REVISTA MEXICANA DE ECONOMÍA Y FINANZAS Nueva Época REMEF (THE MEXICAN JOURNAL OF ECONOMICS AND FINANCE)

Revista Mexicana de Economía y Finanzas, Nueva Época

Volume 19 Issue 3, July - September 2024, pp. 1-16, e1002

Anthony P. Thirlwall's Theory of Economic Development, Growth and Finance: An Analytical Appraisal from Mexico

Editor: Dr. Ignacio Perrotini Hernández

DOI: https://doi.org/10.21919/remef.v19i3.1002

(Received: February 8, 2024, Accepted: May 31, 2024. Published: June 17, 2024)

An Application of the Kaldor-Dixon-Thirlwall Model for Regional Economic Growth in Mexico

Luis Quintana Romero[1] - Universidad Nacional Autónoma de México, México

Miguel Ángel Mendoza González - Universidad Nacional Autónoma de México, México

Marcos Valdivia López - Universidad Nacional Autónoma de México, México

Abstract

This paper analyzes the links between exports and regional economic growth in Mexico. The Kaldor-Dixon-Thirlwall theoretical model and the econometric methodology of Durbin spatial panel models are used, which were estimated for the periods 2008-2019 and 2008-2023. The econometric results show, among other findings, that the relationship between regional growth and state export growth is null and non-significant, while trade openness and its absolute growth are positive and significant. The weak relationship between exports and regional growth implies that industrial policy proposals other than traditional ones should be promoted. A limitation of this study is the absence of data on regional imports, which could have enabled a more comprehensive examination of theoretical frameworks. Nonetheless, the study's significance lies in highlighting the limited role of the export sector in driving regional growth in Mexico, attributed to the weakening of national productive links.

JEL Classification: F14, F43, C51, 047, R11, R15.

Keywords: exports, regional economics, trade openness, economic growth, spatial econometric models.

Una aplicación del modelo Kaldor-Dixon-Thirlwall para el crecimiento regional en México

Resumen

En este trabajo se analizan los vínculos entre las exportaciones y el crecimiento económico regional de México. Para ello se utiliza el modelo teórico de Kaldor-Dixon-Thirlwall y la metodología econométrica de modelos Durbin de panel espacial, los cuales fueron estimados para los periodos 2008-2019 y 2008-2023. Los resultados econométricos muestran, entre otros hallazgos, que la relación entre el crecimiento regional y el crecimiento estatal de las exportaciones es nulo y no significativo, mientras que para la apertura comercial y su crecimiento absoluto son positivos y significativos. La evidencia de una relación débil entre las exportaciones y el crecimiento regional implica que se deben impulsar propuestas de política industrial diferentes a las tradicionales. La principal limitación de esta investigación fue la falta de información sobre las importaciones regionales, con las cuales se podrían analizar planteamientos teóricos más completos. La originalidad de este trabajo consiste en mostrar que, para el crecimiento regional en Mexico, el sector exportador en las economías estatales tiene un papel limitado que se explica por el debilitamiento de los vinculos productivos nacionales.

Clasificación JEL: F14, F43, C51, 047, R11, R15.

Palabras clave: exportaciones, economía regional, apertura comercial, crecimiento económico, modelos econométricos espaciales.

[1] Corresponding author. Email: luquinta@acatlan.unam.mx

*Acknowledgements: This research was supported by a project financed by UNAM: "PAPIIT-IN308721 Public policies for urban economic reactivation and restructuring in Mexico in the face of economic and social impacts of COVID-19".

1. Introduction

Development encompasses the overall well-being of a population, transcending mere economic growth. Nevertheless, economic growth remains a fundamental prerequisite for realizing development, as it underpins the expansion of goods and services within an economy, the creation of new employment opportunities, and the elevation of purchasing power among the population.
Mexico witnessed robust annual gross domestic product (GDP) growth exceeding 6% until the late 1970s. However, with the onset of the neoliberal era in the mid-1980s, this growth trajectory faltered, halving to a mere 3% per annum.

Examining economic growth at the subnational level reveals significant heterogeneity. Over the past five years, 29 states across the country have experienced positive growth, albeit predominantly at rates below 2%, with only one state exceeding a 6% growth rate, primarily attributable to the performance of the oil industry (INEGI, 2024).

The economic literature has delved into various explanations for this sluggish growth. Drawing on Kaldor's seminal work (1970), one perspective emphasizes the pivotal role of the export sector in driving growth. In Mexico's case, the neoliberal reforms initiated in the mid-1980s culminated in the North American Free Trade Agreement (NAFTA), positioning the export sector as the catalyst for economic expansion. Despite achieving significant strides in developing a dynamic export sector, with its contribution to the country's GDP doubling from 1994 to 2021, this growth failed to translate into sustained economic prosperity. The primary reason for this paradox lies in the low domestic value-added content of exports. Fuji and Morales (2023) estimate that approximately 59% of added value in most manufacturing exports originates externally, resulting in weak linkages with the domestic productive sectors (Fuji and Cervantes, 2017).

Several studies have attempted to confirm Kaldor's first law, positing a positive relationship between manufacturing growth and national product growth, across Mexican states and regions. However, findings have been inconclusive (Ocegueda, 2003; Sánchez and Campos, 2010; Sánchez, 2011; Rendón-Rojas and Mejía-Reyes, 2015), attributed by Loria et al. (2019) to the country's deindustrialization and pronounced shift towards a service-based economy.

The paper is structured into five sections: the first section presents a theoretical discussion of Kaldor's approach and the Dixon-Thirlwall formalization; the second section delineates the specification of the spatial econometric model; the third section presents stylized facts; the fourth section analyzes model results; and a final section offers additional insights and considerations.

