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Evaluating China's role in contemporary South American trade - an economic complexity approach

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Abstract: The rapidly expanding importance of the Chinese economy saw a restructuring of the global trade hierarchy. While this proves challenging for all economic actors, especially peripheral economies are forced to rethink the way they interact and trade with the new emerging economy (EME) powerhouse that is China. In this article, we pay closer attention to the South American (SAC) economies and their specific industrial composition that arguably left them in an unequal relationship with China, placing them in a precarious situation of dependency on low-complexity commodities. Utilising the theoretical framework of economic complexity, we thoroughly assess this asymmetric relationship between SAC and China. Causal linkages are further created by including the findings from this descriptive examination into a structural gravity model of trade. We find that the complexity approach underlines the notion of asymmetry in the Chinese-SAC trade nexus and places the latter in a so-called *quiescence trap*, a disposition which could be outgrown by a significant increase in productive capabilities. The econometric analysis reinforces this, urging additional research on other developing and emerging economies.

Keywords: International Trade, Economic Complexity, Gravity Theory, China, South America

JEL Classification: F10, F14, O53

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1. Introduction

Within international economics of trade, the role of the People's Republic of China as a manufacturer, exporter and overall economic powerhouse has been one of the most discussed and central issues for several decades (Lin, 2011). While much research focuses on the effect China has on the global economic hierarchy, there also is the body of literature which deals with geographically more narrow impacts (Men, 2012). This paper aims at contributing towards the latter, more specifically at shedding more light on the trade relations between China and South American countries (SAC)[1], which have significantly intensified since the beginning of the millenium. Recently, China surpassed the United States (US) as the largest trading partner of the region while also providing large amounts of foreign direct investment (FDI) (Roy, 2022). On the surface, such increasing South-South cooperation is considered beneficial for both trading partners, especially because the South American region as a whole exhibits a trade surplus with China (Vadell, 2019; Giordano and de Mendívil, 2019). However, it is important to pay attention to the particularities of this trade relation and investigate whether a potential *asymmetry* has negative long-term effects for either of the trade partners.

To go beyond this *shallow* analysis of the Chinese-SAC trading nexus is the main goal of this paper, which is achieved by implementing two methodological particularities. Firstly, the productive structures of the countries will be assessed. More specifically, the relatively recent theoretical framework developed by Hidalgo and Hausmann (2009), coined *economic complexity* will be used to assess export baskets in terms of diversification and pervasiveness. Secondly, the results will be integrated into the well-established gravity modelling methodology. This dual analytical approach thus provides the novelty needed to answer the questions:

How can the characteristics of trade between SAC and China in the 21st century be understood by looking at their productive structures? What role do relational factors play in the context of these trade relations?

With this research, the gap between the often purely descriptive nature of bilateral trade literature and more thorough structural analysis is bridged by the calculation of comparative indicators and the investigation of potential asymmetric patterns within the trade relations between China and SAC.

[1] For the purposes of this paper, SAC encompasses Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela.

2. A brief introduction to economic complexity

Similar to the standard trade theory, the starting point for understanding the patterns of trade between China and SAC is the observation of the industrial or productive structure of both trading partners. The economic complexity approach developed by Hidalgo et al. (2007), Hidalgo (2021) and Bahar et al. (2014) argues that exports and imports of an economy contain valuable information on the productive structure and the potential growth of an economy. Put differently, systematically looking at what countries trade (in addition to how much), implies how countries produce their goods and services, and how they can move to more sophisticated products, and hence economically upgrade. Understanding the benefits of applying the economic complexity approach requires clarifying the central concepts, assumptions and mechanisms.

2.1. Capabilities and the role of know-how in trade

A first simple observation states that products require certain inputs to be produced. These inputs may refer to whatever is relevant to be able to produce something competitively, such as infrastructure, material, labour, know-how etc. (Hausmann and Hidalgo, 2011; Hidalgo et al., 2007; Hidalgo, 2021, 2023). Of these, particularly know-how is difficult to capture in measurements but forms a part of an intuitive and widespread argument: you can only produce what you know how to produce. On a societal level, what an economy produces depends on the know-how existing in its constituent individuals and organisations of individuals (i.e. firms), which then combine into joint skills which are labelled capabilities (Hidalgo et al., 2007). Capabilities are by definition not tradeable, as they are not only the formal knowledge attained by education, but also the ”tacit” knowledge that informs production processes but cannot be codified (Bahar et al., 2014). These include ”property rights, regulation, infrastructure, specific labour skills” among others, which ”countries need to have [...] locally available in order to produce” (Hidalgo and Hausmann, 2009, p. 3). The availability of capabilities as non-tradable inputs at the national level thus delineates that economy’s productive structure.

This view of the economy as being determined by the availability of capabilities is more granular than the standard (Heckscher-Ohlin) trade model (Leamer, 1995) as it does not only allow to compare the relative use-intensity of respective factor endowments, it can differentiate the factors into different inputs, beyond the traditional split between labour, capital and land. Each product is made by using a specific set of capabilities. However, similar to the problem of factor endowments, the argument that capabilities determine the productive structure of an economy suffers from the inability to quantify these capabilities (Hausmann and Hidalgo, 2011).

Here, two new assumptions illustrate the theoretical validity of the capabilities approach. Firstly, capabilities can be combined in a multitude of ways to create different products. Products requiring more capabilities and more specific capabilities can be concluded as being more complex and vice versa. On a macro-level this allows for a simple preliminary deduction: countries with a lot of capabilities will be able to make more goods than countries with less capabilities.

2.2. The product space - productive structures as a network

Based on the capabilities approach, two metrics are developed: *product complexity* and *economic complexity*. Jointly, they form what has been labelled the *product space*, connecting countries to what they produce.

Product complexity describes the input of capabilities that are required to produce a specific product. Determining the relative distribution of capabilities by comparing countries' exports, allows to derive two formal measures to describe the product complexity in more detail. First, in order to measure how specialised capabilities are, Hausmann and Hidalgo (2010) introduce the *ubiquity* property. Essentially, this property measures how spread a certain capability is, by comparing how many countries export a certain product in relation to the rest of the world. Hence, the scarcity of complex goods indicates that necessary capabilities for these complex goods are less ubiquitous. Second, the ubiquity of exports is related to product diversification (Hausmann and Hidalgo, 2010). Countries that are able to produce complex goods due to their abundance of capabilities are also able to combine these in multiple ways to create novel products and are thus more diversified. Hausmann and Hidalgo (2010) show that a country's diversification is negatively linked to the ubiquity of its exports, demonstrating that countries which produce goods which are produced by many other countries are less diversified. Hausmann and Hidalgo (2010) summarise this relationship as follows: "Products that require more capabilities will be accessible to fewer countries [...], while countries that have more capabilities will have what is required to make more products" (p.1).

