Building and repairing of ships and boats Rubber and plastics products Coke, refined petroleum products and nuclear fuel Other non-metallic mineral products Basic metals and fabricated metal products	**Low-technology industries** Manufacturing, n.e.c.; Recycling Wood, pulp, paper, paper products, printing and publishing Food products, beverages and tobacco Textiles, textile products, leather and footwear

Source: OECD, "Stan Indicators (2005 Edition)

Appendix E Production, Remunerations and Value Added by Sector (Current Mexican Pesos)

	Total Mexican Manufacturing Industry (Thousands of Current Mexican pesos)		
Year	Total Gross Production Value	Total Remunerations	Value Added
1988	262,444,465	26,052,302	91,239,887
1989	321,127,255	35,366,285	110,228,504
1990	409,522,182	46,116,322	140,608,471
1991	510,218,754	59,038,517	178,728,605
1992	584,582,196	73,313,769	208,364,591
1993	624,660,838	79,694,402	219,934,044
1994	707,519,436	86,580,024	245,012,475
1995	1,081,765,338	96,209,084	350,155,556
1996	882,922,468	73,434,060	304,855,153
1997	1,066,347,491	91,396,853	363,742,678
1998	1,269,517,190	111,160,622	436,888,083
1999	1,440,967,032	135,934,009	503,002,023
2000	1,650,832,145	161,135,184	574,984,759
2001	1,631,564,855	172,207,377	577,865,642
2002	1,671,194,429	174,619,661	602,200,482
2003	2,205,912,092	175,885,623	690,899,054
2004	2,527,682,852	185,128,174	786,493,031
2005	2,765,816,231	192,156,591	854,079,362
2006	3,058,982,931	201,145,162	944,082,217
2007	3,286,339,771	198,379,142	994,100,078
2008	3,559,284,218	198,792,651	1,052,564,347

Source: INEGI

	Food, Beverages and Tobacco Products (Thousands of Current Mexican Pesos)		
Year	Total Gross Production Value	Total remunerations	Value Added
1988	64,287,573	3,964,217	19,963,859
1989	79,727,322	5,527,214	24,427,037
1990	105,276,843	7,269,620	33,232,653
1991	137,831,713	9,767,349	45,101,225
1992	158,621,519	12,406,391	53,754,274
1993	173,980,214	14,649,082	59,297,072
1994	192,375,767	16,186,104	66,644,236
1995	261,449,051	18,179,972	90,937,313
1996	220,785,050	17,100,339	79,913,145
1997	252,858,965	20,724,316	89,790,652
1998	293,755,179	25,128,162	106,489,132
1999	340,197,951	31,127,279	127,285,837
2000	380,954,521	36,544,018	146,782,651
2001	406,421,023	40,401,064	158,167,490
2002	435,636,494	43,599,232	172,911,348
2003	507,051,472	43,499,108	187,422,296
2004	566,550,775	45,926,550	209,749,483
2005	606,213,623	47,367,027	222,821,031
2006	647,578,617	49,394,911	239,400,632
2007	712,075,052	47,771,178	263,882,883
2008	777,868,000	44,844,043	279,257,986

Year	Total Gross Production Value	Total Remunerations	Value Added
Textiles, Wearing apparel, Fur, Leather, Leather Products and Footwear (Thousands of Current Mexican Pesos)			
1988	23,411,818	3,059,964	9,334,216
1989	28,493,538	4,116,856	11,198,626
1990	35,530,841	5,178,172	13,618,890
1991	43,573,801	6,484,046	16,502,799
1992	48,528,041	7,758,539	18,580,575
1993	51,371,431	8,366,757	19,256,816
1994	55,320,635	8,806,054	20,604,890
1995	80,753,718	9,269,148	26,918,030
1996	44,561,626	5,742,631	14,951,607
1997	54,604,350	7,113,432	18,327,167
1998	61,513,671	8,513,661	21,547,477
1999	67,203,231	10,309,448	24,056,409
2000	73,453,845	12,099,182	26,215,208
2001	67,910,436	12,138,937	24,101,982
2002	67,933,300	11,981,026	24,585,632
2003	83,608,277	12,643,835	26,050,242
2004	90,629,396	13,147,866	27,857,581
2005	92,412,401	13,659,676	27,722,268
2006	96,553,126	13,755,622	29,100,727
2007	94,793,350	13,347,524	29,436,961
2008	92,409,281	12,696,739	28,592,029

Source: INEGI

Year	Total Gross Production Value	Total remunerations	Value Added
Wood Products Including Furniture (Thousands of Current Mexican Pesos)			
1988	8,953,649	806,194	3,644,156
1989	11,132,618	1,027,670	4,405,326
1990	13,177,990	1,311,246	5,191,669
1991	15,935,384	1,641,971	6,127,930
1992	17,856,688	1,969,129	6,845,517
1993	19,041,729	2,028,609	7,144,970
1994	20,825,286	2,218,207	7,529,386
1995	26,342,110	2,298,393	8,975,617
1996	5,226,579	764,883	1,677,996
1997	6,652,621	866,748	2,132,962
1998	8,187,634	1,045,099	2,553,764
1999	9,345,091	1,216,679	2,976,564
2000	9,945,319	1,478,502	3,101,272
2001	9,238,619	1,543,750	2,854,917
2002	9,483,715	1,553,175	3,043,560
2003	17,609,587	2,644,967	5,263,231
2004	19,725,444	2,819,978	5,966,154
2005	20,876,075	2,834,767	6,242,641
2006	21,984,743	3,029,113	6,495,611
2007	21,920,916	3,095,146	6,431,171
2008	21,817,442	3,038,902	6,280,249

Paper and Paper Products, Printing and Publishing (Thousands of Current Mexican Pesos)			
Year	Total Gross Production Value	Total Remunerations	Value Added
1988	14,251,428	1,719,431	5,107,574
1989	17,403,299	2,213,806	6,100,545
1990	20,961,048	2,903,003	7,476,658
1991	24,974,940	3,709,332	9,089,263
1992	28,468,840	4,717,488	10,725,277
1993	29,739,406	5,118,228	11,329,797
1994	33,247,501	5,543,280	12,630,205
1995	49,086,377	5,855,398	17,934,469
1996	41,358,898	4,639,303	15,566,033
1997	47,919,994	5,556,373	17,736,947
1998	58,217,879	6,728,602	22,114,630
1999	68,827,591	8,166,835	26,489,740
2000	78,718,581	9,623,790	29,983,739
2001	76,781,732	10,676,629	29,908,537
2002	78,593,604	11,415,236	30,431,862
2003	84,402,045	8,667,351	25,318,118
2004	90,678,919	8,927,430	27,538,615
2005	98,875,909	9,231,485	30,156,460
2006	106,457,491	9,401,243	32,266,501
2007	108,688,146	8,831,886	32,449,321
2008	114,948,535	9,281,405	34,000,406

Source: INEGI

Chemicals, Petroleum Products, Rubber and Plastics Products (Thousands of Current Mexican Pesos)			
Year	Total Gross Production Value	Total remunerations	Value Added
1988	47,771,579	4,980,923	17,692,865
1989	55,300,315	6,485,114	20,551,366
1990	67,955,980	8,441,505	25,506,176
1991	78,965,992	10,973,104	30,283,591
1992	87,723,293	13,240,291	34,456,626
1993	92,458,528	14,318,738	35,075,177
1994	103,766,960	15,242,502	38,337,720
1995	161,174,594	17,447,633	60,197,048
1996	160,331,005	16,963,370	61,292,887
1997	190,643,713	21,498,731	72,307,163
1998	224,078,113	25,846,550	86,761,233
1999	251,143,057	31,437,456	98,681,604
2000	286,290,058	37,073,839	110,945,470
2001	288,407,007	39,257,230	114,649,097
2002	297,921,331	39,633,140	125,301,306
2003	657,091,547	47,883,778	193,899,463
2004	772,908,472	48,834,720	221,564,491
2005	885,226,108	49,945,633	250,777,242
2006	968,963,858	51,802,895	278,088,825
2007	1,027,696,825	51,129,805	281,318,884
2008	1,169,306,733	53,020,136	310,389,219

	Non-Metallic Mineral Products (Thousands of Current Mexican Pesos)		
Year	Total Gross Production Value	Total Remunerations	Value Added
1988	12,161,472	1,489,828	6,564,215
1989	14,250,614	2,050,608	7,609,400
1990	18,918,791	2,724,569	10,065,065
1991	24,891,585	3,512,919	12,919,089
1992	30,152,126	4,294,200	15,441,009
1993	34,260,251	4,751,006	17,557,131
1994	37,136,074	5,049,339	19,125,269
1995	43,288,670	5,369,930	22,746,419
1996	36,861,229	4,280,160	19,369,008
1997	44,398,632	5,058,780	23,128,498
1998	56,724,738	6,007,880	30,164,182
1999	67,790,217	7,365,204	37,278,832
2000	76,207,866	8,702,174	43,106,939
2001	75,497,899	9,614,590	42,344,795
2002	78,390,855	9,823,266	43,246,823
2003	100,692,182	9,222,879	50,289,547
2004	109,390,738	10,000,610	54,881,378
2005	115,982,976	10,574,411	57,343,971
2006	126,824,643	11,082,831	62,983,797
2007	136,069,124	11,135,820	67,114,108
2008	137,301,120	11,732,975	67,234,778

