Mexico's external restricton and trade compostion: a bilateral approach

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Abstract

Recent studies have questioned the explanatory power of Thirlwall's Law in the case of Mexico and other developing countries, due to its omission of foreign trade specialization and use of time series for empirical evaluation. In response to these criticisms, this article estimates income elasticities of export and import demand using dynamic panel models in a bilateral framework between Mexico and 39 trading partners, including the composition of exports and imports as key regressors. Once controlled for the composition of international trade, the results from the estimates using the weak version of Thirlwall's Law accurately predict the economic growth observed in Mexico between 1990 and 2016.

Keywords: foreign trade; balance of payments; restricted growth model; Thirlwall's Law; trading partners.

1. INTRODUCTION

Since the 1980s, the Mexican economy has gone into a process of transformation, moving towards a growth strategy based on the external sector (Moreno-Brid and Ros-Bosch, 2010), shifting its focus to the world stage (Wacziarg and Welch, 2008). The size of the Mexican economy's external sector grew, as did its share of Gross Domestic Product (GDP). Nevertheless, the Mexican economy's economic growth has been relatively small (Esquivel, 2010; Vázquez-Muñoz and Avendaño-Vargas, 2012).

Mexico finds itself in a macroeconomic balance consistent with a low rate of economic growth. From an orthodox perspective, the Mexican economy's slow growth in recent decades raises the question of why it is not growing (Kehoe and Ruhl, 2010; Hanson, 2010; Kehoe and Meza, 2013). Different works carried out from a critical perspective have taken on the task of analyzing the factors behind the Mexican economy's slow pace of growth, including its relationship with the external sector (Perrotini-Hernández and Vázquez-Muñoz, 2019; Ros, 2013a).

From a neoclassical approach, economic growth can be explained based on a production function, depending on productive and technological factors (Barro, 1999; Romer, 1994; Ros, 2013b) and benefits from liberalization processes based on specialization, comparative advantages, best practices and the dissemination of knowledge and technology (Appleyard and Field Jr., 2014; Krueger, 1974; Grossman and Helpman, 1990).

There are various criticisms regarding the implementation of liberalization strategies for the external sector in developing economies (Palley, 2012). For example, the negative effect stemming from specialization in primary goods and low value-added industries due to constant deterioration in terms of trade, the reduction of the multiplier effect of autonomous expenditure and a race to the bottom to reduce production costs, to the detriment of working conditions.

From an aggregate demand approach, Thirlwall's Law (Thirlwall, 1979) indicates that in the long run the economic growth of open economies is constrained by their balance of payments. Starting off with a state of balance with the external sector, limits on economic growth are dictated by the relationship between income elasticities of export and import functions. To ease the restriction, export growth rate needs to increase and income elasticity of imports to decrease, with income elasticity of exports surpassing that of imports being the most favourable condition (Thirlwall, 1979 and 2011; Thirlwall and Hussain, 1982).

Empirical evaluations of Thirlwall's Law abound (Thirlwall, 2011), some of which agree with its predictive power while others question its validity (Hierro Recio *et al.*, 2018; Holland *et al.*, 2004; Thirlwall, 2011). In the case of Mexico, there is empirical evidence which allows one to question the robustness of the law (Capraro, 2018; Clavijo Cortes and Ros Bosch, 2015; Perrotini-Hernández *et al.*, 2019), giving way to theoretical explanations of the possible deficiencies in Thirlwall's Law (Clavijo Cortes and Ros Bosch, 2015). One of the critical points is related to the omission of the role played by specialization and the composition of foreign trade. In standard models and Thirlwall's original approach, whether a country exports or imports goods with higher or lower added value comes second (Clavijo Cortes and Ros Bosch, 2015). However, empirical works point out that the elasticity of demand for exports and imports is influenced by the composition of foreign trade (Tovar-García, 2018; Tovar-García and Carrasco, 2019; Wierts *et al.*, 2014).

The goal of this work is to estimate the limits to economic growth in Mexico according to Thirlwall's Law, taking into account export and import functions that control the effect of foreign trade's composition. To this end, it is based on recent findings where trade in goods from R&D-intensive industries has direct and indirect effects on import and export performance, as well as on the external balance (Carrasco and Tovar-García, 2019 and 2020; Tovar-García, 2018; Tovar-García and Carrasco, 2019; Wierts *et al.*, 2014).

Furthermore, we contribute to the empirical literature by using bilateral data, instead of time series, between Mexico and the rest of the world following Nell's multilateral approach to Thirlwall's Law (2003), albeit with a substantially different empirical approach. We used a database of bilateral trade between Mexico and 39 of its main trading partners from 1990-2016, following a novel strategy in estimating the export and import functions that have traditionally been estimated using cointegration analysis.

