

## **Mexican manufacturing exports. Cointegration analysis with respect to their determinants**

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The aim of this paper is evaluate some of the principal determinants of manufactures Mexican exports. Besides the introduction, the paper is integrated by other three sections and the conclusions. In the second section it is make a revision of the international trade theory, emphasizing the role of the exports in the process of economic growth. In the third section it is a review of empirical literature about the determinants of manufactures exports is done. In the fourth section it is described the model to estimate, also the used variables. Subsequently, in the same section, it is come to the estimation of the model and to the discussion of the results. Finally, the conclusions are presented.

### **Exportations, Manufactures, Economic growth**

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**Introduction**

The manufactures occupies an important place in the foreign trade of Mexico: The manufacturing deficit was the traditional cause of the deficit in the trade balance. Today's manufacturing exports, are the most important item of Mexican exports and represent an option of creating jobs.

The dynamism and composition of exports may help to explain the conditions in which business operate and the difficulties they may be facing. The export performance is a manifestation of competitiveness, as the economic growth or size of the company (Inter-American Development Bank, 2001:49).

In the design of recent economic policies in the emerging economies, the export promotion has played a important role. The study of exports is important for its short term and long term effects. In the short-term the increase or decrease in exports affects the trade balance, while the long-term behavior can contribute to the growth or downturn in the economy as a whole (Rodríguez and López, 2010:43).

According to Thirlwall (2003:73), industrial activity, especially manufacturing is a strategic sector because it appears to be in countries with close association between the level of per capita income and the level of industrialization and where is also a close association between GDP growth and the the manufacturing industry.

Countries that grow quickly tend to be those where the share of industry in GDP rises faster.

There are several factors that may influence the export performance of a country. The objective of this work is to identify, using the approach of Engle-Granger cointegration, the variables that determine the behavior of Mexican manufactured exports. Although after reaching a maximum in 1998 of 89.7 percent of Mexico's total exports, manufacturing exports have been decreasing their share of Mexican exports. During 2009-2010 represented more than 82 percent of Mexican exports. No doubt still remain an important foreign trade item of Mexico.

**Theoretical background**

For a long time, scholars of international trade have attempted to define the link between international trade and economic growth. Some time ago there was some consensus on the existence of a positive correlation between the both, as a result of which the importance of growth strategies is highlighted, which drew some of the recommendations of the "Washington Consensus".

Representative authors of this review are David Dollar, Jeffrey Frankel and David Romer, among others, who argue that openness induces higher growth, what happens basically because countries can adopt the best technologies, leading to increased productivity, which leads an increased of growth (Rodríguez Arana, 2005:74).

The situation has changed since this century. Today the literature is characterized by having more questions than answers about the link between international trade and economic growth

One of the most critical inputs is the one of Rodrik and Rodriguez, who question the positive correlation between trade openness and growth, stating that this correlation is affected by methodological problems and, therefore, the results of these studies are not robust.

This perspective is reinforced by Winters, who based on a literature review concludes that although there is evidence for a positive relationship, the methodological problems prevent to be completely safe (Machinea and Vera, 2006:11). According to these authors, "Although the relationship between trade openness and growth is far from unambiguous analysis of the export performance of Latin America from 1990 to the present arises a positive correlation between export growth and economic growth emerges" (Machinea and Vera, 2006:12).

The reasons why the increase in exports has a positive impact on growth are:

- The generation of foreign exchange through exports, with less real cost than it would locally produce to fuel the economic expansion production, raising the average productivity of both the country and the world at large. The point here is not only the generated volume of foreign exchange, but also the perspective of its future growth. Hence the relevance of promoting exports of goods and services whose external demand trends, present sharp rise in time. To sustain high growth in the volume of exports is essential to diversify the export basket towards products with more dynamic international demand.
- By the positive effects or linkages of the export activity has over other local activities, thanks to the demand for products and services from local suppliers (allowing change physical and human resources underutilized or reallocating to more productive uses, or stimulating new investment of these providers). These positive effects will be greater if is greater the number of companies and industries related to exports. This impact will be stronger the greater national capacity to absorb learning exporting companies, which highlights the importance of the links between export activity and mechanisms of transfer and internal diffusion of technology and training of human capital.
- Exports may also play a macroeconomic role. In economies with external development restrictions, higher exports contribute to increase the rate of resources used (Ffrench-Davis, 2005:177-178). In other words, exports can generate output growth when there are shortfalls in domestic demand. This is especially important in small economies, where it is likely that external markets are the main drivers of growth.
- Growth of robust exports leads to adults and better jobs. Manufactured exports are typically an intensive labor so the demand for labor increases with the increase in exports. Exporting firms also create jobs with higher salaries and better work conditions of firms competing with imports.

- A growth in strong exports help prevent crisis in the balance of payments (Freund and Pierola, 2008:2).
- The existence of greater contact with the international economy and the demands of competitiveness that face the export activities and their suppliers. This effect will be greater the more differentiated the product and greater national capacity to absorb learning exporters.
- The advantage of economies of scale and specialization related to the enlargement of markets where local companies allocate their production (Gutierrez and Romero, 2007:8).

In the nineties emerged some questions about the importance of exports to spur economic growth; authors like Ghatak and others noted that manufacturing exports are not the total exports, the main determinants of economic growth (Gutierrez and Romero, 2007:8). For this reason this work focuses on manufacturing exports to Mexico.

According to Marco Fugazza (2004:3), the positive correlation between economic growth and export performance is a statement with a strong empirical support. In this way, a better understanding of the determinants of export performance would contribute to a better understanding of the relationship between trade openness and economic growth.

Sustained export growth depends on the level and variability of the real exchange rate and the direct and indirect costs of exporting business. So to facilitate export expansion opening must be accompanied, in the initial stages of a real depreciation.

The low tariff itself initiate a process of improving the real exchange rate, which requires to materialize macroeconomic discipline to keep constant the gap between domestic spending and product (Vittorio Corbo, 1999:474).

The predominant role of the real exchange rate to promote exports increased is surprising given the modest effects of the exchange rate on exports which have reported the majority of studies . Only in a few cases , the exchange rate has been identified as an important factor in stimulating the growth of exports. Some recent studies discussed the link between an undervalued exchange rate and growth of Chinese exports, although some authors are the most important external demand. It has also been found that the depreciation of the exchange rate is an important part of accelerating economic growth and undervaluation leads to income growth in developing countries. Changes in relative prices lead to entering new export industries and the discovery of new markets. The undervalued exchange rate makes it easier to be successful in these new markets and products (Freund and Pierola, 2008:4-5 ).

Macroeconomic stability, with structural reforms aimed at increasing efficiency, especially trade reform the surest way to promote exports. This overall strategy needs to be complemented with the development of an institutional framework to support the export efforts. In the initial stages, when the average and variance of tariffs are still high, it is necessary to have a prompt refund of paid duties on inputs used in export products mechanism. Such measures reduce the anti-export trade policy implicit in (Corbo, 1999:475) bias.

The endogenous growth models incorporate increasing returns to scale and externalities, thus assigning a role to foreign trade and in particular the growth of exports through specialization and the exploitation of economies of scale, access to a greater variety of materials premiums, learning acquired through experience and negotiations in the global economy and the integration and adaptation of technologies (Corbo, 1999:474). In these models, exports are related to output growth side effects to override the diminishing returns of the factors, assumptions in the neoclassical model.

