How do exports to China affect the productivity of Latin American and Caribbean countries?

Sebastián Castellano

LinkedIn: Sebastián Gonzalo (塞巴) Castellano Unda

Abstract

This paper analyzes the impact of exports to China on labor productivity in Latin American and Caribbean countries using a panel data approach with a random effects model. The analysis is based on data from 32 countries between 2000 and 2023. The results show that exports to China have a positive and significant effect on productivity, supporting the hypothesis that trade contributes to economic performance. However, variables such as human capital, innovation, and capital-labor ratio do not exhibit significant impacts. The study also finds no clear evidence of a learning-by-exporting effect. The variance decomposition reveals that most of the variation in productivity stems from differences between countries rather than within them. These findings highlight the importance of export structure, innovation systems, and country-specific characteristics in shaping productivity outcomes in the region.

本文使用带有随机效应模型的面板数据方法，分析了对中国出口对拉丁美洲和加勒比地区国家劳动生产率的影响。研究基于 2000 年至 2023 年间 32 个国家的数据。结果显示，对中国的出口对生产率有显著的正向影响，支持了贸易有助于经济表现的假设。然而，人力资本、创新以及资本-劳动比等变量并未显示出显著影响。此外，研究未发现明显的“通过出口学习”（learning by exporting）效应。方差分解表明，生产率的大部分变异来自国家之间的结构性差异，而非国家内部的时间变化。这些发现强调了出口结构、创新体系和国家特有因素在决定该地区生产率结果中的重要性。

Chinese exports; labor productivity; random effects model; Latin America and the Caribbean; panel data; innovation; learning effect

Introduction

In recent decades, The integration of Latin America and Caribean Countrys into the global economy has been a significant economic phenomenon, documented by scholars such as the Economic Commission for Latin America and the Caribbean (ECLAC). In its reports, ECLAC (2023) states that Latin America and the Caribbean have entered the international market as a region that mainly exports primary products and food. The ECLAC report also conducts an investigation into the impact of China on Latin America between 2000 and 2022, confirming that trade between these two regions multiplied by 35, displacing the European Union as the second-largest trading partner in 2010. This information is relevant because, as demonstrated by Kalaitzi and Chamberlain (2020), the way a country or region integrates into the global market and changes in trade patterns determine the growth and development of a country or region.

Thus, although exports to China have increased, organizations like ECLAC question whether trade with China leads to economic growth and improved productivity. Latin America and the Caribbean have remained a primary-exporting region in relation to China, which would lead to deindustrialization and a lack of diversification, harming competitiveness and productivity. On the contrary, there are also opposing positions. As per the studies by Dorn (2021) and Bastos (2020), China's rapid rise presents a complex mix of opportunities and challenges for the region. This has led to competition shocks but also opened new doors for trade expansion and economic diversification. Bonialian (2021) goes further, stating that Latin America is a geostrategic center for the logic of the Silk Road and that it is a good opportunity to send Latin America's production surpluses to China.

The motivation for this research is to understand the real impact of exports on the productivity of Latin America and the Caribbean, as there is little consensus regarding the repercussions that having China as the main trading partner has had and will have on the region. To this end, a model presented by Kalsoom (2024) fixed effect method will be applied to address the endogeneity problem using the expansion of exports to China. Prior to this, relevant literature will be presented where the variables and their instruments will be specified. Next, the methodology will be detailed, along with the data and their sources. In the following section, the results will be shown, and based on these, conclusions and the insights that can be drawn from these results will be presented in the postscript.

Literature Review

This section aims to identify the possible causes of variations in a country's productivity and to provide theoretical support for the hypotheses that will be presented. It will also seek to compare with other articles and theories regarding the effect of exports to a specific country on productivity variations. As will be seen below, there are several studies with contrary conclusions for both the case of Latin America and the world.

The Effect of Exports on Productivity

It is well known that international trade facilitates economic growth. However, economic growth should be considered as the ultimate result of a dynamic economy that produces more or less efficiently and therefore has the capacity to export more. This is evidenced in the article written by Choudhri (2000), who found that for each sector, trade liberalization is a significant determinant of the rate of aggregate productivity growth.