Creating a matrix that measures both the ubiquity of products and the diversification of countries, Hausmann and Hidalgo (2010, 2011) develop a perspective which they label the *product space*. This matrix captures the relationship between products as given by the export baskets of countries. As such the product space measures the complexity of products and their relative position to other products based on that complexity. In other words, the product space captures the relationship between capabilities, i.e. the fact that capabilities can be recombined into new products.

A country's economic complexity is then determined by the set of capabilities it possesses. In the product spaces this relates to how many capabilities are present in the country and whether these capabilities are connected to the production of complex goods (Hidalgo et al., 2007, 2019). This is measured by the complexity of exported products (product complexity), as indicated by the ubiquity of exports as well as the country's overall diversification (Hausmann and Hidalgo, 2010). This is achieved by the integration of the *Revealed Comparative Advantage* (RCA) (Balassa, 1965) metric into the product space. Alterations in the product space indicate certain industrialisation or de-industrialisation tendencies.

2.3. Productive dynamics and industrial upgrading

Based on the product space as a theoretical framework to capture the productive structure of an economy, the ability to produce more complex products depends on the accumulation of capabilities. Conversely, the absence of capabilities to produce a certain product suggests that the respective industry does not exist as the complementary inputs, i.e., they are missing. This chicken-egg-problem hypotheses two tendencies that are central to understanding the accumulation of capabilities, which are illustrated in the *quiescence trap*.

The quiescence trap, or trap of economic stasis is the logical outcome of the assumption that the relationship between the number of capabilities and product complexity is non-linear (Hausmann and Hidalgo, 2010). This nonlinearity is given by the network structure of the product space. The argument is as follows: a country is able to accumulate more capabilities by moving to the production of products that are nearby in the product space, as these products overlap with the already existing capabilities in the country (Hidalgo and Hausmann, 2009). In the concentrated space of complex products that share a lot of capabilities there are inherent scale economies in the accumulation of capabilities. The more capabilities a country has to produce more complex goods, the more capabilities it is able to accumulate. Conversely, a country that possesses limited capabilities, or capabilities that are used to produce products which are less connected in the product space, is less able to accumulate more capabilities. The quiescence trap captures this country in a state of limited capabilities and thus a restrained ability to produce other products.

To understand the quiescence trap and its consequences for economic development in detail, Hausmann and Hidalgo (2010) and Jun et al. (2020) use the concept of *product relatedness* which describes the relationship between elements within the product space (Hidalgo, 2021). Products which share a lot of capabilities are closely related, while products that are only scarcely linked are less related. On a theoretical level, product relatedness captures how easy it is for countries to move to the production of other products (Hidalgo et al., 2019). Empirically, complex goods are highly related to each other, while primary goods or low-skill manufactured goods are less related. Hidalgo and Hausmann (2009) show ”that the level of complexity of a country’s economy predicts the types of products that countries will be able to develop in the future suggesting that the new products that a country develops depend substantially on the capabilities already available in that country” (p. 5). Hence, they argue for an endogenous tendency in the accumulation of capabilities. The more capabilities one has to produce a certain product, the more likely one is to produce other complex products and accumulate even more capabilities, based on their relatedness. As such, capabilities are compatible with other theories outlining agglomeration effects and path-dependencies (Krugman, 1979).

Starting from the endogenous tendency inherent in capability accumulation, how can countries on the one hand diversify and on the other hand produce more complex products? Previous studies answer this question by looking at the knowledge diffusion between neighbouring countries (Bahar et al., 2014). Their argument is that if capabilities are tacit knowledge that cannot be traded but rather diffuses, even across borders, then the export basket of neighbouring countries should be predictive of a country’s own future productive structure (Bahar et al., 2014; Jun et al., 2020). Put differently, the economic complexity of one’s neighbours might be the source for countries to move to more complex products.

Central here is that capabilities not only drive the possibility to produce products but also the productivity with which firms produce a given product. Hence, if capabilities drive productivity, they also drive competitiveness. Thus, the accumulation of capabilities must be linked to exports, either in what is exported or in how much a country exports of a certain good.

3. Trade patterns and empirical complexity in China-SAC trade

The pattern of trade between China and SAC can be approached by examining the respective productive structures, since production itself determines what an economy can trade. Based on the economic complexity approach, the productive structure of an economy is determined by the available capabilities within that economy. Therefore, the Economic Complexity Index (ECI) captures the relative distribution of capabilities across countries over time (Figure 1). The index suggests that the existing capabilities in a given country determine its economic complexity (Hidalgo and Hausmann, 2009). Importantly, the ECI is a relative indicator ranking countries in terms of standard deviations from the world complexity average. Countries located at the top and with an ECI above 0 exhibit greater capabilities than the world average, while countries at the bottom and with an ECI below 0 have capabilities below the world average. To illustrate, an increase in the index means a relative increase in the number or specialisation of capabilities, while conversely a decreasing index indicates the relative loss of capabilities as compared to the world average (Hausmann and Hidalgo, 2011).

