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CHINA AND DEINDUSTRIALIZATION IN LATIN AMERICA

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ABSTRACT, KEYWORDS AND JEL CODES

This paper analyzes the process of deindustrialization in Latin America and the impact of China on this process. After discussing the main theoretical explanations for premature deindustrialization and presenting some empirical data on the process of deindustrialization in Latin America, this paper undertakes a novel panel data analysis to provide greater clarification on the role of China in the early deindustrialization process of Latin American countries. The findings suggest that the import of manufactured goods from China does not have a significant effect on manufacturing employment and is in fact associated with an increase, not a decrease, in the share of manufacturing value added. On the other hand, exports to China are negatively associated in this sample with the share of both manufacturing employment and manufacturing value added. This supports the view that trade with China may be a part of the explanation for deindustrialization, not through competition from Chinese manufacturers but rather through the impact on the competitiveness of primary exports and exchange rate appreciation, and that that one of the most relevant factors for deindustrialization in Latin America is related to the Dutch disease.

KEYWORDS: Industrialization; Deindustrialization; International Trade; South-South Cooperation; Economic complexity.

JEL CODES: F16; F14; O14; O54; O53.

1. INTRODUCTION

Industrialization, as a structural transformation of economies, has been the most successful driver of global development. In other words, industrialization is arguably the main process responsible for global differences in per capita income. Manufacturing is a sector with unique characteristics that distinguish it in terms of advancing a country's production. Manufacturing provides increasing returns that are not found in other sectors of the economy. Moreover, productivities in the manufacturing sector exhibit

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unconditional convergence, which means that sectors with lower productivity grow faster, gradually merging with their technological frontiers (López, 2016).

Deindustrialization, defined as the long-term decline in the manufacturing industry's share of employment and value-added (Tregenna, 2009), is a complex phenomenon that sparks debates and controversies in economics, theory, and politics. One reason for this is that deindustrialization does not manifest itself in the same way or with the same characteristics and consequences in all contexts. Countries at various stages of development have seen a decline in industrial participation in terms of employment and value-added in recent decades but with varying outcomes.

Latin America has long been known as a supplier of primary goods and raw materials, with most countries experiencing late and incipient industrialization. However, since the 1990s, the manufacturing industry has shown signs of declining share of value added and employment, despite these economies not having high per capita incomes. During the same period, the emergence of China as an important agent in the world trade scene is one of the main factors for the industrialization of countries in Asia (Kim & Lee, 2014). This emergence has had different implications for countries in Latin America.

This paper aims to understand the impacts of China's advance on the region's deindustrialization trajectory. This is justified by the growing interest that the topic has received in recent years and the importance of research that aims to shed light on new elements involving this theme.

1.2. General Objectives

This study aims to investigate and analyze the relationships between early deindustrialization in Latin America and China's increased participation in international trade with those countries.

1.3. Specific Objectives

This paper has three specific objectives, which are:

a) Explore the main theories for deindustrialization in Latin America;

b) Understand the current economic relationships between Latin American countries and China;

c) Analyze the impacts of trade relations between China and Latin America on the deindustrialization process in this region.

1.4. RESEARCH QUESTIONS AND HYPOTHESES

Based on the specific objectives, two research questions and two hypotheses were established, with the second hypothesis being subdivided into two sub hypotheses.

Q1 How did the main indicators related to deindustrialization in the 20 countries that make up Latin America behave, from 1999 to 2020?

Q2 What is the impact of trade relations with China for the period 1999 to 2020 on the deindustrialization processes for 11 Latin American countries?

The following hypotheses seek to explore the possible causes of deindustrialization in Latin America.

H1: In the period 1990-2020, Latin American countries have undergone premature deindustrialization in terms of manufacturing value added and/or employment.

H2a: Trade expansion with China, in the form of manufactured goods imports from China, has accelerated deindustrialization in Latin American countries as domestic producers have faced increased competition from Chinese manufacturers.

H2b: Trade expansion with China, in the form of manufactured goods exports to China, has accelerated deindustrialization in Latin American countries as these economies have become more reliant on the primary sector.

1.2. STRUCTURE

This work is divided into 5 parts, the first of which is the introduction, a space dedicated to identifying the objectives of the work. The second section presents the theoretical framework, which aims to explore the concept of deindustrialization, the process of deindustrialization in Latin America, and the role of China on the world stage. The third part is related to the methodology used in the research, developed through panel data analysis. The fourth part presents the findings of the research and how they relate to the theoretical framework. Finally, the fifth and final section correspond to the final considerations, which seek to discuss whether the objectives proposed in the research were achieved.

2. DEINDUSTRIALIZATION

Nicholas Kaldor, a pioneer in the study of industrialization and economic development, believed that developing an economic growth theory based on a single-product economy was inappropriate because demand and supply conditions differed across sectors. His distinction between industry, agriculture, and services is as follows. On the demand side, he proposed that the income elasticity of demand for industrial products was greater than that for agriculture, but it was roughly comparable to that for services. On the supply side, it was assumed that the manufacturing industry had a higher potential for productivity growth for the reasons stated above. Kaldor's first law captures the relationship between the growth rate of the manufacturing industry and Gross Domestic Product (GDP). It states that the faster the growth rate of the manufacturing industry in the economy, the faster the GDP growth will be (Dasgupta & Singh, 2007).

Post-Keynesian, Schumpeterian, and structuralist theories contend that growth is both sector- and activity-specific. These "sector-specific" growth theories all have one thing in common: the pattern and dynamics of growth are heavily influenced by the activities under development. Capital accumulation has specific effects on growth in the manufacturing industry. These lines of thought stand out for considering how technological change, externalities, synergies, balance of payments sustainability, and the capacity of developing countries are directly related to the size, strength, and depth of the manufacturing sector (Palma, 2019).

Therefore, how these structural changes occur in economies is fundamental to understanding economic growth. In particular, deindustrialization is first defined as the process of reducing the share of industrial jobs in employment in a country or region (Tregenna, 2009). However, this concept can be expanded to refer to a reduction in the share of either/both manufacturing/industrial employment in total employment and manufacturing/industrial value added in total GDP (Oreiro & Feijó, 2010).

It is important to highlight that deindustrialization is not necessarily associated with economic stagnation; a country may be experiencing an increase in its industrial sector and developing new technologies and, nevertheless, still face deindustrialization in a relative sense, or purely in terms of the employment share. Furthermore, deindustrialization is not necessarily associated with a return to primary exports. We should therefore distinguish between "positive" and "negative" deindustrialization. Some manufacturing activities which are more labor intensive or have lower added value may be transferred abroad, thereby reducing the industry's share of employment. Deindustrialization may be accompanied by an increase in the share of products with greater technological content and greater added value in the export basket and it may be accompanied by a transfer of the labour force to advanced, high-productivity services. In all these cases, it is a "positive" form of deindustrialization.

However, in other cases deindustrialization may be accompanied by a reprimarization of the export basket, that is, the export basket may turn to commodities, primary products, or manufactures with little added value or technological content. Deindustrialization in this case is considered "negative" because it replaces higher-productivity activities with lower-productivity production and constrains economic growth, This may be due to a variety of reasons, including in some cases the so-called "Dutch disease", or deindustrialization caused by the appreciation of the real exchange rate (Marconi & Rocha Marcos, 2012), possibly due to the discovery of limited natural resources in a country or region (Monteiro & Penna, 2021).