Generally, several arguments in favor of trade liberalization are presented, as it contributes to increased productivity. Related to this discussion, the most significant change in global trade in recent years has been the emergence of China as the world's factory. This new market is attractive to developing countries, including, of course, those in Latin America and the Caribbean. If we focus for a moment on imports from China, the arguments in favor of such imports also generate an increase in productivity. According to Bloom (2016), the absolute volume of innovation increases within the firms most affected by Chinese imports in their output markets.

Regarding exports to China at the global level, Ahn (2017) and Locker (2004) have different results. Locker mentions that emerging economies are the ones that benefit the most from the increase in productivity, while Ahn asserts that industrialized countries are the ones that benefit the most from exports to China. However, the latter study was conducted using data from 1990 to 2000. In the same vein, Doan (2015) studies the case of Vietnam and discovers that the increase in exports and, in general, trade with China has led to a decrease in productivity.

The Case of Latin America and the Caribbean

For the Latin American case, there are some articles that argue about the benefits of exporting and having trade relations with China. For example, the

article by Zuñiga & Crespi (2012), which focused on the study of Argentina, Chile, Colombia, Costa Rica, Panama, and Uruguay, using survey data, found that cooperation, foreign ownership, and exporting increase the propensity to invest in innovation activities and encourage innovation investment, and therefore improve productivity. However, this was only true for half of the countries analyzed. The annual reports by ECLAC (2023) also stand out. They have a less optimistic view, arguing that the expansion of commercial exchange with China has not led to a diversification of regional exports, which remain concentrated in a limited number of basic products. This has deepened the region's primary-export specialization, moving it away from an export trajectory based on the incorporation of knowledge and environmental sustainability. However, given the growing demand in China for safe, diverse, and high-quality food, the region has a great opportunity to diversify and add value to its exports to that country in the food sector, taking advantage of its natural comparative advantages.

As can be seen, unlike the general consensus on the benefits of opening up to foreign trade, there is evidence both in favor of and against the positive effects that this has on productivity. In this way, this article will seek to answer whether trade, and more specifically, exports, have a benefit for productivity in Latin America and the Caribbean.

H1: Exports have a direct and significant effect on productivity.

Innovation as a Driver of Productivity

The main argument focuses on the idea that the increase in exports is driven by the increase in producers' innovations, which in turn generates an increase in productivity (Areti Gkypali, 2021). This, in turn, leads to a more general conclusion. If it is understood that innovation comes from the producer, then it is understood that those economies that invest in knowledge and worker training, and that also invest in technology and equipment improvement, have higher productivity. This is also related to investment in research and development, as also demonstrated by Khanna (2021).

Regarding investment and development, Benavente (2005) develops the case for Chile, showing that the productivity of plants in the medium term is positively affected by significant technological improvements. Moreover, public support in the financing of research and development has a significant impact. For every dollar of public support received, the productivity of the beneficiary firms has improved, on average, by an equivalent of five dollars. This highlights the importance of public participation in promoting investment in research and development to increase productivity, which can have positive

consequences for the competitiveness of firms in the domestic market and in exports.

As can be deduced, there is a general consensus that there is a positive relationship between innovation, investment in research and development, and a country's productivity, which in turn increases exports. It should also be understood that when talking about investment and promoting innovation in an economy, an extrapolation can also be made regarding how much society in general allocates to innovation and research and development. As will be seen in the next section, the variable Human Capital will be chosen as a proxy for innovation, as well as the resources that the state allocates to investment in research and development.

H2: Innovation has a direct and significant effect on productivity

"Learning by exporting" as a Driver of Productivity

The learning experiences from exporting are different for developed countries than for developing countries. As mentioned by Rastoka (2023), in a globalized world, developed countries quickly benefit from knowledge transfer, but often these innovations are so rapid that they become temporary. The opposite occurs in developing countries, where knowledge transfers through exports have a much deeper impact. Reggiani (2018) goes further in his analysis, demonstrating how export destinations significantly shape productivity improvements at the industry level, with advanced economies offering greater opportunities for learning and efficiency gains. This provides theoretical support for focusing only on exports to China and how developing economies have learned from this experience to improve their productivity.