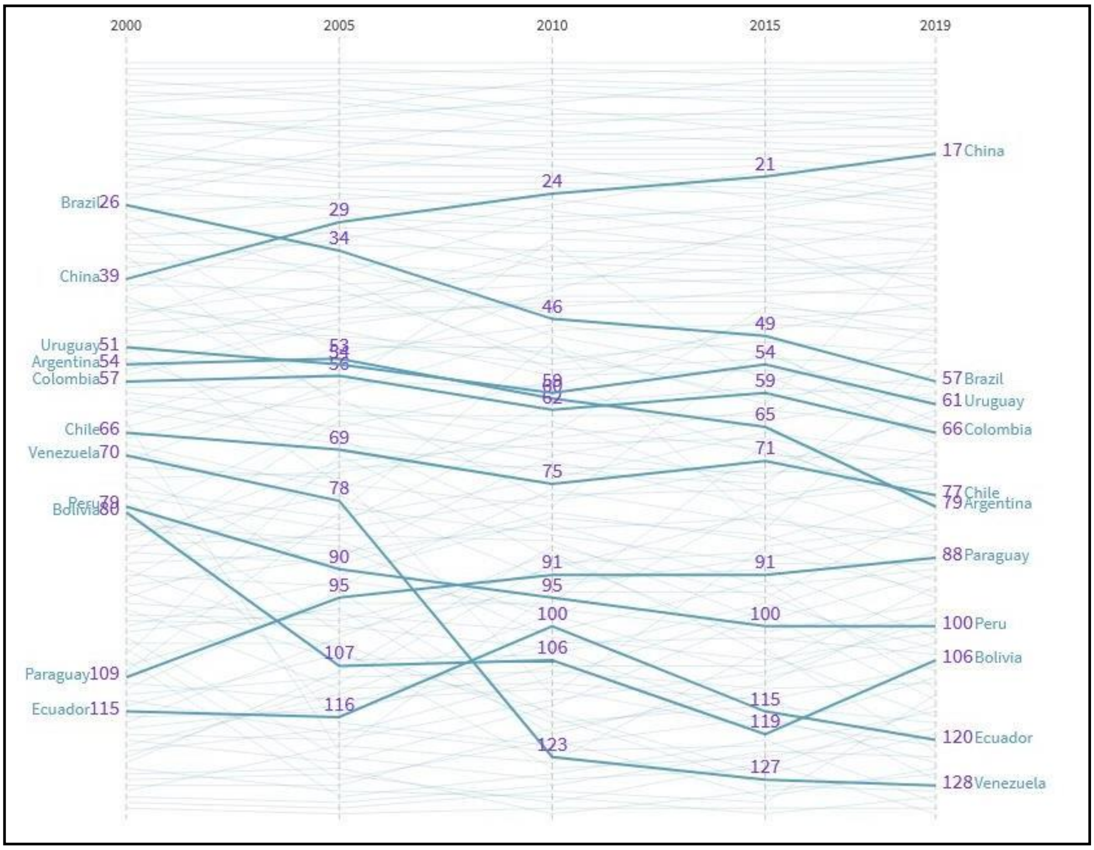


Figure 1: Development of ECI ranking per country 2000 - 2019

Source: Harvard Growth Lab (2024)

While China experienced an improvement in the ECI between 2000 and 2019, the positions of nearly all SAC deteriorated in the same period. The deteriorating positions of SAC can be explained by either the real loss of capabilities or by other countries' increase in capabilities. While China has managed to acquire differential capabilities with respect to world average, SAC have not caught up and instead fallen behind China and other partners. This previous dynamic presented for SAC and China is robust to other measures of productive capacities such as the Productive Capacities Index (PCI) calculated by the United Nations Conference on Trade and Development (UNCTAD, 2021). The PCI aims to quantify the capacities to produce goods and services and integrate into the global economy of countries in terms of three elements. First, the productive resources available to the economy and how they are used, including human, physical and natural capital, energy and transport. Second, the entrepreneurial capabilities that are related to the know-how and technology present in the economy. Third, productive linkages that capture the interactions between the above dimensions to induce processes of structural change and upgrading in GVCs. As such this complementary indicator captures the absolute distribution of capabilities.

Figure 2 shows the PCI between 2000 and 2019 for SAC, China, the EU and the US as a benchmark. Overall, it shows the outstanding performance of China, which, despite starting the period close to South America, has accumulated capacities so rapidly that it has been able to close the gap with the EU and the US. Even though the SAC were able to slightly increase their productive capacities in absolute terms, the gap with China has been widening over the last two decades. Consequently, it is possible to affirm that the productive structures of South America and China are increasingly divergent, with the latter having capacities more similar to those of industrialised core economies such as the EU and the US than those of a peripheral economy. Based on the relative and the absolute distribution of capabilities, we can state that there exists a profound asymmetrical pattern in the productive structures of SAC and China.

When two economies have asymmetric production structures, it is to be expected that their trade pattern also showcases a similar degree of asymmetry. This is because goods differ in the capabilities they require to be produced and exported competitively in world markets, thus, countries with different capabilities will not trade the same goods.

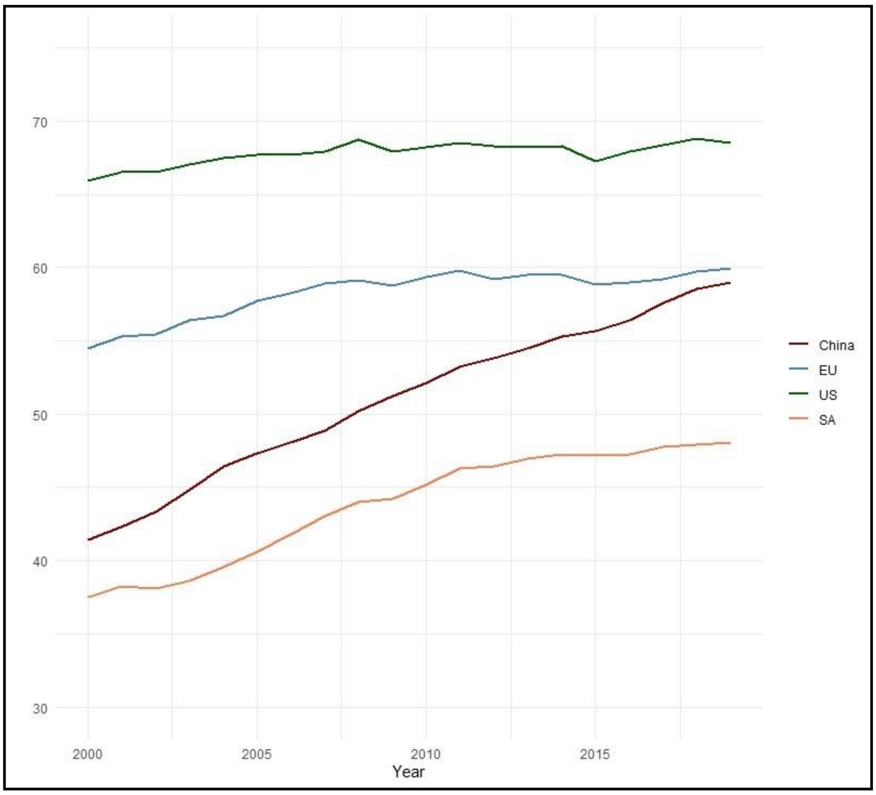


Figure 2: PCI for selected regions, 2000 - 2019

Source: UNCTAD (2021), authors' own depiction

By looking at the composition of imports and exports, one can discern the asymmetrical pattern of production in the trade data (Figure 3). Generally, it can be observed that SAC exports to China are concentrated in low-complexity products while high-complexity products have a negligible share. Thus, the bottom 30% of goods in the product complexity ranking accounted for 64% of exports to China, while they represented 60% for the EU, 43% for the US and 35% among SAC. On the other hand, the top 20% of goods in the complexity ranking accounted for only 2% of exports to China, while this share was 5% for the EU, 7% for the USA and 23% among SAC trade. Imports follow a pattern of trade opposite to that of exports. The top two deciles of goods in the complexity ranking accounted for 56% of imports from China, which is a similar level to that observed for the EU (62%) and USA (58%) but much higher than that of intra-regional imports (34%). Thus, this contrast between the complexity of imported and exported goods, weaker in the case of intra-regional trade, shows that trade with China follows a logic similar to that historically observed with countries of the Global North.