The issue of the Dutch disease indicates that each country's natural resource abundance influences the relationship between manufacturing employment and per capita income. In some countries, the scarcity of natural resources imposes the need to follow an "industrialization path" aimed at generating a trade surplus in manufacturing to finance their inevitable trade deficit in natural resources; in others, the generation of a surplus in natural resources makes it possible to finance a manufacturing deficit. Thus, Palma (2019) defines the Dutch disease as a process in which, following the discovery of a natural resource (natural gas in the case of the Netherlands), a country moves from one reference group to another; in this case, from the group of countries aiming to generate a trade surplus in the manufacturing sector to the group capable of generating a trade surplus in commodities.

In developing economies, the decline in manufacturing may be characterized as premature in two different ways. The first sense is more descriptive and refers to the fact that these economies have been experiencing deindustrialization much earlier than the historical norm. Countries that began to industrialize later were unable to develop sizeable industrial sectors and began to deindustrialize at significantly lower income levels than was the case in the early industrializers (Rodrik, 2016). Second, it is premature because early deindustrialization could harm economic growth. Manufacturing activities have several aspects that make them essential to the growth process. The manufacturing industry tends to be highly dynamic in terms of technology, in addition to being a sector capable of absorbing a significant amount of unskilled labor. The combined characteristics of the manufacturing industry make it an outstanding staircase for developing economies. Thus, early deindustrialization has the potential to eliminate the main channel that enabled previous rapid growth (Rodrik, 2016).

In other words, premature deindustrialization may be defined as deindustrialization that begins at a lower level of GDP than is generally the case, or deindustrialization which begins when manufacturing has not yet reached employment and GDP percentages typically associated with the turning point of industrialization (Tregenna, 2015).

3. Deindustrialization and Structuralism in Latin America

In this section, we will discuss the characteristics and impact of deindustrialization in Latin America, the historical roots of this process, and the main features of Latin American structuralism.

3.1. Deindustrialization in Latin America

As seen previously, deindustrialization in developed economies may or may not impact growth, depending on its specific form. For example, it could result in a stimulus to growth if positive deindustrialization in mature economies is associated with a shift in resources from the manufacturing industry to advanced services and other research and intensive development activities.

However, in the case of premature deindustrialization in middle-income countries, it is difficult to argue that this experience could be positive for long-term growth. This trend is concerning because it has the potential to reduce industrial competitiveness due to low productivity, as seen in China (Feng & Wang, 2021). Displaced workers from deindustrialization may become employed in low-productivity and informal activities, leading to lower aggregate productivity and rising income inequality in middle-income countries (Özşahin & Özbay Daş, 2021).

In this context, deindustrialization represents a pathological state when it prevents the economy from reaching its full potential for growth, employment, and use of resources. Most Latin American countries faced a deindustrialization process in the 1980s and 1990s because of the Washington Consensus policies of international financial institutions, which Latin America was forced to follow in response to the debt crisis, promoting structural change in these countries' economies (Dasgupta & Singh, 2007).

During this period, countries that previously utilized an industrial policy based on state-led import substitution industrialization (ISI) and had achieved levels of industrialization characteristic of developed countries underwent a regime change from ISI to comprehensive trade and financial liberalization. For as long as ISI made it difficult for foreign-manufactured products to enter the domestic market, national production of these products increased, boosting regional industrial development. However, their industrial base continued to lag their more efficient international counterparts. As a result of the policy shift toward greater liberalization, there was an "invasion" of international products sold at lower prices, exposing national industries to much greater competition. There was then a migration of domestic capital to the primary sector, which can be understood as the transformation of its economic structure from a policy-induced trade surplus in manufacturing to a policy-induced trade surplus in primary goods.

This shift involved some large and sudden changes in relative prices, mainly because of lower tariffs, which reduced the prices of imported goods, increases in capital inflows which put upward pressure on the exchange rates, and the end of institutional support for industry. Brazil, Argentina, Chile, and Uruguay experienced the greatest deindustrialization after their economic reforms, while also being among the countries in the region that had previously industrialized the most and subsequently implemented the most drastic reforms (Palma, 2019).

Industrialization is a recent phenomenon in most Latin American economies. Most of the workforce in these countries migrated from the fields to the cities and from agriculture to industry. Their aspirations in society were supported by industrial policy, as new political leaders emerged. In these countries, the manufacturing industry has already reached its peak in terms of employment and added value. Latin America today faces early deindustrialization alongside a growing service sector, as in most developed countries, but also a clear process of reprimarization in some cases (Castillo & Martins Neto, 2016).

Argentina, Brazil, and Chile currently face premature deindustrialization as they increase their specialization in raw materials, resource-based manufacturing, and low-productivity services. Mexico is a more complex case, insofar as deindustrialization has lost momentum in the last two decades. Argentina, on the other hand, seems to have partly reversed its deindustrialization process in the early 2010s (Castillo & Martins Neto, 2016). The Colombian case also presents a certain particularity, since industrial take-off occurred around four decades later than in Argentina, Brazil, Chile, and Mexico, but in this case, too, the period of greatest industrial expansion was short-lived and came to an end decades ago (Echavarría & Villamizar, 2005).

The Mexican economy has experienced a process of structural and sectoral change associated with a very significant setback in economic development and economic stagnation, which is explained by the existence of a low rate of accumulation in the industrial sector. This low rate of accumulation manifested itself as a “dynamic insufficiency” of the sector, both to absorb the working age workforce and to trigger the country's economic growth. The structural reform program implemented by the government in the 1990s favored the low rate of capital accumulation, by causing a series of shocks on the supply and demand side, which generated permanent negative effects on the economy's potential GDP (Hernández-Bielma & Calderón-Villarreal, 2016).

When analyzing this process along the northern border of Mexico, these trends do not coincide with the rest of the country because of the nature of industry in Mexico. The presence of these companies in the industrial sector along Mexico's northern border has resulted in the creation of qualified jobs, technology transfer, and an increased flow of foreign currency. Until the North American Free Trade Agreement (NAFTA) went into effect, an industry composed of transnational corporations, whose products were destined for export to the United States, on the Mexico-United States border was a regional guarantee of successful performance due to salary and transportation costs, as well as fiscal benefits (Sidón et al., 2022).

3.2. Structuralism in Latin America

Latin American structuralism is linked to the idea that economic development depends on structural change to overcome bottlenecks and other obstacles; thus, it emphasizes the role of industry in accelerating this process (Gala et al., 2018). In the middle of the twentieth century, the fundamental diagnosis of the problem of Latin American development was that Latin America's role in the international division of labor as a supplier of primary products facilitated the reproduction of underdevelopment and that only a change in the productive structure could reverse this situation. Industrialization would be a catalyst for structural change required to overcome underdevelopment and achieve a more equitable insertion instead of a subordinate one, breaking with the classic “center-periphery” division (Prebisch, 1949).

The national-developmentalist ideology, particularly in its Latin American version, was relatively influential between the 1950s and the 1980s, with the first decade of this period possibly having the greatest influence (Colistete, 2001).The main strategy used during this period was import substitution industrialization, which aimed to "shift the dynamic center" of the economy from the external sector to internal demand, from export to internal consumption, to substitute imports oriented toward the ultimate goal of densifying national production chains and creating a complete industrial network (Tavares, 2010).

The failure of ISI in many Latin American countries is one of the most serious criticisms directed toward the Structuralist approach. While ISI did result in some industrial growth, it was often described as inefficient, with low competitiveness, and an overreliance on state subsidies (Simachev et al., 2016). ISI also caused balance-of-payments problems in some cases, as industries continued to rely on imported machinery, technology, and inputs for production (Mendes et al., 2014).

