Article **ECORFAN Journal**
June 2016 Vol.2 No.2 32-45

An exogeneity analysis for Mexico's foreign trade and economic growth

BALTAZAR-ESCALONA, Juan Carlos*†

UAEM

Received January 28, 2016; Accepted June 01, 2016

Abstract

This work is a study of exogeneity between foreign trade and economic growth of Mexico for the quarterly period from 1980 to 2012. Many studies investigating the relationship between trade and growth omit the exogenous behavior of the first to be assumed as endogenous. This paper intends to carry out such tests to elucidate the correct functional form. That is to say determine which variable is exogenous (independent) and which endogenous (dependent). According to the results of exogeneity, it is checked, on the one hand, there is insufficient evidence of compliance with export-led growth approach to Mexico. On the other hand, neither a case of import-led growth is seen. That is, growth induced by foreign trade. Based on the above, exports, obviously, would be behaving as a function of product US and Mexico product. In contrast, imports mainly behave as a function of the foreign product local product. These findings raise the Mexican foreign trade heavily dependent on US product and for the economic growth of Mexico itself and for the period considered this behavior has been maintained and accentuated.

Trade liberalization, foreign trade, economic growth and exogeneity

Citation: BALTAZAR-ESCALONA, Juan Carlos. An exogeneity analysis for Mexico's foreign trade and economic growth. ECORFAN Journal-Republic of Peru 2016, 2-2: 35-45.

* Correspondence to Author (email: cbaltazare@uaemex.mx)
† Researcher contributing first author.

Introduction

Countless researches have centered on analyzing the relationship between foreign trade and economic growth. They have found that growth can be achieved by placing greater emphasis on export growth. However, their results have been limited to analyzing whether they are associated or in which direction they are caused. While these two statistical techniques represent a valid way of analyzing this relationship they do not allow us to clarify how these two variables are impacted. In other cases, it is used as an argument that economic openness leads to the growth of countries by reducing their trade barriers. In this respect, since the investigations were not sufficiently conclusive, there was a strong debate in favor of or against this measure. This process of trade liberalization was driven by the well-known Washington Consensus from the 1990s.

Under the context of the previous process, Mexico used in the early 1980s a profound structural transformation of its economy. This involved, in part, the initial opening of the economy with its entry into the General Agreement on Tariffs and Trade (GATT) in 1986, now the World Trade Organization (WTO); and its consolidation with the entry into force in 1994 of the North American Free Trade Agreement (NAFTA) and that prevails until today. The fact that foreign trade does not affect the growth of the economy has important implications for a country like Mexico that is constantly using its export sector or the gradual reduction of tariff barriers to promote economic growth. The paper is organized as follows: after the introduction, in the second part, a brief empirical review is presented; In the third, the objectives and hypotheses are commented; In the fourth, the Hausman contrast is explained as the methodology used and the model is specified; In the fifth, the results are described.

In the sixth, we discuss the economic implications of the results obtained and in the seventh, we conclude.

An empirical review

In general, the studies that validate the traditional export-led growth hypothesis, as well as those based on the open trade policy, have been carried out without the corresponding exogeneity tests.

Initially, research has included correlation tests such as the classical studies developed by Michaely (1977), Balassa (1978), Tyler (1989) and Kavoussi (1984) and Granger's causality tests (Jung and Marshall, 1985; Chow, 1987; Bahmani-Oskooee et al., 1991). Other studies have focused on measuring the effect of open trade policy on per capita product growth such as cross-sectional models (Sachs and Warner, 1995; Wacziarg and Welch, 2003). In response to the latter, new studies more skeptical, showed that these models present errors in the commercial policy indicators used, as well as conceptual defects (Rodriguez and Rodrik, 2000). The first models, on the one hand, do not establish a functional relationship[1] Or show an ambiguous causality;[2]

[1] Michaely (1977) finds a high correlation between exports and GDP for a sample of 41 countries in the period 1950-53; Balassa (1978) chooses a sample of 10 countries arriving at the same result that Michaely for the period 1960-73; Tyler (1989) shows this correlation for a sample of 55 middle-income developing countries and 49 non-OPEC developing countries in the period 1960-77; Kavoussi (1984) finds the same when analyzing a heterogeneous sample of 73 countries in the period 1960-78.

[2] Jung and Marshall (1985) finds that of 37 countries under study in only four there is a causal relationship of trade to the product; Chow (1987) finds that of the eight countries that covered his study in six there is a causal relationship in two directions; Bahmani-Oskooee et al. (1991) finds a causal relationship of exports to the product and in other cases in both directions..

ISSN-On line: 2414-4819
ECORFAN® All rights reserved.

