

## Mexico: Financial Growth direct foreign investment and its terms of trade

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This research seeks to explain the reasons why the increases in foreign direct investment flows are not sufficient for the Mexican economy have sustained rates of growth. Although many factors may be, it is assumed that the problem lies in trade due to its low contribution to the economic boost in Mexico. Through a VAR (5) model using quarterly data from first quarter of 1980 to first quarter of 2010 with Gross Domestic Product, Foreign Direct Investment and Terms of Trade data, in the impulse-response analysis is that a shock random random foreign direct investment will not disrupt economic growth, but when a random shock in the terms of trade, the economy began a process of instability in the long term.

**Economic growth, foreign direct investment, term of trade, co-integration.**

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## Introduction

The economic growth in any country is important because orient to the extern capital to the formulation of new projects of investment, to the application of the productive plant in dynamic sectors and to the consolidation of the most reliable companies.

This phenomenon resulting in a biggest production, an increase in the income and, for the same, an increase in the employment, translating it in a better welfare for the population. The behavior of the national production of our country was market by the different circumstances in the application of the economy policy. The best years of growth of the Mexican economy had been in the denominate model of stabilized develop, but at the end it generated structural problems. In the eighties it had and structural adjustment in the economy in order to made it more efficient, searching to set up the sustainable growth in the flow of external capital. For such purpose in the beginning of the nineties it is execute a reform to the foreign direct investment under a perspective of economic freedom. However, the results have not been the expected, the flow of foreign investment has increased but the economic growth of the last years has not been sustainable. For the above, it is important to make the next approach: Which economic variables affect to the Gross Domestic Product of Mexico given its exterior dependence?

The present research tries to explain the causes for which the increases of the foreign investment flows are not enough for Mexican economy to present a sustainable growth.

For such reason, it assumes that the problem lies in the directory of the interchange terms.

In this form, this study analyzes the long-term relation of the economic growth (presented by the evolution of the PIB) with the foreign investment, trying to identify the impact that the last two variables have over the Gross Domestic Product in Mexico. It starts from the supposed that the economic growth in Mexico, although is positively influenced by the capitacion of foreign direct investment, it maintains with moderate variations because the deterioration of the interchange terms. The corroboration of this hypothetical affirmation will be achieve through the specification and estimation of a self-regressive model that involve representative production variables, the foreign direct investment and those that are used in researches and in the teaching of economic science.

## Antecedents

From the perspective of the Mexican economy evolution, the economic growth had its best registers before the eighties. To this, Leon (1998; 56) affirm that the stability model and the economic growth that Mexico applied since the fifties until the beginnings of the seventies allowed the country grew in an annual inflation average of 3.85 percent. As well, points that during the period of Luis Echeverria the production decelerates, because the average annual growth of the production falls to 4.5 percent and the inflation increase almost 10 percent.

One of the principal causes was the lack of internal save: the increase of the deficit in the current account triply and the public deficit passed from 1.8 to 7.2 as percentage of the Gross Domestic Product (PIB). The financing of both deficits was made with more engagement of public debt, passing from 12.6 to 24.7 percent respect to PIB.

In that same period, points, the inflationary pressures in Mexico propitiated that the prices differential with United States expanded even more: the relation of interchange and, in consequence, a production fall (Leon 1998; 65).

In the eighties it had a structural adjustment of the economy in order to make it more efficient, searching to set up the sustainable growth with flow of external capital. For such purpose, in the beginning of the nineties execute a reform to the foreign direct investment under a perspective of the economic liberalism. However, the results were not the expected, the flows of foreign investment have increased but the economic growth of the last years has not been sustainable.

### Theoretical Framework

In which from could it be analyzed the economic growth? What kind of relation does the economic growth, the direct foreign investment and the interchange terms have? Then it describes in a short form the way to analyze the economic growth and the studies that had been elaborated to the respect.

From a historic perspective, the economic growth could be analyzed by the different phases that a society could get through. These phases of the economic growth could transit in the follow steps: the traditional society, the predisposition of takeoff, the takeoff, the impulse to the maturity and the step of the mass consumption (Rostow, 1959).

However, is important analyzed the economic growth from a theoretical perspective in order to search the factors that in the long term influence in the production of a country.

To this respect, the pioneer work of Solow (1956) affirm that the per capita product of long term is determinate by the save range and the income level, doing emphasis accumulation of capital and the technology state.