2. The Kaldor-Dixon-Thirlwall approach to regional growth

In the seventies, Kaldor (1970) highlighted the unequal regional performance of the economy in the United Kingdom as a problem. When examining the causes of regional inequality, he criticized the neoclassical explanation of factor endowments. The model put on trial by Kaldor was known as Hecksher-Ohlin, which, by assuming immobile production factors between regions, stated that it is more convenient for a region to specialize in manufactures that intensively use its most abundant factor, while its external market should specialize in those goods that it can produce at a relatively

lower cost (Capello, 2015). Contrary to the neoclassical idea, to Kaldor, regional growth depends on industrial development, which cannot be explained by factor endowments but is the result of a process of cumulative circular causality, as proposed by Myrdal (1959). In this circular process, two forces operate that bring forth spatial externalities that bolster growth. One of these forces is associated with Verdoorn's law (2002), which states that a region with greater industrial development enables greater productivity and efficiency, which triggers regional growth. In this mechanism of regional growth, Kaldor (1967, 1976, and 1984) sees industrial development as the engine of growth because of the improvement it induces in the entire economy's productivity. The fundamental concept here is that when considering two regions, a surge in external demand for a particular product prompts the industry with lower costs (characterized by lower relative efficiency wages) to respond. Consequently, due to the phenomenon of increasing returns within this industry, production escalates, thereby boosting productivity—consistent with Verdoorn's law—in the region with the most favorable industrial conditions. Accordingly, exports from one region to another engender centripetal forces within the more industrially advanced region, while simultaneously generating centrifugal forces in the less developed region. This dynamic exacerbates regional inequalities, amplifying their magnitude.

Kaldor establishes a clear difference when the effect of exports occurs between regions of the same country and between regions of different countries. In the first case, he considers that the mobility of the labor force is greater than international mobility and that the regions share the same fiscal and monetary institutional system that operates as a compensator for any movement of exports, which does not happen with an external deficit that needs to be compensated with greater inflows of foreign capital.

Since Kaldor did not put forward a formal model of these ideas, Dixon and Thirlwall (1975) formalized them in a mathematical model to make them operational. The basic equation to explain growth is the following:

$$g_t = \gamma x_t \quad [1]$$

Where g_t is the growth rate of output at time t, x_t is the growth rate of exports in t, and γ is the product to export elasticity.

Exports, in turn, will depend on domestic prices (pd), foreign prices (pf), and foreign income (z):

$$x_t = \eta(pd)_t + \delta(pf)_t + \epsilon(z)_t \quad [2]$$

Where η, δ, and ϵ are the elasticities of exports to domestic and foreign prices and income, respectively.

While prices and foreign income are considered exogenous, domestic prices depend on a margin (τ) on internal wage costs ($w - r$):

$$(pd)_t = (w)_t - (r)_t + (\tau)_t \quad [3]$$

The core of the formalization of the Kaldor model proposed by Dixon and Thirlwall is found in the productivity growth equation (r), which depends on the growth of industrial production and is where Verdoorn's law operates:

$$r_t = r_a + \lambda(g)_t \quad [4]$$

Where r_a is the growth of autonomous productivity, and λ the Verdoorn coefficient.

By searching for the reduced form of the system of equations, the Kaldor equilibrium equation is obtained:

$$(g)(t) = \gamma\left[\frac{\eta(w_t - r_t + \tau_t) + \delta(pf)_t + \epsilon(z)_t}{1+\gamma\eta\lambda}\right] \quad [5]$$

It follows from the equilibrium equation (5) that differences in regional growth depend on regional differences in the Verdoorn coefficient (λ); the latter can also foster any initial differences between the regions in the other determinants of the equation. In this system of equations, an increase in exports (x) in equation (2) gives rise to rounds of cumulative effects, but according to equation (5), an equilibrium growth rate will be reached in the long run.

The discussion of the Dixon-Thirlwall formalization of the Kaldor-Verdoorn law has given rise to numerous works at the national level (McCombie, 1983; McCombie and Ridder, 1984, Thirlwall, 1983; Bianchi, 2002 Forges et al., 2019) and at the regional level (Bernat, 1996; Fingleton and McCombie, 1998; Pons and Viladecans, 1999; Fingleton and López-Bazo, 2003; Millemaci and Ofria, 2014; Clavijo-Cortes, 2021; Tridico and Pariboni, 2017; Magacho and McCombie, 2017; Dosi and Yu, 2019; Gabrisch, 2021). These works confirm the relevance of the assumption of increasing returns to explain growth and use a wide variety of estimation methods to determine the degree of returns to scale in different economies. The results obtained for the Verdoorn coefficient vary depending on the estimation method used and the spatial dimension to which the model is applied. However, they do manage to substantiate a positive relationship between the autonomous components of demand and productivity (Deleidi et al., 2023).

In Latin America, efforts have also been made to estimate the Kaldor model at the regional level (Torres et al., 2013; Borgoglio et al., 2015; Pereira et al., 2021; Nassif et al., 2022; Angeles-Castro et al., 2023), which warn of debilitation of the positive impact of the industry on productivity from the beginning of the neoliberal reform process in the region and in countries where governments with orthodox policies have remained in power for a long time, such as Mexico, where the main limitation to export-led growth is found in the balance of payments (McCombie et al., 1994; Guerrero, 2003; Vázquez et al., 2013; Quintana et al., 2013; Rendón et.al. 2015).

The difficulties in applying the Dixon-Thirlwall model at the subnational levels of an economy lie in the absence of foreign trade data for states or municipalities. In the Mexican case, there is only information on the exports produced by the states, but there is no information on their imports. Therefore, this study will follow the methodology proposed by Tagliani (2018), which only tests for the first of the equations proposed by Dixon-Thirlwall, namely, that there exists a positive relationship between exports and production.

3. Durbin spatial panel model for exports and regional growth

By the Kaldor-Dixon-Thirlwall approach and considering the lack of information on imports or their price and income elasticities by state, it can be established that the growth of GDP per inhabitant ($\Delta pibpc_{i,t}$) is a positive function of exports for each of the states. In this research, we propose that the positive effects of exports on regional growth in Mexico are observed through three links: through *export growth* ($vin\_exp_{1,i,t}$), *trade openness* ($vin\_exp_{2,i,t}$), and the *absolute increase in trade openness* ($vin\_exp_{3,i,t}$). These are written in a single-column vector that includes all three ($vin\_exp_{,I,t} = \left[vin\_exp_{1,i,t}, vin\_exp_{2,i,t}, vin\_exp_{3,i,t}\right]'$) to simplify the econometric specification.