On the other hand, with respect to the latter they may present specification errors or simply omit the problem of endogeneity of foreign trade[3] respectively. In fact, the respondents also do not emphasize this last point.[4]

For this reason, it is imperative that, before making judgments or estimating any regression to measure the effect of foreign trade on economic growth, the exogeneity tests must first be carried out. In this article it is considered that within the foreign trade the commercial opening constitutes a component of public policy.

Objetives and hypotesis

The objectives and hypotheses are explained and described below:

General

Analyze that growth models where the product appears as a function of foreign trade present specification errors.

Where the first concept refers to GDP and the second refers to exports, as well as imports of goods.

Specific

To carry out the corresponding exogeneity tests to show, on the one hand, that both exports and imports present problems of endogeneity in growth models. On the other hand, in these functional relations, validate the exogenous condition of the product (whether local or foreign) to stimulate Mexico's foreign trade.

Hypotesis

The hypotheses to be investigated, according to Hausman's exogeneity tests, can be considered where:

The hypothesis is tested:

Null: The product (local or foreign) is a variable that behaves as endogenous (or dependent) or correlates with the error term.

Against the hypothesis:

Alternative: The product (local or foreign) is a variable that behaves as exogenous (or independent) or is not correlated with the error term.

If one accepts the first hypothesis rejecting the second, it means that economic growth measured by GDP can be induced by foreign trade. That is to say, in this sense, the export-led growth approach or, if applicable, the import-led growth approach would be fulfilled.

On the other hand, if the first hypothesis is rejected by accepting the second, it implies that foreign trade is determined by the product (whether local or foreign). In this case, none of the two approaches mentioned in the previous paragraph would be fulfilled.

[3] Sachs and Warner (1995) construct a dichotomous opening variable composed of five commercial policy criteria and conclude that the countries with the greatest economic opening tended to grow faster than the most protected during the 1970-1989 period. Wacziarg and Welch (2003) find that the dichotomous variable of Sachs and Warner is sensitive to the 1990-1999 period, concluding that trade liberalization policies increase the degree of openness by positively impacting economic growth.

[4] Rodriguez and Rodrik (2000) perform a reestimation of the cross-sectional models, finding that the different indicators of trade policy are weak indicators or are more related to poor economic performance, suggesting even address protectionism.

ISSN-On line: 2414-4819
ECORFAN® All rights reserved.

Methodology

Time series data are used for exports and imports of goods in aggregate, as well as the GDP of Mexico and the United States deflated by inflation. The observations are quarterly for the period 1980-2012. The methodology used for this analysis of variables is Hausman contrast exogenity tests.

The contrast of Hausman.

In general, the model can be modeled (Hausman, 1978, Engel et al., 1983, Kwan and Kwok, 1995):

$$DY_t = \beta DX_t + z_t\gamma + \varepsilon_t \quad (1)$$

Where zt is a vector consisting of other variables such as wt and the lagged values of variable X and variable Y. Assuming that there is a series of instruments Zt ∈ It, including zt, DXt can be estimated as $\hat{\mu}_t = Z_t \hat{\pi}$, that is, From the regression

$$DX_t = Z_t \hat{\pi} + \hat{\mu}_t \quad (2)$$

By least squares method. Accordingly, if ε and η are jointly homoscedastic (under the null hypothesis of exogeneity), a test for the weak exogeneity of DXt for β is to estimate equation (1) by incorporating $\hat{\mu}_t$ as an additional regressor and then testing its significance. To prove the non-variability of β to changes in DX requires proof of superexogeneity. For this, it must be included $\hat{\mu}_t$ as $\hat{\mu}^2_t$ in equation (1) and prove its overall significance.[5] Taking as a reference the models of trade openness and economic growth, this methodology can be applied by analyzing whether a variable x is exogenous or, if appropriate, endogenous.[6]

This requires the incorporation of one or more additional variables known as instrumental. An instrumental variable z may or may not be highly correlated with this x variable to be tested, but should not be correlated with the error term. For example, be two variables x and y, within which you want to know their exogenous nature of one of the other. In this sense, the following equation is taken as the general model (Pérez, 2006: 424-426)

$$y = \beta_0 + \beta_1 x + u_{t1} \quad (3)$$

In equation (3) it is assumed that the variable (x) may be correlated with the error term of the dependent variable y, which may be giving rise to an endogeneity problem. The objective is then to test whether x is exogenous or actually endogenous in the equation. For this purpose, an auxiliary regression is first estimated with the purpose of estimating a residual variable as an instrument:

$$x = \alpha_0 + \alpha_1 z_i + \mu_t \quad (4)$$

Where z is the chosen instrumental variable i. In this sense, the Hausman test7 is equivalent to contrasting the individual significance of (u), which refers to the residuals of the variable x over its instrumental variable used z.8 To verify the exogeneity of the variable x, we estimate the equation (4). By incorporating the estimated residual variable in equation (3) asinstrumental utilizada z.[8] In order to verify the exogeneity of the variable x, the equation (4) is estimated by incorporating the estimated residual variable in equation (3) as:

$$y = \beta_0 + \beta_1 x + \beta_2 \hat{u} + u_{t2} \quad (5)$$

[8] The estimated waste variable can be expressed as: $\mu_t = x_t - (\hat{\alpha}_0 + \hat{\alpha}_1 z_t)$.