Critics, such as those from a neoliberal perspective, argue that the Structuralist emphasis on insulating domestic markets and reducing reliance on global trade hindered Latin American countries from taking advantage of the benefits of globalization. Countries that protected inefficient industries missed out on the opportunities that could come from integrating into global value chains, foreign investment, and technological transfers that could increase productivity (Ibarra, 2011).

Some of the limits of structuralist and neoliberal models, new approaches have appeared that combine market integration with targeted state intervention. These models highlight the importance of institutional quality, human capital development, and innovation, which were not prioritized in the structuralist framework (Leiva, 2010).

4. The impact of China on deindustrialization

In this section, we discuss China's impact on international trade and the origins of Chinese economic growth.

4.1. Global impact

The substantial increase in Asian consumption over the past thirty years, coupled with its increasing integration with global flows of trade, capital, talent, and innovation, has been one of the most notable global developments of the recent past. This phenomenon has involved a qualitative and quantitative change, with Asia not only participating in these flows but also influencing their direction and configuration.

Between 2007 and 2017, China's production of labor-intensive goods nearly tripled, from US$3.1 trillion to US$8.8 trillion, while their global export share fell, indicating a shift toward domestic consumption. The United Nations Statistics Division reported that China accounted for 28% of global industrial production in 2018. This placed the country ahead of the United States, which previously had the world's largest manufacturing sector until China overtook it in 2010 (Tonby et al., 2019).

As previously discussed, one source of deindustrialization affects almost all countries at some point in time during the process of economic development: the “benign” inverted-U relationship between income per capita and the shares of manufacturing employment and value-added. However, other potential causes of deindustrialization are more “negative” and concern only specific groups of countries. These include the Dutch disease and the emergence of China as an important agent in the world trade scene (Kim & Lee, 2014).

The economic relationship between China and Latin America has grown significantly, especially in the 2000s, as both regions increased their economic interactions. China's strategic objectives in Latin America include expanding economic cooperation, strengthening political relations, and establishing a sphere of influence in the region. This strategic partnership aims to elevate China's status on a systemic level, indicating a stronger economic bond between the two regions (Yu, 2015). Furthermore, China's impact on Latin America and the Caribbean has been both direct and indirect, with its rapid growth and integration into the global economy shaping the economic landscape of Latin American countries. (Jenkins et al., 2008).

Trade relations between China and Latin American countries have been largely characterized by the raw materials export from Latin America to China, resulting in Latin American economies with low value-added export baskets and leading to concerns about deindustrialization in Latin American economies (Lopez & Munoz, 2020).However, this has played out differently in different Latin American countries, namely due to differences in the composition (not just the volume) of bilateral trade flows with China (Kim & Lee, 2014).

In the case of Brazil, although Chinese products are taking up an increasing share of the domestic market, they continue to represent a relatively small proportion of total sales of manufactured products in general. Likewise, although Brazil has been losing market share to China in the United States, European Union, and Latin American markets, given the size of the domestic market and the relatively small proportion of industrial production that is exported, this also has not had a major impact on aggregate industrial production so far (Jenkins & Barbosa, 2012).

Thus, China's influence on the Brazilian industry has been both direct and indirect. The direct effects included an increase in imported manufactured goods from China, which partially displaced domestic production and was not offset by an increase in Brazilian manufactured goods exports to China. As a result, the trade deficit with China helped to increase Brazil's overall industrial deficit. However, focusing on the bilateral trade balance with China fails to capture the direct impact on Brazilian industry, which is also affected by Chinese competition in third markets (Jenkins, 2015).

4.2. China and international integration

The economic relationship between China and Latin America goes beyond the trade competition dimension. For example, China has been seeking to strengthen its global participation by financing development projects in several countries. China has become the largest creditor to Latin American governments, lending at low interest rates and investing in both the industrial and agricultural sectors. Strengthening ties with the region is part of the Chinese government's development strategy and involves operating its international insertion to foster internal growth using the market structure to its advantage, thereby obtaining a greater share of the global market (Gallagher & Irwin, 2015).

China has emerged as a driving force in the rise of the Global South, with South-South Cooperation (SSC) being inextricably linked to China's economic importance in the international system. Returning to the premise that China is the primary actor, we must understand how the present and future of South-South Cooperation work by understanding the mechanism it uses when forming alliances with Southern nations.

Emma Mawdsley's (2019) analytical periodization of South-South Cooperation is worth considering here. The chronological scheme is divided into three distinct temporal phases. The first phase, known as 'SSC 1.0', represents the Third World's developmental assumptions and desires from 1950 to 2000. The second phase, known as 'SSC 2.0', refers to the period of increased cooperation in the early 2000s. The final phase, 'SSC 3.0', emerges after fifteen years of cooperation expansion and reveals the new challenges and outlook for the Global South.

An example of these challenges can be seen in the Sino-Brazilian relationship, which is more of a center-periphery relationship and thus represents dependence rather than equal gains and mutual development (in the sense that the periphery exports low-value-added products, while the center exports high-value-added products). However, it is hard to determine whether China deliberately seeks to act in this way, because the deficient Brazilian endogenous structure predates the expansion of the Sino-Brazilian bilateral relationship. In light of this, preexisting favorable conditions existed for Brazil-China cooperation to result in a center-periphery relationship (Portela, 2021;Jenkins, 2012).

5. Empirical analysis

This section presents our empirical analysis and is divided into two parts: the first part seeks to explore the available data on Latin American countries; while the second section presents the econometric model developed to analyze the relationships between the variables, the sources used can be found in the appendix.

5.1. Historical evolution and recent outlook

The initial concept of deindustrialization refers to a reduction in the share of manufacturing employment in total employment. Data on employment in the manufacturing sector in Latin America and the Caribbean has been available with aggregate data since 1991, with the most recent data from 2022.

It is possible to observe a reduction in the share of industrial employment over this period by about 10.87%, from a share of 23.5% in 1991 down to a share close to 21% in 2022 (Figure 1).

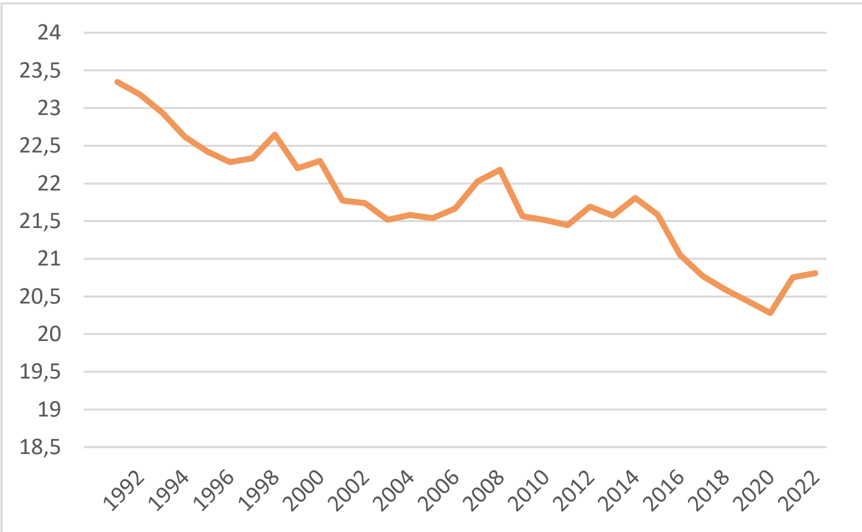

Figure 1 - Latin America & Caribbean LCN Employment in industry (% of total employment) (modeled ILO estimate)

As previously described, Latin America presents great heterogeneity among countries, in so far as these have gone through different historical processes. In order to facilitate the analysis, we chose to analyze the countries in a segmented way (Figure 2). The five largest economies in Latin America, in terms of PPP, are Brazil, Mexico, Argentina, Colombia and Peru, which together represent more than 70% of the region's total GDP.