Source: INEGI

	Basic Metals (Thousands of Current Mexican Pesos)		
Year	Total Gross Production Value	Total remunerations	Value Added
1988	20,119,064	1,605,812	6,939,836
1989	23,106,372	2,063,411	7,976,241
1990	27,519,913	2,353,833	9,279,157
1991	28,161,248	2,591,949	9,324,198
1992	29,139,633	2,802,213	9,382,147
1993	30,109,414	2,480,572	9,707,089
1994	34,795,488	2,614,752	11,161,417
1995	64,243,322	2,957,548	20,581,218
1996	89,994,516	4,174,405	25,931,449
1997	109,685,875	5,057,852	31,508,014
1998	116,207,312	5,682,319	34,335,484
1999	117,895,298	6,511,099	33,913,290
2000	131,174,547	7,151,930	37,736,419
2001	112,528,038	7,407,487	32,695,589
2002	118,471,930	7,463,917	30,824,633
2003	138,837,274	6,400,782	35,630,608
2004	197,962,593	7,248,909	52,207,252
2005	207,651,959	7,692,961	56,100,365
2006	265,298,357	8,650,438	69,393,338
2007	288,413,945	9,851,134	73,981,066
2008	330,697,877	11,159,822	84,221,913

Fabricated Metal Products , Machinery and Equipment, Medical, Precision and Optical Instruments (Thousands of Current Mexican Pesos)			
Year	Total Gross Production Value	Total Remunerations	Value Added
1988	66,766,837	7,904,489	19,837,924
1989	84,915,243	11,045,105	25,094,543
1990	110,347,220	14,715,458	32,192,466
1991	144,305,289	18,834,584	44,559,047
1992	169,364,380	23,982,309	53,036,662
1993	178,008,343	25,551,734	54,000,744
1994	211,505,735	28,250,900	61,501,520
1995	365,141,321	31,821,676	91,990,456
1996	281,691,700	19,387,112	85,266,393
1997	356,946,241	25,045,191	107,714,561
1998	447,594,742	31,633,356	131,513,878
1999	514,858,507	39,114,958	150,660,627
2000	609,934,608	47,692,752	175,179,939
2001	590,829,432	50,319,449	171,318,437
2002	580,701,493	48,267,631	169,982,886
2003	603,049,598	42,660,058	162,103,097
2004	664,841,324	45,825,363	181,258,499
2005	722,541,505	48,271,464	196,936,214
2006	808,060,009	51,255,453	220,041,349
2007	878,962,001	50,423,423	233,231,287
2008	896,655,150	50,118,396	236,017,625

Source: INEGI

Other Manufacturing Industries (Thousands of Current Mexican Pesos)			
Year	Total Gross Production Value	Total remunerations	Value Added
1988	4,721,045	521,444	2,155,242
1989	6,797,934	836,501	2,865,420
1990	9,833,556	1,218,916	4,045,737
1991	11,578,802	1,523,263	4,821,463
1992	14,727,676	2,143,209	6,142,504
1993	15,691,522	2,429,676	6,565,248
1994	18,545,990	2,668,886	7,477,832
1995	30,286,175	3,009,386	9,874,986
1996	2,111,865	381,857	886,635
1997	2,637,100	475,430	1,096,714
1998	3,237,922	574,993	1,408,303
1999	3,706,089	685,051	1,659,120
2000	4,152,800	768,997	1,933,122
2001	3,950,669	848,241	1,824,798
2002	4,061,707	883,038	1,872,432
2003	13,570,110	2,262,865	4,922,452
2004	14,995,191	2,396,748	5,469,578
2005	16,035,675	2,579,167	5,979,170
2006	17,262,087	2,772,656	6,311,437
2007	17,720,412	2,793,226	6,254,397
2008	18,280,080	2,900,233	6,570,142

Appendix F Data Processing by Subsector (Linear Model)

Total Mexican Manufacturing Industry (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	1,202,166,847	119,336,538	417,938,200	1,202,166,847	0.286	(1.25)	20.91	18.60
1989	1,131,516,053	124,615,767	388,398,430	2,333,682,900	0.321	(1.14)	21.57	18.64
1990	997,202,338	112,295,026	342,387,060	3,330,885,237	0.328	(1.11)	21.93	18.54
1991	943,963,596	109,228,072	330,668,552	4,274,848,834	0.330	(1.11)	22.18	18.51
1992	913,170,082	114,522,715	325,484,272	5,188,018,916	0.352	(1.04)	22.37	18.56
1993	883,149,251	112,672,425	310,944,075	6,071,168,167	0.362	(1.02)	22.53	18.54
1994	863,147,488	105,624,420	298,906,138	6,934,315,655	0.353	(1.04)	22.66	18.48
1995	514,007,123	45,714,309	166,378,459	7,448,322,777	0.275	(1.29)	22.73	17.64
1996	263,703,209	21,932,614	91,051,349	7,712,025,986	0.241	(1.42)	22.77	16.90
1997	253,392,111	21,718,288	86,434,793	7,965,418,097	0.251	(1.38)	22.80	16.89
1998	225,550,536	19,749,506	77,620,328	8,190,968,632	0.254	(1.37)	22.83	16.80
1999	209,832,186	19,794,575	73,246,654	8,400,800,818	0.270	(1.31)	22.85	16.80
2000	221,990,764	21,668,177	77,319,373	8,622,791,583	0.280	(1.27)	22.88	16.89
2001	208,762,637	22,034,347	73,939,295	8,831,554,220	0.298	(1.21)	22.90	16.91
2002	196,981,222	20,582,162	70,980,482	9,028,535,441	0.290	(1.24)	22.92	16.84
2003	222,581,163	17,747,229	69,713,165	9,251,116,604	0.255	(1.37)	22.95	16.69
2004	232,898,815	17,057,572	72,466,882	9,484,015,419	0.235	(1.45)	22.97	16.65
2005	253,793,698	17,632,456	78,371,064	9,737,809,118	0.225	(1.49)	23.00	16.69
2006	270,830,374	17,808,605	83,585,344	10,008,639,491	0.213	(1.55)	23.03	16.70
2007	279,116,801	16,848,821	84,431,329	10,287,756,292	0.200	(1.61)	23.05	16.64
2008	282,354,253	15,770,011	83,498,817	10,570,110,546	0.189	(1.67)	23.08	16.57

Source: INEGI (Production, Remunerations and Value Added)

Food, Beverages and Tobacco Products (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	294,479,020	18,158,700	91,447,497	294,479,020	0.199	(1.62)	19.50	16.71
1989	280,925,220	19,475,555	86,070,503	575,404,240	0.226	(1.49)	20.17	16.78
1990	256,353,181	17,701,806	80,922,794	831,757,421	0.219	(1.52)	20.54	16.69
1991	255,004,581	18,070,723	83,442,473	1,086,762,002	0.217	(1.53)	20.81	16.71
1992	247,781,110	19,379,901	83,969,021	1,334,543,112	0.231	(1.47)	21.01	16.78
1993	245,974,273	20,710,960	83,834,557	1,580,517,385	0.247	(1.40)	21.18	16.85
1994	234,691,305	19,746,447	81,303,498	1,815,208,690	0.243	(1.42)	21.32	16.80
1995	124,229,045	8,638,320	43,209,396	1,939,437,735	0.200	(1.61)	21.39	15.97
1996	65,942,060	5,107,373	23,867,727	2,005,379,795	0.214	(1.54)	21.42	15.45
1997	60,085,917	4,924,641	21,336,612	2,065,465,712	0.231	(1.47)	21.45	15.41
1998	52,190,422	4,464,430	18,919,540	2,117,656,134	0.236	(1.44)	21.47	15.31
1999	49,539,287	4,532,723	18,535,237	2,167,195,421	0.245	(1.41)	21.50	15.33
2000	51,227,731	4,914,149	19,738,162	2,218,423,152	0.249	(1.39)	21.52	15.41
2001	52,002,545	5,169,413	20,237,910	2,270,425,697	0.255	(1.36)	21.54	15.46
2002	51,347,831	5,138,977	20,380,805	2,321,773,528	0.252	(1.38)	21.57	15.45
2003	51,162,558	4,389,151	18,911,303	2,372,936,086	0.232	(1.46)	21.59	15.29
2004	52,201,566	4,231,638	19,326,161	2,425,137,653	0.219	(1.52)	21.61	15.26
2005	55,626,688	4,346,440	20,446,251	2,480,764,341	0.213	(1.55)	21.63	15.28
2006	57,334,076	4,373,232	21,195,595	2,538,098,417	0.206	(1.58)	21.65	15.29
2007	60,478,260	4,057,322	22,412,213	2,598,576,677	0.181	(1.71)	21.68	15.22
2008	61,707,446	3,557,431	22,153,241	2,660,284,122	0.161	(1.83)	21.70	15.08

Source: INEGI (Production, Remunerations and Value Added)

Textiles, Wearing apparel, Fur, Leather, Leather Products and Footwear (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	107,241,398	14,016,631	42,756,798	107,241,398	0.328	(1.12)	18.49	16.46
1989	100,399,126	14,506,052	39,459,202	207,640,524	0.368	(1.00)	19.15	16.49
1990	86,518,971	12,609,049	33,162,523	294,159,495	0.380	(0.97)	19.50	16.35
1991	80,616,562	11,996,234	30,532,083	374,776,057	0.393	(0.93)	19.74	16.30
1992	75,805,174	12,119,537	29,024,533	450,581,231	0.418	(0.87)	19.93	16.31
1993	72,629,238	11,828,971	27,225,402	523,210,469	0.434	(0.83)	20.08	16.29
1994	67,489,124	10,743,059	25,137,202	590,699,594	0.427	(0.85)	20.20	16.19
1995	38,370,601	4,404,290	12,790,259	629,070,195	0.344	(1.07)	20.26	15.30
1996	13,309,259	1,715,157	4,465,609	642,379,454	0.384	(0.96)	20.28	14.36
1997	12,975,425	1,690,338	4,355,015	655,354,878	0.388	(0.95)	20.30	14.34
1998	10,928,912	1,512,591	3,828,262	666,283,790	0.395	(0.93)	20.32	14.23
1999	9,786,068	1,501,252	3,503,070	676,069,858	0.429	(0.85)	20.33	14.22
2000	9,877,488	1,627,002	3,525,212	685,947,346	0.462	(0.77)	20.35	14.30
2001	8,689,303	1,553,206	3,083,906	694,636,649	0.504	(0.69)	20.36	14.26
2002	8,007,198	1,412,186	2,897,872	702,643,847	0.487	(0.72)	20.37	14.16
2003	8,436,251	1,275,790	2,628,524	711,080,098	0.485	(0.72)	20.38	14.06
2004	8,350,525	1,211,435	2,566,777	719,430,623	0.472	(0.75)	20.39	14.01
2005	8,479,842	1,253,424	2,543,819	727,910,465	0.493	(0.71)	20.41	14.04
2006	8,548,436	1,217,869	2,576,464	736,458,901	0.473	(0.75)	20.42	14.01
2007	8,051,029	1,133,638	2,500,152	744,509,930	0.453	(0.79)	20.43	13.94
2008	7,330,731	1,007,219	2,268,175	751,840,660	0.444	(0.81)	20.44	13.82