The features include emerge from the following hypotheses:

- The productivity of the export sector would be greater than of the non-export because the first is exposed to international competition, with its requirements of best management practices and technological improvements, participates in a dynamic competitive environment. Thus, any growth in exports is associated with the generation of products in a highly productive sector and increased in economic growth.
- The existence of externalities from the export sector to the rest of the economy. The increased production capacity of the productive sectors would spread to other sectors as an "imitation" effect as the pressure of having access to raw materials and more efficient services in order to exporters improve their market competitiveness worldwide.
- The export growth contributes to raise the level of GDP for a certain level of domestic demand and helps to reduce dependence on foreign savings and thus to obtain financing for imports of intermediate production inputs that allow print dynamic growth. Exports are a tool for growth.
- A greater amount of cumulative exports reflects the existence of specialization through economies of scale and learning effects.
- The knowledge gap between countries explain disparities in growth. In order of the growing of international trade the differences are reducing.
- Trade liberalization has a positive and significant effect on growth.
- To the extent that a country register a higher volume of exports can have a much wider market for their products. A more developed export sector attracts investments to reduce project risk and thereby fosters greater economic growth (Corbo, 1999:476-477).

In summary, theoretical models that explain the relationship between the growth of exports and the economy based on the assumption that the marginal productivity of the factors of production employed in export-oriented activities are greater than those observed in other sectors.

The largest export sector productivity is due to a better coordination of production processes, to a higher degree of utilization of installed capacity and primarily to the development of dynamic factors arising from the application of new technologies, coupled with the increased managerial skills required to face an increased competition from foreign markets (Gaviria, 2005:54).

The export growth allows a dynamic process develops a domestic application of technologies that increase the productivity of the factors of production. This results in an expansion of the production possibilities of the economy, not only in its export capacity but also in its production capacity in non-tradable sectors (Gaviria, 2005:54).

The previous ideas are living in so-called laws of economic growth of Kaldor. The first law is that there is a strong causal link between the growth of manufacturing output and GDP growth. The second states that there is a strong positive causal relationship between the growth of manufacturing output and productivity growth in the sector as a result of returns to scale. This law is known as Verdoorn Law.

The third law states that there is a strong positive causal relationship between the rate in which the manufacturing sector expands and the productivity growth outside the manufacturing sector due to diminishing returns in agriculture and in many irrelevant sector activities provided to work services to the industrial sector (Thirlwall, 2003:74).

In this way the growth of total factor productivity of the economy is positively associated with growth in output and industrial employment and negatively with employment growth outside of manufacturing.

Given these "laws", we can ask, What determines the growth of the manufacturing sector? Kaldor says is the demand from the agricultural sector in an early stage of development and export growth in later stages (Thirlwall, 2003:74). A rapid growth in exports and the product can establish a virtuous circle of growth with a rapid increase in exports leads to rapid output growth, and rapid growth of the product leading to a rapid increase in exports through a favorable increase impact product in competitiveness (Thirlwall, 2003:75).

### **Review of the empirical literature**

Pierola and Freund (2008) try to answer the question of how countries can stimulate and sustain strong export growth. To achieve this, we examined 92 episodes of export surges, defined as significant increases in the growth of manufactured exports that are held at least seven years.

The authors find that export surges in developing countries tend to be preceded by a large increase in the real exchange rate which leads to a significantly undervalued currency and a reduction in exchange rate volatility. In contrast, in developed countries, the role of the exchange rate is less pronounced.

The authors examine why the rate is so important in developing countries and find that the depreciation leads to a reallocation of resources in the export sector. In particular, depreciation generates more entries in new products and new markets, and the falling percentage of new entries that fail after a year. These new products and markets are important because they represent 25 percent of export growth during the surge in developing countries.

The authors argue that maintaining a competitive currency leads firms to expand product and market space for exports inducing a reorientation of the tradable sector.

Cuevas (2010, a) investigates the impact of labor productivity, wages, the real exchange rate and some other variables, on the international competitiveness of the manufacturing industry in the period between January 1996 and of May 2008. Constructs a international competitiveness index for the Mexican manufacturing sector and analyzes the dynamic effects of different variables on the above index. Stresses that the international competitiveness of the manufacturing industry depends on a wide variety of factors, which are closely related.