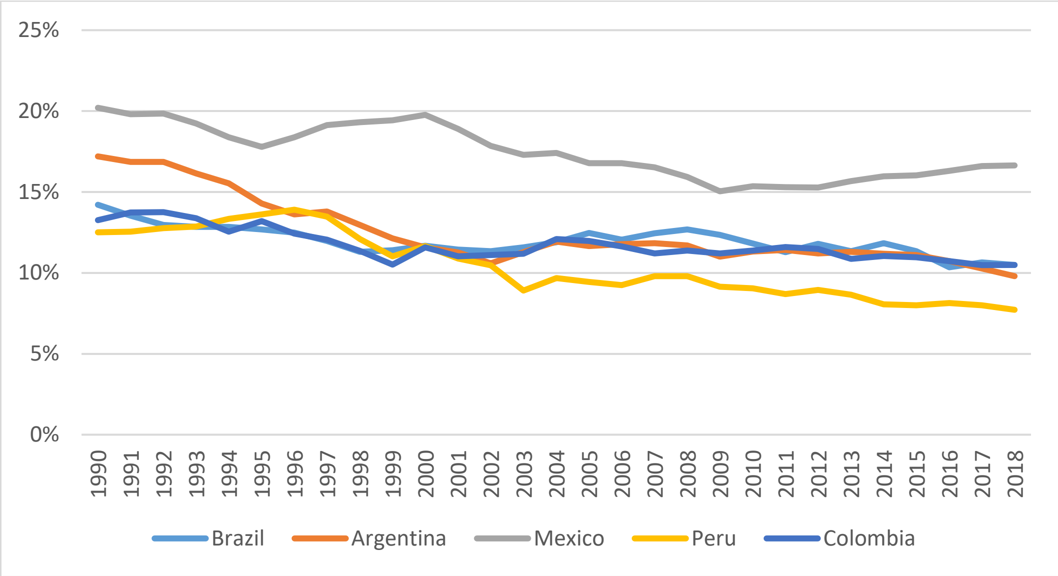

Figure 2 - Share of labor employed in manufacturing (1990 to 2018)

As we can observe in Figure 2, all five selected countries showed a drop in the share of labor employed in manufacturing in the period from 1990 to 2018. The second classic

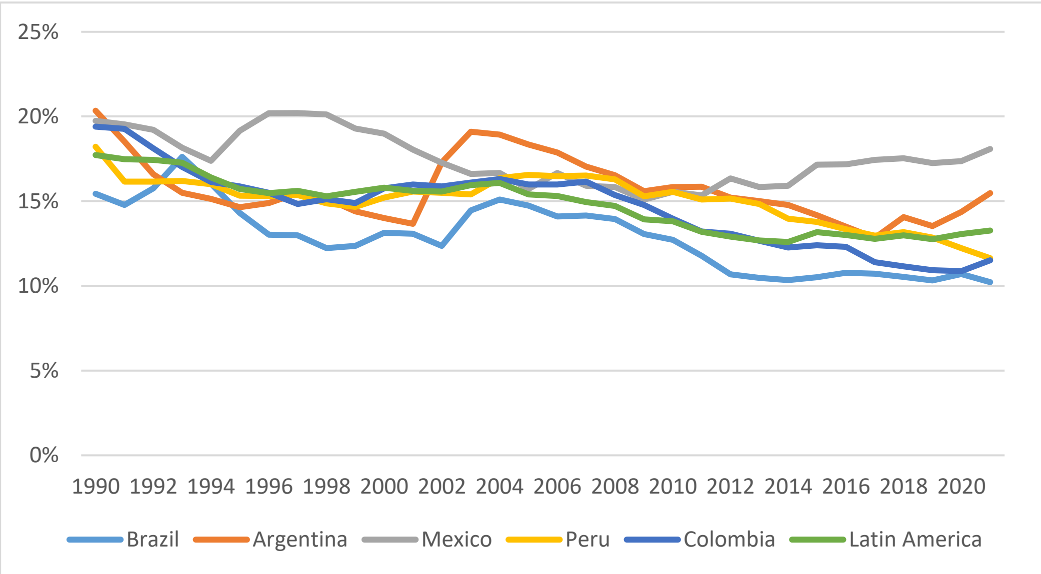

Figure 3 – Share of manufacturing industry value added in GDP (1990 to 2020)

indicator, the share of the manufacturing industry in added value (Figure 3) also indicates a reduction over time. However, we can observe the case of Mexico, which differs from the rest of the countries in that it presents the lowest value in the historical series in 2009, after which there is a constantly increasing trend.

Another topic raised about deindustrialization is countries' loss of competitiveness in the face of international trade, so understanding how imports have changed over time is critical. The data below indicate a strong growth in the total value of imports by these countries, with all countries doubling their imports (at current prices) over the last 20 years (Figure 4).

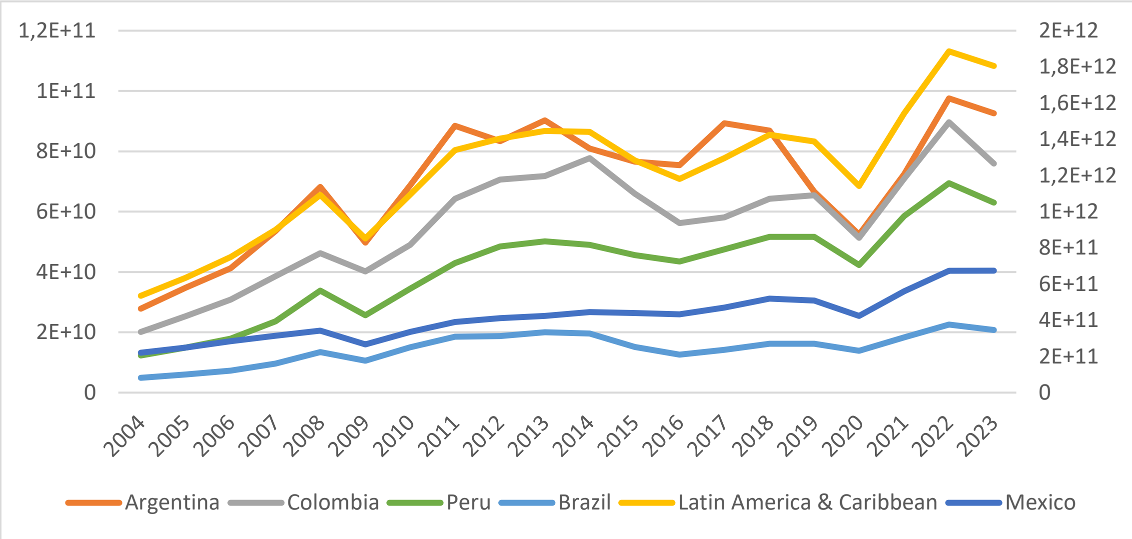

Figure 4 – Imports of goods and services (BoP, current US$)

However, more specific data on manufactured goods imports show that most Latin American countries have been reducing their share of these imports (Figure 5).