Source: INEGI (Production, Remunerations and Value Added)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
Wood Products Including Furniture (Thousands of USD Dollars at 2005 Constant Prices)								
1988	41,013,553	3,692,894	16,692,612	41,013,553	0.221	(1.51)	17.53	15.12
1989	39,226,617	3,621,073	15,522,498	80,240,170	0.233	(1.46)	18.20	15.10
1990	32,088,915	3,192,935	12,641,915	112,329,085	0.253	(1.38)	18.54	14.98
1991	29,482,300	3,037,836	11,337,378	141,811,385	0.268	(1.32)	18.77	14.93
1992	27,893,756	3,075,957	10,693,315	169,705,142	0.288	(1.25)	18.95	14.94
1993	26,921,311	2,868,060	10,101,602	196,626,453	0.284	(1.26)	19.10	14.87
1994	25,406,077	2,706,130	9,185,572	222,032,530	0.295	(1.22)	19.22	14.81
1995	12,516,608	1,092,095	4,264,817	234,549,137	0.256	(1.36)	19.27	13.90
1996	1,561,027	228,448	501,169	236,110,164	0.456	(0.79)	19.28	12.34
1997	1,580,837	205,962	506,848	237,691,001	0.406	(0.90)	19.29	12.24
1998	1,454,667	185,679	453,718	239,145,668	0.409	(0.89)	19.29	12.13
1999	1,360,823	177,172	433,444	240,506,491	0.409	(0.89)	19.30	12.08
2000	1,337,367	198,817	417,034	241,843,859	0.477	(0.74)	19.30	12.20
2001	1,182,103	197,527	365,293	243,025,962	0.541	(0.61)	19.31	12.19
2002	1,117,831	183,070	358,740	244,143,794	0.510	(0.67)	19.31	12.12
2003	1,776,844	266,883	531,071	245,920,638	0.503	(0.69)	19.32	12.49
2004	1,817,488	259,831	549,717	247,738,126	0.473	(0.75)	19.33	12.47
2005	1,915,607	260,121	572,830	249,653,732	0.454	(0.79)	19.34	12.47
2006	1,946,443	268,186	575,096	251,600,175	0.466	(0.76)	19.34	12.50
2007	1,861,797	262,878	546,215	253,461,972	0.481	(0.73)	19.35	12.48
2008	1,730,755	241,073	498,206	255,192,727	0.484	(0.73)	19.36	12.39

Source: INEGI (Production, Remunerations and Value Added)

Paper and Paper Products, Printing and Publishing (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	65,280,837	7,876,116	23,396,021	65,280,837	0.337	(1.09)	17.99	15.88
1989	61,321,834	7,800,512	21,495,729	126,602,671	0.363	(1.01)	18.66	15.87
1990	51,040,962	7,068,924	18,205,951	177,643,632	0.388	(0.95)	19.00	15.77
1991	46,206,522	6,862,692	16,816,186	223,850,155	0.408	(0.90)	19.23	15.74
1992	44,470,894	7,369,141	16,753,849	268,321,049	0.440	(0.82)	19.41	15.81
1993	42,045,751	7,236,182	16,018,135	310,366,800	0.452	(0.79)	19.55	15.79
1994	40,560,719	6,762,596	15,408,382	350,927,519	0.439	(0.82)	19.68	15.73
1995	23,323,679	2,782,227	8,521,668	374,251,198	0.326	(1.12)	19.74	14.84
1996	12,352,697	1,385,625	4,649,120	386,603,895	0.298	(1.21)	19.77	14.14
1997	11,387,046	1,320,340	4,214,763	397,990,942	0.313	(1.16)	19.80	14.09
1998	10,343,360	1,195,446	3,929,026	408,334,302	0.304	(1.19)	19.83	13.99
1999	10,022,605	1,189,246	3,857,410	418,356,907	0.308	(1.18)	19.85	13.99
2000	10,585,448	1,294,131	4,031,975	428,942,355	0.321	(1.14)	19.88	14.07
2001	9,824,407	1,366,100	3,826,869	438,766,762	0.357	(1.03)	19.90	14.13
2002	9,263,712	1,345,497	3,586,959	448,030,474	0.375	(0.98)	19.92	14.11
2003	8,516,344	874,554	2,554,651	456,546,818	0.342	(1.07)	19.94	13.68
2004	8,355,088	822,567	2,537,387	464,901,906	0.324	(1.13)	19.96	13.62
2005	9,072,939	847,089	2,767,183	473,974,845	0.306	(1.18)	19.98	13.65
2006	9,425,329	832,349	2,856,750	483,400,175	0.291	(1.23)	20.00	13.63
2007	9,231,148	750,113	2,755,999	492,631,322	0.272	(1.30)	20.02	13.53
2008	9,118,746	736,284	2,697,216	501,750,068	0.273	(1.30)	20.03	13.51

Source: INEGI (Production, Remunerations and Value Added)

Chemicals, Petroleum Products, Rubber and Plastics Products (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	218,824,994	22,815,876	81,044,863	218,824,994	0.282	(1.27)	19.20	16.94
1989	194,854,822	22,850,787	72,414,285	413,679,816	0.316	(1.15)	19.84	16.94
1990	165,475,437	20,555,391	62,108,524	579,155,253	0.331	(1.11)	20.18	16.84
1991	146,096,201	20,301,509	56,028,139	725,251,455	0.362	(1.02)	20.40	16.83
1992	137,031,691	20,682,528	53,824,356	862,283,145	0.384	(0.96)	20.58	16.84
1993	130,718,423	20,243,918	49,589,496	993,001,569	0.408	(0.90)	20.72	16.82
1994	126,591,845	18,595,287	46,770,597	1,119,593,414	0.398	(0.92)	20.84	16.74
1995	76,583,050	8,290,345	28,602,979	1,196,176,464	0.290	(1.24)	20.90	15.93
1996	47,886,198	5,066,464	18,306,399	1,244,062,662	0.277	(1.28)	20.94	15.44
1997	45,301,943	5,108,662	17,182,077	1,289,364,605	0.297	(1.21)	20.98	15.45
1998	39,811,149	4,592,063	15,414,555	1,329,175,754	0.298	(1.21)	21.01	15.34
1999	36,571,202	4,577,891	14,369,917	1,365,746,956	0.319	(1.14)	21.03	15.34
2000	38,498,008	4,985,395	14,919,064	1,404,244,964	0.334	(1.10)	21.06	15.42
2001	36,902,368	5,023,057	14,669,627	1,441,147,333	0.342	(1.07)	21.09	15.43
2002	35,115,548	4,671,500	14,769,080	1,476,262,880	0.316	(1.15)	21.11	15.36
2003	66,301,917	4,831,574	19,564,863	1,542,564,797	0.247	(1.40)	21.16	15.39
2004	71,215,211	4,499,595	20,414,787	1,613,780,008	0.220	(1.51)	21.20	15.32
2005	81,229,116	4,583,055	23,011,537	1,695,009,125	0.199	(1.61)	21.25	15.34
2006	85,788,267	4,586,426	24,620,896	1,780,797,391	0.186	(1.68)	21.30	15.34
2007	87,284,782	4,342,578	23,893,095	1,868,082,173	0.182	(1.71)	21.35	15.28
2008	92,759,867	4,206,031	24,622,849	1,960,842,040	0.171	(1.77)	21.40	15.25

Source: INEGI (Production, Remunerations and Value Added)

Non-Metallic Mineral Products (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	55,707,475	6,824,384	30,068,387	55,707,475	0.227	(1.48)	17.84	15.74
1989	50,213,111	7,225,472	26,812,294	105,920,586	0.269	(1.31)	18.48	15.79
1990	46,067,987	6,634,431	24,508,822	151,988,573	0.271	(1.31)	18.84	15.71
1991	46,052,306	6,499,306	23,901,806	198,040,879	0.272	(1.30)	19.10	15.69
1992	47,100,339	6,707,927	24,120,248	245,141,217	0.278	(1.28)	19.32	15.72
1993	48,437,349	6,717,001	24,822,377	293,578,566	0.271	(1.31)	19.50	15.72
1994	45,304,634	6,160,006	23,332,119	338,883,200	0.264	(1.33)	19.64	15.63
1995	20,568,865	2,551,554	10,808,094	359,452,065	0.236	(1.44)	19.70	14.75
1996	11,009,375	1,278,359	5,784,958	370,461,440	0.221	(1.51)	19.73	14.06
1997	10,550,279	1,202,099	5,495,937	381,011,718	0.219	(1.52)	19.76	14.00
1998	10,078,079	1,067,398	5,359,161	391,089,798	0.199	(1.61)	19.78	13.88
1999	9,871,544	1,072,514	5,428,506	400,961,342	0.198	(1.62)	19.81	13.89
2000	10,247,827	1,170,199	5,796,678	411,209,169	0.202	(1.60)	19.83	13.97
2001	9,660,137	1,230,210	5,418,118	420,869,306	0.227	(1.48)	19.86	14.02
2002	9,239,814	1,157,854	5,097,439	430,109,120	0.227	(1.48)	19.88	13.96
2003	10,160,053	930,608	5,074,321	440,269,173	0.183	(1.70)	19.90	13.74
2004	10,079,181	921,449	5,056,729	450,348,354	0.182	(1.70)	19.93	13.73
2005	10,642,699	970,317	5,261,933	460,991,053	0.184	(1.69)	19.95	13.79
2006	11,228,557	981,230	5,576,339	472,219,610	0.176	(1.74)	19.97	13.80
2007	11,556,680	945,792	5,700,164	483,776,291	0.166	(1.80)	20.00	13.76
2008	10,891,953	930,764	5,333,664	494,668,243	0.175	(1.75)	20.02	13.74