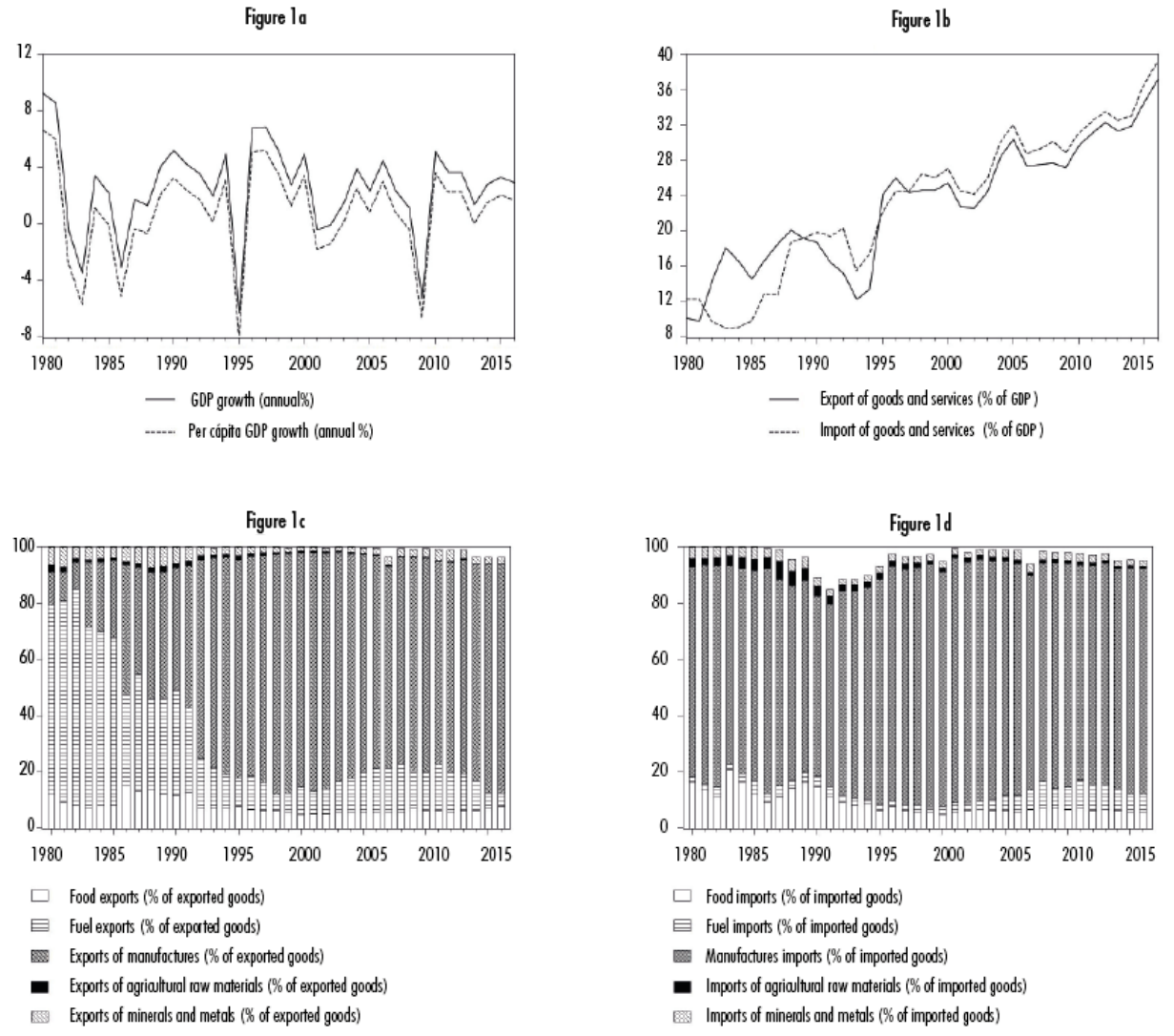
Likewise, the research employs dynamic models with panel data and the System Generalized Method of Moments (SYS GMM) (Blundell and Bond, 1998), controlling endogeneity problems and the autoregressive nature of exports and imports in order to obtain strong estimates of income elasticities, a key input for calculating the limits of economic growth.

This text consists of six sections. The second presents the main features of Mexico's process for opening up trade. The third section describes Thirlwall's Law and the main studies of Mexico. Meanwhile, the fourth section describes the methodology and data used. The fifth presents the results, and final section consists of the overall conclusions.

2. TRADE OPENNESS, TRANSFORMING THE EXTERNAL SECTOR AND ECONOMIC GROWTH

Opening up to the external sector and a reduction of the public sector were at the core of the adjustment process in the 1980s. This sought to tie the Mexican economy's economic growth to the external sector. At the time, this sector was transformed (see Figure 1). One of the most important changes is the persistent growth of exports. While it has been a widespread fact of the developing world, Mexico's case is special because of the extent of the export sector's growth.

Figure 1. Economic growth and the transformation of the external sector



Source: Created by the authors with data from the World Bank's World Development Indicators (2020).

The average annual growth rate of export growth per decade since the 1960s to date has been 10.1, 9.7, 13.4, 2.4 and 7.9%, respectively. The proportion of Mexican exports is higher than the average observed in Latin America, East and South Asia, North America and the global average. Only those of the European Union, Central Europe and the Baltic countries are greater due to unique characteristics which explain the differences.

A reliance on imported goods is another characteristic of the external sector, strengthening the link between exports and imports. With data from the Organization for Economic Cooperation and Development (OECD), the average content of exports which is imported in Mexico grew from 27.3% in 1995 to 33.5% in 2014, representing the highest value of any country in the OECD except for South Korea. Something similar happens when we compare two countries with a similar level of development, such as Colombia or Brazil. At the industrial level, the branches with the highest imported content are those with the highest technological intensity (computers, electronic and optical equipment, electrical devices and machinery, along with motor vehicles, trailers and semi-trailers).