In the other hand, the behavior of the economy in the long term could be analyzed through the own information structure. To this respect, Toro (2009) estimate in the per capita income of long term in some emergent markets of Asia and Latin America. To eliminate the observed volatility in the PIB per capita used mobile averages of 15 years in order to find the growth rate of the series through the application of the filter of Hodrick- Prescott. The research found that the convergence process of the Latin American countries required twice the time that the Asiatic economies need (Toro, 2009).

There is an important relation between the economic growth with the flows of capital that get through the countries' frontiers, because they could be inverted in actions, bonds or in the productive sector.

For that, the movements of capital classify in foreign stock market investment o and foreign direct investment (IED).

This last is the biggest importance for the economies in development, because in 2004 represents around the 2.5 percent of the gross national income, as much as the stock market investment was approximately of the 1.5 percent (Kumar, 2007).

The importance of the IED in emergent economies and the economies in development lies in the source of resources that represents, is more stable and, therefore, least volatile.

To this respect, and in general terms, the economies that present a bigger volatility on its flow of capital obtain a minor economic growth. In 2006, for example, China presented an annual average growth of the Gross Domestic Product (PIB) of 9 percent with a volatility of capital flows near to 0.9 percent; while South Africa got an annual average growth of the PIB near the 2.5 percent associated to a volatility of the 3.1 percent (Kumar, 2007).

Additionally, the flows of IED generate a potential to the economies for the impact that have in the technologic development, in the formation of human capital and in the growth of PIB. As well, the countries with growth models to outside could conceive the IED as a promoter tool of the exportations and a source creator of researches. Also, given the conjuncture of the external sector of some countries, the IED could finance the deficit in current account and supply or complement to the domestic investment.

In this sense, Kumar (2007) points that for each dollar of IED generated an increase of 50 cents in the domestic investment and of 75 cents in the domestic save.

From the above, the IED of biggest importance in the international movements of capital. Although its impact in the economic growth is discussed because the economists have problems to establish a strong link between the two variables. However, the analysis suggests a meaningful link between the IED and the PIB. Even do that the IED does not impulse an immediate economic growth, its effects are positives in a year after the increase (Kumar, 2007).

In the other hand, a variable of important analysis for anchored economies to the economic growth of the exterior in the correspondent to the relation of internal and external prices, denominate terms of interchange. The influences of the variations in the interchange terms are seen as important driver forces of the newest economic cycles and which affected to many industries and developing countries posterior to the oil crisis of the seventies.

In the eighties, the fluctuations in the prices of the primary services non-oil caused an impact in the interchange terms (IT) of the developing economies (Mendoza, 1995).

In that sense, the relation between the economic growth and the TI is analyzed by Wong (2010) whom use information of series of time in order to analyze the impact of the IT and its volatility about the economic growth in Japan and Korea.

Using the cointegration method of Johansen (1988),<sup>32</sup> shows that the real PIB per capita and the TI determinate jointly. According to the described study, an increase in the volatility of the TI will cause a diminution in the real PIB per capita and an increase in the price of the oil will drive a diminution in the TI. Estimating the variance decomposition shows that the important factors of real PIB per capita are different between Japan and Korea.

For example, in Japan the financial development has a negative impact in the PIB per capita; while in Korea register a weak positive impact. Additionally, a little economy is more susceptible to the shocks in the TI. In general, although, a favorable and less volatile indicator of the TI is important for the economic growth (Wong, 2010).

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<sup>32</sup> Citado por el autor

Additionally, the impact of the TI volatility about the levels of products is generated by Grimes (2006) for the economy of New Zealand. In the beginnings of the growth with minimum volatilities of PIB.

On its search for explain that phenomenon; Grimes (2006) affirm that approximately the half of the annual variations of PIB could be explained by levels and the volatility of the TU; although highlight that the explanation is better in a chart of steps of the economic activity (Grimes, 2006).

### Methodology

The present research is of type correlational, longitudinal, non-experimental and therefore qualitative where is assumed that the economic growth in Mexico, even if is influenced positively by the capitation of the foreign direct investment, it maintains with moderate variations because the deterioration of the interchange terms. For such effect, is estimated a model of self-regressive vectors of order 5, identify as VAR (5), where are use the variables of the Gross Domestic Product (PIB) for the economic growth; Foreign Direct Investment (IED), represent of the flows of extern capital; and the last, the Interchange Terms (TI) Importations (IPIM) and the Prices Index to the Exportations (IPEX). The information of the variables is storage in the official web sites of internet of the State dependencies like The National Institute of Statistic Geography and Informatics (INEGI) and the Bank of Mexico (Banxico). The type of information is sample with trimestral frequency understood between the first trimester of 1980 and the first trimester of 2010.

