Latin America and China: mutual benefit or dependency?[1]

Damares Lopes Afonso, Suzana Quinet de Andrade Bastos and Fernando Salgueiro Perobelli

Abstract

This article seeks to contribute to the debate on China-Latin America relations. It considers whether the trade relations that exist between China and the region are mutually beneficial or, instead, reinforce Latin America's dependency on the international scenario. The effects of Chinese growth on a group of Latin American countries are analysed using the computable general equilibrium model of the Global Trade Analysis Project (GTAP). Chinese growth was simulated through an expansion of the Chinese capital stock, thus mirroring the trend observed in recent decades. The results suggest a return to the commodity export model and a reduction in industrial activity in the Latin American countries analysed, particularly in the high-tech sectors. Nonetheless, well-being in Latin America also increased, mainly owing to improvements in the terms of trade (resulting from the commodity price boom).

Keywords

International economic relations, international trade, economic development, exports, imports, commodities, trade policy, economic dependence, industrialization, economic development, China, Latin America

JEL classification

F10, D58, F63

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I.   Introduction

China is one of Latin America's main trading partners. Trade relations between China and the region are "strategic" because Latin America has abundant natural resources, such as soybeans, iron ore and oil, which are essential for Chinese industries. Moreover, Latin America represents a consumer market for Chinese products, which mostly consist of manufactured goods.

In addition to trade flows, China is intensifying its diplomatic and political relations with the governments of Latin American countries. Chinese representatives describe the mutual benefits of Latin America-China relations as a "win-win" situation.

In 2008, China published its first policy paper on Latin America and the Caribbean (also called the White Paper on Latin America and the Caribbean); and, in 2016, it published the second. Both documents identify areas in which there is potential for greater cooperation between China and the region, including greater political proximity, intensification of bilateral trade, investments in production infrastructure, financial assistance, support and exchanges in the social and cultural areas, cooperation in the international arena, and in peace and security agreements (MFA, 2016).

Chinese investments in Latin America are based on its participation in public utility concessions (energy, telecommunications and transport), and also on direct investments ranging from venture financing to consolidate road and rail networks and the extraction of mineral resources (Silveira, 2017).

However, this begs the question of whether the trade relations between China and the region are of mutual benefit, or whether, instead, they are reinforcing Latin America's dependency on the international scenario —as a region that has been characterized since colonial times as a commodity exporter and technologically reliant on the external market (Blázquez-Lidoy, Rodríguez and Santiso, 2006; Jenkins, Peters and Moreira, 2008; Ferchen, 2011; Cintra, 2013; Kim and Lee, 2014; Silveira, 2017).

Accordingly, this article seeks to evaluate the structure of interdependence prevailing in trade relations between China and a group of Latin American countries —Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Panama, Paraguay, Peru, the Plurinational State of Bolivia and Uruguay. This is done using the computable general equilibrium (CGE) model of the Global Trade Analysis Project (GTAP).

The empirical strategy entails simulating the effect of the growth of the Chinese economy as a result of a 10% expansion of its capital stock, which is equivalent to the average annual growth of its capital stock in recent decades, according to Penn World Table version 9.0 data (Feenstra, Inklaar and Timmer, 2015). The aim is to assess the impact of Chinese economic growth on sectoral production, exports and imports, and the variation in well-being in the selected Latin American countries, and also in China itself.

The hypothesis analysed is that, while China's economic growth has boosted trade relations with Latin America, mainly through its demand for commodities and improved terms of trade (commodity price boom), it has also contributed to the decline in Latin American industrial activity and an increase in its imports of manufactured goods "made in China". Thus, trade relations between China and the region could be aggravating Latin America's historical dependency on the international scenario, in contrast to Chinese discourse proclaiming the mutual benefits of these relations.

The section that follows this introduction offers some reflections on relations between Latin America and China. The third section describes the database, methodology and empirical strategy employed; and the fourth section presents the results of the model. The fifth and last section offers final thoughts.

II.   Trade relations between Latin America and China

This section starts by analysing the data on trade between Latin America and China, before contextualizing the antagonistic nature of this relationship.
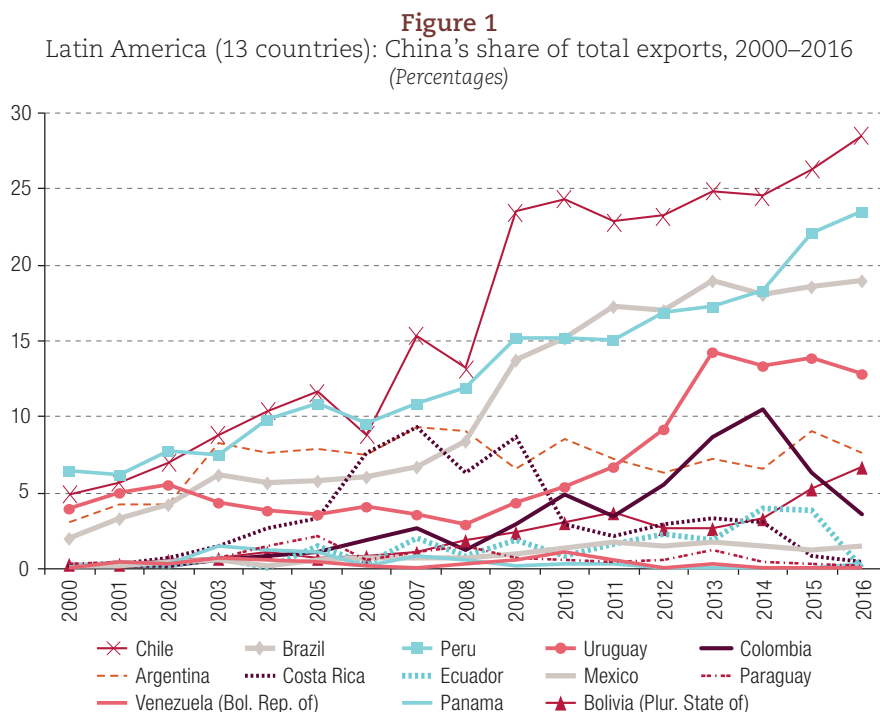
1.   Latin America-China trade relations in figures

China's economic and social structure has undergone considerable changes, especially since the 1990s. Its industrial development is the result of planning. The famous comment made by China's leader, Deng Xiaoping, in 1978, that "it doesn't matter whether the cat is black or white, as long as it catches mice", illustrates the Chinese economy, which, as a hybrid between a centralized economy and a market economy, is currently the world's second largest in terms of production.