The high imported content of exports forces a link between the growth of exports and imports and limits the spillover effects of exports on the rest of the economy if there is no domestic industry providing supplies to the exporting industry. Within the context of Thirlwall's Law, these facts implicitly restrict the growth of Mexico's economy. In other words, a high content of imported goods in exports implies that the value added in the country is relatively low and the effects on growth are limited.

Furthermore, there is a concentration of Mexico's foreign trade's point of origin and destination in the North American region, particularly the United States. This can be explained by geographic proximity, the breadth of the territory, population size, and its level of development. The preponderance of this nation as a trading partner is seen in both the flow of exports and imports, though imports from Asia have gained relevance since China's joined the World Trade Organization (WTO).

Various attempts have been made to diversify markets, mainly by means of trade agreements. To this we must add the improvement, modernization and development of the export infrastructure which allows a reduction in the average cost of conducting international trade operations.

Finally, we have observed a fundamental change in the composition of foreign trade by means of transitioning from petroleum as the primary good exported to manufactures, particularly those of high and medium technological intensity. This transition occurred mainly in the first half of the 1990s. However, the effects of such expansion and transition of foreign trade are accompanied by precarious economic growth rates and economic crises. On average, the economic growth per capita in the Mexican economy has been close to 1%.

3. THIRLWALL'S LAW AND PRIOR STUDIES OF MEXICO

While economic growth has historically been the concern of economists (Sundrum, 1990; Ros, 2013b), Thirlwall (1979) was a pioneer in analyzing growth from a demand perspective. Taking up the previous developments of Harrod (1933), Prebisch (1959) and Kaldor (1975), Thirlwall recognizes that the process of economic growth is different in closed and open nations. For the latter, economic growth must be consistent with external balance (Thirlwall, 1979 and 2011; Thirlwall and Hussain, 1982). By omitting capital flows or assuming that the capital account cannot finance current account deficits indefinitely, Thirlwall's base model can be described based on the current account balance (see equation (1)):

$$P_{dt}X_t = P_{ft}M_tE_t \qquad (1)$$

Given the export and import functions, we have equations (2) and (3)

$$X_t = a\left(\frac{P_{dt}}{P_{ft}E_t}\right)^{\eta} Z_t^{\varepsilon} \qquad \eta < 0, \varepsilon > 0 \qquad (2)$$

$$M_t = b\left(\frac{P_{ft}E_t}{P_{dt}}\right)^{\psi} Y_t^{\pi} \qquad \psi < 0, \pi > 0 \qquad (3)$$

Where X and M represent exports and imports in real terms, respectively. t is the time, P_f and P_d represent price levels domestically and abroad, E is the nominal exchange rate, Z is the level of income from abroad, Y is the level of domestic income, η and ψ are the elasticities with regards to price, and ε and π are the elasticities with regards to the influx of demand for exports and imports.

In order to achieve the model in its dynamic form, with growth rates, the logarithms are obtained and differentiated with regards to time, as expressed by equations (4) (5) (6).

$$p_{dt} + x_t = p_{ft} + e_t + m_t \qquad (4)$$

$$x_t = \eta(p_{dt} - p_{ft}e_t) + \varepsilon(z_t) \qquad (5)$$

$$m_t = \psi(p_{ft}e_t - p_{ft}) + \pi(y_t) \qquad (6)$$

By substituting equations (5) and (6) into equation (4) we get a growth rate consistent with the balance of payments, equation (7):

$$y_t = \frac{[(1+\eta+\pi)+(p_{dt}-p_{ft}-e_t)]\psi+\varepsilon(z_t)}{\pi} \quad (7)$$

Thirlwall's Law underscores the role of exports as the main component of aggregate demand and as a trigger for economic growth as they revitalize other components of aggregate demand and loosen the restrictions on growth imposed by the balance of payments (Clavijo Cortes and Ros Bosch, 2015). There are indirect effects from an increase in exports on economic growth upon inducing capital accumulation by improving expectations for economic growth and through a wealth effect due to the initial improvement of the external balance (McCombie and Thirlwall, 1994).

The growth of a component in aggregate demand other than exports leads to a deterioration in the balance of payments, reducing the capacity for growth. Thus, a persistent deficit in the current account will lead to growth of external debt, leading to a deterioration in growth capacity. Therefore, the growth rate of an open economy is constrained by its balance of payments which in turn depends on how exports and imports respond to changes in income level (Thirlwall, 1979).

If one assumes that relative prices, measured in the same currency, do not change in the long run, Thirlwall's Law is summarized in equation (8), known as the "weak" version. Assuming that relative prices change, equation (9), one gets the "strong" version (Thirlwall, 1979 and 2011; Thirlwall and Hussain, 1982).

$$y_{bp} = \frac{x}{\pi} \quad (8)$$

$$y_{bp} = \frac{\varepsilon(z_t)}{\pi} \quad (9)$$

The validity of Thirlwall's Law has been positively assessed favorably in various countries (Hierro Recio *et al.*, 2018; Holland *et al.*, 2004; Thirlwall, 2011). Nevertheless, in the case of some developing countries, such as Mexico, empirical evidence shows that certain aspects need to be addressed (Capraro, 2018; Clavijo Cortes and Ros Bosch, 2015; Perrotini-Hernández *et al.*, 2019).