Equation (6) presents a panel model with constant fixed effects (μ_i), where α is an average constant, $u_{i,t}$ is the random disturbance term, and i, t are the i spatial units at time t. The Kaldor-Thirlwall approach and our three-link hypothesis are confirmed by proving that the three parameters of the vector $\beta = [\beta_1, \beta_2, \beta_3]$ are meaningful and positive $\beta > 0$.

$$\Delta pibpc_{i,t} = \beta vin\_exp_{,i,t} + a + \mu_i + u_{i,t} \quad [6]$$

A modified version of equation (6) is proposed through the methodology of the spatial panel Durbin model with fixed effects to estimate spatial externalities (spatial spillovers) of the three export links on the regional growth of Mexico. This spatial model offers the advantage of identifying the externalities due to the exports of the spatial units and the externalities of the exports of the neighbors on the economic growth of the spatial units. According to Elhorst (2014), the general spatial Durbin form of model (6) is expressed as follows:

$$\Delta pibpc_{i,t} = \rho W \Delta pibpc_{i,t} + \beta vin\_exp_{,i,t} + \theta W vin\_exp_{,i,t} + a + \mu_i + u_{i,t} \quad [7]$$

In equation (7), the spatial weight matrix W is based on the five k closest neighbors; the parameter ρ measures the spatial dynamics of economic growth weighted by W of the five neighbors of each state, while vector $\theta = [\theta_1, \theta_2, \theta_3]$ weighted by W measures the spatial effects of the exports of the five neighbors on the economic growth of the states. In a broader sense, to confirm the direct effects and positive spatial externalities of exports on regional growth in Mexico following the Kaldor-Thirlwall approach and our hypothesis of the three links, it must be true that the three parameters of the vectors$\beta = [\beta_1, \beta_2, \beta_3]$ and $\theta = [\theta_1, \theta_2, \theta_3]$ are meaningful and positive $\beta > 0$ and $\theta > 0$**,** and that the parameter ρ is also meaningful and positive.

To measure the direct, indirect (externalities), and total effects of exports on the regional growth of Mexico, equation (7) is written in terms of spatial equilibrium and is derived with respect to vector $vin\_exp_{,i,t}$. According to LeSage (2009) and Quintana and Mendoza (2022), the three effects are obtained from the matrix specified in equation (8).

$$\textit{Direct, indirect, and total effects}: \quad (I - \rho W)^{-1}(\beta_k I_n + \theta_k W) \quad [8]$$

4. Regional data, measurements, and trends

Data

We compiled a series of exports by state from 2007 to 2023 using the statistics on annual goods exports by state from the National Institute of Statistics and Geography (INEGI for its acronym in Spanish) for the period 2007-2022, its quarterly series until the third quarter of 2023 and our estimates for the last quarter of 2023. INEGI publishes exports data in thousands of dollars, so they were multiplied by the average exchange rate, divided by the implicit GDP deflator by state base year 2018=100, and divided by a million to obtain a series of exports by state at billions of constant 2018 pesos. In the case of state GDP, we completed a series for the same period as the exports (2007-2023) using the annual series in billions of constant 2018 pesos and the quarterly Indicator of State Economic Activity (ITAEE) base 2018 until the third quarter of 2023, both published by INEGI, as well as our estimates. GDP per capita was computed as GDP in billions of 2018 pesos divided by the total population of each state. Although the 32 states were considered when building the databases, the states of Tabasco and Campeche were not considered for the analysis since the country's main oil infrastructure is installed there, and this skews the export growth data and the GDP.

Measurements

For the measurements of *economic growth* ($\Delta pibpc_{i,t}$) and of *export growth* ($\Delta exp_{i,t}$) per state, we calculate the growth rates of GDP per capita and exports at constant 2018 prices, where i denotes the state identifier and t represents the years from 2008 to 2023.

$$\Delta pibpc_{i,t} = ((pibpc_{i,t} - pibpc_{i,t-1})/pibpc_{i,t-1}) * 100 \quad [9]$$

$$\Delta exp_{i,t} = ((exp_{i,t} - exp_{i,t-1})/exp_{i,t-1}) * 100 \quad [10]$$

For the indicator of *trade openness* via exports ($aper\_ext_{i,t}$), we use the ratio of exports to GDP of each state as a percentage, where both exports and GDP are in billions of 2018 pesos.

$$aper\_ext_{i,t} = (exp_{i,t}/pib_{i,t}) * 100 \quad [11]$$

Finally, we measure the *absolute increase in trade openness to GDP* by state ($\Delta aper\_ext\_pib_{i,t}$) as the difference in the indicator of trade openness but considering a one-year lagged GDP –or the previous year's GDP. The indicator is based on measurements used to estimate the multiplicative effects of demand components on economic growth, as shown in specification (12b).

$$\Delta aper\_ext\_pib_{i,t} = ((exp_{i,t}/pib_{i,t-1}) - (exp_{i,t-1}/pib_{i,t-1})) * 100 \quad [12a]$$

$$\Delta aper\_ext\_pib_{i,t} = ((exp_{i,t} - exp_{i,t-1})/pib_{i,t-1}) * 100 \quad [12b]$$

Regional trends

During the years between 2008 and 2023, the average growth rate of GDP per capita among the states was 0.14%, which exhibits their slow growth. In this period, two global economic crises occurred (2009 and 2020), with very different regional impacts across Mexican states. After the 2009 economic crisis and a nine-year recovery period, a group of 18 states with diverse territorial locations in the north, center, and south of Mexico achieved above-average economic growth in the period 2008-2019. Of this group, only six states stand out for a per capita economic growth between one and two percent, which are the states with an industrial base: San Luis Potosí, Guanajuato, Aguascalientes, Chihuahua, and Zacatecas, as well as Mexico City, which has a services profile. In the group with economic growth below the average for the 2008-2019 period, there are 12 states, of which 10 presented negative GDP per capita growth rates. The states of Oaxaca, Chiapas, and Veracruz are the ones with the worst economic performance (see Table 1).