Among the most important factors may be mentioned the labor productivity, wages, cost of credit, the real exchange rate, the cost of raw materials, intermediate inputs and capital goods, the tax incentive scheme, the system government regulations, market structures, price, quality and diversity of the finished products, technological development and, of course, the infrastructure available in the country.

Also, the export dynamics are determined not only by these factors of international competitiveness but also by external demands for Mexican products. This, depends on the level of economic activity in the United States, since that nation with Mexico makes over 80 percent of trade.

In order to study the dynamic effects of different variables on the international competitiveness of the manufacturing industry uses two gvar models (Generalized vectorautoregression model).

From these models, performs various tests and estimates, being the most important finding that labor productivity influences on international competitiveness further that the real exchange rate. It also shows that manufacturing strengthened when international competitiveness decreases in other words when the cost of labor per unit of output factor, ie, when labor productivity grows over wages. In this context, a comprehensive and consistent training program, training and encouragement to labor productivity in general factor would be not only more effective but also more efficient than a real depreciation of the currency in improving the international competitiveness of manufacturing and therefore, the promotion of exports of this industry.

It would be more effective under the productivity of labor has more influence on the level of international competitiveness that the real exchange rate; Likewise, it would be more efficient if an increase in labor productivity does not generate the negative effects that are typically associated with a real depreciation of the currency, rising in domestic currency of imported inputs, inflationary pressures, discouragement of productive activity, including other

Cuevas (2010, b) evaluates different variables determining Mexico's manufacturing exports, using two complementary econometric models: an integrated autoregressive moving average (ARIMA) in a structural way, to estimate elasticities, and a general vector of autoregression (GVAR), which enables to estimate the dynamic responses of the manufacturing exports to various types of disturbances. The Gvar method produces independent empirical evidence of the order of the equations, representing a significant improvement over traditional recursive VAR models.

Uses analysis series of univariate and multivariate time to assess, from two different perspectives, the factors influencing manufacturing exports. Concludes that increased labor productivity and expansion of external demand have a significant effect on the growth of manufactured exports. Moreover, the evidence suggests that a depreciation of the real exchange rate could reduce rather than increase the volume of exports in the short term.

An explanation of this unusual result is that a real depreciation of the currency, especially in developing countries, generates two opposite effects: on one hand, exports are cheaper in terms of foreign exchange, but on the other one, to increase the domestic currency cost of imported intermediate inputs.

The net effect on the international competitiveness of Mexico seems to be negative, at least in the short term.

One of the important implications from the point of view of economic policy, is a comprehensive and coherent set of measures designed to raise the productivity of labor, could stimulate manufacturing exports more effectively than a depreciation of the real exchange rate.

Daniel Jaime Camacho (2011) analyzes the influence of labor productivity and total factor productivity of Mexican manufacturing exports. The study period was from January 2000 to January 2008. Considers two stationary multiple regression models. In the first model the effects of labor productivity, real exchange rate and wages, among other variables, on Mexican manufacturing exports are analyzed. Then, the total factor productivity replaces labor productivity, in order to study how this variable influences on manufacturing exports.

The effects they have on manufacturing exports confirms its importance for decision making in the design of the economic policy.

Rodriguez and Lopez (2010) analyze the relationship between manufacturing exports and productivity of manufacturing in Mexico.

Unlike Cuevas, they found that increased productivity does not cause an increase in exports but that the increase of these is causing increases in productivity.

### **The Model**

#### **Description of the variables used and the relationships between them.**

The variables used are the deflated Mexico manufacturing exports by the price index of exports published by the National Institute of Statistics and Geography (INEGI), the real exchange rate calculated based on the relative version of purchasing power parity purchase and the rate of productivity of labor in manufacturing. Monthly data for the period January 1993-May 2011. 1993 was selected as the starting year when the North American Free Trade Agreement (NAFTA) had already been negotiated but not ratified.

The data of manufactured exports from Mexico were obtained from the Bank for Economic Information INEGI, the same as the index price of exports that was used. The data on the productivity of labor in manufacturing were obtained from two series of Economic Information Bank (EIB) INEGI, one based in 1993 on part of series that are no longer updated and the other based in 2008. both series were chained.