Moreno-Brid (1999) conducted one of the first empirical tests of Thirlwall's Law for Mexico in the period of 1950-1996. Findings show favorable evidence, given that real export growth rates (an average of 6.5% for the period) and GDP growth rates (4.8%) are cointegrated in the period analyzed. Furthermore, the drop in Mexico's average growth rate from 1982 to 1996 (1.1%) is explained by the increase in the income elasticity of the import function, estimated at 2.47 for the period of 1982-1996 which contrasts with the elasticity of 1.04 estimated for the period of 1950-1981. For the period of 1967-1999, said elasticity was estimated at 1.77. Moreno-Brid (2003) finds that the predictive power of Thirlwall's Law improves when capital flows and interest payments abroad are taken into account. The income elasticity of the import function estimated with cointegration analysis is closer to the hypothetical or implicit one calculated using observed data according to the basic formulas of the weak version of the Law.

Subsequently, Guerrero-de-Lizardi (2003) estimates the income elasticities of exports and imports by means of a stochastic specification within the balance-of-payments-constrained growth model. Its estimates indicate two distinct periods (1940-1981 and 1982-2000), where the ratio of import and export income elasticities fell from 1.74 in the first period to 0.94 in the second.

Expanding the basic model, Ibarra and Blecker (2016) analyze the Mexican economy's balance of payments through a disaggregation of trade; the results show a tightening of external restriction in the post-economic-liberalization period, and a reduction in the impact of the real exchange rate resulting from the process of economic integration. The authors also point out that while a country cannot grow by going over the restrictions imposed by the balance of payments, it is possible to do so by going under when faced by further restrictions.

In the case of Mexico, the process of economic openness was accompanied by the liberalization of foreign direct investment, boosting the import of supplies, displacing local industries and tightening external restrictions (Pacheco-Lopez, 2005). Therefore, in the context of Latin America, trade openness has not set up exports as a drag factor in economic growth due to a focus on assembly and extractive activities within the context of the exporter-importer model (Landa-Díaz and Arriaga-Navarrete, 2017).

Perrotini-Hernández and Vázquez-Muñoz (2019) present a unified view from Thirlwall's perspective that includes the interaction between productive capacity, endogeneity of the natural growth rate and external constraint on product growth. From 1974-1982, the Mexican economy experienced a high rate of economic growth accompanied by increasing trade imbalances and inflows of financial capital, which, while improving productive capacity, simultaneously increased financial fragility. From 1983-2017, the liberalization process led to a scenario with a new balance, in line with a lower accumulation of productive capacity, lower growth rate, and consistent with external equilibrium.

Note that Thirlwall's Law and empirical evidence which favor it have been challenged for ignoring other elements of domestic aggregate demand as well as the relevance of other supply-side factors (Capraro, 2018; Clavijo Cortes and Ros Bosch, 2015; Perrotini-Hernández *et al.*, 2019). The weaknesses of the empirical evidence is in turn related to its object and method, focusing on demonstrating that exports and imports grow at similar rates using cointegration analyses with variables that by definition are positively correlated (Clavijo Cortes and Ros Bosch, 2015). The law is particularly called into question in developing countries where exports can also be determined by the difference between domestic demand and production (Clavijo Cortes and Ros Bosch, 2015).

As such, it is important to verify whether the pattern of specialization limits economic growth. Advancements in this regard are previous works (Araujo and Lima, 2007; Gouvea and Lima, 2010; Romero and McCombie, 2016) on the sectoral composition of productive activity and its effects on the price and income elasticity of demand for exports and imports. The pattern of specialization is key in explaining the differences in income between countries, which themselves result in different values for income elasticities of the export and import functions.

This work estimates the income elasticities which address prior criticisms by taking into account recent empirical results that emphasize the role of commercial composition in external sector performance and trade balance (Carrasco and Tovar-García, 2019 and 2020; Tovar-García, 2018; Tovar-García and Carrasco, 2019; Wierts *et al.*, 2014). High-tech goods have great income elasticity and are inelastic with regards to price, which has both direct and indirect positive effects on the performance of the external sector. An export sector with great technological innovative potential provides fewer restrictions on economic growth (Clavijo Cortes and Ros Bosch, 2015).

4. METHODOLOGY AND DATA

According to Thirlwall's Law (Romero and McCombie, 2018), the income elasticities of export and import functions are essential in estimating the upper limit of economic growth in the long run. Equations (10) and (11) present the basic regression models for estimating said functions. There are two fundamental changes compared to standard models. First, in this new empirical approach the models have a bilateral structure corresponding to Mexico's relationship with 39 trade partners. Therefore, a panel structure is constructed from bilateral data.