Given the health and economic crisis of 2020 and the economic recovery of the last three years, we registered a reduction in national potential growth when comparing the average GDP per capita growth rate before the crisis (2008-2019) with the period that includes the crisis and recovery years (2008-2023): an average growth rate of 0.19% for the former period versus an average of 0.14% for the latter period. In regional terms, the results show that the states with the best performance in the period before the health and economic crisis reduced their potential growth. The growth rates from 2008 to 2023 are lower than those from 2008 to 2019, all the way from San Luis Potosí to Querétaro in Table 1. Nevertheless, most of the states with lower performance in the period before the crisis increased their potential growth after the crisis. In this case, the growth rates for 2008-2023 are higher than those for 2008-2019, as shown in Table 1, from Baja California to Oaxaca, except for Tlaxcala and Nuevo León.

The ranking of the states' potential growth changed with this inversion of before and after the health and economic crisis of 2020. Now, 16 states form the group with growth above the average: two new members adhered (Baja California and Baja California Sur) while four former states moved to the low-growth group (Querétaro, Durango, Coahuila, and Colima) with the characteristic of negative average growth rate for the period 2008-2023, except for Querétaro (see Table 1).

The reduction in the states' potential growth, especially the group with the highest economic growth before the crisis of 2020, is partly explained by the impact of the global health and economic crisis on international trade, particularly on regional exports from Mexico. To identify the trends of the links, Table 1 presents the three proposed measurements of regional exports: export growth, trade openness, and the absolute increase in trade openness to GDP.

The lower average growth of states' exports is in line with the fall in states' potential growth: the growth rate of exports went from 5.09% in the period previous to the crisis (2008-2019) to 3.78% in the period that includes the crisis and its economic recovery (2008-2023). We also noticed that regional economies that lead the ranking of export growth tend to grow faster than those with lower export dynamics, though there are cases where export growth is not related to economic growth in states with higher or lower GDP per capita, such as Mexico City, Guerrero, and Nayarit. Another noteworthy trend is that post-crisis export growth has not been sufficient to reach the average rate of the previous period (2008-2019) in most states; only the export sectors of Mexico City, Hidalgo, Chiapas, and Oaxaca managed to exceed the growth in external sales of the period before the 2020 crisis (see Table 1).

Trade openness, measured as the ratio of exports to GDP, increased from 26.71% to 28.36% on average in general from the period before the crisis (2008-2019) to the period that comprises the crisis and economic recovery (2008-2023). The increase in trade openness due to the economic crisis was manifested by the combination of negative growth rates of exports and GDP, where reductions in export levels were lower than those in production levels in most states. The atypical cases with negative to virtually no changes in trade openness were Mexico City, Yucatán, Quintana Roo, Mexico State, Morelos, Chiapas, and Oaxaca (see Table 1).

Regarding the absolute increase in trade openness to GDP, a reduction is observed from 1.3% to 0.98% average among the states from the period 2008-2019 to 2008-2023, which shows the impact of the export sector, weighted by its importance in the economy, on the reduction in regional growth after the 2020 crisis. Most of the states presented a loss in the absolute increase in trade openness to GDP; the states of San Luis Potosí, Guanajuato, Aguascalientes, Chihuahua, Puebla, Coahuila, and Sonora stand out. The external sectors of Mexico City and Chiapas do not seem to be affected, while for Oaxaca and Hidalgo, there is an absolute increase instead of a reduction in trade openness to GDP (see Table 1).

Table 1. Exports and regional economic growth in Mexico, 2008-2023

Average percentage

States	Export growth		Trade openness		The absolute increase in trade openness to GDP		GDP per capita growth	
	2008-2019	2008-2023	2008-2019	2008-2023	2008-2019	2008-2023	2008-2019	2008-2023
San Luis Potosí	10.91	7.92	35.02	38.68	3.57	2.46	1.99	1.44
Guanajuato	12.61	9.71	29.64	33.28	3.07	2.41	1.52	1.38
Aguascalientes	9.30	5.70	50.16	53.52	4.39	2.45	1.42	0.41
Chihuahua	6.72	5.23	101.05	107.59	6.36	4.83	1.37	1.36
Mexico City	1.12	2.07	1.38	1.40	0.01	0.02	1.22	0.92
Zacatecas	3.45	2.76	26.36	27.01	0.57	0.38	1.20	0.96
Yucatán	0.49	0.33	7.18	6.77	-0.01	-0.02	0.95	0.49
Michoacán	43.73	32.32	5.83	8.74	1.35	0.91	0.88	0.79
Quintana Roo	19.18	15.25	0.29	0.26	0.02	0.00	0.84	0.74
Jalisco	3.90	3.17	22.16	22.51	0.68	0.57	0.76	0.74
Sonora	4.33	2.63	42.12	42.83	1.54	0.86	0.67	0.56
Puebla	8.30	5.65	27.93	29.73	2.01	1.21	0.66	0.25
Mexico State	8.30	5.69	15.09	14.96	0.98	0.61	0.57	0.40
Colima	43.57	34.08	3.60	5.32	0.64	0.59	0.48	-0.30
Durango	10.23	7.60	9.98	11.99	0.97	0.70	0.41	-0.08
Sinaloa	30.61	22.13	3.77	5.27	0.78	0.49	0.32	0.21
Coahuila	8.74	7.09	70.56	78.27	5.19	4.42	0.30	-0.18
Querétaro	11.18	9.10	28.87	32.65	2.72	2.35	0.28	0.12
Total average	5.09	3.87	26.71	28.36	1.30	0.98	0.19	0.14
Baja California	2.76	1.90	82.55	84.64	2.20	1.50	0.15	0.38
Tlaxcala	6.13	5.39	16.02	17.73	0.87	0.79	0.14	-0.19

Nuevo León	6.41	5.29	32.47	34.40	1.94	1.63	0.12	-0.07
Tamaulipas	2.59	1.26	66.52	68.44	1.66	0.73	-0.09	-0.07
Guerrero	35.12	25.85	3.41	4.07	0.42	0.29	-0.17	-0.15
Baja California Sur	7.08	6.08	2.53	2.79	0.15	0.14	-0.21	0.16
Nayarit	23.50	16.32	1.59	1.92	0.24	0.14	-0.39	-0.24
Morelos	5.63	2.77	23.09	22.18	0.83	0.32	-0.41	-0.24
Hidalgo	5.22	7.84	8.98	9.42	0.29	0.52	-0.52	-0.05
Veracruz	4.30	3.46	10.26	10.76	0.35	0.25	-0.96	-0.96
Chiapas	2.01	2.69	5.47	5.35	0.00	0.03	-1.10	-0.67
Oaxaca	7.33	8.71	4.91	4.85	0.02	0.13	-1.19	-0.01
Group > average	13.15	9.91	26.72	28.93	1.94	1.40	0.88	0.57
Group < average	9.01	7.30	21.48	22.21	0.75	0.54	-0.39	-0.18

Source: Authors' elaboration using exports and GDP data by state from INEGI.
Note: The state ranking goes from highest to lowest state performance as measured by GDP per capita growth for the pre-crisis period, defined from 2008 to 2019.