From a structural point of view, the factors responsible for China's success include: the creation of special economic zones (SEZs) —consisting of strategically concentrated production clusters near Hong Kong Special Administrative Region (SAR) of China— to attract foreign investment and take advantage of positive spillovers; gradual trade liberalization, intellectual appropriation of production techniques; and government investment in science and technology, along with other incentives (Nonnenberg, 2010).

In this context of expansion, China widened the scope of its trade and financial relations with a variety of countries, including several in Latin America. Trade relations between Latin America and China began to intensify from 2002, following the latter's admission into the World Trade Organization (WTO), and Hu Jintao's 2004 visit to the region, during which trade and investment agreements were signed (Medeiros and Cintra, 2015).

In 2000–2016, China's share of the exports of the countries analysed was heterogeneous. In some cases, such as the Bolivarian Republic of Venezuela, Colombia, Panama and Paraguay there is no defined export growth path. In others, however, such as Chile, Peru and Brazil, China's share of their total exports increased after the 2008 crisis (see figure 1).
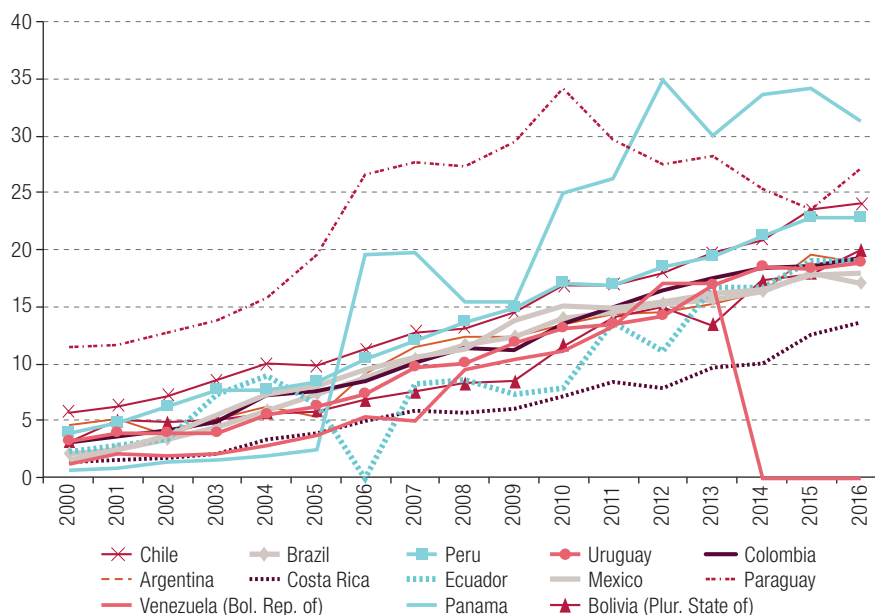
Figure 1
Latin America (13 countries): China's share of total exports, 2000–2016
(Percentages)

Source: Prepared by the authors, on the basis of United Nations International Trade Statistics Database (UN Comtrade) [online] https://comtrade.un.org/data.

Figure 2 shows that in the Latin American countries studied, China increased its share of their total imports in 2000–2016, in most cases supplying more than 10% of total imports since the 2008 crisis.[2]

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[2]   Data for the Bolivarian Republic of Venezuela for 2014–2016 are not available in the International Trade Statistics Database (UN Comtrade).

China's share in the total imports of the Latin American countries is greater than its share in the latters' exports. In general, as shown in figures 3 and 4, China is less "dependent" on Latin America in terms of trade flows.

Figure 2
Latin America (13 countries): China's share of total imports, 2000–2016
(Percentages)

Source: Prepared by the authors, on the basis of United Nations International Trade Statistics Database (UN Comtrade) [online] https://comtrade.un.org/data.

Figure 3
China: exports to 13 Latin American countries, 2000–2016
(Percentage shares)
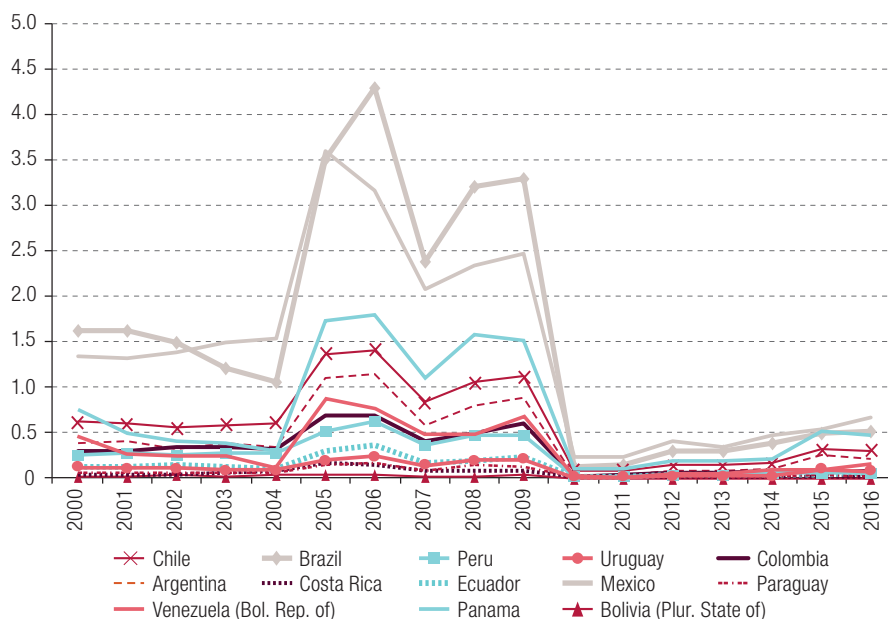
Source: Prepared by the authors, on the basis of United Nations International Trade Statistics Database (UN Comtrade) [online] https://comtrade.un.org/data.