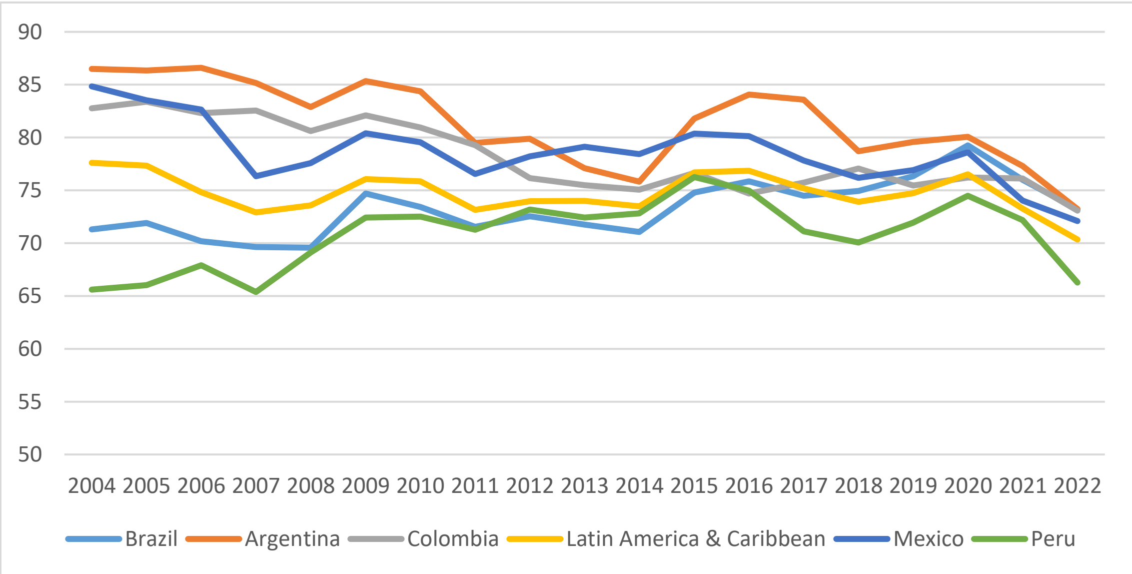

Figure 5 – Manufactures imports (% of merchandise imports)

Exploring the relationship between China and Latin American countries, it is possible to observe the growth in the total value of imports of Chinese manufactured goods in these economies. It is worth noting that Argentina showed the lowest growth in imports from China, growing 7 times over the 20 years analyzed, a value lower than the average growth of 40 times for other countries.

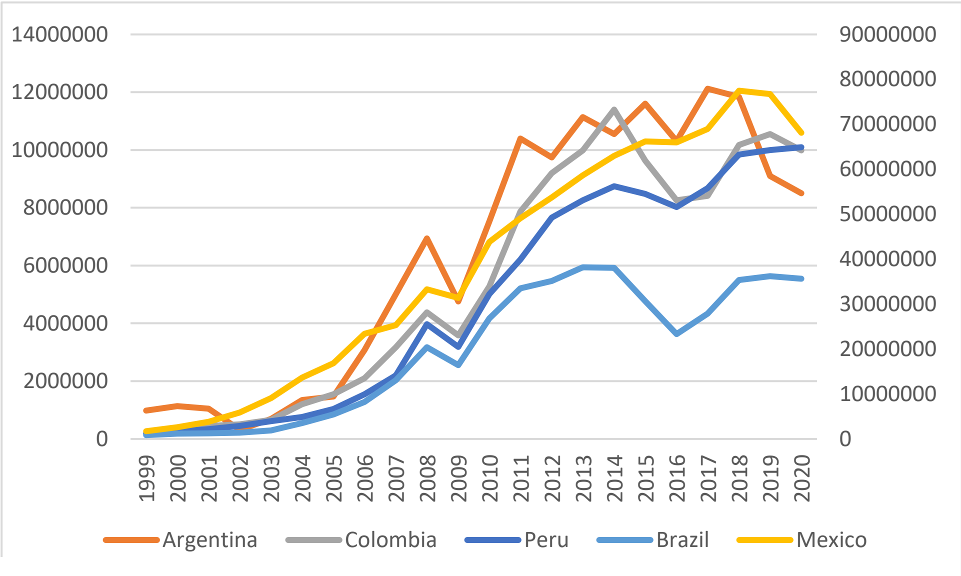

Figure 6 – China Manufactures Import (US$ Thousand)

5.2 Models

The two main indicators for the deindustrialization process are the share of employment in industry and the share of manufacturing value added in total GDP. The scatterplot in Figure 7 suggests that there is indeed a relationship between these two variables, with Haiti as the main outlier.

Table I - SPEARMAN'S RANK CORRELATION

MANUFACTURING VALUE ADDED X EMPLOYMENT IN INDUSTRY

ρ	P-value
0.2356	7.414e-07

Source: Author.

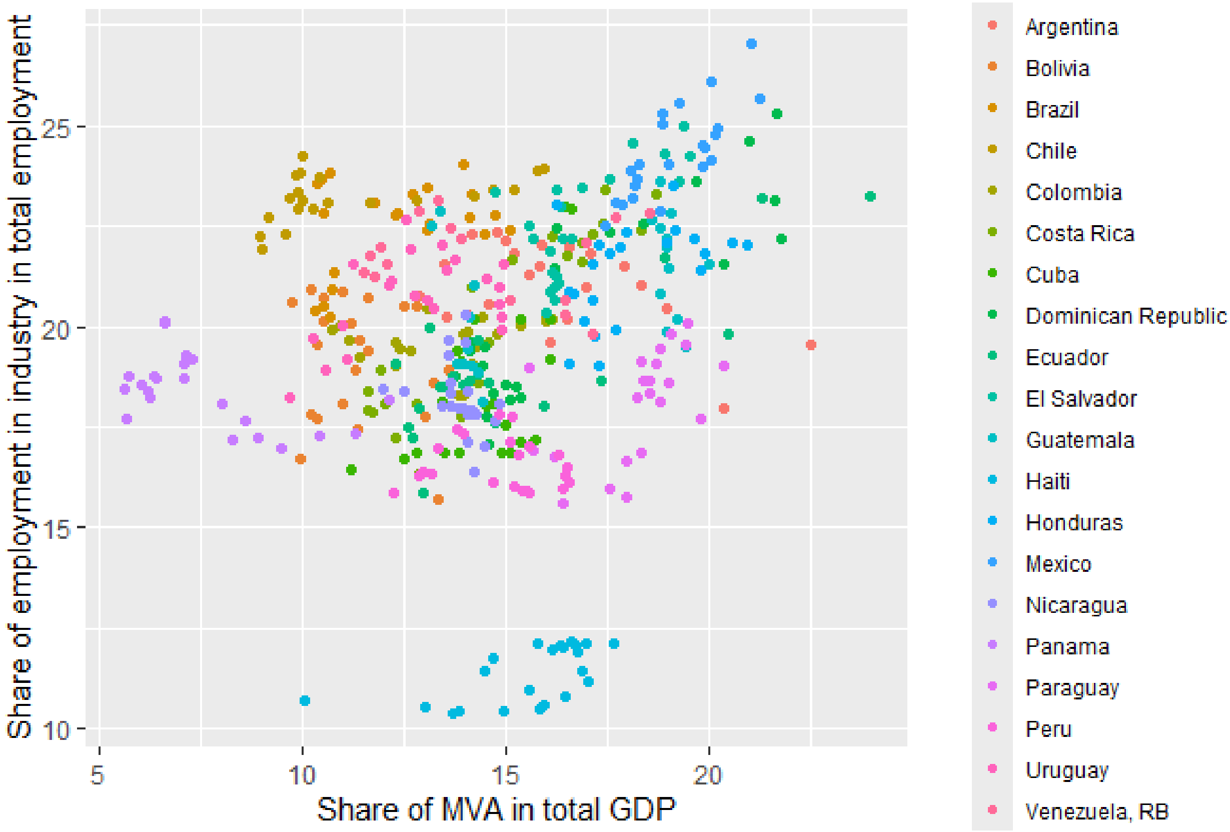

Figure 7 – Manufacturing value added x Employment in industry

Furthermore, the correlation between these two variables was also analyzed using Spearman's correlation coefficient, which is a statistical measure of the strength and direction of association between two ranked variables. It is a nonparametric measure, meaning it does not assume that the data is normally distributed. The test indicates a significant (although weak) correlation between the two variables since the hypothesis that true rho is equal to 0 is rejected (Table 1).