Finally, it is convenient to present the case of Slovenia. Loecker (2013) asserts that although there is a substantial increase in productivity when exporting, the learning experiences differ significantly among producers, with some having a much deeper "learning by exporting" experience than others.

H3: "Learning by exporting" has a direct and significant effect on productivity.

Other Variables that Influence Productivity and Exports

Productivity and exports are influenced by multiple factors. This means that to construct a solid theory, we must also take into account other variables that also affect exports and productivity. In this way, these other variables absorb or isolate the effect of exports on productivity. These variables help to avoid the confusion that could arise if there are additional factors that influence both the dependent variable and the independent variable of interest. For example

Ahn (2017) uses the economic growth rate and the size of the industry as variables, arguing that economic growth improves exports, which in turn improves productivity. Finally, it is also appropriate to mention intensity. Bănică (2018) mentions intensity as the ratio of capital to labor, that is, presents the Capital-Labor ratio as a way to approximate productivity.

Methodology

Data specification

This study employs panel data from 32 countries in Latin America and the Caribbean between 2000 and 2023. All these countries share the characteristic of having heterogeneous production and being primarily primary exporters. There are exceptions, such as Brazil, Mexico, and Peru, which have developed their production matrices in products with higher added value in a better way. However, these countries still largely depend on the income generated by primary products. The countries are: Antigua and Barbuda, Argentina, The Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Puerto Rico, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, Suriname, St. Vincent and the Grenadines, Trinidad and Tobago, Uruguay, Venezuela.

Las variables a usar se basan en la teoría de expuestas en la sección anterior, especialmente, en las variables tomadas por Kalsoom (2004) y las recomendaciones de Takahashi, Iwasaki & Tsubaki (2017), de tenemos de esta manera como variable dependiente la Productividad Labora (prodv), Exportaciones (exports), Economic growth (gdp_growth), , learning by exports (lbexp), Innovación (hum_cap), investigación y desarrollo (rea_dev), y finalmente Ratio Capital/Trabajo (KL).

The variables to be used are based on the theories presented in the previous section, especially on the variables taken by Kalsoom (2004) and the recommendations of Takahashi, Iwasaki & Tsubaki (2017). We thus have the following variables: Labor Productivity (prodv), Exports (exports), Economic Growth (gdp_growth), Learning by Exports (lbexp), Innovation (hum_cap), Research and Development (rea_dev). The argument in this case is that an economy with a larger number of employees leads to a larger scale of production, and finally the Capital/Labor Ratio (KL).

Some of these variables need to be calculated:

$$Labor\ Productivity = \frac{Value\ added}{Total\ number\ of\ employees}$$

Regarding the capital-labor ratio, it is decided to take gross fixed capital formation as capital to visualize the magnitude of that ratio at the country level.

$$\frac{Capital}{Labor} = \frac{Gross\ Fixed\ Capital\ Formation}{Total\ number\ of\ employees}$$

For future research and to ensure academic transparency, a table with the sources of these data will be attached.

Labor Productivity (prodv), Exportas (exports), Economic growth (gdp_growth), learning by exports (lbexp), Innovación (hum_cap), investigación y desarrollo (rea_dev), capital-labor.

Table 1: Data Sources

Variable	Acronyms	Data Source
Labor Productivity	prodv	United Nation Industrial Development Organization (2024) and WTO (2024)
Exports	exports	World Integrated Trade Solution (2023)
Economic Growth	GDP_growth	World Development Indicators (2024)
Human Capital	human_cap	International Labour Organization (2022)
Research and development	reas_develop	World Development Indicators (2024)
Learning by exporting	lbexp	United Nation Industrial Development Organization (2024)
Capital to labor	KL	World Development Indicators (2024)

For the model, following the recommendations of Takahashi, Iwasaki & Tsubaki (2017) and Kalsoom (2004), the equations were transformed to the natural logarithm and other control variables were added, such as innovation (whose proxy variable is Human Capital) and the Capital-Labor Ratio, whose justification is detailed in the previous section. So the model is as follows:

$$lnprdv_{it} = \alpha_0 + \alpha_1 lnexports_{it} + \alpha_2 lnhum\_cap_{it} + \alpha_3 lbexp_{it} + \alpha_4 reas\_devlop_{it} + \alpha_5 KL_{it}\ \alpha_6 GDP\_growth + e_{it}$$

Ahn (2017) mentions that this model may have heterogeneity problems because the years from 2000 to 2023 have been subject to shocks. Therefore, it aims to capture those shocks that affect all units in a specific year. Also, although the countries in Latin America share a similar economic structure, it is advisable to isolate the common aspects to observe only their varying degrees.