Figure 4
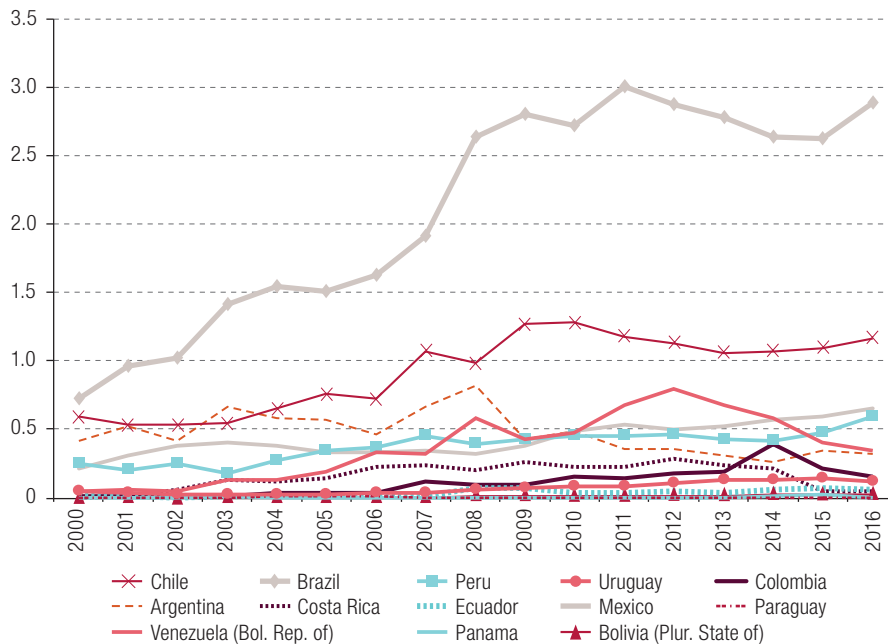China: imports from 13 Latin American countries, 2000–2016
(Percentage shares)

Source: Prepared by the authors, on the basis of United Nations International Trade Statistics Database (UN Comtrade) [online] https://comtrade.un.org/data.

The share of individual Latin American countries in the volume exported to and imported by China varies between 0% and 4.5%. Brazil, Mexico, Panama, Chile and Argentina are the leading destinations for Chinese exports; and Brazil and Chile are major suppliers of Chinese imports (see figures 3 and 4).

Since 2010, the share of China's exports destined for the Latin American countries studied has declined. This reflects an increase in the total exported by China to other countries and not by an absolute reduction in Chinese sales to Latin America, which grew significantly in the period following the 2008 crisis.

Costa Rica's sales to China fell sharply in 2015–2016, possibly linked to Intel's exit from Costa Rica in 2014.
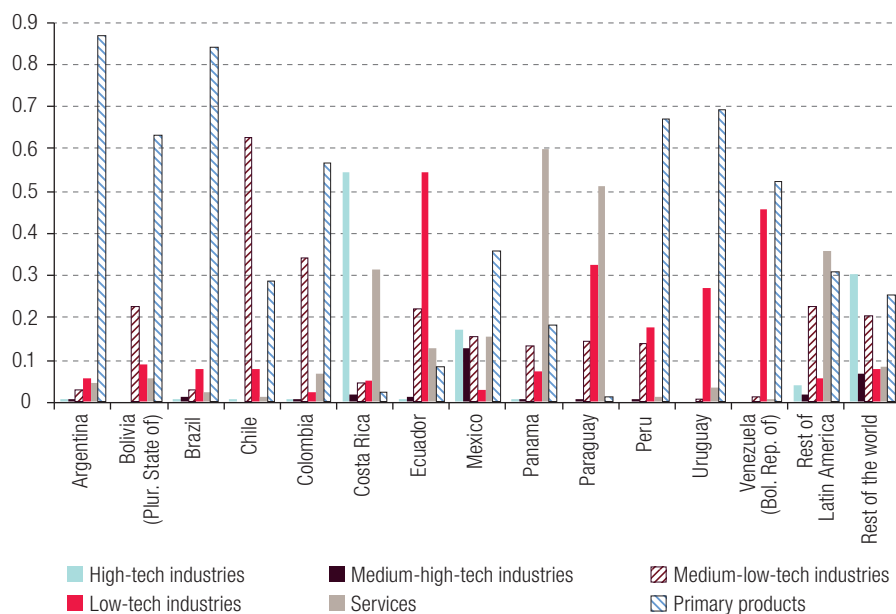
In addition to the differences in the quantities exported and imported, the trade patterns of both Latin America and China display qualitative differences, as shown in figures 5 and 6.[3] The data, which refer to 2011, are taken from the Global Trade Analysis Project, version 9 (GTAP 9) database.

With the exceptions of Costa Rica and Mexico, Latin American countries display a pattern of exporting commodities and medium-low technology-intensive industrial products to China (see figure 5). While commodities account for the bulk of exports from Argentina, the Bolivarian Republic of Venezuela, Colombia, Mexico, Peru and the Plurinational State of Bolivia, exports to China from Mexico and the rest of the world are more diversified, as they are more widely distributed among the different sectors of the economy. Costa Rica is the only country in which most exports to China come from the high-tech industrial sector.

In contrast, the technological pattern of the region's imports from China (see figure 6) is the opposite of that of its exports to that country, since they are mainly concentrated in the industrial sectors: high, medium and low-tech products. Commodities and services account for less than 10% of imports from China in the Latin American countries analysed.
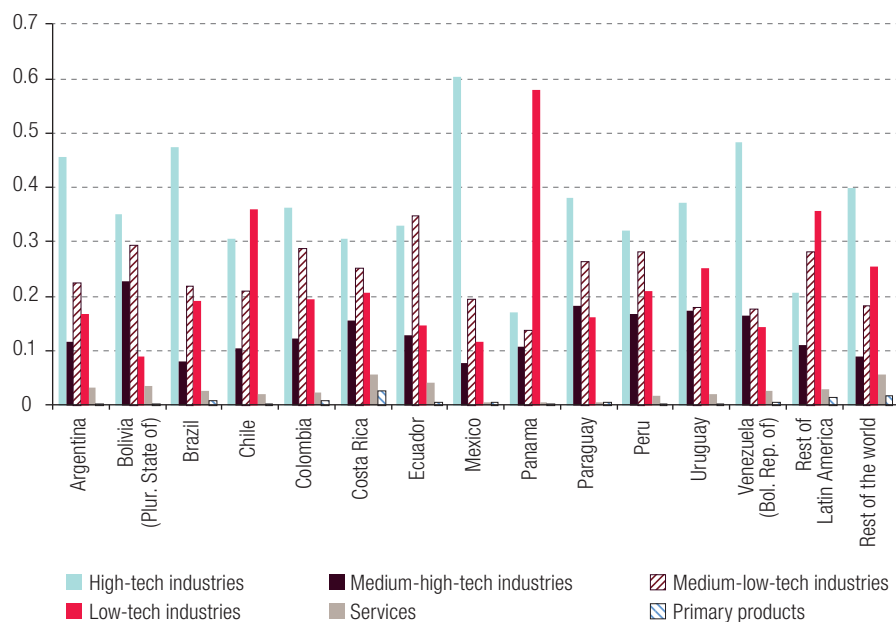
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[3] For details of the sectoral aggregation, see table 1 in section III.3.