ECORFAN® All rights reserved.

If the coefficient of the estimated residuals of equation (5) is statistically significant, the variable x is considered endogenous. Otherwise, exogenous. Therefore, if x does not correlate with the error term, it will be justifiable to estimate this equation by the ordinary least squares (OLS) method. That is, it means that the equation is well specified. If it is correlated with the error term it means that this equation cannot be estimated or is poorly specified. This leads us to argue in particular that in the models of cross-cut growth by openers, one of the assumptions of the classical linear regression model has been overlooked.[9]

According to Kennedy (1997: 58), an important property is that observations of the independent variable must be considered fixed in repeated samples.10 that is, the sample can be repeated with the same independent variables.

The formulation of a model of simultaneous equations would constitute a violation of this assumption. This means that there can be no dual functionality between foreign trade and growth. In this sense, the most probable analysis is the uniecuacionales and time series models, using the methodology of Box-Jenkins.[11]

Model

The objective of using an instrumental variable is not to assume the exogenous role of foreign trade as argued in the previous studies since it is assumed endogenous. That is, to demonstrate that a model of product growth in terms of exports or total imports is incorrectly specified. For this, the equation of exports, as well as of imports, is analyzed by analyzing the exogeneity of the product. In fact, a variable that is not related to the previous variables is used as instrumental variable. That is, a totally arbitrary variable is chosen in the case of Mexico and the United States as the variable that fulfills this condition. Based on equation (4), the residual variable is estimated from GDP (local and foreign) as a function of the instrumental variable (z):[12]

$$PIB = \beta_0 + \beta_1 z + \mu_{1t} \quad (6)$$

In order to verify the exogeneity of this GDP, it is estimated, on the one hand, the total exports equation (XT), incorporating the previously estimated residual variable:

$$XT = \beta_0 + \beta_1 PIB + \beta_2 \hat{\mu} + \mu_{2t} \quad (7)$$

On the other hand, the total imports (MT):

$$MT = \beta_0 + \beta_1 PIB + \beta_2 \hat{\mu} + \mu_{2t} \quad (8)$$

Kwan and Kwok (1995) test the weak exogeneity and superexhaustion of exports for the case study of China. They determine the optimal number of lags for the growth rate of output and exports.

[9] These models refer to the per capita product as a function of different opening trade policy indicators and in some cases the least squares methodology is used in two stages with instrumental variables to soften the problem of endogeneity and without correcting it..

[11] According to the Box-Jenkins methodology, in time series models, a variable such as Yt can be explained by its past or lagged values, and stochastic error terms. According to this specification, the ARIMA models are also called aortic models because they are not derived from any economic theory. While the models of simultaneous equations are based on economic theories (Gujarati, 2003: 811).

[12] In the estimation of the residual variable of equation (4) one can use the own lagged value of GDP as part of the instrumental variable z as independent variables.

ISSN-On line: 2414-4819
ECORFAN® All rights reserved.

In this case, they estimate the growth rate of the product as a function of one, two and three lags of the product itself and the growth of exports, as well as the estimated residual variable. They also include the growth rate of the labor force and investment as a proportion of GDP. All its variables are taken in first differences.

Results

Following the described procedure, the exogeneity tests were applied for a period of more than three decades of commercial opening to analyze how these variables have been related in this period. All economic variables were adjusted for inflation. These were estimated in logarithms and first differences to avoid problems of stationarity. The value of the t statistic is in parentheses. The significance is: () ***, 99%; () **, 95%; () *, 90%. The abbreviations n. S. Are not statistically significant.

It begins by reporting the results regarding the analysis of exogeneity of the product of Mexico and later of the product of the United States with respect to exports.