The series of the real exchange rate was constructed from the relative version of purchasing power parity. National consumer index price (CPI) and the Consumer Index Price (CPI) in the United States were used.

Both series were carried to the same base period in this case was May 2006. May of 2006 was chosen because for the second quarter of this year can be seen that the current account was in balance, which is consistent with a type of equilibrium, real exchange rate. The series of the real exchange rate was obtained by multiplying the result of the division of the CPI between the nominal exchange rate. Both the latter and the CPI series also were obtained from the Bank for Economic Information INEGI.

The CPI series was obtained from the website of the Department of Labor of the United States while the series of the index of industrial production in the United States was obtained from [www.econstats.com](http://www.econstats.com).

The model is specified as follows:

$$LXMANR_t = \beta_0 + \beta_1 LIPIEU_t + \beta_2 LPRODL_t + \beta_3 LTCCR_t + \mu_t \quad (1)$$

Where:

$LXMANR_t$ , the dependent variable is the logarithm of Mexican manufactured exports in millions of constant dollars.

$LIPIEU_t$ , is the logarithm of the index of Industrial Production of the United States, with 2000 as the base year.

$LPRODL_t$ , is the logarithm of the productivity of labor in manufacturing in Mexico. It is an index with 2008 as the base year.

$LTCCR_t$ , is the log of real exchange rate calculated on the relative version of Purchasing Power Parity.

$\mu_t$ , is the stochastic term which makes the purely mathematical function in an economic recession.

All the variables are in Log, because ADF tests suggest that if economic time series work in nominal terms are not stationary. A positive relationship between the index of industrial production in the United States is supposed ( $LIPIEU_t$ ) and Mexican manufacturing exports. The industries of the two countries are closely linked so It can be expected that Mexico manufactured exports respond to changes in the industrial production of the United States.

It is expected that the productivity of labor in manufacturing is positively related to exports and that as the productivity of labor increases, exports become more competitive.

The relationship between exports and the real exchange rate is expected to be positive since an increase of the real exchange rate implies a depreciation of the peso, making Mexican exports more attractive in terms of prices. An increase in the real exchange rate becomes more competitive Mexican manufacturing exports.

### Model Estimation

To estimate the model version 6 was used Eviews econometric package. The methodology used for estimating the cointegration model is given by Engle Granger.

Practically all classical econometric literature was based on the assumption that the variables are stationary.

However, most of the variables that appear in econometric time series models are not. This has important implications for the development of models and the distribution of their estimators.

A stationary series has a constant mean, that does not vary with time; an equally constant and finite variance; limited memory of his past conduct, with transient effects of a random disturbance. Graphically series will tend to return to its mean and cross repeatedly, fluctuating around a relatively constant amplitude. A simple example of stationary series is generated by a white noise.

Granger and Newbold (1974) were the first authors clearly stated the importance of the potential problems that the use of integrated variables could lead to misleadingly high correlations. The most obvious solution, also given by them in the line of Box and Jenkins (1970), is to distinguish the series to achieve its stationarity, working with these different series. This strategy was applied by a large number of researchers following the publication of the work of Granger and Newbold. There was, however, satisfactory: Davidson, Hendry, Srba and Yeo (1978) and Hendry and Mizon (1978) noted that, in expressing the model in differences, it was not possible to infer the long-term solution from estimated model. A more satisfactory treatment of the models with integrated variables is not achieved until the second half of the eighties, with the emergence of the literature on cointegration (Anchuelo, 1993). Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary, provided that all variables are integrated in the same order.

The linear combination of balance, if exist is any equation or cointegration vector and can be interpreted as the ratio of long-run equilibrium between the variables. The purpose of the test is to determine whether cointegration a group of non-stationary series is cointegrated and therefore, if the estimated residue is stationary. Thus, to explore the nature of the cointegration relationship between groups of variables cointegration methodology, where the cointegration relationship between the variables is linear, which is embodied in one or, at most,  $k-1$  cointegrating vectors used, where  $k$  is the number of variables included in the analysis.