Source: INEGI (Production, Remunerations and Value Added)

Basic Metals (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	92,158,437	7,355,666	31,788,976	92,158,437	0.231	(1.46)	18.34	15.81
1989	81,417,041	7,270,584	28,104,886	173,575,478	0.259	(1.35)	18.97	15.80
1990	67,012,052	5,731,674	22,595,106	240,587,530	0.254	(1.37)	19.30	15.56
1991	52,101,560	4,795,405	17,250,843	292,689,089	0.278	(1.28)	19.49	15.38
1992	45,518,733	4,377,309	14,655,759	338,207,823	0.299	(1.21)	19.64	15.29
1993	42,568,871	3,507,048	13,723,941	380,776,693	0.256	(1.36)	19.76	15.07
1994	42,449,206	3,189,901	13,616,515	423,225,899	0.234	(1.45)	19.86	14.98
1995	30,525,590	1,405,296	9,779,286	453,751,489	0.144	(1.94)	19.93	14.16
1996	26,878,739	1,246,773	7,744,968	480,630,228	0.161	(1.83)	19.99	14.04
1997	26,064,239	1,201,878	7,487,130	506,694,467	0.161	(1.83)	20.04	14.00
1998	20,646,134	1,009,557	6,100,261	527,340,600	0.165	(1.80)	20.08	13.83
1999	17,167,796	948,140	4,938,420	544,508,396	0.192	(1.65)	20.12	13.76
2000	17,639,309	961,735	5,074,493	562,147,705	0.190	(1.66)	20.15	13.78
2001	14,398,232	947,806	4,183,479	576,545,937	0.227	(1.48)	20.17	13.76
2002	13,964,112	879,761	3,633,254	590,510,049	0.242	(1.42)	20.20	13.69
2003	14,008,973	645,852	3,595,203	604,519,021	0.180	(1.72)	20.22	13.38
2004	18,240,126	667,909	4,810,337	622,759,147	0.139	(1.97)	20.25	13.41
2005	19,054,324	705,913	5,147,818	641,813,471	0.137	(1.99)	20.28	13.47
2006	23,488,478	765,876	6,143,814	665,301,949	0.125	(2.08)	20.32	13.55
2007	24,495,695	836,681	6,283,391	689,797,645	0.133	(2.02)	20.35	13.64
2008	26,233,913	885,297	6,681,235	716,031,557	0.133	(2.02)	20.39	13.69

Source: INEGI (Production, Remunerations and Value Added)

Fabricated Metal Products , Machinery and Equipment, Medical, Precision and Optical Instruments (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	305,835,667	36,207,716	90,870,633	305,835,667	0.398	(0.92)	19.54	17.40
1989	299,205,250	38,918,259	88,422,511	605,040,917	0.440	(0.82)	20.22	17.48
1990	268,699,745	35,832,709	78,389,899	873,740,661	0.457	(0.78)	20.59	17.39
1991	266,981,444	34,846,155	82,439,381	1,140,722,105	0.423	(0.86)	20.85	17.37
1992	264,562,427	37,462,528	82,848,047	1,405,284,532	0.452	(0.79)	21.06	17.44
1993	251,669,266	36,125,195	76,346,577	1,656,953,799	0.473	(0.75)	21.23	17.40
1994	258,029,157	34,465,051	75,029,575	1,914,982,956	0.459	(0.78)	21.37	17.36
1995	173,499,033	15,120,255	43,709,803	2,088,481,989	0.346	(1.06)	21.46	16.53
1996	84,133,101	5,790,365	25,466,587	2,172,615,090	0.227	(1.48)	21.50	15.57
1997	84,819,782	5,951,394	25,595,803	2,257,434,871	0.233	(1.46)	21.54	15.60
1998	79,522,542	5,620,184	23,365,596	2,336,957,413	0.241	(1.42)	21.57	15.54
1999	74,973,184	5,695,881	21,939,051	2,411,930,597	0.260	(1.35)	21.60	15.56
2000	82,019,150	6,413,342	23,556,804	2,493,949,747	0.272	(1.30)	21.64	15.67
2001	75,598,043	6,438,494	21,920,605	2,569,547,790	0.294	(1.23)	21.67	15.68
2002	68,446,428	5,689,234	20,035,632	2,637,994,219	0.284	(1.26)	21.69	15.55
2003	60,848,971	4,304,489	16,356,543	2,698,843,189	0.263	(1.33)	21.72	15.28
2004	61,257,984	4,222,315	16,701,023	2,760,101,174	0.253	(1.38)	21.74	15.26
2005	66,301,036	4,429,431	18,071,038	2,826,402,210	0.245	(1.41)	21.76	15.30
2006	71,542,470	4,537,957	19,481,600	2,897,944,679	0.233	(1.46)	21.79	15.33
2007	74,652,373	4,282,584	19,808,898	2,972,597,052	0.216	(1.53)	21.81	15.27
2008	71,130,705	3,975,839	18,723,029	3,043,727,757	0.212	(1.55)	21.84	15.20

Source: INEGI (Production, Remunerations and Value Added)

Other Manufacturing Industries (Thousands of USD Dollars at 2005 Constant Prices)								
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	Ln (L)
1988	21,625,466	2,388,554	9,872,414	21,625,466	0.242	(1.42)	16.89	14.69
1989	23,953,032	2,947,474	10,096,523	45,578,498	0.292	(1.23)	17.63	14.90
1990	23,945,089	2,968,108	9,851,526	69,523,587	0.301	(1.20)	18.06	14.90
1991	21,422,120	2,818,212	8,920,263	90,945,707	0.316	(1.15)	18.33	14.85
1992	23,005,957	3,347,886	9,595,145	113,951,664	0.349	(1.05)	18.55	15.02
1993	22,184,768	3,435,091	9,281,987	136,136,433	0.370	(0.99)	18.73	15.05
1994	22,625,420	3,255,942	9,122,678	158,761,853	0.357	(1.03)	18.88	15.00
1995	14,390,653	1,429,927	4,692,157	173,152,506	0.305	(1.19)	18.97	14.17
1996	630,753	114,050	264,812	173,783,259	0.431	(0.84)	18.97	11.64
1997	626,644	112,975	260,608	174,409,903	0.434	(0.84)	18.98	11.63
1998	575,270	102,157	250,208	174,985,173	0.408	(0.90)	18.98	11.53
1999	539,677	99,756	241,599	175,524,850	0.413	(0.88)	18.98	11.51
2000	558,435	103,409	259,951	176,083,285	0.398	(0.92)	18.99	11.55
2001	505,498	108,534	233,487	176,588,783	0.465	(0.77)	18.99	11.59
2002	478,747	104,082	220,701	177,067,530	0.472	(0.75)	18.99	11.55
2003	1,369,253	228,328	496,686	178,436,783	0.460	(0.78)	19.00	12.34
2004	1,381,646	220,835	503,963	179,818,428	0.438	(0.83)	19.01	12.31
2005	1,471,447	236,667	548,654	181,289,876	0.431	(0.84)	19.02	12.37
2006	1,528,318	245,480	558,790	182,818,194	0.439	(0.82)	19.02	12.41
2007	1,505,038	237,235	531,201	184,323,231	0.447	(0.81)	19.03	12.38
2008	1,450,139	230,072	521,202	185,773,370	0.441	(0.82)	19.04	12.35

Source: INEGI (Production, Remunerations and Value Added)

Appendix G Data Processing by Subsector (Cubic Model)

Total Mexican Manufacturing Industry
(Thousands of USD Dollars at 2005 Constant Prices)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	1,202,166,847	119,336,538	417,938,200	1,202,166,847	0.286	(1.25)	20.91	437.12	9,139.02	18.60	(0.26)	0.83
1989	1,131,516,053	124,615,767	388,398,430	2,333,682,900	0.321	(1.14)	21.57	465.30	10,036.76	18.64	0.27	1.20
1990	997,202,338	112,295,026	342,387,060	3,330,885,237	0.328	(1.11)	21.93	480.77	10,541.64	18.54	0.28	1.21
1991	943,963,596	109,228,072	330,668,552	4,274,848,834	0.330	(1.11)	22.18	491.78	10,905.62	18.51	0.17	1.12
1992	913,170,082	114,522,715	325,484,272	5,188,018,916	0.352	(1.04)	22.37	500.40	11,193.75	18.56	0.02	1.01
1993	883,149,251	112,672,425	310,944,075	6,071,168,167	0.362	(1.02)	22.53	507.46	11,431.40	18.54	(0.14)	0.91
1994	863,147,488	105,624,420	298,906,138	6,934,315,655	0.353	(1.04)	22.66	513.46	11,634.97	18.48	(0.31)	0.81
1995	514,007,123	45,714,309	166,378,459	7,448,322,777	0.275	(1.29)	22.73	516.71	11,745.47	17.64	(0.41)	0.75
1996	263,703,209	21,932,614	91,051,349	7,712,025,986	0.241	(1.42)	22.77	518.29	11,799.48	16.90	(0.46)	0.72
1997	253,392,111	21,718,288	86,434,793	7,965,418,097	0.251	(1.38)	22.80	519.77	11,849.82	16.89	(0.51)	0.70
1998	225,550,536	19,749,506	77,620,328	8,190,968,632	0.254	(1.37)	22.83	521.04	11,893.41	16.80	(0.56)	0.68
1999	209,832,186	19,794,575	73,246,654	8,400,800,818	0.270	(1.31)	22.85	522.20	11,932.99	16.80	(0.60)	0.66
2000	221,990,764	21,668,177	77,319,373	8,622,791,583	0.280	(1.27)	22.88	523.39	11,973.90	16.89	(0.64)	0.64
2001	208,762,637	22,034,347	73,939,295	8,831,554,220	0.298	(1.21)	22.90	524.48	12,011.50	16.91	(0.68)	0.62
2002	196,981,222	20,582,162	70,980,482	9,028,535,441	0.290	(1.24)	22.92	525.49	12,046.24	16.84	(0.72)	0.61
2003	222,581,163	17,747,229	69,713,165	9,251,116,604	0.255	(1.37)	22.95	526.61	12,084.68	16.69	(0.77)	0.59
2004	232,898,815	17,057,572	72,466,882	9,484,015,419	0.235	(1.45)	22.97	527.75	12,124.00	16.65	(0.81)	0.57
2005	253,793,698	17,632,456	78,371,064	9,737,809,118	0.225	(1.49)	23.00	528.97	12,165.86	16.69	(0.86)	0.55
2006	270,830,374	17,808,605	83,585,344	10,008,639,491	0.213	(1.55)	23.03	530.23	12,209.45	16.70	(0.91)	0.53
2007	279,116,801	16,848,821	84,431,329	10,287,756,292	0.200	(1.61)	23.05	531.50	12,253.25	16.64	(0.97)	0.51
2008	282,354,253	15,770,011	83,498,817	10,570,110,546	0.189	(1.67)	23.08	532.75	12,296.47	16.57	(1.02)	0.49