Finally, it is also important to clarify that several limitations have been presented. For example, several countries have not published their data for the last year. Others have only published certain data during the first years starting from 2000, and others have “gaps,” meaning that there are several years in which they did not present data and then resumed presenting it. Therefore, the data is not homogeneous. There has also been the case where the international institutions responsible for collecting data have only updated their information until 2019. Therefore, this lack of information will undoubtedly influence the estimation and validation of the variables.

Results and Discussion

As we saw, Kalsoom (2004) recommends using fixed effects because he believes that the intrinsic characteristics of each country should be controlled for. That is, the individual effects of each country are correlated and should be controlled for. However, according to the Hausman test, the p-value is 0.8858, which means that a random effects model is recommended.

This contradicts the original model, which means that possibly for the Latin American case, the best option is to use random effects. The RE model takes advantage of both "within" variation (within the country over time) and "between" variation (between countries). This allows for extracting additional information about how countries behave on average, not just how they vary internally. This is useful when the interest is also in comparing average structures across countries, such as which countries are more productive due to their general export orientation toward China. Furthermore, if the individual effects are uncorrelated with the explanatory variables (as assumed by the RE model), then the RE estimator is more efficient than the FE model, since it does not lose degrees of freedom by introducing a dummy for each country. This is particularly important when working with a medium-sized sample and several years, as in this study, where the RE model can generate more precise estimates (lower variance of the estimators) than the FE model.

Table 1: Random Effect GLS regression

Within R2 = 0.308			
Between R2 = 0.0307			
Overall R2 = 0,0014			
Variable	Coefficient	z-value	P > z
ln_exports	1,176,568	5.29	0.000
human_capital	-18,300,000	-0.77	0.439
LBExp	-1,852,832	-1.64	0.102
reas_and_develop	-17,900,000	-1.92	0.055
capital_to_labor	1,645.153	1.05	0.296
GDP_growth	-122,665.6	-0.76	0.447
_cons	3,152,903	0.22	0.829
Prueba de Wald = 42,57			
rho = 0.9078			

Chart/graph created by the author.

The model results show a Within R2 of 0.308, indicating that 30.8% of the variation in labor productivity over time within each country is explained by the model. The Between R2 is 0.0307, suggesting that only a small portion of the differences in country averages is captured by the included variables. The Overall R2 is very low, 0.0014, reflecting that total variance is difficult to explain without distinguishing individual and temporal components. However, the Wald test yields a chi2 of 42.57 with strong statistical significance, indicating that the model as a whole is valid and that at least one explanatory variable has a significant effect on productivity.

Regarding the explanatory variables, it is observed that log exports have a positive and significant effect on labor productivity. This result aligns with the theoretical hypothesis that trade openness and access to markets such as China can generate efficiency and competitiveness gains, which in turn translate into productivity increases. This is one of the main findings of the model and reinforces the importance of international trade in the economic growth of the region.

On the other hand, variables such as human capital, the capital-to-labor ratio, GDP growth, and investment in research and development were found to be not significant. The same applies to the "learning by exporting" variable, which does not show clear evidence of improving productivity in the countries analyzed. This may indicate that although these factors are theoretically

important, in practice they face structural or measurement limitations in the Latin American context that prevent their impact from being reflected in this specific model.

The lack of significance for several variables can be attributed to multiple reasons. First, the available data presents limitations: many countries have incomplete or outdated series, which affects the robustness of the estimates. Second, some of these variables may require more time for their effects to materialize, such as innovation or human capital, whose benefits tend to appear in the long term. Finally, there may also be institutional or structural factors not captured by the model that interfere with the relationship between these variables and productivity.

The value of rho = 0.9078 indicates that approximately 91% of the total variance in the model is due to between-country differences, rather than changes within countries over time. This confirms that structural characteristics specific to each country are the main drivers of labor productivity, further supporting the use of the random effects model for this analysis.