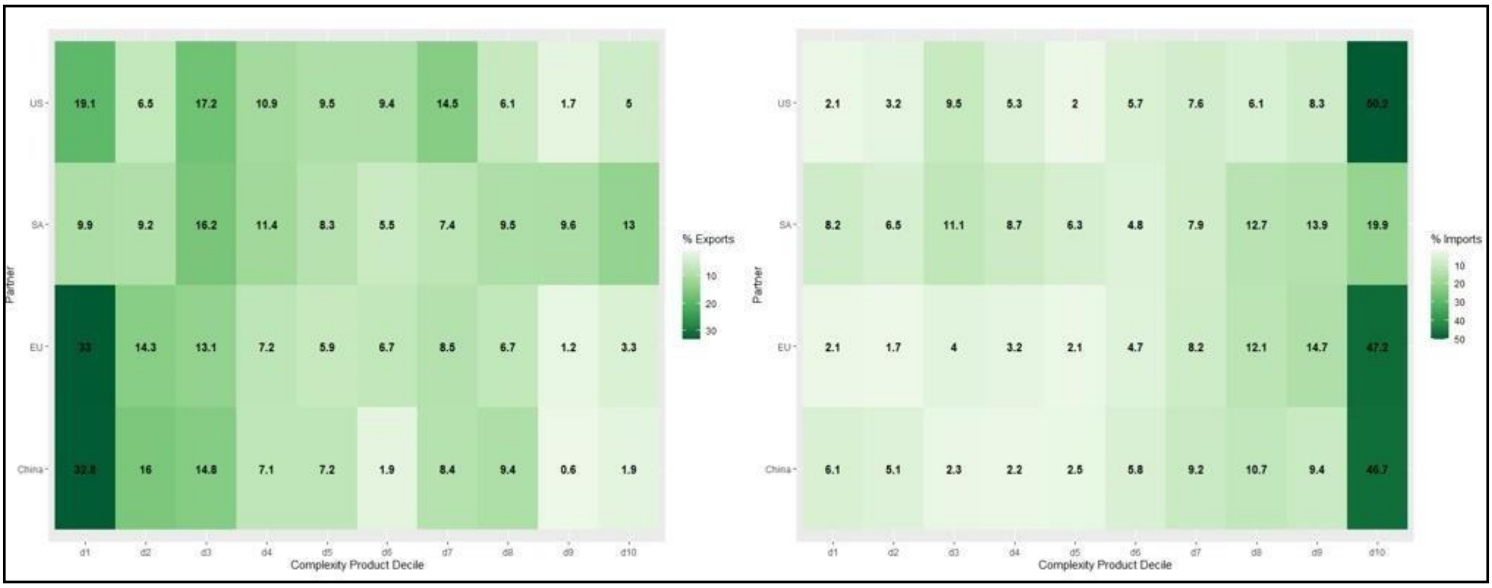


Figure 3: Composition of exports / imports by complexity decile and partner, 2000 - 2019

Source: Harvard Growth Lab (2024), authors' own depiction

It should be highlighted that the import of highly processed and complex goods and the export of less complex goods are a general feature of trade by SAC with the exception of the intra-regional trade among SAC. Importantly, the asymmetry in trade between SAC and China generally bears resemblance with the trade relations with the US and the EU. There are centre-periphery dynamics within an international division of labour, whereby SAC export low-complexity goods and mainly (unprocessed) commodities to the mentioned regions which in turn export their processed and manufactured goods for which they source commodities (Henrique et al., 1979; Rama and Hall, 2021). Thus, SAC can be considered the periphery while China can be considered to exhibit core-characteristics as a key global economic actor (Jenkins et al., 2008). The asymmetrical trade patterns as seen in the heatmaps in connection with the PCI and the ECI indicate that China's productive structure is becoming more similar to that of the EU and the US.

While the contrast between the export and import complexity supports the argument that trade with China follows a centre-periphery constellation, there are some additional features that make trade with China even more asymmetric in comparison with the EU and the US. First, the product complexity index of the goods traded with China are increasingly divergent relative to other trading partners. On the one hand, Figure 4 (left) shows that the complexity index for exports to China has been the lowest during the studied period. While there has been a downward trend for all trading partners, this drop has been more pronounced in the case of China especially when contrasted with the USA and SAC. On the other hand, Figure 4 (right) shows that China is the only partner for which import complexity exhibits an upward trend. Despite having started the century with the lowest complexity index, imports from China have overtaken the US and caught up with the EU.

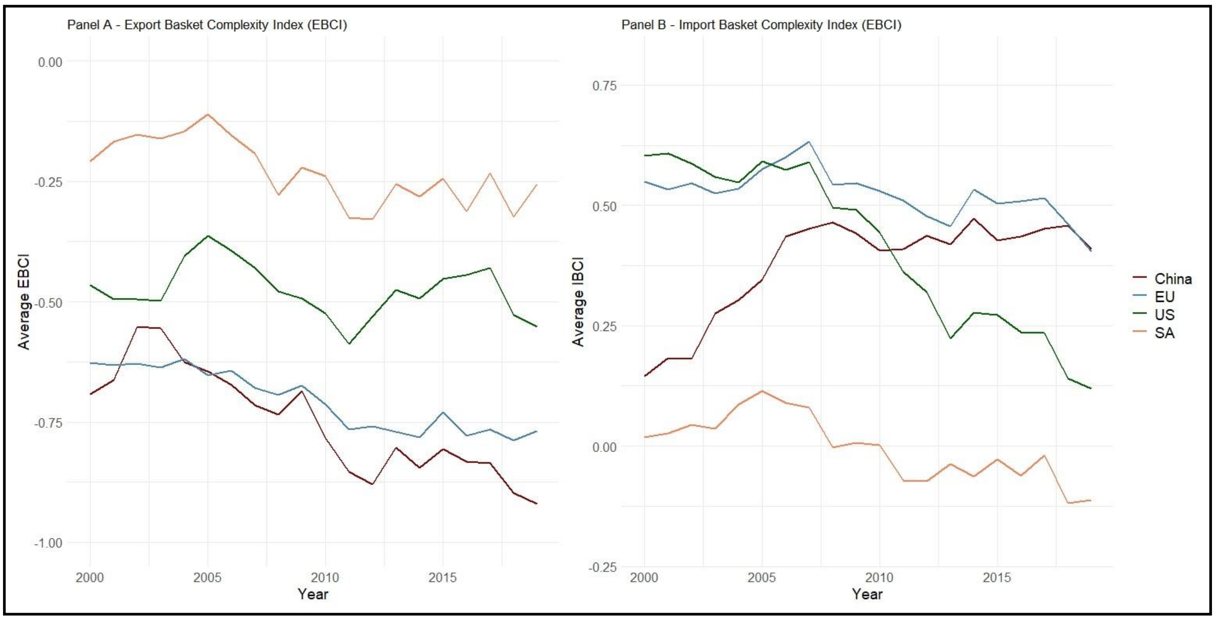


Figure 4: Average product complexity for SAC exports by trading partner 2000 - 2019 (in %)
Source: Harvard Growth Lab (2024), authors' own depiction

Second, exports to China exhibit the lowest level of diversification. Figure 5 shows the normalised Herfindahl-Hirschman Index (HHI) for exports (Hirschman, 1945; Herfindahl, 1950).[2] Overall, it can be seen that the value of exports to China is concentrated in a smaller number of products compared to the rest of the trading partners. In fact, the concentration of exports to China was 80% and 62% higher than the EU and US in the studied period, respectively.