Source: INEGI (Production, Remunerations and Value Added)

Food, Beverages and Tobacco Products
(Thousands of USD Dollars at 2005 Constant Prices)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	294,479,020	18,158,700	91,447,497	294,479,020	0.199	(1.62)	19.50	380.28	7,415.69	16.71	(0.32)	0.80
1989	280,925,220	19,475,555	86,070,503	575,404,240	0.226	(1.49)	20.17	406.85	8,206.45	16.78	0.23	1.17
1990	256,353,181	17,701,806	80,922,794	831,757,421	0.219	(1.52)	20.54	421.85	8,664.45	16.69	0.26	1.20
1991	255,004,581	18,070,723	83,442,473	1,086,762,002	0.217	(1.53)	20.81	432.91	9,007.31	16.71	0.15	1.11
1992	247,781,110	19,379,901	83,969,021	1,334,543,112	0.231	(1.47)	21.01	441.50	9,276.69	16.78	0.00	1.00
1993	245,974,273	20,710,960	83,834,557	1,580,517,385	0.247	(1.40)	21.18	448.64	9,502.56	16.85	(0.16)	0.89
1994	234,691,305	19,746,447	81,303,498	1,815,208,690	0.243	(1.42)	21.32	454.52	9,690.12	16.80	(0.33)	0.79
1995	124,229,045	8,638,320	43,209,396	1,939,437,735	0.200	(1.61)	21.39	457.35	9,780.66	15.97	(0.42)	0.75
1996	65,942,060	5,107,373	23,867,727	2,005,379,795	0.214	(1.54)	21.42	458.78	9,826.61	15.45	(0.47)	0.72
1997	60,085,917	4,924,641	21,336,612	2,065,465,712	0.231	(1.47)	21.45	460.04	9,867.30	15.41	(0.52)	0.70
1998	52,190,422	4,464,430	18,919,540	2,117,656,134	0.236	(1.44)	21.47	461.11	9,901.78	15.31	(0.55)	0.68
1999	49,539,287	4,532,723	18,535,237	2,167,195,421	0.245	(1.41)	21.50	462.11	9,933.80	15.33	(0.59)	0.66
2000	51,227,731	4,914,149	19,738,162	2,218,423,152	0.249	(1.39)	21.52	463.11	9,966.22	15.41	(0.63)	0.65
2001	52,002,545	5,169,413	20,237,910	2,270,425,697	0.255	(1.36)	21.54	464.11	9,998.45	15.46	(0.66)	0.63
2002	51,347,831	5,138,977	20,380,805	2,321,773,528	0.252	(1.38)	21.57	465.07	10,029.62	15.45	(0.70)	0.61
2003	51,162,558	4,389,151	18,911,303	2,372,936,086	0.232	(1.46)	21.59	466.02	10,060.06	15.29	(0.74)	0.60
2004	52,201,566	4,231,638	19,326,161	2,425,137,653	0.219	(1.52)	21.61	466.96	10,090.51	15.26	(0.78)	0.58
2005	55,626,688	4,346,440	20,446,251	2,480,764,341	0.213	(1.55)	21.63	467.94	10,122.32	15.28	(0.82)	0.57
2006	57,334,076	4,373,232	21,195,595	2,538,098,417	0.206	(1.58)	21.65	468.93	10,154.43	15.29	(0.86)	0.55
2007	60,478,260	4,057,322	22,412,213	2,598,576,677	0.181	(1.71)	21.68	469.95	10,187.59	15.22	(0.90)	0.54
2008	61,707,446	3,557,431	22,153,241	2,660,284,122	0.161	(1.83)	21.70	470.96	10,220.71	15.08	(0.94)	0.52

Source: INEGI (Production, Remunerations and Value Added)

Textiles, Wearing apparel, Fur, Leather, Leather Products and Footwear
(Thousands of USD Dollars at 2005 Constant Prices)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	107,241,398	14,016,631	42,756,798	107,241,398	0.328	(1.12)	18.49	341.90	6,321.97	16.46	0.67	1.60
1989	100,399,126	14,506,052	39,459,202	207,640,524	0.368	(1.00)	19.15	366.77	7,024.19	16.49	(0.02)	0.99
1990	86,518,971	12,609,049	33,162,523	294,159,495	0.380	(0.97)	19.50	380.24	7,414.46	16.35	(0.04)	0.97
1991	80,616,562	11,996,234	30,532,083	374,776,057	0.393	(0.93)	19.74	389.74	7,694.19	16.30	0.08	1.06
1992	75,805,174	12,119,537	29,024,533	450,581,231	0.418	(0.87)	19.93	397.05	7,911.59	16.31	0.25	1.19
1993	72,629,238	11,828,971	27,225,402	523,210,469	0.434	(0.83)	20.08	403.03	8,090.94	16.29	0.44	1.35
1994	67,489,124	10,743,059	25,137,202	590,699,594	0.427	(0.85)	20.20	407.91	8,238.51	16.19	0.62	1.53
1995	38,370,601	4,404,290	12,790,259	629,070,195	0.344	(1.07)	20.26	410.46	8,315.77	15.30	0.72	1.65
1996	13,309,259	1,715,157	4,465,609	642,379,454	0.384	(0.96)	20.28	411.31	8,341.58	14.36	0.76	1.69
1997	12,975,425	1,690,338	4,355,015	655,354,878	0.388	(0.95)	20.30	412.12	8,366.28	14.34	0.79	1.74
1998	10,928,912	1,512,591	3,828,262	666,283,790	0.395	(0.93)	20.32	412.79	8,386.74	14.23	0.83	1.77
1999	9,786,068	1,501,252	3,503,070	676,069,858	0.429	(0.85)	20.33	413.38	8,404.81	14.22	0.85	1.81
2000	9,877,488	1,627,002	3,525,212	685,947,346	0.462	(0.77)	20.35	413.97	8,422.81	14.30	0.88	1.84
2001	8,689,303	1,553,206	3,083,906	694,636,649	0.504	(0.69)	20.36	414.48	8,438.45	14.26	0.90	1.87
2002	8,007,198	1,412,186	2,897,872	702,643,847	0.487	(0.72)	20.37	414.95	8,452.71	14.16	0.93	1.90
2003	8,436,251	1,275,790	2,628,524	711,080,098	0.485	(0.72)	20.38	415.44	8,467.58	14.06	0.95	1.93
2004	8,350,525	1,211,435	2,566,777	719,430,623	0.472	(0.75)	20.39	415.91	8,482.14	14.01	0.97	1.96
2005	8,479,842	1,253,424	2,543,819	727,910,465	0.493	(0.71)	20.41	416.39	8,496.77	14.04	1.00	1.99
2006	8,548,436	1,217,869	2,576,464	736,458,901	0.473	(0.75)	20.42	416.87	8,511.36	14.01	1.02	2.03
2007	8,051,029	1,133,638	2,500,152	744,509,930	0.453	(0.79)	20.43	417.31	8,524.97	13.94	1.04	2.06
2008	7,330,731	1,007,219	2,268,175	751,840,660	0.444	(0.81)	20.44	417.71	8,537.24	13.82	1.06	2.09

Source: INEGI (Production, Remunerations and Value Added)