Exports

The following equation tests the exogenous role of the local product in relation to exports:

$$\Delta \log(XT) = 0.02 + 0.84\Delta \log(PIB) - 2.09E-06\hat{\mu} \quad (9)$$

(1.85)* (3.57)*** (- 0.55) n. s.
R^2 = 0.11 D. W. = 2.28 n = 1980:2 – 2012:4

In contrast to equation (9), in (10) the exogenous role of the foreign product is tested:

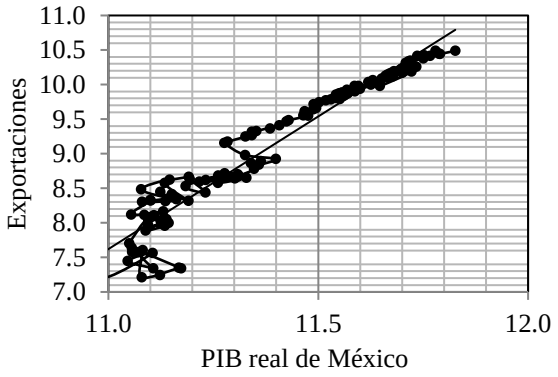
$$\Delta \log(XT) = 0.002 + 3.07\Delta \log(GDP) - 9.74E-05\hat{\mu} \quad (10)$$

(0.14) n. s. (2.08)*** (- 0.17) n. s

R^2 = 0.04 D. W. = 2.48 n = 1980:2 – 2012:4

Equation 9 was estimated considering the constant, the GDP of Mexico that is the variable to be tested and the residue variable that contains the arbitrary instrumental variable. As can be seen the coefficient of the residue variable is practically zero and statistically not significant (0.58). This result, according to Hausman's evidence, would indicate that Mexico's GDP is exogenous. That is, in another sense, it means that it cannot be specified as a dependent in terms of exports.

However, the dispersion graph 1 shows that while exports and GDP appear highly correlated, their effect on the former can be weak to stimulate sales abroad. These goods are mainly concentrated in: manufacturing exports; Agriculture, forestry and fisheries; and extractive. From Graph 1, between the two variables, there is not an approximately linear relationship, especially in the early years of the 1980s. This means that for each percentage increase in GDP, in those years, there is no significant positive effect on export growth. This behavior can be modeled using dichotomous variables identifying the years to capture structural changes



Graphic 1 Mexico. Exports and local product (1980: 1-2012: 4) *Source: Estimate based on INEGI*

ECORFAN® All rights reserved.

Kwan and Kwok (1995), for example, arrive at a different result when analyzing the case of China for the period 1952-1985. Applying evidence of weak exogeneity and superexogeneity, in Engel and Hendry's sense, they find that exports are exogenous in their growth equation, thus validating the export-led growth hypothesis. In contrast, Blanco (1994) and Aspe (2005) emphasized that the best way for a country like Mexico to resume its growth - making it more attractive abroad and achieving its economic efficiency - was through the outward-oriented development model through openness commercial.

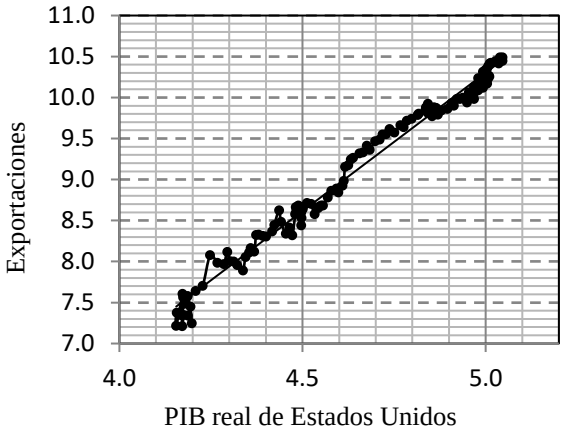
Other authors such as Tornell et al. (2004) considered that GDP growth could have been lower without trade liberalization. Kose et al. (2004) state that while the growth of the country's economy declined, it did better after pre-NAFTA. Even the United States Congress (2003) argues that the increase of Mexican exports to the United States contributed to the increase in Mexico's GDP.13 the common denominator of this literature is to argue that exports have an impact on the local product omitting the endogenous problem of exports as can be seen from Graphic 1.

The result from equation (8) shows that the coefficient of the residual variable is practically zero and statistically non-significant (0.86). This result indicates that foreign GDP is exogenous.

That is, the foreign product performs as an exogenous or independent variable with respect to Mexico's exports. In this regard Blecker (1996) considered that in the absence of an internal stimulus to grow, Mexico, sought the promotion of exports. Nevertheless, it indicated that these cannot serve as motor of growth, in the meanwhile, the exchange policy operates with opposite purposes.

He points out that with the devaluation, while stimulating exports and allowing an improvement in the trade balance, it is not possible to promote a rapid expansion of the economy, or to operate export-led growth. Weisbrot et al. (2004) in replicating a study carried out by the World Bank show that NAFTA rather reduced Mexico's economic growth. According to this body, NAFTA increased per capita output in Mexico by four percent at the end of 2002. For the authors, this was one percent.14

From the results of equation (10) and the scatter plot 2 it can be seen that exports and GDP of the United States are highly correlated, approximately, linearly. In contrast to the graph (7), a strong dynamic effect is observed here that foreign product exerts to stimulate foreign sales, particularly of manufacturing goods. In economic terms, it means that for each percentage increase in foreign GDP, exports will increase more than proportionally. Conversely, this behavior shows that, in the face of a contraction of this product, exports are contracted procyclically.