Once captured the information, it submit to the analysis study impulse-answer and, posteriorly, to the analysis of cointegration for submit the economic theory in the field of the statistical rigor. This procedure allows identify, in first place, the convergence to the balance in the VAR and, in second place, the existence of a stable relation (of long term) between the dependent variable (PIB) and the explicative variables (IED and TI). To support the convergence of the model re used different statistics of test in order to know the number of necessary laggards in the VAR.

In the relation of long term is applied the statistics of test of Johansen to know the co-integrant vector. Afterwards is presented the tool of analysis for the evaluation of the general statistic models, the cointegration analysis.

### Analysis of the cointegration and self-regressive vectors.

Stable relationship (of long term) between the variables of the statistic model could be carried to the cointegration analysis. However, it necessary to approach previously the concept of the unit roots to determinate if the series of the model have the same order of the integration. When used time series in the modeling of an economic situation is presented a common problem: the phenomenon of the spurious regression. This problem surge because the series of time involved present strong tendencies and, therefore, a  $R^2$  high, even if there is not a meaningful relation between variables. Therefore, is important to find if the relation between the economic variables is real or spurious (Gujarati, 1997). If it is modeled with series that present tendencies is possible that the results of the regression be apparently satisfactory:  $R^2$  closer to one, statistic  $t$  and  $F$  meaningful but with a low Durbin-Watson (d).

To this respect, granger and Newbold suggest as good practice rule to suspect that the regression is spurious that  $R^2 > d$ . This problem is not newly discovered. In 1926 Yule identified the existence of correlations “without sense”;<sup>33</sup> analyzed the risk of return a non-stationary variable over another non-stationary without relation, that is known as regression “without sense”, calcified the series of time according to its properties of serial correlation in random to level, in first differences and in second differences.

Nowadays this three types of series are called integrates with order zero, one and two, respectively (Hendry & Jusellius, 2000). The integration of the series eliminates the problem of the unit root. In the econometric analysis of the time series have some proves to corroborate the existence of the unit root like the one of Dickey-Fuller Increased (ADF), the Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS). Named tests are approached by Leon (2008) and are resumed in the char 1. In the other hand, the cointegration is possible to understand it as an econometric tendency to evaluate the correlation between non-stationary variables of time series.

Statistic of test for the detection of the unit root

	Estadístico	Hi
rueba		pótesis nula
DF	$\tau = \frac{\hat{\delta} - 0}{Se(\hat{\delta})}$	Ex istencia de raíz unitaria
P	$\tilde{t}_\alpha = t_\alpha \left( \frac{\gamma_0}{f_0} \right)^{1/2} - \frac{T(f_0 - \gamma_0)[Se(\hat{\alpha})]}{2f_0^{1/2}s}$	Ex istencia de raíz unitaria

$$LM = \sum_t \frac{S(t)^2}{(T^2 f_0)}$$

Ex istencia de estacionariedad

**Chart 1**

If two or more series are non-stationary, but in a lineal combination are stationary, then it said that the series are cointegrated. The null hypothesis of statistic meaning affirm that between the involved variables could or not be vector of cointegration. If mentioned vector has an order of integration one, could mean a balance relation between the original series, is said that such series are cointegrated in order one.

The balance is characteristic by force that tends to push the economy of return to its relation of long term. Traditionally, the economic theory proposed the forces which tend to maintain the relation between the involved series. If this situation is presented is decided that there is a relation of balance (or long term).

In statistic terms is possible to affirm that exist a measure in which the values of the series tend to return in the overtime. Therefore, the force of cointegration implies the inexistence of common tendencies between the observed facts of the analyzed variables.

This could suggest, from the perspective of the economic modeling that there is not congruency between the empirical facts and the theoretical explanation which relate the involved variables.

<sup>33</sup> Quoted in Hendry y Juselius (2000)

In this last situation is possible to affirm that the theoretical model lack of empiric content in the facts; or, that the variables which have been selected in the econometric model do not represent adequately to the variables that the economic theory proposes.

Nowadays, the procedure of Johansen is used to prove the cointegration existence through the tests lamda-max and the trace. The comprehension of Johansen procedure by the part of a model VAR (1) where is stable that follows a stationary process when  $\lim_{n \rightarrow \infty} B^n = 0$  and was possible is in the determinant  $[B - \lambda I] = 0$  the absolute value of the characteristic roots is  $|\lambda_i| < 1$ . Si alguna de las raíces características es  $|\hat{\lambda}_i| = 1$ , The model is not necessary. In the search of a stationary process is modeled the VAR in first differences which is expressed as:

$$\Delta Y_t = (B - I)Y_{t-1} + U_t \tag{1}$$

Or

$$\Delta Y_t = \Phi Y_{t-1} + U_t \tag{2}$$

Being  $\Phi$  a matrix of (m×m) parameters. The principal objective of the test of cointegration of Johansen is to find the Rank of matrix  $\Phi$ , Which determinates the number of cointegration vectors.