Conclusions

This research aimed to evaluate the impact of exports to China on the labor productivity of Latin American and Caribbean countries, using a panel data model with a random effects specification. The empirical results confirm that exports to China have a positive and statistically significant effect on productivity. This finding supports the hypothesis that trade with China, particularly in export-oriented economies, can be a driver of productivity gains in the region.

However, other variables traditionally associated with productivity—such as human capital, research and development investment, and capital-labor ratio—did not show statistically significant effects in this context. This may reflect the limited development of innovation systems, institutional weaknesses, or time lags in the impact of these variables on productivity. The variable measuring "learning by exporting" also failed to show a significant and positive effect, suggesting that the benefits of trade are not automatic and depend on internal absorptive capacities.

The high value of rho indicated that most of the variance in productivity comes from structural differences between countries rather than from temporal variations within each one. This reinforces the need to consider country-

specific characteristics when analyzing productivity dynamics and designing policies.

Recommendations

Promote diversification within export structures: While exports to China positively influence productivity, relying on a narrow range of primary products can limit long-term growth. Policies should promote higher-value exports through investment in processing, branding, and certification.

Strengthen national innovation systems: Governments should prioritize stable and efficient funding for research and development, along with policies to connect universities, firms, and the public sector.

Invest in absorptive capacity: Countries must improve institutional quality, technical training, and access to technology to ensure that productivity gains from exports are sustainable and widespread.

Address data quality gaps: Many countries still lack consistent and reliable data. Strengthening national statistical systems is key for effective monitoring, evaluation, and policy design.

Appendix

Hausman Test

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. hausman FE RE, constant sigmamore

Note: the rank of the differenced variance matrix (6) does not equal the number o
       may be problems computing the test.  Examine the output of your estimator
       that the coefficients are on a similar scale.

                 ——— Coefficients ———
                   (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                    FE           RE         Difference       Std. err.
-------------------------------------------------------------------------------
  ln_exports     1579272      1176568        402703.7        571996.9
human_capi~l     4657062    -1.83e+07        2.29e+07        1.19e+08
       LBExp    -1870618     -1852832       -17785.94        379940.7
reas_and_d~p    -1.86e+07    -1.79e+07       -760425.5        2.36e+07
capital_to~r     2310.579     1645.153        665.4264        484.6333
  GDP_growth    -218327.7    -122665.6       -95662.16        69918.64
       _cons    -1.68e+07      3152903       -1.99e+07        7.72e+07
-------------------------------------------------------------------------------
                           b = Consistent under H0 and Ha; obtained from xtreg.
            B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

    chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =   2.34
Prob > chi2 = 0.8858
(V_b-V_B is not positive definite)
```

The explanation about no-significant results is related to the theory put forward by the Economic Commission for Latin America and the Caribbean

ECLAC (2023), or the reader's deeper understanding, this organization is responsible for monitoring the socioeconomic indicators of Latin America and the Caribbean, proposing structural change policies in the region, and is the creator of the "Structuralist School" designed for Latin America and the Caribbean. This organization explicitly states that the primary-export model leads to low added value in exports and that deepening this model leads to a worsening of this situation where the added value is not increased and, therefore, productivity is not increased. Or at least, the variables used as instruments do not directly determine this relationship. Palau (2023) puts forward something similar. He mentions regarding exports to China and its link with productivity that his hypothesis was verified only for half of the countries he had chosen, all of which are Latin American countries. For his part, Loecker (2013) states that investments in research and development behave differently depending on the industry in which they are invested.

The discussion can also be expanded by taking into account the actual experience of companies in Latin America and the Caribbean in exporting to China. Since there are countries whose track record and experience in exporting to China have just begun, it is not possible to study the effects of exports to China on productivity because the data are too recent, as suggested by Bernard&Jensen (1999). Finally, comparisons can be made between 2SLS models, models with fixed effects, and Cobb-Douglas production function models, as Bigsten (2003)

As can be seen, it is necessary to conduct more in-depth research, taking into account a larger number of years or keeping abreast of updates of new data regarding countries that do not usually publish them on time. There is also the possibility of improving the used model with other methods or treating the data in a better way.

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