Figure 5
Latin America (selected countries) and the rest of the world: exports to China, 2011
(Percentages)

- High-tech industries
- Medium-high-tech industries
- Medium-low-tech industries
- Low-tech industries
- Services
- Primary products

Source: Prepared by the authors, on the basis of A. Aguiar, B. Narayanan and R. McDougall, "An overview of the GTAP 9 database", *Journal of Global Economic Analysis*, vol. 1, No. 1, 2016 [online] https://www.gtap.agecon.purdue.edu/databases/v9/v9_doco.asp.

Figure 6
Latin America (selected countries) and the rest of the world: imports from China, 2011
(Percentages)

- High-tech industries
- Medium-high-tech industries
- Medium-low-tech industries
- Low-tech industries
- Services
- Primary products

Source: Prepared by the authors, on the basis of A. Aguiar, B. Narayanan and R. McDougall, "An overview of the GTAP 9 database", *Journal of Global Economic Analysis*, vol. 1, No. 1, 2016 [online] https://www.gtap.agecon.purdue.edu/databases/v9/v9_doco.asp.

In general, trade with China is more important for Latin America than vice-versa. Moreover, the pattern of trade between China and the region displays an antagonism between Latin America's role as an exporter of commodities and as an importer of industrial and higher-tech products from China.

2.   Mutual benefits or dependency?

Studies on the antagonism that pervades trade relations between Latin America and China date back to the "dependency" scholars, such as Raúl Prebisch and Celso Furtado, authors in the tradition of the Economic Commission for Latin America and the Caribbean (ECLAC).[4] The traditional ECLAC view saw the world economy organized in a centre-periphery system. The centres consist of countries that dominate capitalist production techniques, have diversified production structures and are mostly exporters of manufactured goods. The periphery, in contrast, comprises countries lagging behind in the mastery of production techniques, which are developed mainly in the commodity exporting sectors.

The ECLAC analysis recognizes the dynamic nature of the relations between the core and the periphery, which fosters the distinctions between these countries and acts as a mechanism of circular and cumulative causation (Myrdal, 1957). This dynamic is influenced directly by different rates of absorption of technical progress, since productivity growth is much higher in industrial economies (centre) than in economies that are specialized in primary products (periphery). This alone would lead to a secular differentiation of income in favour of the centre (Colistete, 2001).

In addition to this difference, the income elasticity of demand for the primary products exported by the periphery is lower than that of the industrial products exported by the centre. This generates a tendency towards external imbalance in the periphery, with direct effects on the terms of trade, boosting purchasing power in commodity boom periods and reducing it in periods of recession.

The key to reversing this mechanism was seen as industrialization of the "periphery" countries. Classical development authors consider industrialization and the consequent technological progress as drivers of a country's take-off and maturity (Rostow, 1990; Schumpeter, 1983). Thus, industrialization explains the different economic growth paths and external integration of Latin America and China.

Between the 1960s and 1980s, many Latin American countries industrialized through an import substitution process. However, owing to both domestic and external factors, such as the oil crises of 1973 and 1979, and growing indebtedness, they suffered a "lost decade" in the 1980s. Then, in the 1990s, Latin America's industrial policies were overtaken by the liberal wave.

In contrast, during the same period, China invested heavily in restructuring the production structure of its industrial sectors. It increased its production capacity on the basis of an extensive factor-use model — that is, by copious use of cheap labour and increased investment. China grew mainly because of high rates of investment, with gross fixed capital formation increasing from 29% of gross domestic product (GDP) in 1980 to 42% in 2010 (Beim, 2011).

Given its substantial growth in the 2000 decade, China not only expanded its trade relations with Latin America, but also increased its investments in the region, particularly after the 2008 crisis. According to ECLAC (2011), the sectoral destinations and amounts of foreign direct investment (FDI) in Latin America vary across recipient subregions and are higher in South America, where they are concentrated in natural resources and services.

China's trade and investment relations with Latin America are framed by South-South cooperation, which invokes the principle of mutual benefits for both regions. However, in terms of trade, these relations seem to strengthen the core-periphery trade pattern, which could harm Latin America's industrial and technological development in the long run.

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[4]   According to Tavares (2000), a theory of dependency could be inferred from Furtado's theory of underdevelopment, even before André Gunder Frank, Fernando Henrique Cardoso and Enzo Falleto developed their versions.

In this debate, Blázquez-Lidoy, Rodríguez and Santiso (2006) assess whether China is an "angel" or a "demon" for emerging economies. The authors note that, in the short term, China would have a positive influence on Latin America, particularly in the commodity exporting countries, through the "demand shock", which improved the terms of trade and increased the volume exported (a commodity price boom). The short-term negative effect would occur mainly in countries, such as Brazil, Costa Rica and Mexico, in which production and exports compete with Chinese products. However, the authors argue that the result in the long run is an incentive to re-primarize the production and export structure, which would make these economies more vulnerable to commodity price shocks (boom and bust).

Jenkins, Peters and Moreira (2008) also start by recognizing that trade between Latin America and China involves winners and losers. The authors question the thesis that producers and exporters of raw materials, such as the South American countries (Argentina, the Bolivarian Republic of Venezuela, Brazil and Chile), were the "winners" and that Mexico and the Central American countries, which specialize in commodity chains, were the "losers". They stress that, while the nature of bilateral trade between Latin America and China reproduces the core-periphery pattern, in which primary products are exchanged for manufactured goods, the long-term ecological, economic and social sustainability of this relationship is not taken into account.

III. Database and methodology

1. The Global Trade Analysis Project (GTAP) model

Computable general equilibrium (CGE) models describe all economic activities, such as consumption, production, employment, taxes, domestic and external trade, and saving. These models involve two structures of equations obtained from the accounting relationships of the countries' social accounting matrices and the microfoundation of the economy, in order to characterize these matrices and make them compatible among the various agents (Castilho, 1994).