The principal supposed to evaluate the test is that  $U_t \sim N(0,1)$ . Therefore, even do the used variables are of integration order I(1), error term of the equation (2) is highly correlated for present some tendency in the facts, violating, in consequence, the supposed that the errors present a normal distribution. A form to overcome this problem is to increase the self-regressive process to stay as:

$$Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \dots + B_p Y_{t-p} + U_t \tag{3}$$

Having  $U_t$  a better behavior, namely, get close a normal distribution. Subtracting  $Y_{t-1}$  In both sites of the equation (5) obtain:

$$\Delta Y_t = (B_1 - I)Y_{t-1} + B_2 Y_{t-2} + \dots + B_p Y_{t-p} + U_t \tag{4}$$

Sum and subtracting in both sites of the equation  $(B_1 - I) Y_{t-2}$  has:

$$\Delta Y_t = (B_1 - I)\Delta Y_{t-1} + (B_1 + B_2 - I)Y_{t-2} + \dots + B_p Y_{t-p} + U_t \tag{5}$$

Repeating the procedure, but now with  $(B_1 + B_2 - I) Y_{t-3}$  has:

$$\Delta Y_t = (B_1 - I)\Delta Y_{t-1} + (B_1 + B_2 - I)\Delta Y_{t-2} + (B_1 + B_2 + B_3 - I)\Delta Y_{t-3} + \dots + B_p Y_{t-p} + U_t$$

In general terms is obtained the follow specification:

$$\Delta Y_t = \sum_{i=1}^{p-1} \Phi_i \Delta Y_{t-i} + \Phi Y_{t-p} + U_t \tag{6}$$

Being  $\Phi_i = (B_1 + B_2 + \dots + B_i - I)$  y  $\Phi = (B_1 + B_2 + \dots + B_p - I)$ . The equation (6) is known as a vector model of error correction (VECM). The parameters of the matrixes  $\Phi_i$  Are adjustments of short term and  $\Phi$  are adjustments of long term to a change in  $Y_t$ . Therefore the matrix  $\Phi$  could be expressed as:

$$\Phi = \alpha \beta' \tag{7}$$

Being  $\alpha$  the velocity of balance adjustment and  $\beta$  the matrix of long term coefficients.

The second term of the equation (6) represents the cointegration vector which ensure that  $Y_t$  converges from long term to balance

If we supposed that the content variables in  $Y_t$  are I(1), the  $\Delta Y_{t-i}$  should be I(0) And the term of error,  $U_t$ , Is white noise, that's why is said that the equation is balances and therefore exist  $r \leq (m - 1)$  Relations of cointegration.

If the variables in the levels are stationary the spurious regression problem is took off and the model in levels is adequate to explain the economic relation of cointegration in levels, it passed to make the VAR in differences.

The numbers of vector of cointegration are obtained through find the characteristic roots of  $\Phi$ .

If the rate of the matrix is zero is because the characteristic roots are zero and, therefore, the content variables in  $Y_t$ , do not cointegration. Johansen and Juselius (1990) provide two different statistics of test which could be used to prove the hypothesis about the existence of  $r$  vectors of cointegration: the test of drawn and the test of the own maximum root. The test of drawn presents the statistic:

$$\lambda_{traza} = -T \sum_{i=r+1}^m \ln(1 - \hat{\lambda}_i) \tag{8}$$

Being the hypothesis null the existence of at least  $r$  vectors of cointegration, in other words, the rate of the matrix is minor or equal to  $r$  and the alternative hypothesis is the existence of  $r+1$  vectors of cointegration, the existence of more than a vector of cointegration.

The test of the maximum own root use the follow test statistical:

$$\lambda_{max} = -T \ln(1 - \hat{\lambda}_{r+1}) \tag{9}$$

Where the null hypothesis assumes that the rate is  $r$ ,  $r$  vectors of cointegration and the alternative hypothesis is that the rate is  $(r+1)$ ,  $r+1$  relations of cointegration.

In both tests is calculated the number of characteristic where  $\hat{\lambda}_i$  are the  $i$ -esima characteristic estimated root of the matrix  $\Phi$  and  $T$  is the total number of observations. The equation (6) could be extended and include determinate components (constant, tendencies and fictitious variables) that could be part of the VAR and/or of the cointegrator vector of long term.