Graphic 2 Mexico. Exports and foreign product (1980:1-2012:4) *Source: Estimate based on INEGI and Bureau of Economic Analysis*

ECORFAN® All rights reserved.

Imports

When analyzing the role of the product in Mexico's total imports, it is certainly expected to confirm its exogenous relevance as an important determinant of import goods. However, the results found lead to a very different interpretation. This means that it can lead to a significant re-specification of the import function by the way it is traditionally defined.

The study also requires testing the exogenous role of the local product:

$$\Delta\log(MT) = 0.01 + 1.15\Delta\log(PIB) - 1.4E - 06\hat{\mu} \quad (11)$$

(0.92) n. s. (4.43)*** (- 0.35) n. s.

$R^2 = 0.16$ D. W. = 1.57 n = 1980:2 – 2012:4

Finally, the exogenous role of foreign product in imports is tested:

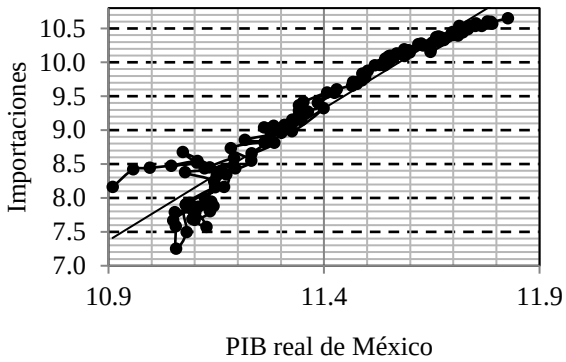
$$\Delta\log(MT) = -0.002 + 2.70\Delta\log(GDP) - 0.002\hat{\mu} \quad (12)$$

(- 0.11) n. s. (1.61) n. s. (0.33) n. s.

$R^2 = 0.03$ D. W. = 1.96 n = 1980:2 – 2012:4

In equation 11 where the GDP of Mexico is tested, the coefficient of the residuals is zero and statistically non-significant (0.73). This result would indicate that the GDP is exogenous. That is, according to this, it has an effect on imports. When performing other tests a variation in the significance of the coefficient of the residues is observed. The Wald test shows this situation. In this case, since the critical value of the F test is slightly greater than the test statistic, with a significance level of 99%, Mexico's GDP is not exogenous.15 According to this it would indicate that it is dependent or endogenous. Despite this finding cannot be considered the existence of a case of import-led growth.16 That is, import-induced growth.

As evidence of the above, it can be seen from the scatter plot 3 that the correlation between imports and GDP in Mexico is not approximately linear but rather is a ratio in parabolic form. This finding may be indicating the weak role of the local product to stimulate external purchases. These are classified as intermediate consumption goods, capital goods and final consumer goods. The shape of Figure 3 shows that despite a larger percentage increase in local output, the effect on imports growth is relatively low.



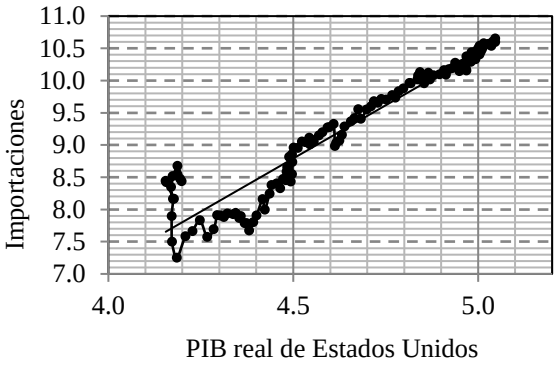
Graphic 3 Mexico. Imports and local product (1980: 1-2012: 4) *Source: Estimate based on INEGI*

The study by Bosworth et al. (1993) points out that GDP may be related to a larger amount of imports through a greater inflow of capital goods, for a country like Mexico. The analysis of causality of Cuadros (2000) of the impact of the commercial opening in Mexico in the period 1983-1997 seems to indicate this situation. First, it does not find a causal relationship between exports and output. Second, the growth of aggregate output is caused by the growth of total imports.17 Tables show that although trade liberalization influenced the product, it did so through imports, constituting itself as a determinant of economic growth. This result of Tables, not being based on impact coefficients, can hardly be considered as a case of growth induced by imports.

ECORFAN® All rights reserved.