The GTAP model is a multiregional and multisectoral CGE model, which assumes perfect competition and constant returns to scale. Diagram 1 shows the structure of an economy modelled by GTAP.

Diagram 1
Multiregional open economy
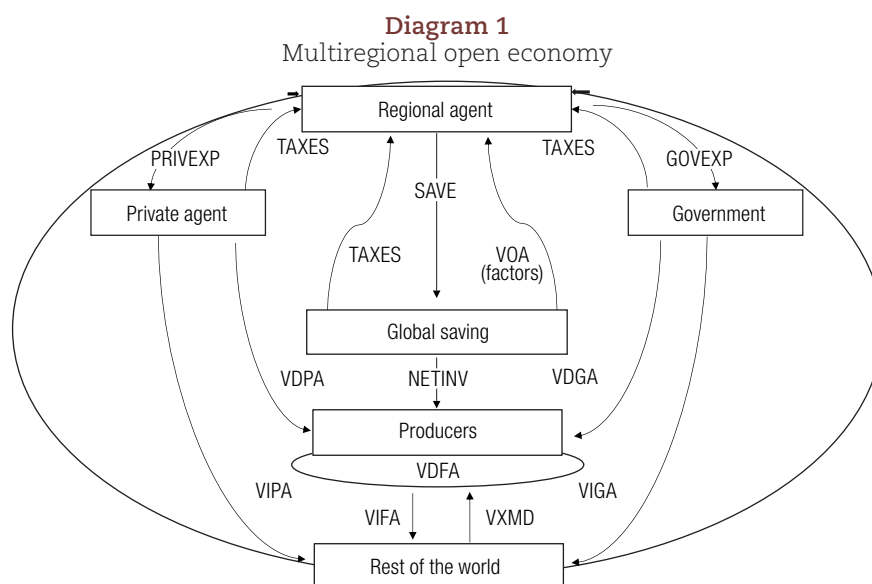
Source: Prepared by the authors, on the basis of M. Brockmeier, "A graphical exposition of the GTAP model", *GTAP Technical Paper*, No. 8, West Lafayette, Purdue University, 2001.

At the top of the diagram is the "regional agent", which is responsible for capturing and distributing all of the economy's expenditures and incomes, which come from the payments made by firms for the use of factors of production (value of output at agents' prices (VOA)) and the collection of taxes (TAXES), which form regional income.

Regional income is distributed among private agents (PRIVEXP), government (GOVEXP) and aggregate saving (SAVE). Government demand is modeled using the Cobb-Douglas utility function, since price and income elasticities are assumed to be unitary: that is, they vary in the same proportion. Household demand is based on a non-homothetic constant difference of elasticities (CDE) function that is flexible with respect to price and income changes (Liu and others, 1998).

Another agent in the model is the goods and services production sector, whose income comes from the sale of its products to: private agents (value of domestic private households' expenditure evaluated at agents' prices (VDPA)); the government (value of government's expenditure on domestic tradable commodities, evaluated at agents' prices (VDGA)); producers (value of firms' purchases of domestic commodities, evaluated at agents' prices (VDFA)); and the rest of the world (value of exports of tradable commodities, evaluated at exporters' domestic prices (VXMD)). In addition, the production sector is financed by global saving (NETINV); the expenditures of the production sector are used to pay for the primary factors of production, land, capital and labour (VOA), and intermediate inputs, both domestic (VDFA) and imported (value of purchases of imported tradable commodities (VIFA)).

Enterprise production functions are modelled using Leontief-type technology, with constant elasticity of substitution, both for the demand for intermediate goods (inputs from other industries, or from their own) and for the primary factors of production (land, capital and labour) (Hertel, Tsigas and Narayanan, 2012). Substitution between intermediate goods and factors of production is not permitted owing to the separability hypothesis.

Bilateral trade in intermediate goods is characterized by the Armington assumption, which treats goods of different origins as imperfect substitutes. This makes the modelling more realistic, since it deals with different regions that have different consumption and production patterns.

The external sector of the economy also interacts with private agents and the government through the purchase of imported goods and services (value of expenditure on imported tradable commodity (VIPA) and value of government's expenditure on imported tradable commodity (VIGA), respectively).

The model also includes trade margins and taxes or subsidies on domestic or foreign production. Exports are valued free on board (FOB) and imports at cost, insurance and freight (CIF), which include insurance or freight costs, if any. Taxes on exports (XTAX) and on imports (MTAX) are also channelled to the regional agent.

In addition, GTAP features a global banking sector, which intermediates global saving and trade, leaving no imbalances between the supply of and demand for goods (Hertel and Tsigas, 1997).

The choice of endogenous and exogenous variables to close the model considers the capital stock as fixed. Although the standard model allows for variations in investment in different regions, this investment does not feed back into the economy since the model is a static one.

2. Database

The database is provided by the Global Trade Analysis Project (GTAP), coordinated by the Centre for Global Trade Analysis in Purdue University's Department of Agricultural Economics. The project has a standard multiregional, multisector CGE model; it uses the RunGTAP software and version 9 of the GTAP model, for which the base year is 2011 and which includes 140 regions, 57 sectors, and primary factors of production.

The 140 regions in the GTAP database were grouped into 16, as follows: Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, China, Colombia, Costa Rica, Ecuador, Mexico, Panama, Paraguay, Peru, the Plurinational State of Bolivia, Uruguay, the rest of Latin America, and the rest of the world. The regional aggregation is shown in table 1.