The mechanism with Sargan who linked the static balance of the economic theory with dynamic models denominated distributed lag models; posteriorly, Davison, Hendry, Srba and Yeo (1978) introduced a type of model which they called mechanism of "error correction" (ECMs)<sup>34</sup> (Hendry & Juselius, 2000). The distributed lag models have the follow specification.

$$y_t = b_0 + b_1 y_{t-1} + b_2 x_t + b_3 x_{t-1} + \varepsilon_t \tag{10}$$

The former model called be formulated in the called form of balance correction substring  $y_{t-1}$  in both sides and summing and subtracting  $\beta_2 x_{t-1}$  of the right side (Hendry and Juselius, 2000) in order to stay in the following form:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta x_t - \alpha_2 (y_{t-1} - \beta_1 x_{t-1} - \beta_0) + \varepsilon_t \tag{11}$$

Being  $\alpha_1 = b_2$  ,  $\alpha_2 = (1 - b_1)$  ,  
 $\beta_1 = (b_2 + b_3) / (1 - b_1)$  y  $\alpha_0 + \alpha_2 \beta_0 = b_0$  .

Models such the above explain the growth in  $y_t$  for the growth in  $x_t$  and the passed imbalance between levels.

<sup>34</sup> 'Error-correction' mechanisms (ECMs).



The magnitude of the imbalance is represented by  $(y_{t-1} - \beta_1 x_{t-1} - \beta_0)$  and the velocity of adjust to its balance by  $\alpha_2$  (Hendry & Juselius, 2000).

To understand the former equation, initially Granger introduces the concept of cointegration where there is a genuine relation.

Then, Engle and Granger (1987) points that the mechanism of errors correction and the cointegration are two names of the same thing (Hendry & Juselius, 2000); Therefore, the relation between the analysis of the cointegration and the mechanism of errors correction could be analyzed from the perspective of Engle and Granger (1987). In this focus, is supposed that there is a relation of long term between  $y_t$  and  $x_t$ , being both  $I(1)$ , the model to estimate with simple information is represented as:

$$y_t = \beta x_t + u_t \tag{12}$$

A relation of long term between the variables implies that the lineal combination of the same should be  $I(0)$ , in other words,  $u_t$  should be stationary. To clarify  $u_t$  of the former equation is obtained the following equation.

$$y_t - \beta x_t = u_t \tag{13}$$

The matrix form of the former equation is represented as:

$$(1 \quad -\beta) \cdot \begin{pmatrix} y_t \\ x_t \end{pmatrix} = u_t \tag{14}$$

If the vector  $(1 \quad -\beta)$  achieve that  $u_t$  be stationary then it is denominate cointegration vector.

In other words, if  $y_t$  and  $x_t$  cointegrate,  $CI(1,1)$ , then the cointegration vector  $(1, -\beta)$

Allows that the deviations of  $y_t$ , in respect of its trajectory of the long term be  $I(0)$ . Such situation require that the information of the variables to be of time series. A model or a mechanism of error correction (ECM) could be raised (Engel & Granger, 1987) in the following form:

$$\begin{aligned} \Delta y_t &= \alpha_1 (y_{t-1} - \beta \cdot x_{t-1}) + \varepsilon_{1t} \\ \Delta x_t &= \alpha_2 (y_{t-1} - \beta \cdot x_{t-1}) + \varepsilon_{2t} \end{aligned} \tag{15}$$

Where

$\varepsilon_{1t}$  and  $\varepsilon_{2t}$  are withe noise or random crashes which could be correlation.

$\alpha_1$ ,  $\alpha_2$  and  $\beta$  are positive parameters.

In a balance situation (of long term), in other words when  $y_{t-1} = \beta \cdot x_{t-1}$ , the parameters ( $\alpha_1$  and  $\alpha_2$ ) take the value of cero and therefore the first differences to the random crashes ( $\Delta y_t$  and  $\Delta x_t$ ) will be the same that the random crashes ( $\varepsilon_{1t}$  and  $\varepsilon_{2t}$ ).

However if  $y_t$  and  $x_t$  Are deviated of the balance to long term in the current period, the term error correction ( $\alpha_1$  and  $\alpha_2$ ) Is different of cero each variable partially adjust to reestablish the relation of balance. Therefore,  $\alpha_1$  and  $\alpha_2$  measure the velocity of adjustment of the short term dynamic and its relation of long term.