To show the possible expected signs of the links between the external sector and GDP per capita growth, the graphs in Figure 1 present the scatter diagrams of GDP per capita growth and each of the three links, with regression lines for the periods 2008-2019 and 2008-2023 to identify possible changes in trends. In the scatter diagrams, the size of the circles is defined by the 2019 GDP per capita to examine if it is an important factor in the relationship between the links of the external sector and economic growth and in the change in its slope.

The slopes of the regression lines in the scatter diagrams of Figure 1 are noticeably small and positive for the three links between the external sector and GDP per capita growth for the period before the economic crisis (2008-2019), although the slope for the absolute increase in trade openness to GDP is larger. The other feature worth noticing is that such slopes are modified as a consequence of the economic crisis of 2020, a change in the sign of the slope from positive to negative is observed for the external links of export growth and trade openness, while a change in magnitude, but maintaining the positive sign, is seen in the absolute increase in trade openness to GDP. The scatter diagrams also show a shortening in the range of values for the links of export growth and absolute increase in trade openness to GDP, whereas there is an increase in the range of values for trade openness, as shown by the size of the regression lines in red for the period 2008-2023.

Through the size of the economy identified by the 2019 GDP per capita, the scatter diagrams show that the highest-income economies are not the ones with the highest exports and economic growth; the medium regional economies are best linked to trade openness or the absolute increase in exports to GDP to promote economic growth (see Figure 1).

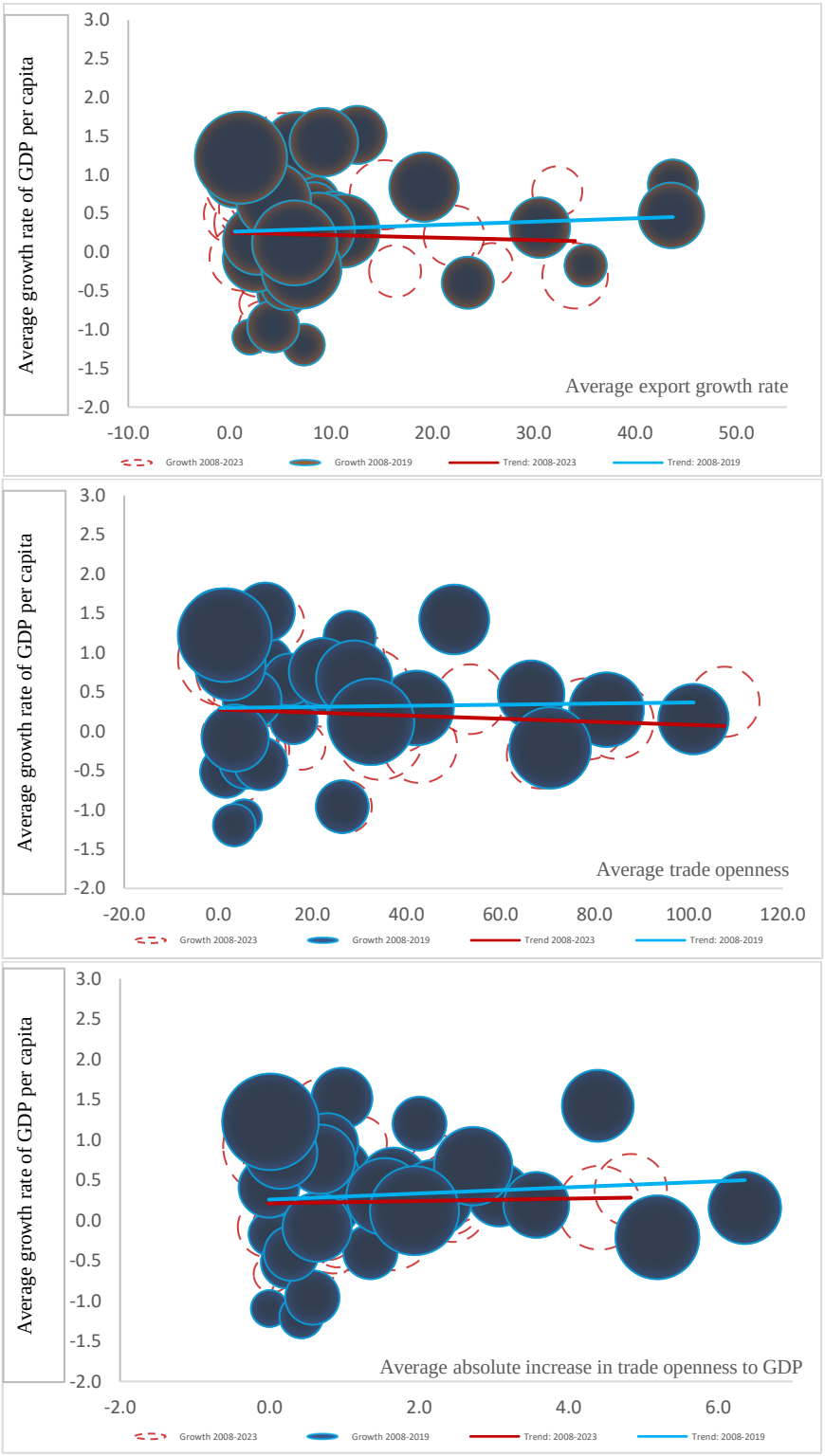

Figure 1. Links between exports and regional economic growth in Mexico, 2008-2023
Period average percentage

Source: Authors' elaboration using data on exports and GDP by state from INEGI.