Table 1
Regional and sectoral aggregation of the database of the Global Trade Analysis Project, version 9 (GTAP 9)

Regional aggregation	Sectoral aggregation
Selected Latin American countries: Argentina, Bolivia (Plurinational State of), Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Panama, Paraguay, Peru, Uruguay, Venezuela (Bolivarian Republic of).	**Primary products:** rice, not husked (pdr), wheat and meslin (wht), other cereals (gro), vegetables and fruits (v_f), oil seeds (osd), sugar cane and beets (c_b), vegetable fibres (pfb), other crops (ocr), animal husbandry (ctl), other animal products (oap), raw milk (rmk), other animal products (wol), forestry (frs), fishing (fsh), coal (coa), petroleum and related services (oil), gas and related services (gas), other mining activities (oxt, formerly omn), meat: bovine, ovine, caprine, equine (cmt), other meat products (omt).
China	
Rest of Latin America: rest of South America, El Salvador, Guatemala, Honduras, Nicaragua, rest of Central America, and Dominican Republic.	**Low-tech industries:** vegetable oils (vol), dairy products (mil), processed rice (pcr), sugar (sgr), other food (ofd), beverages and tobacco (b_t), textiles (tex), clothing (wap), leather products (lea), sawn wood and wood and cork products (lum), paper and stationery products (ppp).
Rest of the world: Australia, New Zealand, rest of Oceania, Hong Kong (SAR) of China, Japan, Republic of Korea, Mongolia, Taiwan Province of China, rest of East Asia, Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Philippines, Singapore, Thailand, Vietnam, rest of Southeast Asia, Bangladesh, India, Nepal, Pakistan, Sri Lanka, rest of South Asia, Canada, United States, rest of North America, Jamaica, Puerto Rico, Trinidad and Tobago, Caribbean, Austria, Belgium, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Slovenia, Portugal, Slovakia, Spain, Sweden, United Kingdom, Switzerland, Norway, rest of the European Union, Albania, Bulgaria, Belarus, Romania, Croatia, Russian Federation, Ukraine, rest of Eastern Europe, rest of Europe, Kazakhstan, Kyrgyzstan, rest of the former Soviet Union, Armenia, Azerbaijan, Georgia, Bahrain, Iran (Islamic Republic of), Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Turkey, United Arab Emirates, rest of Western Asia, Egypt, Morocco, Tunisia, rest of North Africa, Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Nigeria, Senegal, Togo, rest of West Africa, Central Africa, South Central Africa, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, United Republic of Tanzania, Uganda, Zambia, Zimbabwe, rest of East Africa, Botswana, Namibia, South Africa and rest of the world.	**Medium-low-tech industries:** refined petroleum and coke (p_c), nonmetallic minerals (nmm), iron and steel (i_s), nonferrous metals (nfm), metal products (fmp).
	Medium-high-tech industries: chemicals, rubber and plastics (crp), motor vehicles (mvh), other transportation equipment (otn).
	High-tech industries: electronic equipment (ele), other machinery and equipment (ome), other manufacturing (omf).
	Services: electricity (ely), gas distribution (gdt), water (collection, treatment and distribution) (wtr), construction (cns), trade (trd), other transport (otp), water transport (wtp), air transport (atp), communication (cmn), financial services (ofi), insurance (isr), other business services (obs), recreation and other services (ros), public administration (osg), housing (dwe).

Source: Prepared by the authors, on the basis of A. Aguiar, B. Narayanan and R. McDougall, "An overview of the GTAP 9 database", *Journal of Global Economic Analysis*, vol. 1, No. 1, 2016 [online] https://www.gtap.agecon.purdue.edu/databases/v9/v9_doco.asp.

The 57 sectors were grouped into six categories. The industrial sectors were divided into four categories of technological intensity: low, medium-low, medium-high and high-tech, based on the parameters of the Organisation for Economic Co-operation and Development (OECD, 2011). In addition, the service sector and the primary goods production sector are analysed separately. The products assigned to each sector are presented in table 1.

Primary factors of production are divided into three categories: land, labour and capital. Labour and capital are mobile factors of production, in which mobility is represented by a constant elasticity of transformation. The land factor is immobile and is only present in the primary goods production sector.

3.   Empirical strategy

The strategy involves simulating the growth of the Chinese economy through an expansion of capital investment (increase in total capital stock). China's capital stock grew by an average of 9.6% per year between 1981 and 2014; so the empirical strategy is to simulate an increase of approximately 10%

in China's capital stock and trace the effects of such growth on the sectoral production, exports and imports, and well-being of selected Latin American countries, and of China itself.

The parameter used for the shock is qo ("Capital", "China") = 10%, such that the increase in the stock of capital is proportional to the amount of capital used in each sector.

Diagram 2 displays the main causal relations in the GTAP model, following the change in China's capital stock. As can be seen, following the positive shock to the Chinese capital stock, the price of capital decreases in this economy, which stimulates production, especially in capital-intensive sectors. The increase in production lowers product prices; and, since the Chinese economy is highly export-oriented, its exports to the rest of the world increase. At the same time, China's output growth draws in additional imports from the rest of the world, including Latin America, from which it mainly imports commodities.

Diagram 2
Causal relations of the GTAP model following the change in China's capital stock
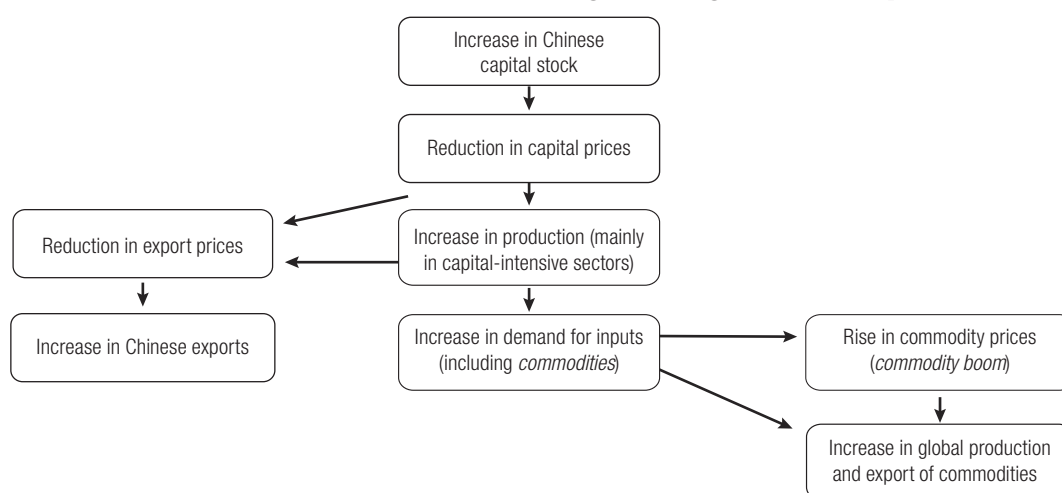
Source: Prepared by the authors.

IV. Results

Table 2 shows the effects of Chinese growth on sectoral production in selected Latin American countries, and in China and the rest of the world.