In this way, for example, while  $\alpha_1$  is bigger, bigger will be the answer of  $y_t$  to the deviation of the former period to its balance of long term. Otherwise, while  $\alpha_1$  is minor,  $y_t$  is a little bit sensible to the balance error of the former period.

If both parameters are equal to zero then the balance relation of long term will not be in the model stopping to be a model of error correction or cointegration.

It is possible to obtain different specification of the ECM in the moment to suppose that have intercept: or well through a VAR are added different lags of the first differences of the series, in such form that the generalized form of the ECM is:

$$\begin{aligned}\Delta y_t &= \mu_1 + \phi_1(L)\Delta y_{t-1} + \Omega_1(L)\Delta x_{t-1} - \gamma_1[y_{t-1} - \alpha x_{t-1}] + \varepsilon_{1t} \\ \Delta x_t &= \mu_2 + \phi_2(L)\Delta y_{t-1} + \Omega_2(L)\Delta x_{t-1} - \gamma_2[y_{t-1} - \alpha x_{t-1}] + \varepsilon_{2t}\end{aligned}\quad (16)$$

The election of the optimum quantity of the lags in the above equations could be established in analogue form to an VAR, selecting the order  $k$  that minimize the Akaike criterion or the Schwarz criterion, the error of the final prediction and the information criterion of Hannan-Quinn. For relation effect of the present research the relation of long term stay established by the following equation:

$$LPIB_t = \beta_1 LIED_t + \beta_2 LTI_t + U_t \quad (17)$$

One of the techniques to obtain the relation of balance is through the dynamic specification which starts from the equation (17).

According to the model of error correction exposed in the equation (11), the former relation could be established as:

$$\Delta LPIB_t = \alpha_1 \Delta LIED_t + \alpha_2 \Delta LTI_t + \gamma U_{t-1} + \varepsilon_t \quad (18)$$

### The product, the foreign direct investment and interchange terms in a stable model of long term

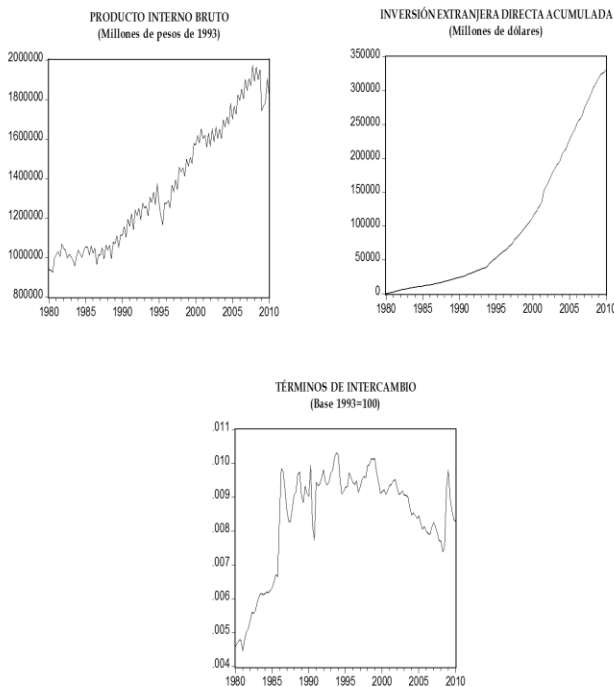
The specification of the long term model between the PIB, the IED and the TI represented in the equation (17) was formulated, in a logarithm form, from the established in the in the theoretical framework of the research. The hypothesis that it search to prove through the estimation of such model is the following: the economic growth in Mexico, even do is positively influence by the capitacion of foreign direct investment, it is maintain with moderate variations because the interchange terms deterioration. The representative variables in the model are the PIB for the economic growth, the IED as representative of extern capitals flows and the relation of the TI represented by the quotient between the Index of Prices to the Imports (IPIM) and the Index of Prices to the Exports (IPEX). The information was obtained of the internet official web sites of the National Institute of Geographic Statistic and Informatics (Instituto Nacional de Estadística Geografía e Informática INEGI) and the Bank of Mexico (Banxico). The type of information is sample with trimestral frequency understood between the first trimester of 1980 and the first trimester of 2010.

To start the empiric analysis is necessary to identify the behavior of the series that are part of the model.

For that, the figure 1 present the evolution of the variables where is observed that the PIB, the IED and the TI present a higher tendency similar during the period of study; although the behavior of the TI are very irregular. Additionally, is possible to observe an existent relationship between the PIB and the IED and TI variables: as much for the PIB, the IEDP and the TI seems to be a positive relation.