Second, the models include the composition of exports and imports as key variables in determining export and import functions. In this regard, we followed previous works (Araujo and Lima, 2007; Gouvea and Lima, 2010; Romero and McCombie, 2016) on the sectoral composition of productive activity and its effects on price and income elasticity along with recent evidence of the trade composition's effects on international trade (Tovar-García, 2018; Tovar-García and Carrasco, 2019; Carrasco and Tovar-García, 2019 and 2020; Wierts *et al.*, 2014).

$$lnX_{Mj,t} = \beta_{0j} + \beta_1 lnY_{jt} + \beta_2 lnTCR_{Mj,t} + \beta_3 lnCE_{Mj,t} + Control'\lambda + e_j + v_{jt} \quad (10)$$

$$lnM_{Mj,t} = \beta_{0j} + \beta_1 lnY_{Mt} - \beta_2 lnTCR_{Mj,t} + \beta_3 lnCM_{Mj,t} + Control'\lambda + e_j + v_{jt} \quad (11)$$

X and *M* represent exports and imports, respectively, in dollars and at constant prices. Dependent and independent variables are introduced in logarithms and the coefficients represent elasticities. Subscripts *M*, j and *t* correspond to Mexico, trade partner and time, respectively. Exports depend on the income level of the rest of the world (Y_{it}) and the real exchange rate (TCR_{Mjt}). Imports, on the other hand, depend on the level of (Mexico's) domestic income and the real exchange rate (TCR_{Mjt}). A depreciation of the Mexican peso against the currency of the trade partner should increase exports and reduce imports, and vice versa. The nominal exchange rate (pesos per unit of foreign currency), multiplied by the ratio between the trade partner's and Mexico's price levels, is used to calculate the TCR. The level of income approaches the GDP in constant dollars in terms of total GDP and per capita GDP.

Control variables, the effect of foreign trade composition, and research and development-intensive industries' share of trade, are added to the conventional model. Control variables are dichotomous for groups of trade partners, according to the geographical region (North America, Europe and Latin America), and for crisis and recession years (1995, 2001, 2008 and 2009). CE_{Mj} *and* CM_{Mj} respectively represent the composition of exports and imports with each trading partner. The inclusion of foreign trade composition addresses the criticism of the predictive power of Thirlwall's Law when it comes to developing countries (Clavijo Cortes and Ros Bosch, 2015).

The estimated export and import functions have two advantages. The first is that they present a multilateral approach. The second is that they include the proportion of goods from highly research-and-development-intensive industries that Mexico exports and imports, thereby permitting control of the sectoral effect had by high-tech goods on the price and income elasticities of the respective demand functions. The model gives relevance proportional to the size of trade with each trade partner and the type of good traded, which improves estimates of the income elasticities of export and import functions, fundamental inputs for calculating limits on economic growth according to Thirlwall's Law.

The data comes from the OECD-STAN Bilateral Trade Database by Industry and End-use category, the World Development Indicators (2020) and the International Monetary Fund. The composition variables of exports and imports refer to the ratio of exports and imports from industries with a high level of research and development as a proportion of total exports in accordance with fourth Revision of the International Standard Industrial Classification (ISIC) obtained from the OECD-STAN Bilateral Trade Database by Industry and End-use category.

The period analyzed (1990-2016) is restricted by the availability of data on bilateral trade between Mexico and 39 of its main trading partners. The trade partners included in the sample are: Australia, Austria, Belgium, Brazil, Canada, China, Colombia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the USA. Table 1 shows the basic descriptive statistics, with panel data, of the main variables used in the empirical analysis.

Table 1. Descriptive statistics

Variable	*Observations*	*Average*	*Standard deviation*	*Minimum*	*Maximum*
Exports (a)	1 009	5056667	3.07E+07	0.52	3.19E+08
Real exports (a)	1 009	5430910	3.14E+07	0.7	2.94E+08
Imports (a)	1 003	5074762	2.09E+07	45.01	1.96E+08
Real imports (a)	1 003	5488961	2.20E+07	62.19	1.80E+08
Mexico's real per capita GDP	1 053	8547	742.88	7258	9708
Mexico's real GDP	1 053	9.40E+11	1.74E+11	6.54E+11	1.26E+12
Trade partner's real per capita GDP	1 035	31276	21651	531	111968
Trade partner's real GDP	1 041	1.22E+12	2.34E+12	7.92E+09	1.70E+13
Exports of high-tech goods (a)	984	1118797	6871967	0.005	6.58E+07
Composition of exports	984	0.18	0.19	7.19E-07	0.99
Imports of high-tech goods (a)	1 005	976521	3763293	0.02	3.42E+07
Composition of imports	962	0.18	0.18	4.29E-06	0.98
Real exchange rate (b)	1 034	9.09	7.30	0.004	28.74

Notes: (a) thousands of dollars; (b) with regards to each trade partner's currency.

Source: Calculated by the author using data from the World Bank and OECD-STAN Bilateral Trade Database by Industry and End-use category.

To estimate the export and import functions, we took into consideration the possibility of using cointegration analysis. However, the evidence with panel data indicates that only variables related to the income level have unitary roots.

The tests used were Im-Pesaran-Shin and Fisher-ADF, including constant and trend combinations (Im *et al.*, 2003; Maddala and Wu, 1999). In the face of this difficulty, we suggest the use of dynamic models for panel data and the general method of moments.