Pacheco López (2005) suggests the same situation. That is, Mexico faces an external restriction on growth. This is due to the fact that the income elasticity of the demand for imports tends to grow faster than the income elasticity of demand for exports tends to grow. According to the foregoing, this situation was further accentuated by the entry into force of NAFTA. The result obtained by equation (11) where the United States GDP is tested, it can be seen that the coefficient of residues is zero and statistically non-significant (0.38). This result confirms the exogeneity of foreign GDP. This means that unlike the previous result, Mexico's imports as an endogenous variable are rather determined by foreign GDP as an independent variable.

Scatter plot 4 shows that the foreign product itself plays a fundamental role in stimulating Mexico's own imports. According to this graph, for each percentage increase in the foreign product, external purchases will increase more than proportionally. This means that Mexican imports are compromised by a contraction of US economic activity, unlike what happens in Graphic 3.



Graphic 4 Mexico. Imports and foreign product (1980: 1-2012: 4) *Source: Estimate based on INEGI and Bureau of Economic Analysis*

In this regard, Lederman et al. (2005) find convergence between the US and Mexico economies, which is favored by NAFTA. Estimating a structural model of time series for the period 1961: 4-2002: 4, according to its results, non-unilateral trade liberalization had a significant positive impact on the speed of convergence. However, the estimated coefficients for each of its dichotomies of both unilateral and non-unilateral trade liberalization in Mexico are all coefficients close to zero. These coefficients emphasize that they may be showing strong problems of endogeneity.

Economic implications of the results obtained

Using the exogeneity analysis to determine the role of GDP in relation to foreign trade has important economic implications for an economy such as Mexico. That is, by the way their export and import functions should be defined. The results presented in equations (9) and (10) of the previous section show, on the one hand, that Mexican exports act according to the local product as well as the foreign product. By focusing solely on the product, it would be incorrect to specify them only in terms of the foreign product as traditionally assumed (Peñaloza, 1988; Tapia and Cervantes, 1988). Firstly because they are specified according to the foreign product; Or as a function of the local product. On the other hand, contrary to the expected logic, Mexican imports are manifested as a function of foreign product. This leaves between said that would occur with the local product if it restrained imports. Some studies have traditionally specified imports as a function of local GDP (Galindo and Cardero, 1999; Moreno Brid, 2002). Even using industrial indices, as in the study of Garcés (2008) does not include the index of local industrial production in the export function; while in this same study, imports are specified as a function of the local production index.

ECORFAN® All rights reserved.

The analysis of exclusion and weak exogeneity of Garces does not allow to determine the exogenous or endogenous role of these indices. According to the exogeneity tests, the resulting functional relationships would be as follows:

$$X_t = f(\overset{+}{PIB}, \overset{+}{GDP}) \quad (13)$$

$$M_t = f(\overset{+}{GDP}) \quad (14)$$

Where X and M are total exports and imports of goods; GDP and GDP are the local product (Mexico) and foreign (United States) respectively.

From functions 13 and 14, the growth of foreign economic activity would be expected to stimulate growth not only of exports but of total imports. In this sense, with the increase in imports, an increase in local economic activity would be expected, creating a positive feedback effect on Mexican exports.

The above results can be contrasted with the tests of causality in the contrast of Granger (1969). The test was performed with the variables in logarithms and in first differences including up to a maximum of four lags:

$$X_t = \sum_{i=1}^{4} \delta_i PIB_{t-i} + \sum_{i=1}^{4} \lambda_i X_{t-j} + \varepsilon_{2t} \quad (15)$$

$$X_t = \sum_{i=1}^{4} \alpha_i GDP_{t-i} + \sum_{i=1}^{4} \beta_i X_{t-j} + \varepsilon_{1t} \quad (16)$$

$$M_t = \sum_{i=1}^{4} \delta_i PIB_{t-i} + \sum_{i=1}^{4} \lambda_i M_{t-j} + \varepsilon_{2t} \quad (17)$$

$$M_t = \sum_{i=1}^{4} \delta_i GDP_{t-i} + \sum_{i=1}^{4} \lambda_i M_{t-j} + \varepsilon_{2t} \quad (18)$$

$$PIB_t = \sum_{i=1}^{4} \delta_i GDP_{t-i} + \sum_{i=1}^{4} \lambda_i PIB_{t-j} + \varepsilon_{2t} \quad (19)$$

The results of the causality tests are shown in Table 1:

Variables		Dirección de causalidad		
		Rezagos incluidos		
		2	3	4
1	X vs. PIB	PIB→X	PIB→X	No hay causalidad
2	X vs. GDP	GDP→X	GDP→X	GDP→X
3	M vs. PIB	M→PIB	M→PIB	M→PIB
4	M vs. GDP	GDP→M	GDP→M	GDP→M
5	PIB vs. GDP	No hay causalidad	GDP→PIB	GDP→PIB

Table 1 Granger causality tests *Source: Own estimate based on information from INEGI and Bureau of Economic Analysis*

Table 1 shows, on the one hand, that exports are caused by GDP with two and three lag periods. In contrast, with all lags including exports are always caused by US GDP. On the other hand, contrary to expectations, it was found that Mexico's GDP is caused by imports up to four lagged periods. Contrary to the previous result, imports are rather caused by US GDP with two, three and four lags. An end result allows to verify that the local product is caused by the foreign product with three and four lags.