Wood Products Including Furniture
(Thousands of USD Dollars at 2005 Constant Prices)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	41,013,553	3,692,894	16,692,612	41,013,553	0.221	(1.51)	17.53	307.28	5,386.44	15.12	0.19	1.14
1989	39,226,617	3,621,073	15,522,498	80,240,170	0.233	(1.46)	18.20	331.26	6,029.10	15.10	0.09	1.06
1990	32,088,915	3,192,935	12,641,915	112,329,085	0.253	(1.38)	18.54	343.62	6,369.63	14.98	0.09	1.06
1991	29,482,300	3,037,836	11,337,378	141,811,385	0.268	(1.32)	18.77	352.31	6,612.92	14.93	0.11	1.08
1992	27,893,756	3,075,957	10,693,315	169,705,142	0.288	(1.25)	18.95	359.09	6,804.53	14.94	0.14	1.10
1993	26,921,311	2,868,060	10,101,602	196,626,453	0.284	(1.26)	19.10	364.69	6,964.39	14.87	0.16	1.12
1994	25,406,077	2,706,130	9,185,572	222,032,530	0.295	(1.22)	19.22	369.34	7,098.18	14.81	0.19	1.14
1995	12,516,608	1,092,095	4,264,817	234,549,137	0.256	(1.36)	19.27	371.46	7,159.12	13.90	0.21	1.16
1996	1,561,027	228,448	501,169	236,110,164	0.456	(0.79)	19.28	371.71	7,166.52	12.34	0.21	1.16
1997	1,580,837	205,962	506,848	237,691,001	0.406	(0.90)	19.29	371.97	7,173.96	12.24	0.21	1.16
1998	1,454,667	185,679	453,718	239,145,668	0.409	(0.89)	19.29	372.20	7,180.77	12.13	0.21	1.16
1999	1,360,823	177,172	433,444	240,506,491	0.409	(0.89)	19.30	372.42	7,187.11	12.08	0.22	1.16
2000	1,337,367	198,817	417,034	241,843,859	0.477	(0.74)	19.30	372.64	7,193.31	12.20	0.22	1.16
2001	1,182,103	197,527	365,293	243,025,962	0.541	(0.61)	19.31	372.83	7,198.76	12.19	0.22	1.16
2002	1,117,831	183,070	358,740	244,143,794	0.510	(0.67)	19.31	373.00	7,203.89	12.12	0.22	1.17
2003	1,776,844	266,883	531,071	245,920,638	0.503	(0.69)	19.32	373.28	7,212.01	12.49	0.22	1.17
2004	1,817,488	259,831	549,717	247,738,126	0.473	(0.75)	19.33	373.57	7,220.26	12.47	0.22	1.17
2005	1,915,607	260,121	572,830	249,653,732	0.454	(0.79)	19.34	373.86	7,228.90	12.47	0.23	1.17
2006	1,946,443	268,186	575,096	251,600,175	0.466	(0.76)	19.34	374.17	7,237.61	12.50	0.23	1.17
2007	1,861,797	262,878	546,215	253,461,972	0.481	(0.73)	19.35	374.45	7,245.89	12.48	0.23	1.17
2008	1,730,755	241,073	498,206	255,192,727	0.484	(0.73)	19.36	374.71	7,253.54	12.39	0.23	1.18

Source: INEGI (Production, Remunerations and Value Added)

Paper and Paper Products, Printing and Publishing
(Thousands of USD Dollars at 2005 Constant Prices)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	65,280,837	7,876,116	23,396,021	65,280,837	0.337	(1.09)	17.99	323.79	5,826.37	15.88	0.12	1.09
1989	61,321,834	7,800,512	21,495,729	126,602,671	0.363	(1.01)	18.66	348.07	6,493.74	15.87	0.17	1.13
1990	51,040,962	7,068,924	18,205,951	177,643,632	0.388	(0.95)	19.00	360.82	6,853.90	15.77	0.21	1.15
1991	46,206,522	6,862,692	16,816,186	223,850,155	0.408	(0.90)	19.23	369.66	7,107.22	15.74	0.23	1.17
1992	44,470,894	7,369,141	16,753,849	268,321,049	0.440	(0.82)	19.41	376.66	7,310.08	15.81	0.25	1.19
1993	42,045,751	7,236,182	16,018,135	310,366,800	0.452	(0.79)	19.55	382.33	7,475.80	15.79	0.27	1.21
1994	40,560,719	6,762,596	15,408,382	350,927,519	0.439	(0.82)	19.68	387.15	7,617.57	15.73	0.29	1.22
1995	23,323,679	2,782,227	8,521,668	374,251,198	0.326	(1.12)	19.74	389.68	7,692.55	14.84	0.29	1.23
1996	12,352,697	1,385,625	4,649,120	386,603,895	0.298	(1.21)	19.77	390.97	7,730.58	14.14	0.30	1.23
1997	11,387,046	1,320,340	4,214,763	397,990,942	0.313	(1.16)	19.80	392.12	7,764.67	14.09	0.30	1.23
1998	10,343,360	1,195,446	3,929,026	408,334,302	0.304	(1.19)	19.83	393.13	7,794.89	13.99	0.30	1.24
1999	10,022,605	1,189,246	3,857,410	418,356,907	0.308	(1.18)	19.85	394.10	7,823.53	13.99	0.31	1.24
2000	10,585,448	1,294,131	4,031,975	428,942,355	0.321	(1.14)	19.88	395.09	7,853.11	14.07	0.31	1.24
2001	9,824,407	1,366,100	3,826,869	438,766,762	0.357	(1.03)	19.90	395.99	7,879.98	14.13	0.31	1.24
2002	9,263,712	1,345,497	3,586,959	448,030,474	0.375	(0.98)	19.92	396.82	7,904.83	14.11	0.32	1.25
2003	8,516,344	874,554	2,554,651	456,546,818	0.342	(1.07)	19.94	397.57	7,927.26	13.68	0.32	1.25
2004	8,355,088	822,567	2,537,387	464,901,906	0.324	(1.13)	19.96	398.30	7,948.91	13.62	0.32	1.25
2005	9,072,939	847,089	2,767,183	473,974,845	0.306	(1.18)	19.98	399.07	7,972.03	13.65	0.32	1.25
2006	9,425,329	832,349	2,856,750	483,400,175	0.291	(1.23)	20.00	399.85	7,995.63	13.63	0.33	1.25
2007	9,231,148	750,113	2,755,999	492,631,322	0.272	(1.30)	20.02	400.61	8,018.34	13.53	0.33	1.26
2008	9,118,746	736,284	2,697,216	501,750,068	0.273	(1.30)	20.03	401.35	8,040.40	13.51	0.33	1.26

Source: INEGI (Production, Remunerations and Value Added)

Chemicals, Petroleum Products, Rubber and Plastics Products
(Thousands of USD Dollars at 2005 Constant Prices)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	218,824,994	22,815,876	81,044,863	218,824,994	0.282	(1.27)	19.20	368.79	7,082.07	16.94	(0.58)	0.67
1989	194,854,822	22,850,787	72,414,285	413,679,816	0.316	(1.15)	19.84	393.65	7,810.24	16.94	0.45	1.37
1990	165,475,437	20,555,391	62,108,524	579,155,253	0.331	(1.11)	20.18	407.11	8,214.38	16.84	0.49	1.41
1991	146,096,201	20,301,509	56,028,139	725,251,455	0.362	(1.02)	20.40	416.24	8,492.20	16.83	0.33	1.25
1992	137,031,691	20,682,528	53,824,356	862,283,145	0.384	(0.96)	20.58	423.33	8,710.15	16.84	0.09	1.07
1993	130,718,423	20,243,918	49,589,496	993,001,569	0.408	(0.90)	20.72	429.16	8,890.64	16.82	(0.17)	0.89
1994	126,591,845	18,595,287	46,770,597	1,119,593,414	0.398	(0.92)	20.84	434.15	9,046.02	16.74	(0.44)	0.74
1995	76,583,050	8,290,345	28,602,979	1,196,176,464	0.290	(1.24)	20.90	436.91	9,132.47	15.93	(0.60)	0.66
1996	47,886,198	5,066,464	18,306,399	1,244,062,662	0.277	(1.28)	20.94	438.55	9,184.01	15.44	(0.71)	0.61
1997	45,301,943	5,108,662	17,182,077	1,289,364,605	0.297	(1.21)	20.98	440.05	9,231.15	15.45	(0.81)	0.57
1998	39,811,149	4,592,063	15,414,555	1,329,175,754	0.298	(1.21)	21.01	441.33	9,271.36	15.34	(0.90)	0.54
1999	36,571,202	4,577,891	14,369,917	1,365,746,956	0.319	(1.14)	21.03	442.47	9,307.34	15.34	(0.98)	0.51
2000	38,498,008	4,985,395	14,919,064	1,404,244,964	0.334	(1.10)	21.06	443.64	9,344.29	15.42	(1.06)	0.48
2001	36,902,368	5,023,057	14,669,627	1,441,147,333	0.342	(1.07)	21.09	444.73	9,378.85	15.43	(1.15)	0.45
2002	35,115,548	4,671,500	14,769,080	1,476,262,880	0.316	(1.15)	21.11	445.75	9,411.01	15.36	(1.22)	0.43
2003	66,301,917	4,831,574	19,564,863	1,542,564,797	0.247	(1.40)	21.16	447.61	9,469.88	15.39	(1.37)	0.39
2004	71,215,211	4,499,595	20,414,787	1,613,780,008	0.220	(1.51)	21.20	449.52	9,530.62	15.32	(1.53)	0.35
2005	81,229,116	4,583,055	23,011,537	1,695,009,125	0.199	(1.61)	21.25	451.60	9,597.00	15.34	(1.70)	0.31
2006	85,788,267	4,586,426	24,620,896	1,780,797,391	0.186	(1.68)	21.30	453.70	9,664.04	15.34	(1.89)	0.27
2007	87,284,782	4,342,578	23,893,095	1,868,082,173	0.182	(1.71)	21.35	455.74	9,729.32	15.28	(2.08)	0.24
2008	92,759,867	4,206,031	24,622,849	1,960,842,040	0.171	(1.77)	21.40	457.82	9,795.73	15.25	(2.28)	0.21

Source: INEGI (Production, Remunerations and Value Added)