[2] The HHI takes the value of 0 when all goods have the same share in exports and takes the value of 1 when only one product is exported.

Third, the similarity of goods exported to and imported from China is the lowest. Figure 6 presents the average Grubel-Lloyd Index (GLI)[3] (Grubel and Lloyd, 1971) which illustrates inter-/intra-industrial trade (Grubel and Lloyd, 1971; Greenaway and Milner, 1987, 1983). The lowest GLI shown in the SAC-Chinese case indicates that trade takes place more *between* rather than *within* industries. The latter leads to a higher prominence of trading goods produced in different sectors rather than similar goods produced in the same industry.

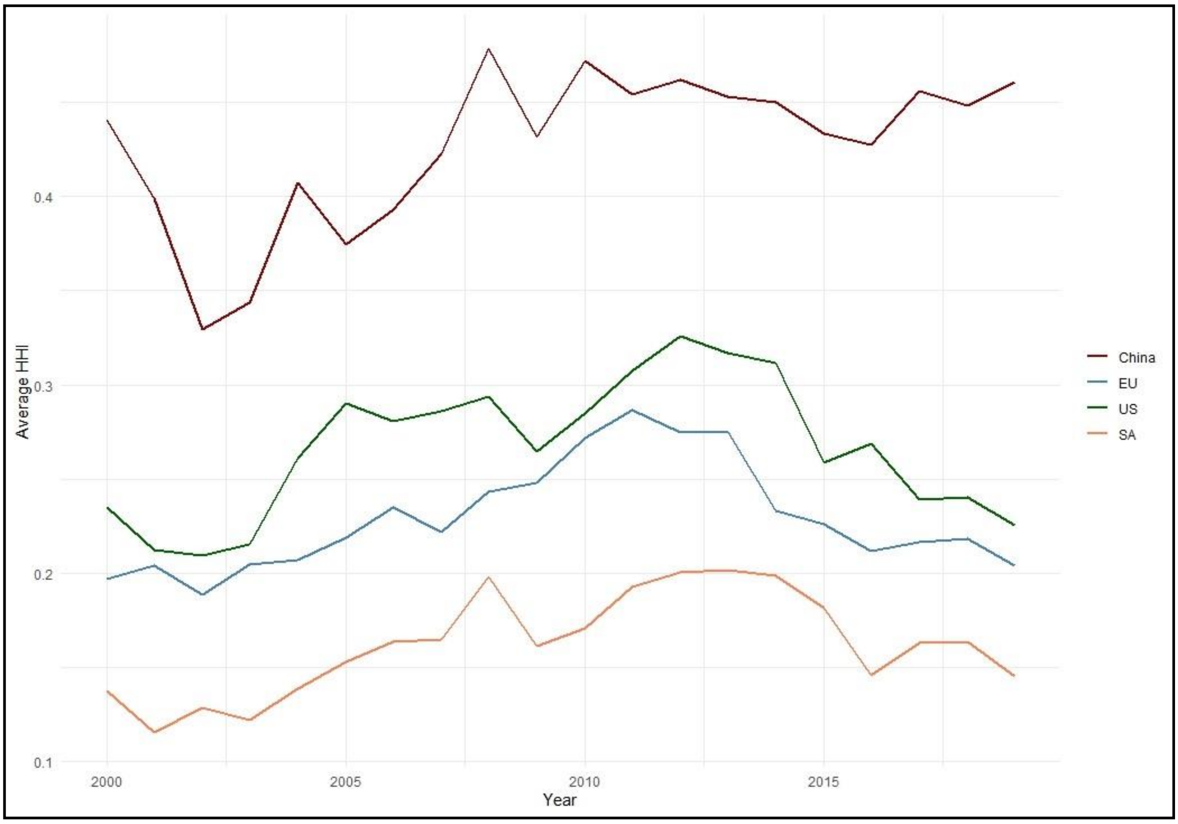


Figure 5: Average HHI for SAC exports by trading partner, 2000 - 2019
Source: Harvard Growth Lab (2024), authors' own depiction

Here, the main argument is that the specific traits of the SAC-China trade originate in the connection between the productive structures of China and SAC as illustrated by the various descriptive metrics underscoring the argument behind the economic complexity approach. This argument draws on examining the product space of each trading partner and discerns the dynamics within the product space. The specifics of the trade with China can be explained by looking at the drivers of the movement in the product spaces of both regions. Therefore, it is necessary to revisit the theoretical attributes of the product space in the context of SAC and China.

3 The GLIIt has the value 0 when a good is either exported or imported and it takes the value of 1 when the exported and imported value of a good equals.

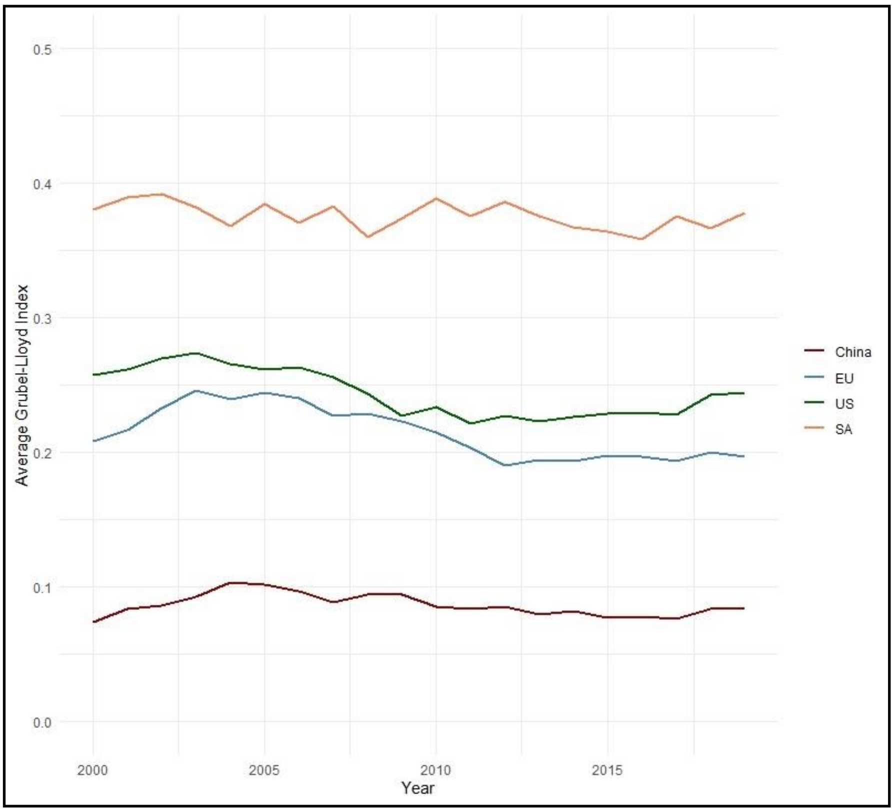


Figure 6: Average GLI for SAC by trading partner, 2000 - 2019
Source: Harvard Growth Lab (2024), authors' own depiction

3.1. Navigating through the product space

The product space is a network connecting different types of products based on the capabilities needed to produce them (Hidalgo et al., 2007). Thus, products using similar capabilities are closer connected in the product space. The highly connected centre of the product space describes mainly industrial goods that required many capabilities. In other words, these are technology-intensive and skill-intensive goods. However, these products share a lot of capabilities among each other, which allows a country, whose product space is quite centralised to expand its industrial production to other similar goods in the densely connected centre. Being in the centre of the product space thus indicates a high degree of industrialisation. The tendency to spread to other closely related products in the product space can thus be described as industrialisation.