Table 2 reports a decrease in the production of industrial sectors in the high, medium and low- tech segments, both in Latin American countries and in the rest of the world. The decrease in production in Latin American countries is more accentuated in the high-tech sector. The only increases in industrial production are recorded in the medium-high, medium-low and low-tech sectors in Costa Rica and in the medium-low-tech sector in Paraguay.

The production of services also increased in the countries analysed; and commodity production grew across the board, except in the Bolivarian Republic of Venezuela (-0.04%), Colombia (-0.11%) and Ecuador (-0.01%).

In China, the increase in the capital stock fuelled output expansion in all sectors, but mainly in the high- and medium-high-tech industrial segments.

Table 2
Latin American (selected countries), China and the rest of the world:
variation in production by sector, 2011
(Percentages)

Countries	High-tech industries	Medium-high tech industries	Medium-low-tech industries	Low-tech industries	Services	Primary products
Argentina	-1.14	-0.68	-0.5	-0.62	0.12	0.06
Bolivia (Plurinational State of)	-1.53	-0.98	-0.51	-0.23	0.04	0.04
Brazil	-0.77	-0.55	-0.55	-0.46	0.12	0.04
Chile	-2.16	-0.83	-0.74	-0.71	0.14	0.52
China	7.27	5.58	5.23	3.49	3.26	2.57
Colombia	-1.67	-0.82	-0.7	-0.34	0.16	-0.11
Costa Rica	-0.99	0.24	0.45	0.01	0.07	0.52
Ecuador	-1.28	-0.73	-0.3	-0.5	0.12	-0.01
Mexico	-1.37	0	-0.07	-0.08	0.09	0.38
Panama	-1.32	-0.59	-0.21	-0.56	0.08	0.08
Paraguay	-1.87	-0.74	0.04	-0.39	0.06	0.01
Peru	-0.55	-0.42	-0.77	-0.23	0.2	0.33
Uruguay	-1.88	-0.95	-0.38	-1.01	0.19	0.15
Venezuela (Bolivarian Republic of)	-1.36	-0.33	-0.63	-0.09	0.14	-0.04
Rest of Latin America	-1.33	-0.28	-0.06	-0.31	0.05	0.27
Rest of the world	-1.19	-0.29	-0.31	-0.23	0.09	0.29

Source: Prepared by the authors, on the basis of results.

In terms of the effects on exports and imports, table 3 shows that Latin American exports declined in the industrial and service sectors after the shock caused by the increase in the Chinese capital stock. The exceptions were Costa Rica, where exports increased in the medium-high and medium-low-tech industrial sectors and in the services sector; and Mexico, where low-tech industrial and service exports grew.

Table 3
Latin American (selected countries), China and the rest of the world:
variation in exports by sector, 2011
(Percentages)

Countries	High tech industries	Medium-high tech industries	Medium-low tech industries	Low tech industries	Services	Primary products
Argentina	-3.59	-1.53	-1.59	-2.14	-1.33	1.07
Bolivia (Plurinational State of)	-4.41	-1.91	-1.53	-1	-1	0.52
Brazil	-5.27	-2.5	-2.25	-2.91	-1.75	0.73
Chile	-3.34	-1.47	-0.93	-1.58	-0.35	1.61
China	11.16	9.91	6.42	4.64	5.73	-7.55
Colombia	-4.7	-1.93	-1.83	-2.07	-1.44	-0.03
Costa Rica	-1.24	0.32	0.92	-0.07	0.63	1.1
Ecuador	-3.91	-1.46	-1.14	-1.88	-0.57	0.12
Mexico	-1.57	-0.05	0.01	-0.36	0.31	1.06
Panama	-1.26	-0.6	-0.16	-0.1	-0.32	2.13
Paraguay	-3.21	-0.79	-0.91	-1.63	-0.94	-0.03
Peru	-3.58	-1.37	-1.45	-1.45	-0.79	1.42
Uruguay	-4.18	-1.21	-1.36	-2.06	-1.03	0.71
Venezuela (Bolivarian Republic of)	-4.95	-1.96	-1.24	-2.4	-1.06	0.18
Rest of Latin America	-2.4	-0.5	-0.23	-0.69	-0.02	1.08
Rest of the world	-1.92	-0.45	-0.44	-0.61	0.13	1.03

Source: Prepared by the authors, on the basis of results.

Over the years, Mexico's production structure has diversified, while Costa Rica is noted for the manufacture of computer chips and other components, especially after Intel set up production facilities in the country and began exporting to Lenovo, HP and Dell —firms that have assembly lines in China (Medeiros and Cintra, 2015; Castillo and Martins, 2016). Exports of services from the rest of the world also grew following the increase in China's capital stock.

Except in the cases of Colombia and Paraguay, commodity exports also reported growth, signalling a re-primarization process in Latin America's export structure. In contrast to the Latin American countries, China's industrial exports increased, particularly in the high- and medium-tech sectors, whereas its commodity exports declined.

Table 4 shows the variation in imports. In Latin America generally, imports grew in the industrial sectors, especially in the high-tech segment; but in Costa Rica and Mexico, they decreased. The region's imports in the primary goods sector generally shrank, although Brazil, Mexico and Peru were exceptions.

Table 4
Latin America (selected countries), China and the rest of the world: variation in imports by sector, 2011
(Percentages)

Countries	High tech industries	Medium-high tech industries	Medium-low tech industries	Low tech industries	Services	Primary products
Argentina	1.45	0.3	0.41	-0.02	0.61	-0.03
Bolivia (Plurinational State of)	0.67	0.39	0.07	0.05	0.64	-0.4
Brazil	3.3	1.05	1.45	0.73	1.1	0.29
Chile	0.89	0.52	0.89	0.45	0.64	-0.05
China	-0.58	-0.16	0.84	1.84	0.1	7.15
Colombia	1.77	0.58	0.78	0.76	0.95	-0.23
Costa Rica	-0.67	0.06	-0.15	-0.21	-0.19	-0.12
Ecuador	1.32	0.36	0.45	0.3	0.74	-0.22
Mexico	0.13	-0.04	-0.05	-0.2	-0.07	0.02
Panama	0.27	0.14	0.67	0.03	0.38	-0.68
Paraguay	0.39	0.19	0.27	0.07	0.76	-0.5
Peru	1.7	0.8	0.71	0.66	0.72	0.27
Uruguay	1.42	0.1	0.38	0.29	1.03	-0.22
Venezuela (Bolivarian Republic of)	1.55	0.65	0.55	0.91	0.89	-0.09
Rest of Latin America	0.54	0.18	0.03	-0.04	0.12	-0.22
Rest of the world	0.84	0.19	0.32	-0.02	0.14	-0.18

Source: Prepared by the authors, on the basis of results.