5.2.1. Dependent Variables

Given the weak correlation between the two variables, two models were specified for the isolated analysis of the two variables. The first model has the share of industrial employment in total employment as the dependent variable, while the second presents the share of manufacturing-added value in GDP as the dependent variable.

Employment is defined as working-age people who were engaged in any activity to produce goods or provide services for pay or profit, whether they were working during the reference period or not due to a temporary absence from a job or a work-time arrangement. In this paper, when we refer to industry, we are specifically referring to the concept of the manufacturing industry, classified according to the International Standard Industrial Classification (ISIC). (ISIC, 2024b) A more detailed explanation of the ISIC classification can be found in the Appendices. value added is a sector's net output after adding all outputs and subtracting intermediate inputs. It is calculated without accounting for depreciation of manufactured assets or depletion and degradation of natural resources.

5.2.2. Independent Variables

GDP per capita is used to assess overall economic development, while external balance on goods and services is used to assess trade competitiveness. To account for the impact of foreign direct investment (FDI, i.e. direct investment equity flows in the reporting economy), the model includes foreign direct investment expressed in terms of net inflows. It is the sum of equity capital, reinvestment of earnings, and other capital. In addition, the exchange rate (in index form) was included since changes in exchange rate policy directly impact on the quantity of imported and exported products. Furthermore, the exchange rate devaluation policy would reduce domestic demand due to its negative effects on wages' purchasing power. The interest rate was selected due to the development of Dutch Disease, interest rate, and currency devaluation. The model includes one dummy variable to account for membership in Mercosur. Finally, to analyze China's impact, the variables manufactured products imported from China and exported to China were also considered.

5.2.3. Sources, countries and period

As seen in Figure 6, Latin America comprises 20 countries, spread across South, Central, and North America. However, not all countries provide their data consistently, which limited their participation in this study. Thus, the models were developed based on eleven countries, namely Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Nicaragua, Paraguay, Dominican Republic, Uruguay, and Venezuela.

The data comprises information from eleven countries for the period from 1999 to 2020, thus, the database is composed of 231 observations. The data choice was made due to the limitation of the available data, in which many countries do not make the data used in the research available regularly, thus limiting the number of countries and the period analyzed. In Table II it is possible to observe the sources of the data used. The main data sources are the World Bank, the Organisation for Economic Co-operation and Development (OECD), the International Labour Organization, and the International Monetary Fund.

5.2.4. Pooled Panel Data Model, Fixed Effects, and Random Effects

The pooled panel data model is one of the simplest approaches to panel data analysis. It entails categorizing all observations, ignoring cross-sectional and temporal dimensions, and treating the dataset as a large sample. This model makes no distinction between individuals or periods, and it assumes that the relationships between the dependent and independent variables are the same across all individuals and periods. The pooled regression model presents the following form:

$$Y_{it} = \alpha + \beta X_{it} + \epsilon_{it}$$

Y_{it} is the share of employment in industry or share of manufacturing value added in country i at time t. $X_{k,it}$ represents the k-th time-varying explanatory variable for country i at time t, while α is the overall intercept and ϵ is the error term.

The fixed effects model is intended to account for unobserved heterogeneity by controlling for individual- or time-specific characteristics that remain constant over time but vary between individuals. The model includes fixed effects for each individual, allowing the intercept to vary across individuals while assuming that the slope coefficients stay constant:

$$Y_{it} - Y_i = \beta(X_{it} - X_i) + (\epsilon_{it} - \epsilon_i)$$

This transformation eliminates the individual-specific effects, thereby removing any potential correlation between the unobserved fixed effects and independent variables. The fixed effects model only estimates coefficients based on within-individual variation.

The random effects model assumes that individual-specific effects are random and unrelated to the independent variables. Unlike the fixed effects model, which accounts for unobserved heterogeneity by differentiating it, the random effects model assumes that unobserved individual effects are included in the error term and are uncorrelated with the regressors. u represents the individual-specific random effect, which is assumed to be normally distributed with mean zero and variance:

$$Y_{it} = \alpha + \beta X_{it} + u_i + \epsilon_{it}$$

To determine the best model to use, the Breuch-Pagan Test, Chow Test, and Hausman Test were used. The Breusch-Pagan Test is a diagnostic tool used in regression analysis to detect heteroscedasticity, which occurs when the variance of residuals (errors) does not remain constant between observations. The test determines whether the residuals correlate with the independent variables. A low p-value indicates that the regression model's assumptions have been violated, resulting in unreliable standard errors. This test determines whether the random effects model is superior to the pooled ordinary least squares (OLS) model.

The Chow Test, which relates the fit of a single regression model to two separate regressions for different subsets of data, is used to identify structural breaks in a dataset. It is used when it is believed that the relationship between variables could change at a certain point. A significant result suggests a structural breakdown. To analyze if fixed effects (variations between individuals or units) are significant, it tests the null hypothesis that the fixed effects are zero, which means that the pooled model outperforms the fixed effects model.

The Hausman Test is used in panel data analysis to differentiate between fixed and random effects models. It examines whether the individual effects are correlated with the explanatory variables. A significant result benefits the fixed effects model, indicating that the random effects model would deliver biased estimates, while a non-significant result shows that random effects are more efficient and should be used, the data sources used can be found in the appendix.

6. Results and Discussion

Tables III and V show the results of the three models for the 11 countries, with dependent variables equal to the Share of Manufacturing Value Added and the Share of Employment in Industry, respectively.

6.1. Manufacturing Value Added

To choose the best model, the Breuch-Pagan Test, Chow Test, and Hausman Test were performed, indicating the fixed effects model as the best model, as seen in Table II.

Table II - MANUFACTURING VALUE ADDED TESTS

CHOW TEST

F	P-value
83.067	2.2e-16

BREUCH-PAGAN TEST

Normal	P-value
28.314	2.2e-16

HAUSMAN TEST

chisq	P-value
160.59	2.2e-16

As can be seen in Table III, the import of products from China presents a small but significant positive value in the dependent variable, contrary to what was expected; on the other hand, exports, as expected, have a negative impact. Furthermore, the data indicates a positive effect for the variables import of manufactured goods, FDI, and exchange rate index.

The data indicates a negative effect on the variables GDP per capita and real interest rate. The data relating to Mercosur, and external balance of goods and services were not significant in this regression.