Thus, addressing the auto-regressive nature of exports and imports and the possibility of double causality between dependent and independent variables in equations (10) and (11), we employed the SYS GMM (Blundell and Bond, 1998). The SYS GMM allows one to include lag in the dependent variable as a regressor and controls endogeneity problems when using independent variable lag as an instrument in total levels and first differences. The strategy requires the absence of second-order serial correlation, which is verified with the Arellano-Bond test, and the validation of internal instruments, with the Sargan test (Baltagi, 2005). We used two-stage estimation allowing a maximum of two lags in independent variables for generating internal instruments, thereby avoiding the problem of too many instruments (Roodman, 2009).

Furthermore, when Thirlwall's Law is analyzed, there is evidence that SYS GMM produces better results than estimates obtained with cointegrated vector error correction models (Romero and McCombie, 2016). Note that the coefficients obtained with the SYS GMM correspond to the short term; in order to obtain the long-term coefficients one needs to divide the coefficient of the dependent variable by one minus the coefficient of the dependent variable as a regressor.

5. Results

Table 2 shows the main estimates of export functions. In columns (1) to (4) we use the logarithm of per capita GDP at constant prices as the independent variable. As proof of robustness, columns (5) to (8) use real GDP logarithms. With said information we obtained eight estimations of income elasticity for exports. The regressions coefficients (1) and (5) correspond to the base model which does not include control variables. Regressions (2) and (6) include dichotomous variables for trade partner groups and region; regressions (3) and (7) add dichotomous variables for years of economic crisis. Finally, regressions (4) and (8) include the composition of exports as a key explicative variable.

Table 2. Export functions

Dependent variable: logarithm of exports at constant prices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent lag	0.82***	0.70***	0.69***	0.71***	0.47***	0.42***	0.41***	0.45***
Trade partner per capita GDP	0.58***	1.04***	1.26***	0.65***				
Trade partner GDP					1.24***	1.64***	1.68***	1.39***
Real exchange rate	-0.20***	-0.15***	-0.30***	-0.08	0.06**	-0.04	-0.14***	-0.06
Composition of exports				0.05***				0.004
North America		1.05	-0.36	0.67		-0.91	-0.31	-1.05
Europe		-2.26***	-2.66***	-2.10***		2.24***	2.51***	1.20***
Latin America		1.37	2.05	-0.28***		-1.46*	-2.38	-2.64
Year 1995			0.57***	0.49***			0.45***	0.41***
Year 2001			-0.15***	-0.10***			-0.20***	-0.21***
Year 2008			0.25***	0.20***			0.12***	0.11***
Year 2009			-0.61***	-0.67***			-0.34***	-0.41***
Constant	-3.38	-5.38	-6.98***	-1.47	-26.9***	-38.2***	-39.2***	-31.1***
Observations	968	968	968	948	969	969	969	948
N x T	39 x 26	39 x 26	39 x 26	39 x 26	39 x 26	39 x 26	39 x 26	39 x 26
Sargan test	38.35	38.56	37.75	37.86	38.22	37.63	37.36	36.37
(p-value)	(0.99)	(0.99)	(0.99)	(0.99)	(0.99)	(0.99)	(0.99)	(0.99)
First-order autocorrelation test	-3.87	-3.85	-3.95	-4.05	-3.83	-3.80	-3.83	-3.91
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Second-order autocorrelation test	-0.07	-0.10	0.36	1.21	-0.42	-0.51	-0.12	0.88
(p-value)	(0.94)	(0.91)	(0.71)	(0.22)	(0.67)	(0.60)	(0.89)	(0.37)
Long-term coefficients								
Trade partner per capita GDP	**3.22**	**3.47**	**4.06**	**2.24**				
Trade partner GDP					**2.34**	**2.83**	**2.85**	**2.53**
Real exchange rate	-1.11	-0.50	-0.97	-0.28	0.11	-0.07	-0.24	-0.11
Composition of exports				0.17				0.01

Notes: *; ** and *** indicate statistical significance at 10; 5 and 1%, respectively.

Source: created by the author.

The eight estimates of income elasticity differ slightly, but coincide in signaling that in the long run export demand is elastic to income. Estimated coefficients range from 2.24 to 4.06.

Estimates show several negative coefficients for export demand price elasticities, implying that a depreciation of the peso reduces exports. However, this result is not robust in terms of its significance and value of the parameter. Previous studies show that the exchange rate appears to have little relevance for Mexican exports within the context of vertical economic integration (Ghosh, 2013). The lack of robustness with regards to the impact of the exchange rate coincides with these results.

There are significant, but contradictory, positive and negative coefficients for the dummy of European countries. Therefore, in general, there is no robust evidence that any geographical group of trade partners has benefited from Mexican exports. The lack of statistical significance in the estimated coefficients suggests that there are no substantial changes with regards to Mexico's trade partners. Furthermore, it is important to highlight that the USA is Mexico's main trading partner, receiving around 70% of Mexican exports in 2018. The coefficients for recession and crisis years show some expected results: in the 1995 crisis, Mexican exports grew within the context of the USA's economic expansion; in 2009, with the global financial crisis, exports fell, which is associated with the widespread decline in global income.