In order to know if the series could be related in a statistic model, is necessary use statistics proves that show the order of the integration of the previously described series. For such reason, and then presents the results of the tests of unitary root (chart 1) of the series in logarithm form which are presented in the chart 1.

Evolution of the IED, the PIB and the TI in Mexico.



Graphic 1

Pruebas de raíz unitaria

Variable	ADF		PP		KPSS	
	estadístico	Prob	estadístico Aj.	Prob	LM <sub>estadístico</sub>	Valores críticos asintóticos
$LPIB_t$	0.1742	0.9698	0.7517	0.82	1.2885	
$\square LPIB_t$	6.0266	0.00*	25.755	0.00*	0.0715	0.739 al 1%
$\square^2 LPIB_t$	8.3389	0.00	135.94	0.00	0.1532	
$LIED_t$	2.6580	0.08	4.5401	0.00	1.3114	0.463 al 5%

$LIE$	13.750	0.00	16.878	0.00	0.5544	
$D_t$	53	00*	28	00	77	
$\square^2 LI$	14.457	0.00	12.487	0.00	0.5012	
$ED_t$	87	00	50	00	72	
$LTI_t$	6	39*	27	25*	74	
$\square LTI_t$	7.1548	0.00	9.2492	0.00	0.5189	0.347 al 10%
$I_t$	51	00	52	00	80	
$\square^2 LT$	8.9218	0.00	63.895	0.00	0.1814	
$I_t$	02	00	41	01	52*	

Nota. Las pruebas ADF y PP tienen como hipótesis nula la existencia de raíz unitaria y la KPSS la estacionariedad de la serie.

Chart 1

The results of the unitary root test of the above chart are evaluated to 5% of significance and points that, according to the ADF test, the series LPIB and LIED are stationary in first difference and the LTI series is stationary in first difference; the PP test shows that only the logarithm of PIB is stationary in first difference while the PIB and TI logarithms are stationary until the second difference. Therefore, and given the heterogeneity of the test's results, is possible to accept the results of the ADF test because its results are congruent with the behavior to long term of the representative series of the model. Now, in order to know the random crashes effect that IED and the TI exert over the PIB, first it should determinate the number of lags that are need in the VAR estimation.

For such purpose, presents in the chart 2 the reason studies of the plausibility (LR), final error of prediction (FPE) and the criteria of Akaike information (AIC), Schwarz (SC) and Hanana-Quinn (HQ). In named chart is showed with asterisk the number of lags that should be include in the VAR, having as result that in all the statistics is pointed that should be include until five lags.

Statistics of test to identify the number of lags in the VAR

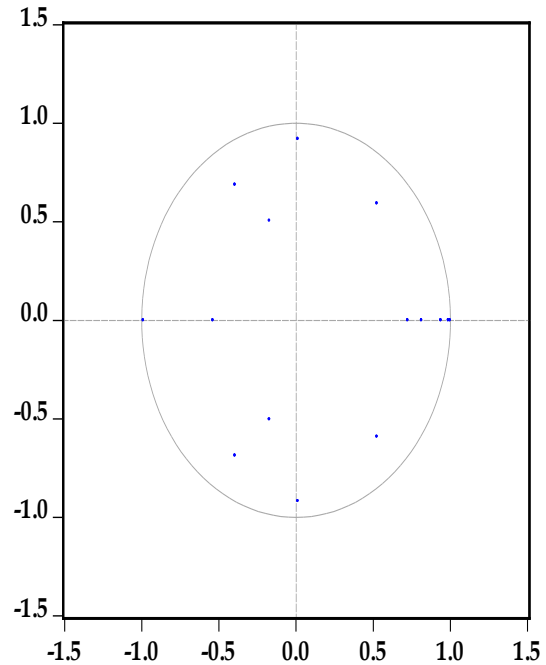
La g	LogL	LR	FPE	AIC	SC	HQ
1	663.734 3	NA	1.86e- 09	-	-	-
2	712.071 1	91.54057	9.28e- 10	-	-	-
3	725.271 8	24.29850	8.62e- 10	-	-	-
4	754.734 4	52.66776	6.01e- 10	-	-	-
5	796.687 4	72.7680 1*	3.36e- 10*	13.30420 *	12.21807 *	12.86346 *
6	804.453 4	13.05788	3.45e- 10	-	-	-
7	810.719 8	10.20370	3.64e- 10	-	-	-
8	814.616 5	6.138167	4.01e- 10	-	-	-

**Chart 2**

The estimation of the VAR(5) model should accomplish with a condition of convergence to the balance. In other words, the model should be stable or follow a stationary process in the long term, meaning that the roots that solve the determinant of the matrix should be minor to one in absolute terms. This is observed in the unitary circle of the figure 2, in which is observed that all the roots that give solution to the model are found inside, that's why they are minor to one in absolute values.