Note: The size of the circle represents the GDP per capita of 2019.

5. Model results

Table 2 presents the results of the estimations of the *spatial panel Durbin models with fixed effects* for the period before the health and economic crisis of 2020 (2008-2019) and the extended period that includes the crisis and the subsequent years of economic recovery (2008-2023). In the specification of the models, the growth rate of GDP per capita is explained by the three export links: growth of exports, trade openness, and the absolute increase in trade openness to GDP. The spatial weights matrix was constructed with the k=5 closest neighbors for the 30 states that were considered –as mentioned in the data and measurements part, Campeche and Tabasco were not included in the estimates since their oil-rich status skews the overall results on economic growth.

The findings for the period 2008-2019 show that the estimated parameters of the three export links are zero and not significant for export growth, negative, small, and significant for trade openness, and positive and significant for the absolute increase in trade openness to GDP. By including the times of the crisis and economic recovery (2008-2023), the estimation results show a small contraction in the size of the parameters of trade openness and the absolute increase in trade openness to GDP, and now the export growth parameter is slightly positive and significant (see Table 2).

The spatial dependence of GDP per capita growth increased with the economic crisis of 2020 and its following recovery; this is because the spatial lag parameter of GDP per capita growth went from 0.57 for the period 2008-2019 to 0.78 in 2008-2023. In the case of the spatial lag for the export links, we find that there is no influence from neighboring states on the growth of exports before and after the economic crisis of 2020; the parameters are negative and not significant for the two estimation periods. The trade openness of neighboring states has had a positive and significant effect, but it has not had important changes because of the crisis and economic recovery after 2020. The link of the external sector measured as the absolute increase in trade openness to GDP had the largest positive and significant parameter (0.21) for the period 2008-2019, but because of the 2020 economic crisis, this link was broken since the parameter is close to zero (0.02) and not significant for the period 2008-2023 (see Table 2).

We estimated *the direct effects* of the links between exports and GDP per capita growth by combining the estimated parameters; for the *indirect effects or spatial externalities*, we used the spatial lag of GDP per capita growth and the spatial lag of export links, and the *total effects* are the sum of direct and indirect effects. The results show that the direct, indirect, and total effects of state export growth on the growth of GDP per capita are not significant either before or after the economic crisis of 2020. The trade openness link has a direct negative effect and an indirect positive effect that cancels each other out, causing the total effect to be statistically equal to zero in the end. The absolute increase in trade openness to GDP was the only link that stayed positive and had the most relevant direct, indirect, and total effects before and after the 2020 economic crisis, but with important changes to highlight. The *direct effect* of the absolute increase in trade openness to GDP on the growth of GDP per capita decreased from 0.30 to 0.27 between the two periods of analysis, while the *indirect effect* practically did not change, being 0.89 in the first period and 0.83 in the extended period. However, for the period 2008-2019, the spatial externalities were mostly due to the combination of the effect of the spatial lag on GDP per capita growth and this link in neighboring states, but after the economic crisis, the link of the absolute increase in trade openness to GDP of neighboring states was

broken and the effect of the spatially lagged GDP per capita growth was amplified from 0.57 to 0.78 for the period 2008-2023 (see Table 2).

Table 2. Results of spatial panel Durbin models between export links and regional economic growth in Mexico, periods 2008-2019 and 2008-2023

Variables	**Durbin spatial panel, 2008-2019**			**Durbin spatial panel, 2008-2023**		
	Coefficients	Std. Error	Pr(>|t|)	Coefficients	Std. Error	Pr(>|t|)
GDP per capita growth: spatial lag	**0.57**	0.05	0.00	**0.78**	0.03	0.00
Export links						
Export growth	**0.00**	0.00	0.97	**0.01**	0.00	0.03
Trade openness	**-0.08**	0.04	0.03	**-0.06**	0.03	0.03
Absolute increase in trade openness to GDP	**0.33**	0.05	0.00	**0.21**	0.04	0.00
Spatial lag in export links						
Export growth	**-0.01**	0.01	0.19	**-0.01**	0.01	0.17
Trade openness	**0.11**	0.05	0.02	**0.09**	0.04	0.01
Absolute increase in trade openness to GDP	**0.21**	0.11	0.05	**0.02**	0.08	0.77
R-squared	**0.53**			**0.65**		
Adjust-R-squared	**0.38**			**0.22**		
Impacts	**Direct**	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
Export growth	**0.00**	**-0.03**	**-0.03**	**0.01**	**-0.03**	**-0.02**
Pr(>|t|)	0.76	0.17	0.17	0.10	0.46	0.60
Trade openness	**-0.07**	**0.16**	**0.09**	**-0.05**	**0.22**	**0.17**
Pr(>|t|)	0.03	0.05	0.28	0.07	0.04	0.12
Absolute increase in trade openness to GDP	**0.38**	**0.89**	**1.27**	**0.27**	**0.83**	**1.10**
Pr(>|t|)	0.00	0.00	0.00	0.00	0.01	0.00

Source: Models programmed in *RStudio* using the library *SDPDmod* (Spatial Dynamic Panel Data Modeling).
Note: The estimates consider 30 states –the states of Campeche and Tabasco are excluded– with their k=5 closest neighbors.

6. Discussion and final considerations

The results obtained show that there is no positive and direct relationship between the states' exports and the growth rate of their GDP per capita. Moreover, upon decomposing the direct and indirect effects of exports on economic growth, as well as investigating spatial spillover effects between states, no significant impacts were found. Similarly, the degree of trade openness—defined as the proportion of exports to GDP—did not emerge as a significant explanatory factor for economic growth. Upon further examination, the direct negative effects and indirect positive impacts of trade openness tended to offset each other.

However, a noteworthy finding was the positive and significant impact of the absolute increase in trade openness, albeit with a modest coefficient that diminishes when considering the adverse effects of the COVID-19 pandemic on growth. This outcome suggests that the influence of exports on states' economies operates dynamically over time, with effects manifesting with delays rather than instantaneously. Additionally, positive spatial spillover effects on GDP were observed between states, implying that the positive impact of absolute export growth on states' GDP per capita is augmented through spatial lags, potentially fostering a cumulative growth dynamic reminiscent of Myrdal's theory.