Finally, the composition of exports is significant in determining export demand (column 4 in Table 2), coinciding with previous findings for Europe (Wierts *et al.*, 2014) and Russia (Tovar-García, 2018). The effect is not robust, losing statistical significance with real GDP as an explanatory variable (column 8). However, according to the working hypothesis, the inclusion of this variable allows for a better estimate of income elasticity of export demand.

Table 3 shows the main estimates of import functions. In columns (1) to (4) we used the logarithm of per capita GDP as an independent variable and for columns (5) to (8) we used the logarithm for real GDP. Thus, eight estimates of income elasticity for imports are also obtained, following the inclusion of control variables in a manner quite similar to that of export functions. As such, regressions in columns (4) and (8) correspond to the most sophisticated model with the inclusion of import composition as a key explicative variable.

Table 3. Import functions
Dependent variable: logarithm of imports at constant prices

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Dependent lag	0.81***	0.65***	0.70***	0.77***	0.83***	0.66***	0.73***	0.77***
Mexico's per capita GDP	2.05***	3.46***	2.72***	1.21***				
Mexico's GDP					0.83***	1.61***	1.13***	0.54***
Real exchange rate	-0.25***	-0.24***	-0.20***	0.02	-0.28***	-0.29***	-0.22***	-0.01
Composition of imports				0.12***				0.12***
North America		9.57***	7.13*	2.97**		8.55*	5.58	2.70*
Europe		-0.28	-0.52	-0.44***		-0.49***	-0.86	-0.46***
Latin America		-0.01	-0.41	0.21		0.12	-2.55	-0.54
Year 1995			-0.18***	-0.34***			-0.29***	-0.38***
Year 2001			-0.12***	-0.05**			-0.13***	-0.07***
Year 2008			0.07***	0.10***			0.11***	0.11***
Year 2009			-0.24***	-0.33***			-0.31***	-0.35***
Constant	-5.75***	-26.8***	-20.5***	-7.47***	-20.2***	-39.8***	-29.9***	-11.41***
Observations	964	964	964	929	964	964	964	929
N x T	39 x 26	39 x 26	39 x 26	39 x 26	39 x 26	39 x 26	39 x 26	39 x 26
Sargan test	38.85	36.57	35.25	35.64	38.68	37.75	36.32	36.67
(p-value)	(0.99)	(0.99)	(0.99)	(0.99)	(0.99)	(0.99)	(0.99)	(0.99)
First-order autocorrelation test	-2.52	-2.46	-2.45	-3.45	-2.54	-2.47	-2.47	-3.45
(p-value)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)
Second-order autocorrelation test	-1.04	-0.96	-0.96	0.66	-1.11	-1.06	-1.02	0.63
(p-value)	(0.29)	(0.33)	(0.33)	(0.50)	(0.26)	(0.28)	(0.30)	(0.52)
Long-term coefficients								
Mexico's per capita GDP	**10.79**	**9.89**	**9.07**	**5.26**				
Mexico's GDP					**4.88**	**4.74**	**4.19**	**2.35**
Real exchange rate	-1.32	-0.69	-0.67	0.09	-1.65	-0.85	-0.81	-0.04
Composition of imports				0.52				0.52

Notes: *; ** and *** indicate statistical significance at 10; 5 and 1%, respectively.
Source: Created by the author.

Import income elasticities range from 2.35 to 10.79. These figures are well above previous estimates, which indicated an elasticity between 0.60 and 2.5 (Moreno-Brid, 1999). In most regressions, the price elasticities of imports are statistically significant, with the expected value (negative) and inelastic. Therefore, an appreciation of the Mexican peso is accompanied by an increase in imports, albeit less than would be proportionate.

Dichotomous variables by geographic groupings of trade partners have no statistical significance or robustness. The dichotomous variables for recession and crisis years show negative values and statistical significance, in short, fewer imports in those years.

Finally, the composition of imports has a positive, significant and robust effect on import performance, in line with the working hypothesis. That is, a 1% increase in the proportion of imports consisting of high-tech goods is accompanied by a 0.12% (inelastic) increase in imports. The inclusion of this

variable allows a better estimate of import income elasticity.

Table 4 shows estimates of Mexico's economic growth according to Thirlwall's Law, using the figures observed in Mexican export growth, world economic growth, and the sample's trade partners' economic growth, given the estimates of the income elasticities of export and import demand in Tables 2 and 3.

Table 4. Estimates of the limits on economic growth according to Thirlwall's Law

Mexican Export Growth (1990-2016) = 6.13		
Observed growth (1990-2016)	GDP per capita	Real GDP
World	1.45	2.81
Country sample	2.15	2.81
Mexico	1.17	2.69
Estimates of export income elasticities		
Regressions (1)/(5) in Table 2	3.22	2.34
Regressions (2)/(6) in Table 2	3.47	2.83
Regressions (3)/(7) in Table 2	4.06	2.85
Regressions (4)/(8) in Table 2	2.24	2.53
Estimates of import income elasticities		
Regressions (1)/(5) in Table 3	10.79	4.88
Regressions (2)/(6) in Table 3	9.89	4.74
Regressions (3)/(7) in Table 3	9.07	4.19
Regressions (4)/(8) in Table 3	5.26	2.35
Growth rates according to the "weak" version of Thirlwall's Lawl		
According to regressions (1)/(5) in Table 3	0.57	1.26
According to regressions (2)/(6) in Table 3	0.62	1.29
According to regressions (3)/(7) in Table 3	0.68	1.46
According to regressions (4)/(8) in Table 3	1.17	2.61
Growth rates according to the "strong" version of Thirlwall's Law (using sample country GDP)		
Regressions (1)/(5) in tables 2 and 3	0.64	1.35
Regressions (2)/(6) in tables 2 and 3	0.75	1.68
Regressions (3)/(7) in tables 2 and 3	0.96	1.91
Regressions (4)/(8) in tables 2 and 3	0.92	3.03
Growth rates according to the "strong" version of Thirlwall Law (using world GDP)		
Regressions (1)/(5) in tables 2 and 3	0.43	1.35
Regressions (2)/(6) in tables 2 and 3	0.51	1.68
Regressions (3)/(7) in tables 2 and 3	0.65	1.91
Regressions (4)/(8) in tables 2 and 3	0.62	3.03