Characteristic roots that guaranty the stability in the VAR(5)

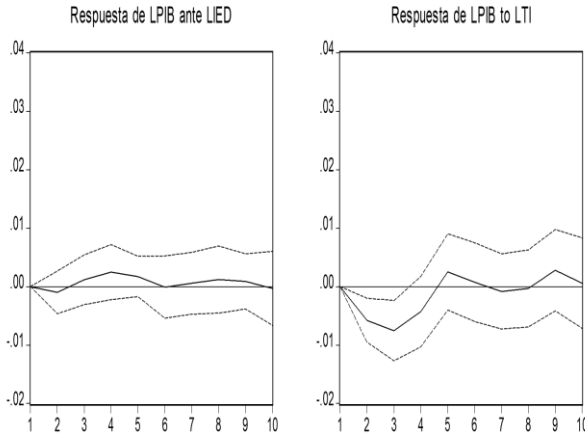
Raíces inversas que solucionan al polinomio característico



**Graphic 2**

Additionally, to estimate the VAR(5) model and identify the effect that cause the random crashes of the IED and TI logarithms over the PIB logarithm it has the following observation of the figure 3. The perturbations in the interchange terms cause a destabilization in the long term in the product levels; while those random crashes in the foreign direct investment flows do not destabilize in a big way to the intern product.

Impact of random crashes of the LIED and LTI over LPIB.



Graphic 3

Furthermore, the application of cointegration analysis in the study of economic growth and its relation with the productive extern capital flows and the relative prices of the commercial interchange throw interesting results. For one part, to apply the test of the specific trace in the equation (8) in a level of significance of the 5% is obtained three cointegrated vectors; such results are observed in the next chart:

Test of trace in the model VAR(5).

Hipótesis No. de ecuaciones	Valor propio	Valor Estadístico crítico		
		De la traza	0.05	Probabilidad**
Ninguno *	0.156329	40.44954	29.79707	0.0021
Al menos 1 *	0.109759	20.90041	15.49471	0.0069
Al menos 2 *	0.063381	7.530102	3.841466	0.0061

Chart 3

However, because the objective of study is to know the relation between the PIB as endogenous variable and the IED and the TI as exogenous variables, the test of cointegration of Johansen throw the follow cointegrated equation.

$$LPIB_t = 0.214663LIED_t - 0.172359LTI_t$$

The cointegrant vector points that for each 1% of increase in the IED the PIB will increase, in average, 0,21% while if the TI increase 1% the PIB decrease 0.17% in average.

Finally, the statistic justification to use LIED and LTI as exogenous variable in the model is possible to see in the application of the causality test of Granger with 5 lags, which throw the follow results of the chart 4.

Causality test of Granger.

Hipótesis Nula:	F-	
	Obs. estadística	Probabilidad
LIED no Causa Granger a LPIB	116 3.70660	0.00395
LTI no Causa Granger a LPIB	116 5.62954	0.00012

Chart 4

In both cases the null hypothesis is rejected because the probability levels of the F statistic are minor to 1% if is consider a level of significance of the 5%. Therefore, the LIED and LTI variables are approved to be specified as exogenous variables in the cointegrant equation of LPIB.

**Conclusions**

Since the commercial opening in the eighties, the economic policy in Mexico has searched to cement the economic growth about the extern capital flows, necessities to complement the domestic investment in productive projects.

This, in effect have carries positive results to the economic growth. However, because the deterioration of the interchange terms, the competitive of the Mexican economy have been decreasing in front of the international competence, pointing that in the exterior produce with lower prices that in our country.

This means that the countries which have commercial interchange with Mexico have more efficient economies.

The presented model and estimated in the present research realize the commented before: The flows of extern direct investment positively influence in the level of national product; otherwise the deterioration and instability in the interchange terms negatively impact to the economic growth and also, destabilizes it.

Although the search of the economic efficiency implies more competitive prices for the Mexican economy, is recommendable generated public policies guided to support the wells and services production with the big aggregate value.

For the above, the competitively should be based in better and new products which could be offer in the international markets.

In that sense, the productive sector in Mexico should be linked to programs of technologic innovation which make reference to the proposal of Solow (1956) in order to generate better and new products in the international market. Posterior researches to this respect should board proposes to the national prices of the economy be more competitive in national and international level. The consequence of the above, and according to the presented model of this work, is reflected in stability about the economic growth in our country.

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