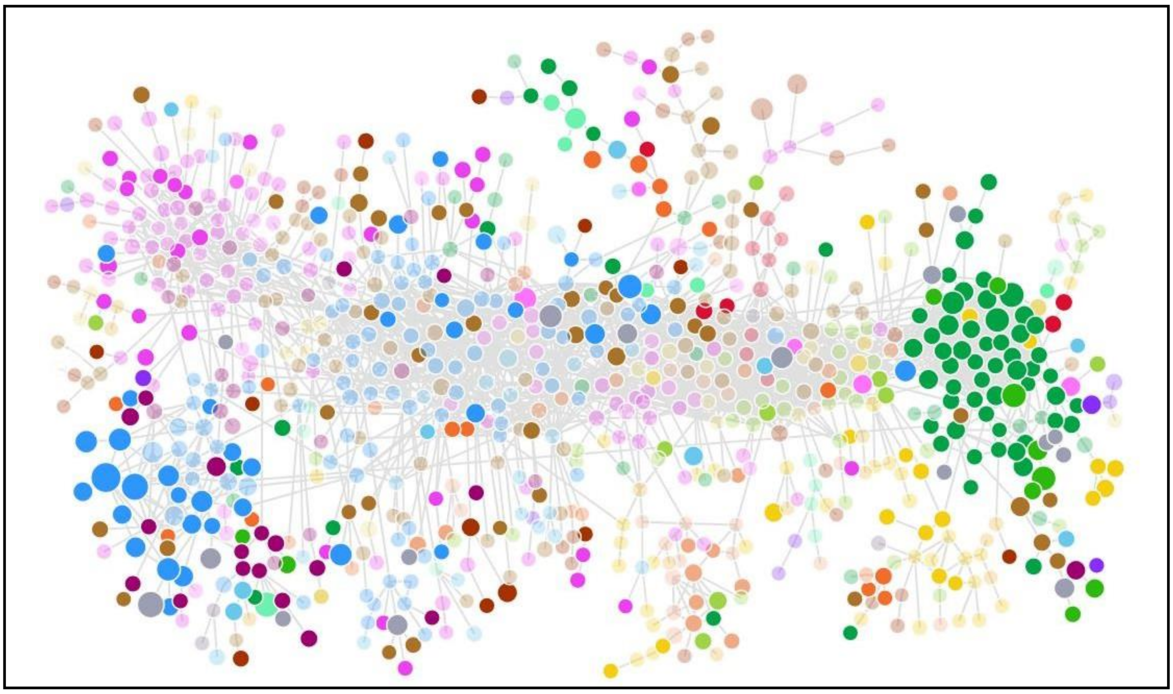
On the contrary, the periphery of the product space mainly covers agricultural, mineral or generally commodities. These products require fewer capabilities and do not share a lot of capabilities with other products in the product space. Further, being in the periphery of the product space indicates a reliance on commodity exports. A tendency to retreat to the edges of the product space can be labelled de-industrialisation or re-primarisation, as capabilities disappear. In essence, the expansion or retreat in the product space indicates whether an economy accumulates or loses capabilities, and thus (de-)industrialises.

When comparing the product spaces of China and Colombia as an SAC example (Figures 7 and 8), two trends can be observed. On the one hand, China manages to increase its production of highly connected goods (as indicated in the increase of the coloured dots, particularly in the highly connected centre) while it also spreads to other goods, thus expanding in the product space. Central is also the move from textiles (as indicated in green) to more sophisticated electronic products and machinery (blue). Thus, one can conclude that China continued its industrialisation which started in the last three decades of the 20th century. This also affirms the conclusions from the PCI as seen previously.

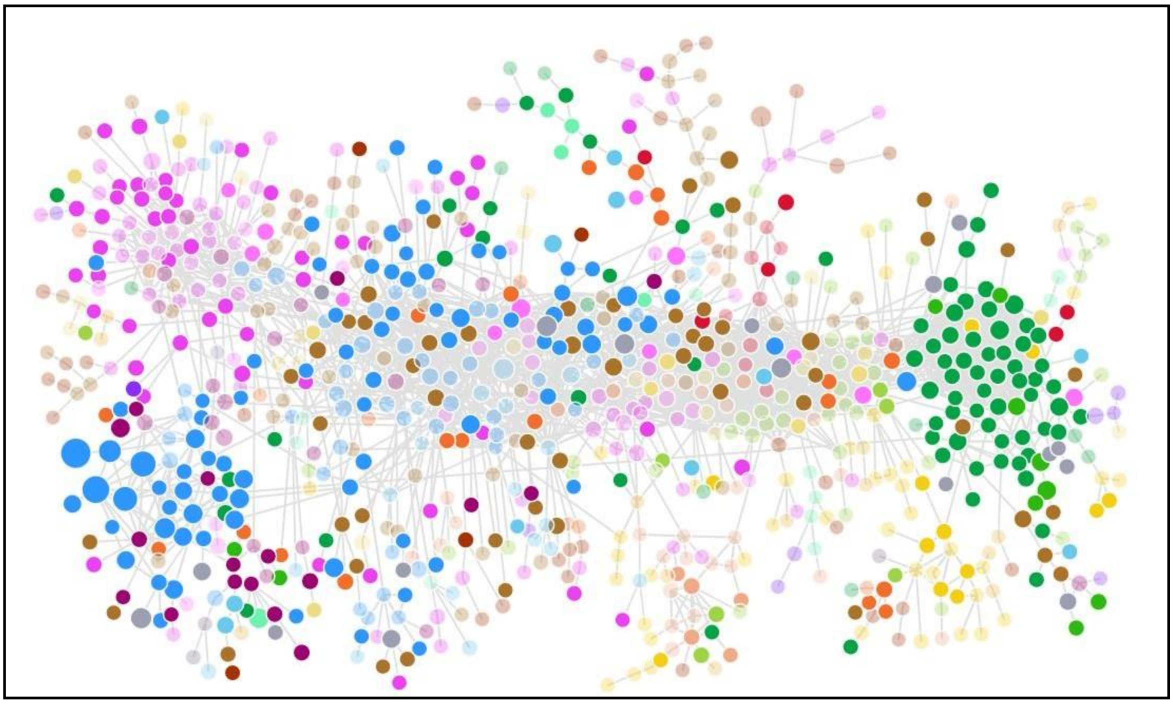
On the other hand, Colombia's product space shows a tendency to turn to the export of unprocessed commodities and low-complexity goods with few connections. At the end of the second decade of the 21st century, mainly energy goods, minerals and agricultural commodities make up the export baskets, while industries rather "disappear" from the product space (dots vanish). Thus, based on this tendency we confirm the view that SAC[4] rather de-industrialise and their exports tend to re-primarise (into commodities).