Table III - MANUFACTURING VALUE ADDED REGRESSION

	Pooled	Fixed Effects	Random Effects
Mercosul	0.014	-1.223	0.014
	(0.558)	(0.924)	(0.558)
Manufactures imports (% of merchandise imports)	0.065**	0.085***	0.065**
	(0.026)	(0.016)	(0.026)
GDP per capita (current US$)	-0.00004	-0.0004***	-0.00004
	(0.0001)	(0.00004)	(0.0001)
External balance on goods and services (% of GDP)	0.044	-0.028	0.044
	(0.028)	(0.021)	(0.028)
Foreign direct investment, net inflows (% of GDP)	0.065	0.125***	0.065
	(0.080)	(0.042)	(0.080)
Import From China in US$ Thousand / GDP (Constant 2015 US$)	0.297***	0.097*	0.297***
	(0.078)	(0.054)	(0.078)
Real effective exchange rate index (2010 = 100)	-0.019*	0.014*	-0.019*
	(0.011)	(0.008)	(0.011)
Real interest rate (%)	-0.018	-0.038***	-0.018
	(0.017)	(0.009)	(0.017)
Exports to China in US$ Thousand / GDP (Constant 2015 US$)	-0.979***	-0.333***	-0.979***
	(0.136)	(0.103)	(0.136)
Intercept	11.813***		11.813***
	(2.196)		(2.196)
Observations	231	231	231
R^2	0.354	0.611	0.354
Adjusted R^2	0.327	0.576	0.327
Note:			*p<0.1; **p<0.05; ***p<0.01

6.2. Employment in industry

To choose the best model, the Breuch-Pagan Test, Chow Test, and Hausman Test were performed, again indicating the fixed effects model as the best model, as seen in Table IV.

Table IV - EMPLOYMENT IN INDUSTRY TESTS

CHOW TEST

F	P-value
37.011	2.2e-16

BREUCH-PAGAN TEST

Normal	P-value
18.46	2.2e-16

HAUSMAN TEST

chisq	P-value
29.753	0.0004832

The results for the employment in industry regression were similar to those observed previously. However, the import and export of products from China did not turn out to be statistically significant, as can be seen in Table V.

The variables import of manufactured goods and exchange rate had a positive impact on the dependent variable, while the variables GDP, external balance and interest rate had negative results. The variables Mercosur and FDI were not significant.

Table V - EMPLOYMENT IN INDUSTRY REGRESSION

	Pooled	Fixed Effects	Random Effects
Mercosul	-0.511	-0.605	-0.057
	(0.434)	(0.961)	(0.800)
Manufactures imports (% of merchandise imports)	0.087***	0.057***	0.061***
	(0.020)	(0.017)	(0.017)
GDP per capita (current US$)	0.0002***	-0.0002***	-0.0002***
	(0.00004)	(0.00005)	(0.00004)
External balance on goods and services (% of GDP)	-0.020	-0.095***	-0.082***
	(0.022)	(0.022)	(0.022)
Foreign direct investment, net inflows (% of GDP)	-0.048	-0.038	-0.033
	(0.062)	(0.043)	(0.044)
Import From China in US$ Thousand / GDP (Constant 2015 US$)	-0.288***	-0.008	-0.050
	(0.061)	(0.056)	(0.056)
Real effective exchange rate index (2010 = 100)	-0.014	0.022**	0.018**
	(0.009)	(0.009)	(0.009)
Real interest rate (%)	0.011	-0.027***	-0.022**
	(0.013)	(0.010)	(0.010)
Exports to China in US$ Thousand / GDP (Constant 2015 US$)	0.354***	0.124	0.142
	(0.106)	(0.107)	(0.106)
Intercept	15.099***		15.957***
	(1.707)		(1.486)
Observations	231	231	231
R^2	0.356	0.238	0.214
Adjusted R^2	0.330	0.169	0.181

Note: *p<0.1; **p<0.05; ***p<0.01

6.3. Discussion

To some extent, the data were consistent with what was expected since they indicate a positive relationship between the volume of exports from Latin America to China and the deindustrialization process. This supports the idea put forth by Portela (2021) relations between China and Brazil constitute a typical center-periphery relationship. On the other hand, contrary to what was hypothesized, imports from China and total imports of manufactured goods have a positive, not negative, effect on the share of manufacturing added value.

In contrast to earlier studies, the import and export of Chinese products is not significantly associated with effects on industrial employment. This could indicate that the labor market responds differently to trade dynamics than to other economic outcomes. Domestic factors or sector-specific dynamics may have a greater impact on industrial employment than overall trade relations with China.

Furthermore, we can observe a relationship between indicators related to trade openness, such as External balance on goods and services and Real effective exchange rate, as central factors in the deindustrialization process, a result similar to that obtained by Bogliaccini (2013), who states that trade reform had a clear detrimental effect on equality through its fostering of deindustrialization in Latin America.

López (2016) states that one of the indicators of Dutch disease is the relationship between exchange rate and employment in industry, and in our case, we indeed observe a significant relationship between these two variables.

The variable related to imports from China proved to be not significant in the industrial employment model, a result different from that observed by Azevedo (2015), who found an extremely high coefficient.

The negative effect of GDP on industry was also observed by Azevedo (2015) and Bogliaccini (2013), which is the expected behavior, where increases in GDP per capita are significantly associated with increases in inequality over time.

Kim and Lee (2014) point out that Latin American countries are not able to cancel out the negative effects of exporting to China and importing from China due to the absence of intra-industry trade links with China. These authors also point out that Latin American countries have been heavily affected by the deindustrialization force of the Dutch Disease, a factor that we can agree with since the trade balance negatively affects the share of manufacturing.

Furthermore, the manufactured goods imports indicator showed a positive relationship for both dependent variables, supporting the view that economic integration is positive for the industrialization of the region. Furthermore, this issue also reinforces the idea that Dutch disease is one of the main factors for deindustrialization, since there would be no competition between imported and national manufacturers.

7. Conclusions

The objective of this analysis was to observe the relationship between the process of early deindustrialization in Latin America and the rise of China as the main trading partner of this region. We have found that the main countries in this region have indeed been undergoing a process of premature deindustrialization, following our hypothesis H1. Contrary to what was expected (H2a), however, increased imports from China are not associated with this process of deindustrialization. Such a relationship could be identified between *exports to* China and deindustrialization (H2b), supporting the idea that deindustrialization has been partly driven by a process of reprimarization operating through exchange rate appreciation and the Dutch disease.

Indeed, the data suggest that the main cause of the deindustrialization process in these countries is linked to the process known as the Dutch Disease (i.e., exchange rate appreciation compromising the competitiveness of the domestic manufacturing sector), rather than to increased industrial competition between these countries and China.

In sum, referring to the specific objectives set out for this paper, we have discussed and illustrated the ongoing deindustrialization process in Latin America, and discussed the main theories which seek to account for this process. Against this background, our empirical analysis has sought to ascertain the specific impact of trade relations with China on the deindustrialization process. Based on a panel data analysis using different model specifications, we have found evidence to support the view that while competition from Chinese manufactured goods does not seem to be a driver of deindustrialization, the main apparent culprit seems to be a generalized process of exchange rate appreciation in the context of the reprimarization of output and exports, which can be adequately described as an instance of Dutch disease, even though this preliminary conclusion calls for further empirical exploration.

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Appendices - ISIC

ISIC is the global reference classification for productive activities. Its main purpose is to provide a set of activity categories that can be used to collect and report statistics on such activities. Since the adoption of the original version of ISIC in 1948, most countries around the world have used ISIC as their national activity classification or developed national classifications based on ISIC.