Non-Metallic Mineral Products (Thousands of USD Dollars at 2005 Constant Prices)												
Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	55,707,475	6,824,384	30,068,387	55,707,475	0.227	(1.48)	17.84	318.11	5,673.68	15.74	0.04	1.03
1989	50,213,111	7,225,472	26,812,294	105,920,586	0.269	(1.31)	18.48	341.44	6,309.27	15.79	0.23	1.18
1990	46,067,987	6,634,431	24,508,822	151,988,573	0.271	(1.31)	18.84	354.92	6,686.45	15.71	0.17	1.13
1991	46,052,306	6,499,306	23,901,806	198,040,879	0.272	(1.30)	19.10	364.96	6,972.23	15.69	0.05	1.03
1992	47,100,339	6,707,927	24,120,248	245,141,217	0.278	(1.28)	19.32	373.16	7,208.46	15.72	(0.10)	0.93
1993	48,437,349	6,717,001	24,822,377	293,578,566	0.271	(1.31)	19.50	380.16	7,412.20	15.72	(0.26)	0.84
1994	45,304,634	6,160,006	23,332,119	338,883,200	0.264	(1.33)	19.64	385.78	7,577.08	15.63	(0.40)	0.76
1995	20,568,865	2,551,554	10,808,094	359,452,065	0.236	(1.44)	19.70	388.09	7,645.48	14.75	(0.47)	0.72
1996	11,009,375	1,278,359	5,784,958	370,461,440	0.221	(1.51)	19.73	389.28	7,680.66	14.06	(0.50)	0.71
1997	10,550,279	1,202,099	5,495,937	381,011,718	0.219	(1.52)	19.76	390.39	7,713.50	14.00	(0.54)	0.69
1998	10,078,079	1,067,398	5,359,161	391,089,798	0.199	(1.61)	19.78	391.42	7,744.12	13.88	(0.57)	0.67
1999	9,871,544	1,072,514	5,428,506	400,961,342	0.198	(1.62)	19.81	392.41	7,773.42	13.89	(0.60)	0.66
2000	10,247,827	1,170,199	5,796,678	411,209,169	0.202	(1.60)	19.83	393.41	7,803.17	13.97	(0.63)	0.65
2001	9,660,137	1,230,210	5,418,118	420,869,306	0.227	(1.48)	19.86	394.33	7,830.61	14.02	(0.66)	0.63
2002	9,239,814	1,157,854	5,097,439	430,109,120	0.227	(1.48)	19.88	395.20	7,856.33	13.96	(0.69)	0.62
2003	10,160,053	930,608	5,074,321	440,269,173	0.183	(1.70)	19.90	396.13	7,884.04	13.74	(0.72)	0.61
2004	10,079,181	921,449	5,056,729	450,348,354	0.182	(1.70)	19.93	397.03	7,910.97	13.73	(0.75)	0.59
2005	10,642,699	970,317	5,261,933	460,991,053	0.184	(1.69)	19.95	397.96	7,938.82	13.79	(0.78)	0.58
2006	11,228,557	981,230	5,576,339	472,219,610	0.176	(1.74)	19.97	398.92	7,967.59	13.80	(0.82)	0.57
2007	11,556,680	945,792	5,700,164	483,776,291	0.166	(1.80)	20.00	399.89	7,996.56	13.76	(0.85)	0.55
2008	10,891,953	930,764	5,333,664	494,668,243	0.175	(1.75)	20.02	400.78	8,023.30	13.74	(0.88)	0.54

Source: INEGI (Production, Remunerations and Value Added)

Basic Metals
(Thousands of USD Dollars at 2005 Constant Prices)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	92,158,437	7,355,666	31,788,976	92,158,437	0.231	(1.46)	18.34	336.32	6,167.77	15.81	(0.09)	0.94
1989	81,417,041	7,270,584	28,104,886	173,575,478	0.259	(1.35)	18.97	359.94	6,828.85	15.80	0.27	1.21
1990	67,012,052	5,731,674	22,595,106	240,587,530	0.254	(1.37)	19.30	372.44	7,187.49	15.56	0.25	1.19
1991	52,101,560	4,795,405	17,250,843	292,689,089	0.278	(1.28)	19.49	380.04	7,408.74	15.38	0.17	1.12
1992	45,518,733	4,377,309	14,655,759	338,207,823	0.299	(1.21)	19.64	385.70	7,574.77	15.29	0.07	1.05
1993	42,568,871	3,507,048	13,723,941	380,776,693	0.256	(1.36)	19.76	390.37	7,712.78	15.07	(0.03)	0.98
1994	42,449,206	3,189,901	13,616,515	423,225,899	0.234	(1.45)	19.86	394.56	7,837.22	14.98	(0.13)	0.91
1995	30,525,590	1,405,296	9,779,286	453,751,489	0.144	(1.94)	19.93	397.33	7,919.94	14.16	(0.21)	0.87
1996	26,878,739	1,246,773	7,744,968	480,630,228	0.161	(1.83)	19.99	399.62	7,988.74	14.04	(0.28)	0.83
1997	26,064,239	1,201,878	7,487,130	506,694,467	0.161	(1.83)	20.04	401.74	8,052.22	14.00	(0.34)	0.79
1998	20,646,134	1,009,557	6,100,261	527,340,600	0.165	(1.80)	20.08	403.34	8,100.45	13.83	(0.40)	0.76
1999	17,167,796	948,140	4,938,420	544,508,396	0.192	(1.65)	20.12	404.63	8,139.27	13.76	(0.44)	0.74
2000	17,639,309	961,735	5,074,493	562,147,705	0.190	(1.66)	20.15	405.91	8,178.03	13.78	(0.49)	0.71
2001	14,398,232	947,806	4,183,479	576,545,937	0.227	(1.48)	20.17	406.93	8,208.87	13.76	(0.52)	0.70
2002	13,964,112	879,761	3,633,254	590,510,049	0.242	(1.42)	20.20	407.90	8,238.12	13.69	(0.56)	0.68
2003	14,008,973	645,852	3,595,203	604,519,021	0.180	(1.72)	20.22	408.85	8,266.85	13.38	(0.59)	0.66
2004	18,240,126	667,909	4,810,337	622,759,147	0.139	(1.97)	20.25	410.05	8,303.36	13.41	(0.64)	0.64
2005	19,054,324	705,913	5,147,818	641,813,471	0.137	(1.99)	20.28	411.27	8,340.49	13.47	(0.69)	0.62
2006	23,488,478	765,876	6,143,814	665,301,949	0.125	(2.08)	20.32	412.73	8,384.92	13.55	(0.75)	0.60
2007	24,495,695	836,681	6,283,391	689,797,645	0.133	(2.02)	20.35	414.20	8,429.76	13.64	(0.81)	0.57
2008	26,233,913	885,297	6,681,235	716,031,557	0.133	(2.02)	20.39	415.72	8,476.23	13.69	(0.87)	0.55

Source: INEGI (Production, Remunerations and Value Added)

Fabricated Metal Products , Machinery and Equipment, Medical, Precision and Optical Instruments
(Thousands of USD Dollars at 2005 Constant Prices)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	305,835,667	36,207,716	90,870,633	305,835,667	0.398	(0.92)	19.54	381.76	7,458.95	17.40	0.16	1.12
1989	299,205,250	38,918,259	88,422,511	605,040,917	0.440	(0.82)	20.22	408.88	8,267.90	17.48	0.06	1.04
1990	268,699,745	35,832,709	78,389,899	873,740,661	0.457	(0.78)	20.59	423.88	8,726.92	17.39	0.06	1.04
1991	266,981,444	34,846,155	82,439,381	1,140,722,105	0.423	(0.86)	20.85	434.93	9,070.39	17.37	0.08	1.06
1992	264,562,427	37,462,528	82,848,047	1,405,284,532	0.452	(0.79)	21.06	443.67	9,345.27	17.44	0.11	1.08
1993	251,669,266	36,125,195	76,346,577	1,656,953,799	0.473	(0.75)	21.23	450.64	9,566.26	17.40	0.14	1.10
1994	258,029,157	34,465,051	75,029,575	1,914,982,956	0.459	(0.78)	21.37	456.80	9,763.26	17.36	0.18	1.13
1995	173,499,033	15,120,255	43,709,803	2,088,481,989	0.346	(1.06)	21.46	460.52	9,882.60	16.53	0.20	1.15
1996	84,133,101	5,790,365	25,466,587	2,172,615,090	0.227	(1.48)	21.50	462.22	9,937.26	15.57	0.21	1.16
1997	84,819,782	5,951,394	25,595,803	2,257,434,871	0.233	(1.46)	21.54	463.86	9,990.46	15.60	0.22	1.16
1998	79,522,542	5,620,184	23,365,596	2,336,957,413	0.241	(1.42)	21.57	465.36	10,038.72	15.54	0.23	1.17
1999	74,973,184	5,695,881	21,939,051	2,411,930,597	0.260	(1.35)	21.60	466.72	10,082.87	15.56	0.24	1.18
2000	82,019,150	6,413,342	23,556,804	2,493,949,747	0.272	(1.30)	21.64	468.17	10,129.76	15.67	0.25	1.19
2001	75,598,043	6,438,494	21,920,605	2,569,547,790	0.294	(1.23)	21.67	469.46	10,171.76	15.68	0.26	1.20
2002	68,446,428	5,689,234	20,035,632	2,637,994,219	0.284	(1.26)	21.69	470.60	10,208.83	15.55	0.27	1.20
2003	60,848,971	4,304,489	16,356,543	2,698,843,189	0.263	(1.33)	21.72	471.59	10,241.06	15.28	0.28	1.21
2004	61,257,984	4,222,315	16,701,023	2,760,101,174	0.253	(1.38)	21.74	472.56	10,272.84	15.26	0.28	1.22
2005	66,301,036	4,429,431	18,071,038	2,826,402,210	0.245	(1.41)	21.76	473.60	10,306.53	15.30	0.29	1.22
2006	71,542,470	4,537,957	19,481,600	2,897,944,679	0.233	(1.46)	21.79	474.69	10,342.09	15.33	0.30	1.23
2007	74,652,373	4,282,584	19,808,898	2,972,597,052	0.216	(1.53)	21.81	475.79	10,378.35	15.27	0.31	1.24
2008	71,130,705	3,975,839	18,723,029	3,043,727,757	0.212	(1.55)	21.84	476.83	10,412.14	15.20	0.32	1.25

Source: INEGI (Production, Remunerations and Value Added)