The methodology for estimating the appropriate model consists firstly in check all the series involved for their degree of integration which allows us to determine their stationarity, if the cointegration tests will be found in one of the cases, the Granger causality search type to see if they are independent, univocal or biunivocal.

The cointegration test proposed by Engle Granger, estimated a static equation (all variables are expressed in time  $t$ ) by OLS, which is called the cointegrating regression (Loría, 2007:281). The results of the first estimation are presented in logarithmic form:

Results of the regression in logarithms

Dependent Variable: LXMANR				
Method: Least Squares				
Sample: 1993M01 2011M05				
Included observations: 221				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7,09267	0,472774	-15,0023	0
LIPIEU	2,078823	0,18118	11,47382	0
LPRODL	0,537314	0,123914	4,336192	0
LTCR	0,109915	0,076508	1,43664	0,1523
R-squared	0,883868	Mean dependent	4,804251	
Adjusted R-square	0,882262	S.D. dependent	0,362625	
S.E. of regression	0,124427	Akaike info crite	-1,31226	
Sum squared resid	3,359617	Schwarz criterio	-1,25075	
Log likelihood	149,0047			
Hannan-Quinn criter.		-1,287425		
F-statistic	550,5204	Durbin-Watson s	0,581333	
Prob(F-statistic)	0			

$$LXMANR_t = -7.092666 + 2.078823LIPIEU_t + 0.537314LPRODL_t + 0.109915LTCR_t \quad (2)$$

**Table 1**

At 5% level of significance, the logarithm of the real exchange rate is not statistically significant, the other independent variables if they are.

The signs are expected for the production rate of the United States and the productivity of labor in manufacturing in Mexico and the real exchange rate. The F statistic indicates that the parameters are set equal to zero.

Spurious regressions according to the criterion of Granger and Newbold (Mata 2004:39) are those which exhibit, inter alia, the following features:

- A determination coefficient  $R^2 > DW$
- Variables not stand in a causal relationship.
- The estimation of a temporal econometric model provides a high goodness of fit, in this case 0.88.

- A relatively low value of DW statistic, indicating positive autocorrelation, 0.58 in this case.

No evidence of heteroscedasticity. However, there is clear evidence for the DW value, autocorrelation which leads to biased standard errors and incorrect hypotheses testing. This spurious regression can be corrected taking into account exports behind in a period ( $LXMANR_{t-1}$ ), as part of an independent variable which has an economic meaning because exports of this time was also determined by what the previous period was exported:

This new regression has a better goodness of fit and has no problems of autocorrelation, as seen in the following table:

Regression results with the endogenous variable lagged one period

LS // Dependent Variable is LXMANR				
Sample(adjusted): 1993:02 2011:05				
Included observations: 220 after adjusting endpoints				
Variable	Coeffici	Std. E	t-Statistic	Prob.
C	-2,41	0,45	-5,308	0
LTCR	0,044	0,05	0,813	0,417
LPRODL	0,145	0,09	1,6015	0,111
LIPIEU	0,751	0,15	4,8466	0
LXMANR(-	0,651	0,04	14,618	0
R-squared	0,941	Mean dependent	4,809536	
Adjusted R-	0,94	S.D. dependent	0,354819	
S.E. of regre	0,087	Akaike info crite	-4,858958	
Sum squarec	1,631	Schwarz criterio	-4,78183	
Log likelihood	227,3	F-statistic	854,8479	
Durbin-Wats	2,335	Prob(F-statistic)	0	

**Table 2**

According to the test augmented by Dickey-Fueller, the four variables of the model (in logs) are not stationary, except  $LTCR_t$  to, the 10%, is stationary and has an integration level I (0). n everything else, the four series have a level of integration I (1).