Our findings are consistent with studies on Kaldor's first law carried out at a national scale that proves a weak relationship between industrial growth and the economic growth of the country. In the case of Mexico, manufacturing exports have this characteristic and reflect the minor role that the export sector has within the state economies due to its growing dependence on imported inputs and its debilitated productive linkages with the national market.

References

[1] Angeles-Castro, G., Domínguez-Blancas, C. S., and Fraga-Castillo, C. A. (2023). Kaldor-Verdoorn laws, Investigación Económica, 82(326), pp. 156-184. https://doi.org/10.22201/fe.01851667p.2023.326.86163

[2] Bernat, G.A., Jr. (1996). Does manufacturing matter? A spatial econometric view of Kaldor,s laws. Journal of Regional Science, 36(3), pp. 463-477. https://doi.org/10.1111/j.1467-9787.1996.tb01112.x

[3] Bianchi, C. (2002). A Reappraisal of Verdoorn's Law for the Italian Economy, 1951–1997. In: McCombie, J., Pugno, M., Soro, B. (eds) Productivity Growth and Economic Performance. Palgrave Macmillan, London. https://doi.org/10.1057/9780230504233_5

[4] Borgoglio, L., and Odisio, J. (2015). La productividad manufacturera en Argentina, Brasil y México: una estimación de la Ley de Kaldor-Verdoorn, 1950-2010. Investigación económica, 74(292), 185-211. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0185-16672015000200011&lng=es&tlng=es

[5] Capello, R. (2015). Regional Economics (2nd ed.). Routledge. https://doi.org/10.4324/9781315720074

[6] Clavijo-Cortes, P. (2022). Output hysteresis in the US: new evidence from a time-varying Verdoorn's law. Journal of Economic Studies, 49(1), pp. 185-197. https://doi.org/10.1108/JES-06-2020-0263

[7] Deleidi, M., Fontanari, C. and Gahn, S.J. (2023). Autonomous demand and technical change: exploring the Kaldor–Verdoorn law on a global level. Econ Polit 40, pp. 57–80. https://doi.org/10.1007/s40888-023-00294-y

[8] Dixon R.J. and Thirlwall A.P. (1975). A model of regional growth rate differences on Kaldorian lines, Oxford Economic Papers, 11, pp.201-212. https://doi.org/10.1093/oxfordjournals.oep.a041312

[9] Dosi, G. and Yu, X. (2019). Technological catching-up, sales dynamics, and employment growth: Evidence from China's manufacturing. Industrial and Corporate Change, 28(1), pp. 79–107. https://doi.org/10.1093/icc/dty023

[10] Fingleton, B. and López-Bazo, E. (2003). Explaining the distribution of manufacturing productivity in the EU regions. Advances in Spatial Science, pp. 375–409. https://doi.org/10.1007/978-3-662-07136-6_14

[11] Fingleton, B. and McCombie, J.S.L. (1998). Increasing returns and economic growth: some evidence for manufacturing from the European Union regions. Oxford Economic Papers, 50, pp. 89-105. https://doi.org/10.1093/oxfordjournals.oep.a028638

[12] Forges, G., Patalano, R. and Traficante, G. (2019). The Italian economic stagnation from a Kaldorian theoretical perspective. Economia Politica, 36(3), pp. 841–861. https://doi.org/10.1007/s40888-017-0084-0

[13] Fuji-Gambero, G. and Morales-López, R. (2023). Calidad de las exportaciones manufactureras de México en el contexto de fragmentación internacional de la producción. El Trimestre Económico, 91(361), pp. 7-46. https://doi.org/10.20430/ete.v91i361.1791

[14] Fujii-Gambero, G., and Cervantes, R. (2017). The weak linkages between processing exports and the internal economy. The Mexican case. Economic Systems Research, 29(4), pp. 528-540. https://doi.org/10.1080/09535314.2017.1351332

[15] Gabrisch, H. (2021). The long-run properties of the Kaldor–Verdoorn law: A bounds test approach to a panel of Central and East European (CEE) countries. Empirica, 48(1), pp. 101–121. https://doi.org/10.1007/s10663-019-09467-0

[16] Torres, L. A. G., Cisneros, M. A. I., Hernandez, J. M. O. and Collado, K. E. C. (2013). Empirical Evidence Of Verdoorn's Law In Mexican Manufacturing. International Business & Economics Research Journal, 12 (2), pp. 205-212. https://doi.org/10.19030/iber.v12i2.7632

[17] Guerrero, C. (2003). Modelo de crecimiento económico restringido por la Balanza de Pagos: Evidencia para México, 1940-2000. El Trimestre Económico, 70(278) (2), pp. 253-273. https://EconPapers.repec.org/RePEc:elt:journl:v:70:y:2003:i:278:p:253-273

[18] Elhorst, J. Paul (2014) Spatial Econometrics: From Cross, Sectional Data to Spatial Panels, Springer. https://doi.org/10.1007/978-3-642-40340-8

[19] INEGI (2024). Crecimiento nacional y estatal de la economía mexicana, Instituto Nacional de Estadística, Geografía e Informática (INEGI). https://mexicocomovamos.mx/publicaciones/2021/08/crecimiento-nacional-y-estatal-de-la-economia-mexicana/#:~:text=La%20econom%C3%ADa%20mexicana%20tuvo%20un,los%20datos%20observados%20del%20PIB.

[20] Kaldor, N. (1976). Capitalismo y desarrollo industrial: algunas lecciones de la experiencia británica. In C. F. Díaz, S. Teitel and V. Tockman (ed.), Política económica en centro y periferia. México: Fondo de Cultura Económica.

[21] Kaldor, N. (1984). Causas del lento ritmo de crecimiento del Reino Unido. Investigación Económica, 43(167), pp. 9-27. https://www.jstor.org/stable/42779413

[22] Kaldor, N. (1967). Strategic Factors in Economic Development. New York State School of Industrial and Labour Relations. Ithaca, NY, Cornell University.