Source: Growth rate data is taken from World Development Indicators (2020), World Bank.

The income elasticities of imports are greater than that of exports, marking a strong restriction in Mexico's economic growth according to Thirlwall's Law. Indeed, Mexico's observed economic growth in the years analyzed is 1.17% in per capita terms and 2.61% total. According to the weak version of Thirlwall's Law, using the more conventional estimate of import income elasticities, Mexico's economic growth should have been 0.57 and 1.26%, respectively. This implies that Thirlwall's Law slightly underestimates the country's economic growth. This bias is also observed when using elasticities obtained with the inclusion of control variables.

However, estimates of economic growth limitations, according to Thirlwall, improve substantially when using income elasticities obtained with the more sophisticated model. In short, the inclusion of commercial composition. In this case the estimates coincide almost perfectly with what is observed, 1.17 and 2.61%, respectively.

Likewise, using the strong version of Thirlwall's Law and the results of conventional export and import functions one gets results that underestimate Mexico's observed economic growth. However, Thirlwall's estimates are very close to what is observed when the income elasticities used in the calculation correspond to models that include the composition of exports and imports. Using the economic growth of the rest of the world, Mexico's

economic growth is estimated to have been 0.92% in per capita terms and 3.03% in total. As a robustness test, exercises were also carried out using the sample's trade partners' average economic growth, estimates are 0.62 and 3.03%, respectively. Therefore, using the strong version once again, the estimated growth limits are close to what is observed, provided that the composition of foreign trade is included as a key variable in the estimation of export and import functions.

6. CONCLUSION

A pioneer in growth analysis from the perspective of demand, Thirlwall's Law indicates that in open economies the limits to economic growth are conditioned by an equilibrium in their balance of payments. To loosen the constraints imposed by the balance of payments, one should seek for income elasticity of exports to surpass that of imports.

In the case of developing countries, the assumption that the pattern of specialization is immaterial when carrying out estimations using Thirlwall's can lead to inadequate results (Clavijo Cortes and Ros Bosch, 2015). As such, if exports are made up of goods which are elastic in terms of income or inelastic in terms of price –such as high-tech goods–, one would expect a loosening in the constraint implied by the balance of payments, and vice versa in the case of imports.

This research carried out estimations of export and import demand functions by controlling the effect of foreign trade composition within the framework of dynamic panel analysis with a bilateral makeup, including 39 of Mexico's trade partners. The composition of exports and imports, defined as the ratio of goods from highly technologically intensive industries, is included in the functions evaluated in order to get a better estimate of income elasticity of exports and imports.

The results allowed us to get estimations of Mexico's economic growth limits for the period of 1990-2016 which coincided almost perfectly with the observed growth rate (1.17% in terms of per capita and 2.69% total). Estimates with standard demand functions, on the other hand, underestimate the rates observed. In the methodological proposal, the inclusion of foreign trade's composition is essential for the weak version of Thirlwall's Law to adequately prognosticate the observed economic growth. Moreover, this is also evidence of the relevance of foreign trade specialization.

The balance of payments constraint is associated with the exporter-importer model that has dominated the Mexican economy's external sector since the beginning of its trade liberalization process. This model has strengthened the link of exports and imports by prioritizing assembly processes in the final stages of global value chains. To ease external restriction, there needs to be a greater drag from Mexican export industries, strengthening domestic production of supplies required by exporting industries.

With regard to the composition of exports, two implications for economic policy can be drawn from the results presented in this work: *1*) the strategy for opening up the market needs to prioritize the development of industrial activities with a high research and development content, *2*) an industrial policy that focuses on the development of intermediate goods for exporting industries needs to be implemented. In short, a reduction of their current dependence on imported supplies within the production process. This would lead to greater economic growth in the external market through the spillover effects produced by ancillary industries.

The methodological proposal of this work allows one to improve estimations of economic growth limits within the context of Thirlwall's Law. However, this empirical approach has two main limitations: *1*) only one type of foreign trade composition is analyzed and other types of composition for exports or imports may have significant effects. A deeper sectoral analysis is needed to address this limitation; *2*) taking into account the significance of the maquilador sector to Mexico, estimates which include highly technologically intensive industrial goods need to take into consideration the domestic content of exports and not just gross value. Both limitations are beyond the scope of this work, leaving the way open for research within the context of Thirlwall's Law.

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