In which case meets the first condition to investigate whether a cointegration relationship between the logarithm of exports and the logarithms of the other independent variables (Perez 2006:670) is presented.

ADF test for  $LTCCR_t$

ADF Test Statistic	-2,652081	1% Critical Value*	-3,462
		5% Critical Value	-2,875
		10% Critical Value	-2,5739

**Table 3**

In the event that all series have a level of integration I (1), the next step is to check whether the variables cointegrate or not. For this, the estimated regression of the cointegration waste in this case the call UXPIEU, UXTCR, UXPRODL used. These error terms result to run regressions between manufacturing exports and each of the independent variables, except lagged. The test results show us that only cointegration work productivity to exports:

Test of cointegration between exports and productivity of labor

ADF Test Statistic	-3,9875	1% Critical Value*	-3,462
		5% Critical Value	-2,875
		10% Critical Value	-2,5739

\*MacKinnon critical values for rejection of hypothesis of a unit root.

**Table 4**

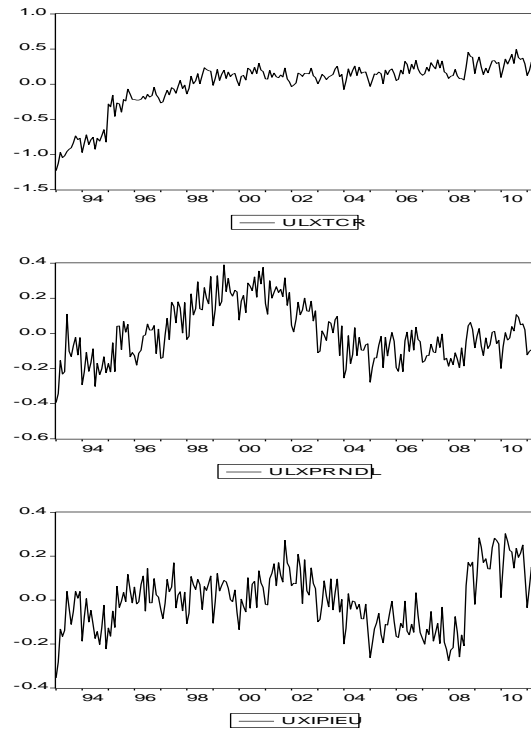
Test of cointegration between exports and LIPIEU

ADF Test Statistic	-2,444714	1% Critical Value*	-3,462
		5% Critical Value	-2,875
		10% Critical Value	-2,5739

\*MacKinnon critical values for rejection of hypothesis of a unit root.

**Table 5**

Estimated waste cointegrating regression



**Graphic 1**

It can be observed in the tables and in the previous graph that exists an equilibrium relationship in the long run, between exports and productivity index of labor, even though both sets individually viewed, are not stationary however the error term is a stationary series (I (0)).

The linear estimation of both series cancel, long-term stochastic trends which means that there is an equilibrium relationship, although there is imbalance in the short term, and we can know the parameter error correction (ECM) .

You can use this error term to relate the behavior of short-term and long-term relationship between exports and productivity index using the error correction mechanism (ECM), which results in the following function:

$$D(LMANR) = 0.0063085751 + 0.22464989D(LPRODL) - 0.23380702ULXPRODL(-1)$$

If you take a holistic manner, with all the variables, it is seen that the parameter setting shows a difference long term (-0.23380702 -0.20836973 against)

$$DLXMANR_t = 0.0039471078 + 0.28521771DPRODL_t + 1.3114821DLPIEU_t - 0.1050914DLTCR_t - 0.20836973ULXPRODL_{t-1}$$

The short-run marginal propensities are 0.28521771 for *LPRODL*; 1.3114821 for *LIPIEU*; - 0.1050914 for *LTCR*.

While for the long term we observe cointegration regression:

$$LXMANR_t = -3.424612 + 1.859406LPRODL_t + ULXPRODL_t$$

Where the adjustment factor in long term is 1.859406 an important fact because the sensitivity of exports changes in the rate of productivity is almost 185%.