In China, the imports of high- and medium-high-tech sectors decreased while those of less technology-intensive industrial sectors, services and primary products all increased, particularly commodity imports (+7.15%).

The variation in well-being is calculated on the basis of the equivalent variation. This represents the change in wealth that would have the same well-being impact as the variation in prices (Mas-Colell, Whinston and Green, 1995). The well-being decomposition effect expresses the effects of shocks in the economy's different well-being contributions, measured in monetary units.

According to Burfisher (2011), the well-being decomposition effect can be divided into six components, as follows: (i) an allocative efficiency effect: this shows the excess burden of each tax; (ii) an endowment effect: changes in the quantities of factors of production (such as capital) that alter an economy's production capacity of; (iii) a technology effect: changes in the productivity of factors or intermediate products, which modify an economy's effective endowments and its productive capacity; (iv) an effect on the terms of trade of the goods produced: changes in the rest of the world and in the

economy in the prices of exported goods and services (valued FOB) and imported goods and services (valued CIF); (v) a saving-investment effect: changes in the price of investment goods relative to the price of saving in the global bank; (vi) a preferences effect: changes in the share of private consumption, government and savings in national expenditure.

Following the 10% positive shock to the Chinese capital stock, the net change in well-being stems from a combination of the allocative efficiency, endowment, terms of trade and investment-saving effects, as shown in table 5. Overall well-being improved for all countries except Costa Rica.

Table 5
Latin America (selected countries), China and the rest of the world:
decomposition of well-being, 2011
(Millions of dollars)

Countries	Allocative efficiency effect	Endowment effect	Terms of trade effect	Investment-saving effect	Total
Argentina	214.21	0	363.3	-72.49	505.02
Bolivia (Plurinational State of)	4.03	0	16.37	0.32	20.72
Brazil	899.01	0	1 713.98	-102.13	2 510.86
Chile	61.3	0	433.64	-56.27	438.68
China	18 262.22	153 011.13	-29 373.98	3 376.33	145 275.69
Colombia	61.73	0	258.72	-13.66	306.79
Costa Rica	-0.06	0	-8.57	-3.76	-12.39
Ecuador	42.76	0	78.94	1.56	123.27
Mexico	252.03	0	281.33	-96.88	436.48
Panama	18.38	0	81.72	35.51	135.62
Paraguay	15.63	0	27.38	5.34	48.36
Peru	-15.68	0	217.18	-36.09	165.41
Uruguay	43.01	0	51.86	2.31	97.19
Venezuela (Bolivarian Republic of)	90.15	0	363.12	-129.14	324.13
Rest of Latin America	18.17	0	38.81	8.87	65.84
Rest of the world	2 563.68	0	25 224.98	-2 892.45	24 896.21

Source: Prepared by the authors, on the basis of results.

Only China suffered the factor endowment effect owing to its increased capital stock. The well-being decomposition effects point to a positive allocation effect in the regions analysed, except in the cases of Costa Rica and Peru.

The terms of trade effect measures the economy's purchasing power and is calculated as the ratio between the price of a country's exported goods and the price of its imported goods. Thus, given the increase in China's production of industrial goods and the increase in its demand for primary products (commodity price boom), Latin American countries gained from trade through improved terms of trade. In contrast, the terms of trade deteriorated in China and Costa Rica. The latter may have experienced a "competitive" effect with Chinese production.

The effect of the investment-saving (I-S) ratio varies from country to country and depends on whether the country is a net demander or supplier of savings.

In general, the largest well-being gains accrue to China, the country that experienced the 10% shock in the capital stock. Brazil, whose main trading partner is precisely China, also recorded a significant well-being gain (Government of Brazil, 2019).

V.   Conclusions

The aim of this paper was to use the CGE model of the Global Trade Analysis Project, to empirically analyse the effects of China's growth on a selected group of Latin American countries and on China itself. Chinese growth was simulated on the basis of a 10% expansion of its capital stock, in line with the trend observed in recent decades.

Most Latin American countries are exporters of commodities and low-tech products to China. In contrast, Chinese exports to the region consist of products associated with the high- and medium-tech industrial sectors, as well as low-tech and low-cost manufactures.

The effects of the simulated Chinese growth on the Latin American countries analysed lead to a reduction in industrial output and an increase in the production of primary products and services.

Nonetheless, there are some exceptions, such as Costa Rica, which experienced increases in production and exports in industrial sectors —other than high-tech— and a reduction in industrial imports. The withdrawal of Intel from Costa Rica in 2014 may have impacted Costa Rica's trade relations. Mexico also diverges from the general Latin American pattern, with imports in the medium- and low-tech industrial sectors declining. The export structure of the Mexican economy has improved in recent years; and, while it both competes and trades with China, it maintains more intensive trade relations with the United States.

The overall picture in Latin America is worrying. Although the partnership between China and the region increased the overall well-being of these economies in the 2000s (thanks to the commodity price boom), signs of deindustrialization can be discerned in the Latin American countries. These include the declining share of industrial production and the increasing output of both services and the commodity export sector.

In contrast, China's industrial production and the technological intensity of its products are increasing. China is no longer merely an exporter of cheap manufactured products, but is now competing in higher technology sectors. It could even hinder the progress of Latin American production in these sectors.

This begs the following question: are trade relations between Latin America and China mutually beneficial or are they fostering dependency? Latin America has abundant natural resources, but its countries' reliance on the production of these resources makes them vulnerable on the international stage —in other words, they are susceptible to what happens in periods of commodity boom and bust. The rise of China and its consequent increase in demand for commodities highlights the degree of specialization present in Latin America's production and export structure, and its fragility in the face of competition in the industrial sectors.

If Latin American countries wish to forge an economic success story, they must rethink their trade relations with China, while also addressing address their domestic shortcomings. Investment in quality human capital and infrastructure, and the pursuit of technical progress through a planned industrial policy involving all sectors of society, including both market and State, are necessary conditions for Latin America to break the shackles of its historical dependency on the international scenario.

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