Summarising the findings of the product space, it appears that SAC retreat to the periphery of the product space while China expands within the centre of the product space. In line with the previous section, this double-movement within the product space confirms the view that the asymmetry between both trading partners deepens. To understand how this dynamic occurs, it helps to pay closer attention to the respective *movements* through the product space.

4. The implications derived from the analysis of Colombia's product space generally hold true for the SACtendencies. For country-specific details, compare Observatory of Economic Complexity (2024).



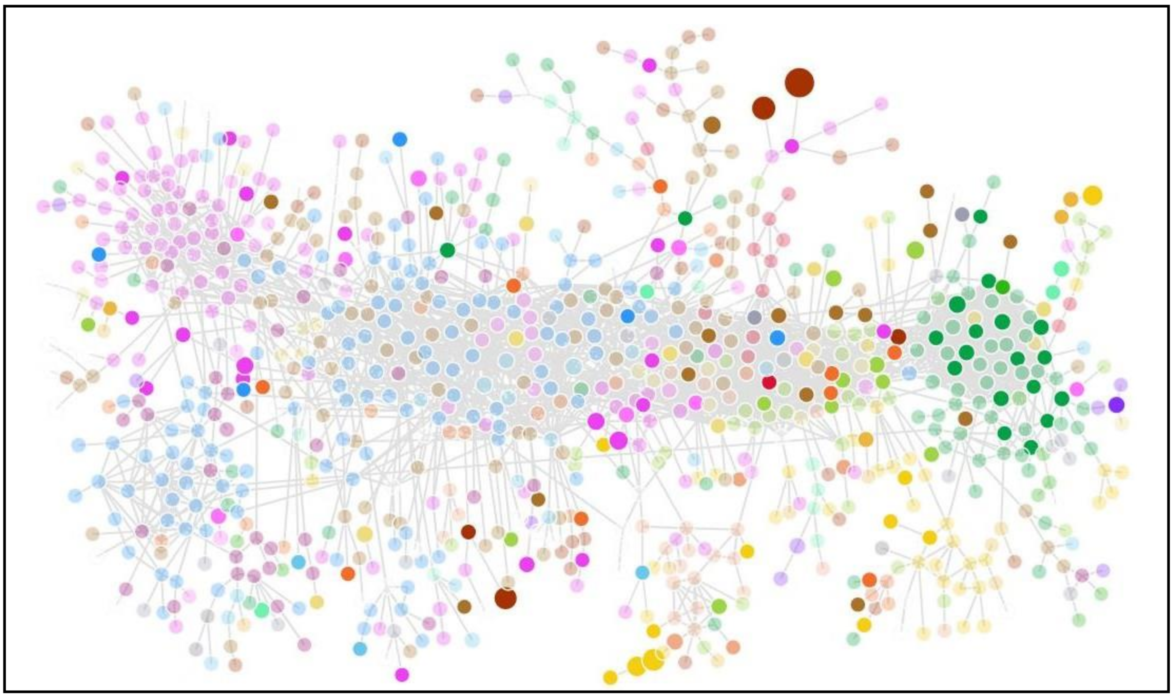
Panel A: 2000



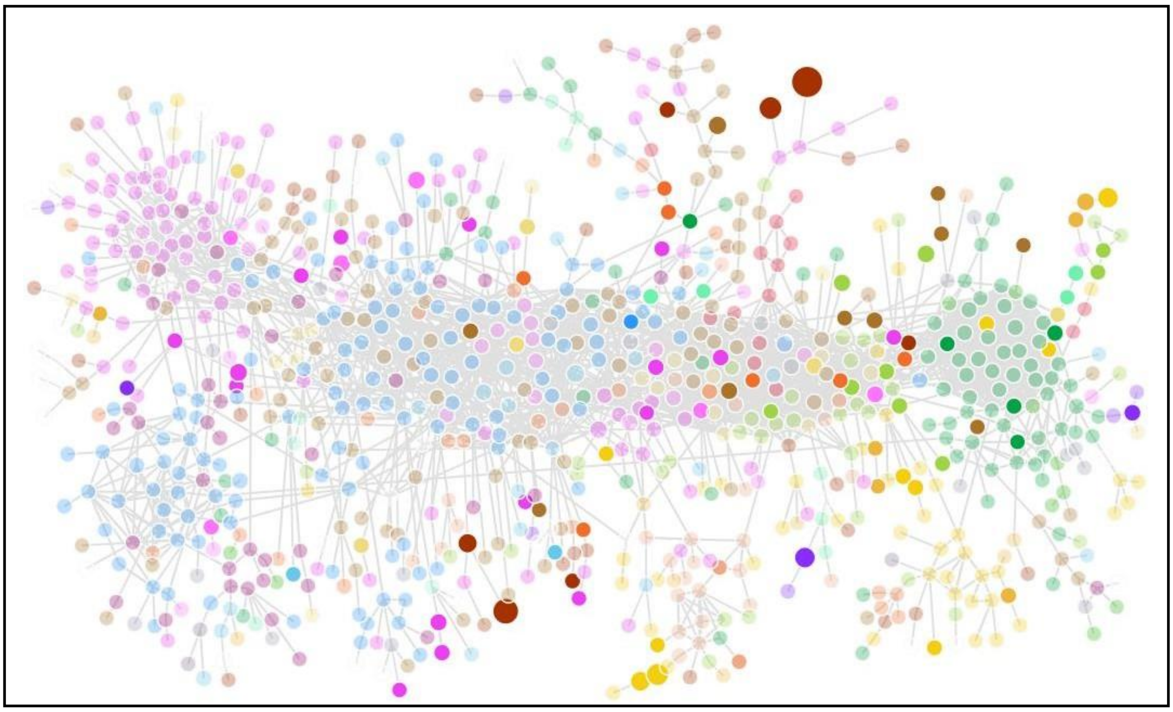
Panel B: 2019

Figure 7: Development of China’s product space 2000 and 2019, products with a RCA > 1

Source: Observatory of Economic Complexity (2024)



Panel A: 2000



Panel B: 2019

Figure 8: Development of Colombia's product space 2000 and 2019, products with RCA > 1

Source: Observatory of Economic Complexity (2024)

3.2. Why is China moving to the centre of the product space?

The asymmetry of the goods exchanged between SAC and China reveals that both regions have an industrial base with different levels of depth that locates them in different areas of the product space. To the extent that industrial manufacturing is the most favourable branch for the accumulation of productive capabilities (as indicated by the centrality in the product space), the country with a higher degree of industrialisation will have a larger and more complex basket of goods that it can produce and export competitively compared to the other. This relationship between industrialisation and centrality in the product space network is mediated by three factors that are elaborated below.