The term -0.23380702 is the error correction mechanism for the long-term equilibrium.

The negative sign acts to reduce the imbalance in the next period (month). If the variables are out of balance in period t-1, the error correction mechanism acts to gradually restore the variables to the balance in the future. In this case it is observed that the deviation of manufactured exports from its level of long-run equilibrium is corrected by about 23% each month.

The fact that there is cointegration between series I (1) indicates a long-term partnership between them, but nothing relates to causation, so the Granger causality test seeks to determine whether statistically last variable x contains information that precedes the behavior of the variable (y) and help to explain (Loría, 2007:306).

The results of the Granger causality tests are presented below:

Granger causality tests			
LPRODL does not Granger Cause LXMANR	219	14.3658	1.00E-06
LXMANR does not Granger Cause LPRODL		0.39914	0.6714
LTCR does not Granger Cause LXMANR	219	0.01996	0.9802
LXMANR does not Granger Cause LTCR		2.38014	0.095
LPRODL does not Granger Cause LIPIEU	219	7.7739	0.0006
LIPIEU does not Granger Cause LPRODL		2.77148	0.0648
LTCR does not Granger Cause LIPIEU	219	0.3471	0.7071
LIPIEU does not Granger Cause LTCR		1.89193	0.1533
LTCR does not Granger Cause LPRODL	219	0.70104	0.4972
LPRODL does not Granger Cause LTCR		2.66097	0.0722

Table 6

The null hypothesis is rejected that the index of industrial production in the United States does not cause Granger exports of manufactures of Mexico. Also, you can not reject the null hypothesis that manufacturing exports do not cause, in Granger, industrial production in the United States. In this case, there is a causal link from the index of industrial production in the United States to Mexican manufacturing exports but not the other.

However, the result of the error correction equation, where the first difference of the logarithm of the index of labor productivity in manufacturing appears as not significant, the null hypothesis that labor productivity in manufacturing is rejected, in Granger sense. Again there is a causal link from labor productivity in manufacturing exports of manufactured goods but not the other.

Finally, one can not reject the null hypothesis that the real exchange rate does not cause exports of manufactures.

### Conclusions

According to the results it can be said that the variables that explain the behavior of Mexican exports of manufactures, the index of industrial production in the United States and the productivity of labor in manufacturing in Mexico, the real exchange rate was not significant. One explanation for this can be found in the high degree of integration of manufacturing industries in the United States and Mexico.

For this high level of integration, the real exchange rate ceases to be a relevant variable-in the decisions of TNCs export U.S. origin set in Mexico. Decisions are made based on overall considerations.

A further explanation could be the required to export and import a significant percentage of the inputs required in the production of exportable goods.

Thus, an increase in the real exchange rate does not necessarily encourages exports, the opposite can happen just as the results obtained.

These results are consistent with those of Cuevas (2010a) finds that the increase in the real exchange rate with little impact on increasing exports and even Cuevas (2010b), can cause exports to decrease. Pierola and Freund (2008), unlike attribute an important role to increase the real exchange rate in the growth of exports.

The adjustment factor is 1.859406 in the long term is important because the sensitivity of exports that changes in the rate of productivity is almost 185%. This indicates the importance of policies aimed at increasing the productivity of labor in manufacturing.

The term -0.23380702 is the error correction mechanism for the long-term equilibrium. The negative sign acts to reduce the imbalance in the next period (month). If the variables are out of balance in period  $t-1$ , the error correction mechanism acts to gradually restore the variables to the balance in the future.

In this case it is observed that the deviation of manufactured exports from its level of long-run equilibrium is corrected by about 23% each month.

It can be seen that there is an equilibrium relationship in the long run, between exports and the rate of productivity of labor, even though the two series, viewed individually, are not stationary, however the error term is a stationary series ( $I(0)$ ), the linear estimation of both series canceled, long-term stochastic trends which allowed us to determine the parameter error correction between the short and the equilibrium is reached in the long term

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