According to these causality tests, the foreign product could be impacting on the local product through its connection with the total imports. Under this logic, the above would be proposing the following functional relations and that would have important economic implications for Mexico:

$$PIB_t = f(\overset{+}{M}) \quad (20)$$

ECORFAN® All rights reserved.

However, due to the functional relationship 14 where imports from Mexico are mainly determined by the foreign product, which is the same result as the causality tests, the functional relationship:

$$PIB_t = f(\overset{+}{GDP}) \quad (21)$$

Where the local product is determined by the foreign product.

Conclusions

Evidence of exogeneity showed that economic growth in terms of GDP cannot be induced by foreign trade. That is, the export-led growth approach to Mexico does not operate. The assumption that it is met raises specification errors.

This argument can be an important indication of the zero incidence of the policy of trade opening in Mexican economic growth. Since both exports and imports are endogenous, while the product is exogenous. In this sense, exports are specified as a function of the local product, on the one hand, and of the foreign product, on the other.

On the other hand, an important specification derived from the analysis of exogeneity is that imports are not determined by the local product as traditionally assumed. These are determined primarily by the foreign product.

In relation to these results the GDP of Mexico may be an import-dependent variable. This is due to the need for intermediate goods and capital to stimulate growth. The foregoing shows a sharp fall in the Mexican economy when its external purchases are slowed due to devaluation or a contraction of the economic activity of its main trading partner.

Appendix

A. The variables used were taken from the following sources:

México INEGI (www.inegi.org.mx)

PIB en miles de pesos a precios corrientes

Índice de precios implícitos del PIB (2008 = 100)

Exportaciones totales en miles de pesos a precios corrientes

Índice de precios implícitos de las exportaciones totales (2008 = 100)

Importaciones totales en miles de pesos a precios corrientes

Índice de precios implícitos de las importaciones totales (2008 = 100)

Variable instrumental utilizada. Servicio Meteorológico Nacional. Comisión Nacional del Agua (www.smn.cna.gob.mx) Temperatura promedio en grados C° (1980:01 - 2006:12).

Banco de México (www.banxico.org.mx)
Tipo de cambio promedio del periodo (1980:01-2006:12)

FMI
International financial Statistics (www.imfstatistics.org)

Índice de precios al por mayor para México (2000=100). Se utiliza como una aproximación del índice de precios al productor.

United States Bureau of Economic Analysis (www.bea.gov)

ECORFAN® All rights reserved.

PIB de Estados Unidos en billones de dólares corrientes Deflactor de precios implícitos del PIB (2000 = 100)

National Climatic Data Center (www.ncdc.noaa.gov)

Temperatura promedio en grados F (1980:01-2006:12).

B. La prueba de Wald se aplicó a partir de la siguiente formulación:

$$F_{calculado} = \left(\frac{SCR^{R} - SCR^{NR}}{SCR^{NR}} \right) \left(\frac{n-k}{q} \right)$$

donde SCR^{R} es la suma de cuadrados de los residuos del modelo restringido y SCR^{NR} del no restringido; n es el número de observaciones totales; k el número de regresores; y q el número de restricciones. Asimismo se requiere el valor crítico de la distribución $F_{\alpha(q,\, n-k)}$. El criterio que se sigue es si el $F_{calculado} > F_{\alpha\,(q,\, n-k)}$ se rechaza la hipótesis nula, pero si el $F_{\alpha\,(q,\, n-k)} > F_{calculado}$ se acepta la hipótesis nula.

References

Aspe Armella Pedro (2005), El camino mexicano de la transformación económica. FCE.

Bahmani–Oskooee, Mohsen; Hamid Mohtadi y Ghiath Shabsigh (1991), Exports, growth and causality in LDCs (A re-examination), Journal of Development Economics,Vol. 36, No. 2, pp 405-415.

Balassa, Bela (1978), Exports and economic growth: further evidence, Journal of Development Economics, Vol. 5, No. 2, pp 181-189.

Blanco Mendoza Herminio (1994), Las negociaciones comerciales de México con el mundo. FCE.

Blecker, Robert (1996), NAFTA, the peso crisis, and the contradictions of the Mexican economic growth strategy. Schwartz Center for Economic Policy Analysis, pp 1-55.

Bosworth, Barry P.; Robert Z. Lawrence y Nora C. Lustig (1993), El impacto del libre comercio en América del Norte, Economía Mexicana, número especial, vol. 11, núm. 2, pp 7-37.