In this work, the concept of the industry was used, which may not be very accurate since the industry is a set of businesses or organizations that carry out a similar activity, so when referring to industry in this work we are specifically referring to the concept of the manufacturing industry.

Section C establishes which types of activities can be understood as manufacturing, the general concept being the physical, chemical or biological transformation of materials, substances, or components into new products, although this cannot be used as the single universal criterion for defining manufacturing (ISIC, 2024a).

Manufacturing typically involves transforming materials into new products and repairing and installing machinery. The result is either a new product or one that has undergone factory rebuilding and remanufacturing. Some activities, while involving transformation processes, are not classified as manufacturing and instead fall under other ISIC categories (ISIC, 2024a). Such as:

- Beneficiating of agricultural products, classified in section A
- Beneficiating of ores and other minerals, classified in section B
- Production of gaseous fuels for energy supply through a permanent network, classified in section D
- Construction of structures, assembling of prefabricated buildings at the site of construction, classified in section F
- Activities of breaking bulk and redistribution in smaller lots, including packaging, repackaging, or bottling products, e.g. as liquors or chemicals; sorting of scrap; mixing paints to customer order; and cutting metals to customer order; treatment not resulting into a different good is classified to section G

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APPENDICES – ADDITIONAL SOURCES

Additional sources include the sources used to construct the graphs and to perform the tests.

Appendix 1 - FIGURES SOURCES

Figure	Source
Latin America & Caribbean LCN Employment in industry (% of total employment) (modeled ILO estimate)	International Labour Organization. “ILO modelled estimates database” ILOSTAT. Accessed February 07, 2024. https://ilostat.ilo.org/data/.
Share of labor employed in manufacturing (1990 to 2018)	The Economic Transformation Database (ETD): Content, Sources, and Methods(de Vries et al., 2021)
Share of manufacturing industry value added in GDP (1990 to 2020)	World Bank staff estimates through the WITS platform from the Comtrade database maintained by the United Nations Statistics Division.
Imports of goods and services (BoP, current US$)	World Bank national accounts data, and OECD National Accounts data files.
Manufactures imports (% of merchandise imports)	World Bank staff estimates through the WITS platform from the Comtrade database maintained by the United Nations Statistics Division.
China Manufactures Import (US$ Thousand)	World Bank staff estimates through the WITS platform from the Comtrade database maintained by the United Nations Statistics Division.
Manufacturing value added x Employment in industry	International Labour Organization. “ILO modelled estimates database” ILOSTAT. Accessed February 07, 2024. https://ilostat.ilo.org/data/. World Bank national accounts data, and OECD National Accounts data files.

Source: Author.

Appendix 2- DATA SOURCES

Indicator Name	Source
Employment in industry (% of total employment) (modeled ILO estimate)	International Labour Organization. “ILO modelled estimates database” ILOSTAT. Accessed February 07, 2024. https://ilostat.ilo.org/data/.
Manufacturing, value added (% of GDP)	World Bank national accounts data, and OECD National Accounts data files.
Manufactures imports (% of merchandise imports)	World Bank staff estimates through the WITS platform from the Comtrade database maintained by the United Nations Statistics Division.
External balance on goods and services (% of GDP)	World Bank national accounts data, and OECD National Accounts data files.
Foreign direct investment, net inflows (% of GDP)	International Monetary Fund, Balance of Payments database, supplemented by data from the United Nations Conference on Trade and Development and official national sources.
Real interest rate (%)	International Monetary Fund, International Financial Statistics and data files using World Bank data on the GDP deflator.
Real effective exchange rate index (2010 = 100)	International Monetary Fund, International Financial Statistics.
GDP per capita (current US$)	World Bank national accounts data, and OECD National Accounts data files.
Exports to China in US$ Thousand / GDP (Constant 2015 US$)	World Integrated Trade Solution (WITS) - World Bank World Bank national accounts data, and OECD National Accounts data files.
Imports from China in US$ Thousand / GDP (Constant 2015 US$)	World Integrated Trade Solution (WITS) - World Bank World Bank national accounts data, and OECD National Accounts data files.

Source: Author.

APPENDICES – DESCRIPTIVE STATISTICS

Below are the descriptive statistics of the data used to carry out this paper, with the 12 variables used in the model, in addition, it should be noted that the data choice was made due to the limitation of the available data, in which many countries do not make the data used in the research available regularly, thus limiting the number of countries and the period analyzed.

Appendix 3 – ADDITIONAL STATISTICS

Statistic	N	Mean	St. Dev.	Min	Max
Employment in industry (% of total employment) (modeled ILO estimate)	242	20.711	2.362	15.590	27.065
Manufacturing, value added (% of GDP)	236	14.422	3.120	8.969	21.755
Manufactures imports (% of merchandise imports)	233	73.118	7.302	43.907	86.944
External balance on goods and services (% of GDP)	236	-1.561	7.988	-27.853	19.190
Foreign direct investment, net inflows (% of GDP)	236	3.793	2.505	-3.084	12.197
Real interest rate (%)	234	10.925	13.794	-18.909	93.915
Real effective exchange rate index (2010 = 100)	238	99.183	47.056	54.591	741.702
GDP per capita (current US$)	236	6,659.170	4,433.060	888.199	19,067.290
Exports to China in US$ Thousand	242	4,192,118.000	10,797,519.000	0.000	67,788,075.000
Imports from China in US$ Thousand	232	8,120,542.000	15,875,441.000	3,837.323	83,509,998.000
GDP (Constant 2015 US$)	236	312,529,642,887.000	537,392,989,482.000	4,856,005,699.000	2,616,156,223,977.000

APPENDICES – ADDITIONAL TEST

Below are the results of the additional tests carried out for the Employment and Value Added variables. The Breusch-Godfrey/Wooldridge test, Studentized Breusch-Pagan test, and Pesaran CD test were performed

The Breusch-Godfrey test (Wooldridge test) is used to detect autocorrelation in the residuals of a regression model, the null hypothesis indicates that no autocorrelation in the residuals is present.

Appendix 4 – VALUE ADDED TEST

	Pooled	Fixed Effects	Random Effects
Breusch-Godfrey/Wooldridge test	2.2e-16***	5.027e-16***	2.2e-16***
chisq	168.23	117.93	168.23
Studentized Breusch-Pagan test	6.239e-09***	6.239e-09***	6.239e-09***
BP	56.522	56.522	56.522
Pesaran CD test		0.6073	2.2e-16***
z		-0.51389	8.6589

Note: *p<0.1; **p<0.05; ***p<0.01

The Studentized Breusch-Pagan (BP) test is used to check for heteroskedasticity, a condition where the variance of the residuals is not constant across observations, the null hypothesis indicates that residuals have constant variance (homoskedasticity).

The Pesaran CD (Cross-Dependence) test is designed to detect cross-sectional dependence in panel data models, the null hypothesis indicates that the cross-sectional dependence is not present (residuals are uncorrelated across entities).

Appendix 5 – EMPLOYMENT TEST

	Pooled	Fixed Effects	Random Effects
Breusch-Godfrey/Wooldridge test	2.2e-16***	2.2e-16***	2.2e-16***
chisq	145.16	117.93	116.68
Studentized Breusch-Pagan test	1.202e-05***	1.202e-05***	1.202e-05***
BP	38.898	38.898	38.898
Pesaran CD test		0.6103	0.343
z		0.50972	0.94816

Note: *p<0.1; **p<0.05; ***p<0.01