[23] Kaldor, N. (1970). The case for regional policies. Scottish Journal of Political Economy, 85, pp. 337-348. https://doi.org/10.1111/j.1467-9485.1970.tb00712.x

[24] LeSage, J.P and Pace, R.K. (2009). Introduction to Spatial Econometrics, Chapman and Hall/CRC. https://doi.org/10.1201/9781420064254

[25] Loria, E., Moreno-Brid, J.C., Salas, E. and Sanchez-Juarez, I. (2019). Explicación kaldoriana del bajo crecimiento económico en México. Problemas del Desarrollo, 50(196), pp.3-26. https://doi.org/10.22201/iiec.20078951e.2019.196.63506

[26] Magacho, G. R., and McCombie, J. S. (2017). Verdoorn's law and productivity dynamics: An empirical investigation into the demand and supply approaches. Journal of Post Keynesian Economics, 40(4), pp. 600–621. https://doi.org/10.1080/01603477.2017.1299580

[27] McCombie, J.S.L. (1983). Kaldor, 's laws in retrospect. Journal of Post Keynesian Economics, 5, pp. 414-429. https://doi.org/10.1080/01603477.1983.11489380

[28] McCombie, J.S.L. and Ridder, J.R. (1984). The Verdoorn law controversy: some new empirical evidence using US State Data. Oxford Economic Papers, 36, pp. 268-284. https://doi.org/10.1093/oxfordjournals.oep.a041637

[29] McCombie, J.S.L. and Thirlwall, A.P. (1994). Economic growth and the balance of payments constraint. Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-23121-8

[30] Millemaci, E. and Ofria, F. (2014). Kaldor-Verdoorn's law and increasing returns to scale: a comparison across developed countries. Journal of Economic Studies, 41 (1), pp. 140-162. https://doi.org/10.1108/jes-02-2012-0026

[31] Myrdal, G. (1959) Teoría económica y regiones subdesarrolladas. Fondo de Cultura Económica, Sección de obras de Economía.

[32] Nassif, A., Feijó, C. and Araujo, E. (2022). Econometric estimation of labor productivity in the Brazilian Manufacturing Sector in the 2000s: A Kaldorian approach. Revista Brasileira de Inovação, 17, pp. 9–32. https://doi.org/10.20396/rbi.v17i1.8650856

[33] Ocegueda, J. (2003). Análisis kaldoriano del crecimiento económico de los estados de México, 1980-2000", Comercio Exterior, 53(11), México, Bancomext. http://revistas.bancomext.gob.mx/rce/magazines/59/5/oceg1103.pdf

[34] Pereira, H.C, Romero, J.P. y Medeiros, V. (2021). Kaldor–Verdoorn's law and institutions: evidence from Brazilian municipalities, Cambridge Journal of Economics, 45(3), pp. 511–536. https://doi.org/10.1093/cje/beaa057

[35] Pons, J. and Viladecans, E. (1999): Kaldor,s laws and spatial dependence: evidence for the european regions. Regional Studies, 33 (5), pp. 443-451. https://doi.org/10.1080/00343409950081284

[36] Quintana, L., Rosales, R.A., and Mun, N. (2013). Crecimiento y desarrollo regional de México y Corea del Sur: un análisis comparativo de las leyes de Kaldor. Investigación Económica, 72(284), pp. 83-110. https://doi.org/10.1016/s0185-1667(13)72593-1

[37] Quintana, Romero, Luis y Mendoza González Miguel Ángel (2022). Econometría Espacial Aplicada utilizando R, FES-Acatlán, UNAM. https://web.siia.unam.mx/siia-publico/v/include/modulo_productos/libros.php?id=629921

[38] Rendón-Rojas, L. and Mejía-Reyes, P. (2015). Producción manufacturera en dos regiones mexiquenses: evaluación de las leyes de Kaldor. Economía, Sociedad y Territorio, 15(48), México, El Colegio Mexiquense. https://doi.org/10.22136/est012015597

[39] Sánchez, I. (2011). Estancamiento económico en México, manufacturas y rendimientos crecientes: un enfoque kaldoriano, Investigación Económica, 70(277), México, UNAM. https://doi.org/10.22201/fe.01851667p.2011.277.37318

[40] Sánchez, I. and Campos, E. (2010). Industria manufacturera y crecimiento económico en la frontera norte de México. Región y Sociedad, 22(49). https://doi.org/10.22198/rys.2010.49.a422

[41] Tagliani, P. (2018). Crecimiento Económico Regional. El caso de la Provincia de Río Negro (Argentina). Investigaciones Regionales, 41, pp. 91-112. https://dialnet.unirioja.es/servlet/articulo?codigo=6716925

[42] Thirlwall, A.P. (1983). A Plain Man's Guide to Kaldor's Growth Laws. Journal of Post Keynesian Economics, 5(3), pp. 345-358. https://doi.org/10.1080/01603477.1983.11489375

[43] Tridico, P. and Pariboni, R. (2017). Inequality, financialization, and economic decline. Journal of Post Keynesian Economics, 41(2), 236–259. https://doi.org/10.1080/01603477.2017.1338966

[44] Vázquez, J. A. and Avendaño, V. L. (2013). ¿Modelo de crecimiento exportador o modelo de estancamiento exportador? El caso de México, 1961-2010. Investigación Económica, 71(282), pp. 93-108. https://doi.org/10.22201/fe.01851667p.2012.282.37365

[45] Verdoorn, P.J. (2002). Factors that determine the growth of labour productivity, pp. 28-36. In McCombie, J., Pugno, M. y Soro, B. (Eds.). Productivity growth and economic performance. Essays on Verdoorn's law. Palgrave McMillan. https://doi.org/10.1057/9780230504233_2

Luis Quintana Romero, Miguel Ángel Mendoza González, Marcos Valdivia López

An Application of the Kaldor-Dixon-Thirlwall Model for Regional Economic Growth in Mexico
Una aplicación del modelo Kaldor-Dixon-Thirlwall para el crecimiento regional en México

Revista mexicana de economía y finanzas
vol. 19, no. 3, e1002, 2024
Instituto Mexicano de Ejecutivos de Finanzas, A. C.,
ISSN: 1665-5346
ISSN-E: 2448-6795

DOI: https://doi.org/10.21919/remef.v19i3.1002