Year	Total Gross Production	Total Remunerations	Value Added	Cumulative Production X	L/Q	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
1988	21,625,466	2,388,554	9,872,414	21,625,466	0.242	(1.42)	16.89	285.25	4,817.72	14.69	0.29	1.23
1989	23,953,032	2,947,474	10,096,523	45,578,498	0.292	(1.23)	17.63	310.99	5,484.32	14.90	0.20	1.15
1990	23,945,089	2,968,108	9,851,526	69,523,587	0.301	(1.20)	18.06	326.06	5,887.75	14.90	0.17	1.13
1991	21,422,120	2,818,212	8,920,263	90,945,707	0.316	(1.15)	18.33	335.83	6,154.42	14.85	0.16	1.12
1992	23,005,957	3,347,886	9,595,145	113,951,664	0.349	(1.05)	18.55	344.15	6,384.43	15.02	0.16	1.12
1993	22,184,768	3,435,091	9,281,987	136,136,433	0.370	(0.99)	18.73	350.78	6,569.85	15.05	0.16	1.12
1994	22,625,420	3,255,942	9,122,678	158,761,853	0.357	(1.03)	18.88	356.56	6,732.98	15.00	0.16	1.12
1995	14,390,653	1,429,927	4,692,157	173,152,506	0.305	(1.19)	18.97	359.85	6,826.22	14.17	0.17	1.12
1996	630,753	114,050	264,812	173,783,259	0.431	(0.84)	18.97	359.99	6,830.15	11.64	0.17	1.12
1997	626,644	112,975	260,608	174,409,903	0.434	(0.84)	18.98	360.12	6,834.03	11.63	0.17	1.12
1998	575,270	102,157	250,208	174,985,173	0.408	(0.90)	18.98	360.25	6,837.59	11.53	0.17	1.12
1999	539,677	99,756	241,599	175,524,850	0.413	(0.88)	18.98	360.37	6,840.92	11.51	0.17	1.12
2000	558,435	103,409	259,951	176,083,285	0.398	(0.92)	18.99	360.49	6,844.35	11.55	0.17	1.12
2001	505,498	108,534	233,487	176,588,783	0.465	(0.77)	18.99	360.59	6,847.46	11.59	0.17	1.12
2002	478,747	104,082	220,701	177,067,530	0.472	(0.75)	18.99	360.70	6,850.38	11.55	0.17	1.12
2003	1,369,253	228,328	496,686	178,436,783	0.460	(0.78)	19.00	360.99	6,858.72	12.34	0.17	1.12
2004	1,381,646	220,835	503,963	179,818,428	0.438	(0.83)	19.01	361.28	6,867.08	12.31	0.17	1.12
2005	1,471,447	236,667	548,654	181,289,876	0.431	(0.84)	19.02	361.59	6,875.92	12.37	0.17	1.12
2006	1,528,318	245,480	558,790	182,818,194	0.439	(0.82)	19.02	361.91	6,885.03	12.41	0.17	1.12
2007	1,505,038	237,235	531,201	184,323,231	0.447	(0.81)	19.03	362.22	6,893.93	12.38	0.17	1.12
2008	1,450,139	230,072	521,202	185,773,370	0.441	(0.82)	19.04	362.52	6,902.45	12.35	0.17	1.12

Other Manufacturing Industries
(Thousands of USD Dollars at 2005 Constant Prices)

Source: INEGI (Production, Remunerations and Value Added)

Appendix H Production, Remunerations, Value Added and Data Processing (Machinery subsectors)

Fabricated Metal Products

Year	Total Gross Production in Thousands of Current Mexican Pesos	Total remunerations in Thousands of Current Mexican Pesos	Value Added in Thousands of Current Mexican Pesos	Production Value in Thousands of USD Dollars at 2005 Constant prices	Labor Value in Thousands of USD Dollars at 2005 Constant prices	Value Added in Thousands of USD Dollars at 2005 Constant prices	Cumulative Production X in Thousands of USD Dollars at 2005 Constant prices	Ln (L/Q)	Ln (X)	(LnX)^2	(Ln X)^3	ln (L)	Annual Learning estimates	d=2^-a
2003	62,637,183	6,716,593	19,567,619	6,320,223	677,718	1,974,414	6,320,223	(1.07)	15.66	245.21	3,839.85	13.43	(0.09)	0.9411
2004	73,628,552	6,980,585	22,611,444	6,784,080	643,186	2,083,402	13,104,303	(1.18)	16.39	268.58	4,401.63	13.37	(0.08)	0.9429
2005	78,940,622	7,216,824	23,357,768	7,243,660	662,222	2,143,329	20,347,963	(1.17)	16.83	283.20	4,765.80	13.40	(0.08)	0.9439
2006	88,261,216	7,677,509	25,821,214	7,814,303	679,737	2,286,109	28,162,266	(1.21)	17.15	294.24	5,047.28	13.43	(0.08)	0.9446
2007	93,872,642	7,809,417	26,441,050	7,972,831	663,273	2,245,702	36,135,097	(1.22)	17.40	302.86	5,270.55	13.40	(0.08)	0.9451
2008	100,916,478	7,567,486	28,546,018	8,005,597	600,321	2,264,525	44,140,694	(1.33)	17.60	309.86	5,454.46	13.31	(0.08)	0.9455

Source: INEGI (Production, Remunerations and Value Added)

Machinery and Equipment

2003	30,900,289	4,795,611	11,891,785	3,117,904	483,887	1,199,906	3,117,904	(0.91)	14.95	223.58	3,343.15	13.09	1.00	2.00
2004	35,841,480	5,375,880	13,837,961	3,302,407	495,330	1,275,019	6,420,311	(0.95)	15.67	245.70	3,851.42	13.11	(0.99)	0.50
2005	41,763,582	5,955,649	16,478,280	3,832,263	546,496	1,512,061	10,252,574	(1.02)	16.14	260.60	4,206.84	13.21	(1.08)	0.47
2006	47,297,709	6,557,105	18,887,027	4,187,554	580,540	1,672,183	14,440,128	(1.06)	16.49	271.77	4,480.31	13.27	(0.55)	0.68
2007	60,774,380	6,733,577	21,690,386	5,161,715	571,899	1,842,217	19,601,843	(1.17)	16.79	281.94	4,734.13	13.26	0.35	1.28
2008	63,228,923	6,903,138	22,177,358	5,015,884	547,619	1,759,306	24,617,727	(1.17)	17.02	289.65	4,929.47	13.21	1.28	2.43

Source: INEGI (Production, Remunerations and Value Added)

Computing Machinery, Communications Equipment, Medical, Precision and Optical Instruments

2003	39,743,965	1,471,834	7,012,622	4,010,250	148,511	707,588	4,010,250	(1.56)	15.20	231.17	3,514.83	11.91	0.24	1.18
2004	36,718,755	1,789,352	8,155,243	3,383,239	164,870	751,418	7,393,488	(1.52)	15.82	250.15	3,956.39	12.01	(0.14)	0.91
2005	37,299,964	1,809,164	8,239,443	3,422,677	166,010	756,058	10,816,165	(1.52)	16.20	262.33	4,248.81	12.02	0.19	1.14
2006	32,043,900	1,841,808	7,784,919	2,837,041	163,066	689,246	13,653,207	(1.44)	16.43	269.93	4,434.78	12.00	0.60	1.51
2007	28,662,910	1,408,466	6,444,692	2,434,410	119,624	547,363	16,087,617	(1.52)	16.59	275.35	4,568.97	11.69	0.98	1.98
2008	24,542,283	1,412,688	5,923,425	1,946,913	112,067	469,899	18,034,531	(1.43)	16.71	279.15	4,663.99	11.63	1.30	2.46

Source: INEGI (Production, Remunerations and Value Added)

Electrical Machinery and Apparatus

2003	55,782,587	5,795,651	17,804,903	5,628,580	584,793	1,796,552	5,628,580	(1.12)	15.54	241.60	3,755.22	13.28	0.14	1.10
2004	67,201,077	6,460,307	21,248,752	6,191,857	595,248	1,957,844	11,820,437	(1.19)	16.29	265.21	4,319.07	13.30	(0.26)	0.84
2005	74,110,896	6,822,258	23,306,448	6,800,480	626,016	2,138,620	18,620,918	(1.23)	16.74	280.22	4,690.84	13.35	(0.28)	0.82
2006	87,194,576	7,420,509	27,202,551	7,719,866	656,983	2,408,407	26,340,784	(1.30)	17.09	291.95	4,988.49	13.40	(0.20)	0.87
2007	100,468,522	6,350,750	29,831,902	8,533,035	539,385	2,533,696	34,873,819	(1.55)	17.37	301.62	5,238.33	13.20	(0.06)	0.96
2008	104,915,003	6,177,289	31,127,814	8,322,796	490,038	2,469,337	43,196,615	(1.62)	17.58	309.10	5,434.39	13.10	0.08	1.06

Source: INEGI (Production, Remunerations and Value Added)

Railroad equipment and Transportation Equipment

2003	413,985,574	23,880,369	105,826,168	41,772,014	2,409,579	10,678,083	41,772,014	(1.49)	17.55	307.92	5,403.35	14.69	(0.87)	0.55
2004	451,451,460	25,219,239	115,405,099	41,596,401	2,323,682	10,633,340	83,368,415	(1.52)	18.24	332.65	6,067.19	14.66	0.21	1.16
2005	490,426,441	26,467,569	125,554,275	45,001,956	2,428,687	11,520,969	128,370,371	(1.56)	18.67	348.58	6,508.23	14.70	0.14	1.10
2006	553,262,608	27,758,522	140,345,638	48,983,705	2,457,631	12,425,653	177,354,076	(1.62)	18.99	360.76	6,852.13	14.71	(0.30)	0.81
2007	595,183,547	28,121,213	148,823,257	50,550,381	2,388,403	12,639,920	227,904,458	(1.67)	19.24	370.35	7,127.15	14.69	(0.86)	0.55
2008	603,052,463	28,057,795	148,243,010	47,839,514	2,225,795	11,759,961	275,743,972	(1.66)	19.43	377.72	7,340.95	14.62	(1.42)	0.37

Source: INEGI (Production, Remunerations and Value Added)