Chow, Peter C. Y. (1987), Causality between export growth and industrial development, Journal of Development Economics, Vol.26, No. 1, pp 55-63.

Congress of the United States (2003), The effects of NAFTA on U.S.-Mexican trade and GDP. A Congressional Budget Office Paper, mayo, pp 1-50.

Cuadros Ramos, Ana María (2000), Exportaciones y crecimiento económico: un análisis de causalidad para México, Estudios Económicos, Vol. 15, No. 1, pp.37-64.

Engle, Robert F; David F. Hendry; Jean–Francois Richard (1983), Exogeneity Econometrica, Vol. 51, No. 2, pp. 277-304.

Galindo, Luis Miguel y María Elena Cardero (1999), La demanda de importaciones en México: un enfoque de elasticidades, Comercio Exterior, mayo, pp. 481-487.

Garcés Díaz Daniel G. (2008), Análisis de las funciones de importación y exportación de México (1980-2000), El Trimestre Económico, Vol. 75, No. 297, enero-marzo, pp. 109-141.

ECORFAN® All rights reserved.

Granger, Clive (1969). Investigating causal relations by econometric models and cross spectral methods. Econometrica, Vol. 37, No. 3, pp. 424-438.

Gujarati, Damodar (2004), Econometría. McGraw-Hill.

Hausman, J. A. (1978), Specification test in econometrics, Econometrica, Vol. 46, No. 6 pp. 1251-1271.

Jung, Woo S. y Peyton J. Marshall (1985), Exports, growth and causality in developing countries, Journal of Development Economics, Vol. 18, No.1, pp 12.

Kavoussi, Rostam (1984), Export expansion and economic growth: further empirical evidence, Journal of Development Economics, Vol. 14, No. 1, pp. 241-250.

Kennedy, Peter (1997), Introducción a la econometría. FCE.

Kose, M. Ayhan; Guy M. Meredith and Christopher M. Towe (2004), How has NAFTA affected the Mexican economy? Review and evidence, IMF working paper, No.59, pp 1-48.

Kwan, Andy C. C. y Banjamin Kwok (1995), Exogeneity and the export-led growth hypothesis: the case of China, Southern Economic Journal, Vol. 61,No. 4, pp. 1158-1166.

Lederman Daniel, William F. Maloney y Luis Servén (2005), Lessons from NAFTA for Latin America and the Caribbean, The World Bank, Standford University Press, pp 27-65.

Michaely, Michael (1977), Exports and growth: an empirical investigation, Journal of Development Economics, Vol. 4, No. 1, pp 49-53.

Moreno Brid, Juan Carlos (2002), Liberalización comercial y la demanda de importaciones en México, Investigación Económica, Vol. 62:240, abril-mayo, pp. 13-50.

Pacheco López, Penélope (2005), Liberalización de la política comercial y crecimiento económico de México, Economía UNAM, vol. 2, no. 4, pp 1-10.

Peñaloza Webb, Ricardo (1988), Elasticidad de la demanda de las exportaciones: la experiencia mexicana, Comercio Exterior, Vol. 38, No. 5, mayo, pp. 381-387.

Pérez, César (2006), Econometría de las Series Temporales. Pearson Educación, S. A., Madrid, España.

Rodríguez, Francisco y Dani Rodrik (2000), Trade Policy and Economic Growth: A Skeptic's Guide to the Cross–National Evidence, University of Maryland y Harvard University, pp 1-90.

Sachs, Jeffrey y Andrew Warner (1995), Economic Reform and the Process of Global Integration, Brookings Papers on Economic Activity, pp 1-118.

Tapia Maruri, Joaquín y Jesús Cervantes González (1988), México: un modelo econométrico del impacto de la apertura comercial en la balanza comercial, actividad económica y precios, Banco de México, Dirección de Organismos y Acuerdos Internacionales, octubre-diciembre.

Tyler, William (1981), Growth and export expansion in development countries: some empirical evidence, Journal of Development Economics, Vol. 9, No. 1, pp 121-130.

ISSN-On line: 2414-4819
ECORFAN® All rights reserved.

Tornell, Aaron; Frank Westerman, Lorenza Martínez (2004), NAFTA and Mexico's less-than-stellar performance. Este documento forma parte de otro presentado: "Liberalization, Growth, and Financial Crisis: Lesson from Mexico and the Developing World", pp 1-41.

Wacziarg, Romain y Karen Horn Welch (2003), Trade liberalization and growth: new evidence, National Bureau of Economic Research, No. 10152, pp 1-88.

Weisbrot Mark, David Rosnik and Dean Baker (2004), NAFTA at ten: the recount. Center for Economic and Policy Research, pp 1-11.

ECORFAN® All rights reserved.