First, industrial manufacturing is characterised by the intensive use of machinery and equipment that allows for the application of technology and the combination of resources to transform basic goods into more complex ones. Second, the industrial sector tends to employ skilled labour and to have strong links with innovation and development activities that lead to greater use of knowledge in production processes. Third, industrial manufacturing is characterised by multiple backward and forward production linkages (Hirschman, 1958) encouraging the emergence of specialised and geographically clustered firms at the upstream and downstream of the value chains (Krugman, 1980).

Thus, this integration of technological equipment, knowledge and a network of interconnected firms allows industrialised economies to produce not only more sophisticated and differentiated goods, but also makes them more likely to explore the production and export of new goods requiring similar capabilities as envisaged by the principle of relatedness. However, despite the industry's ability to pool many differentiated capabilities, SAC and China have not followed a comparable trajectory of industrial development in recent decades. This has left the former region unable to move into the central areas of the product space and export more sophisticated goods, while the latter region has made upgrading in the product space becoming an example of diversification which is captured in the imports originating from China.

Figure 9 exemplifies these opposing trends. On the one hand, China has managed to maintain a stable share of manufacturing in GDP at around 30% over the last 50 years. Considering China's extraordinary average economic growth rate since 1970 of 9.0%, the stability of this ratio indicates that manufacturing has grown at the same rate as GDP. On the other hand, South America shows a declining trend in the share of manufacturing in GDP very similar to that observed in the EU and the US. However, as pointed out by several authors (see e.g., Rodrik, 2016; Tregenna, 2016; Castillo and Martins, 2016), SAC's deindustrialisation is premature because it has occurred before the region converged to a emerging economy status and before enjoying the benefits of industrialisation that Global North countries achieved. The latter is related to technological dynamism, productivity gains, quality jobs for skilled and unskilled labour, and the consolidation of a diversified and valuable export supply.

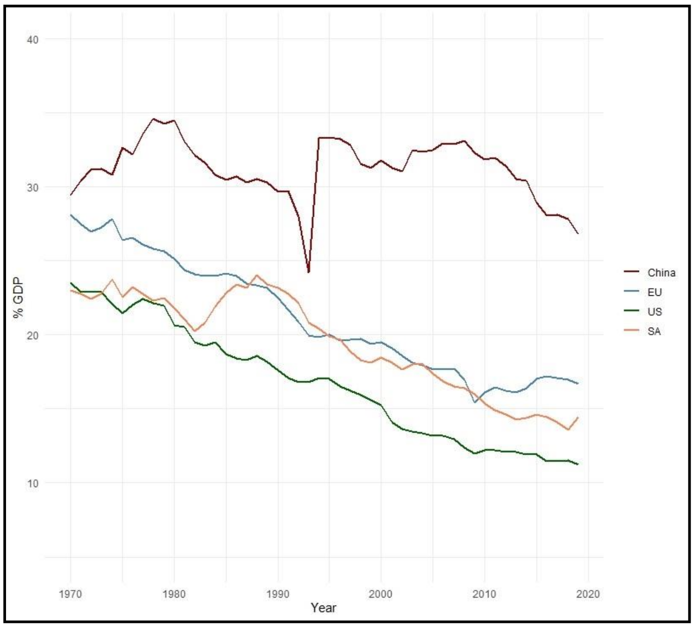


Figure 9: Manufacturing value-added 1970 - 2019 in % of GDP
Source: UNCTAD (2024), authors' own depiction

Although the reasons behind SAC's premature deindustrialization are beyond the scope of this paper, the mirror of the successful Chinese industrialisation experience highlights the importance of industrial development policies for economic upgrading. Thus, while China has been able to consolidate a productive structure capable of competing internationally in technologically dynamic industrial sectors such as machinery, electronics, chemicals and vehicles, South America has moved in the opposite direction by weakening manufacturing sectors and lacking any strategy to reverse this trend. The latter may make it increasingly difficult, as the principle of relatedness suggests, for SAC to be competitive in complex goods because they lack sufficient capabilities in manufacturing. On the other hand, China seems more likely to continue to expand its export supply towards highly complex goods that require similar manufacturing capabilities to those it already possesses.

3.3. Why do SAC remain in the periphery of the product space?

On the demand side, the outstanding economic growth of emerging economies, but especially China, supported by rapid urbanisation, massive investments in infrastructure and the industrialization process already described, led to a growing demand for commodities in world markets. As a counterpart to this, commodity prices have risen sharply from the levels observed at the beginning of the century. This upward trend was particularly strong between 2003 and 2014, a period known as the Commodity Supercycle (Farooki and Kaplinsky, 2013; Jenkins, 2011). After that period, even though they have slowed down, with the exception of other agricultural commodities, commodity prices averaged 2019 with a price two times higher compared to 2000.

On the supply side, the specialisation pattern of South American economies allowed them to benefit from a favourable context for commodity producers. Due to their geographical and climatic conditions, SAC are characterised by significant endowments of natural resources that have given them a comparative advantage in exporting agricultural products, minerals and metals. Apart from this, SAC were able to respond to the demand boom since the extraction and production of these products do not require specialised nor a large number of capabilities. This is because most of these products are exported without much industrial processing and transformation, which outlines their low product complexity index.

All in all, China's voracious appetite for raw materials and South America's competitiveness in these products allowed trade between the two regions to expand with certain specificities pointed out throughout the paper (Bolinaga, 2013). Figure 10 shows that the share of exports of minerals, metals and agricultural products has increased for all trading partners but especially for China. As these products are non-technologically and knowledge-intensive, this is one of the explanations why exports to China have the lowest level of sophistication and complexity.

This re-primarization of SAC associated with a greater dependence on commodity exports ends up reflecting a productive structure that lacks the capacity to add value to the goods produced. In other words, SAC hardly transform the natural resources they possess and end up exporting them with little or no industrial processing, which are indeed manufactured by the Chinese industry (Ocampo, 2019). This, beyond being a deliberate and conscious decision, reflects the fact that SAC are in the middle of a quiescence trap because they lack the know-how and resources to transform commodities into more complex products. This lock-in is exacerbated by the premature deindustrialization of the region, which withers the most technologically dynamic and productive sectors, imposes additional barriers to move into central areas of the product space and limits the possibilities for upgrading in GVCs.

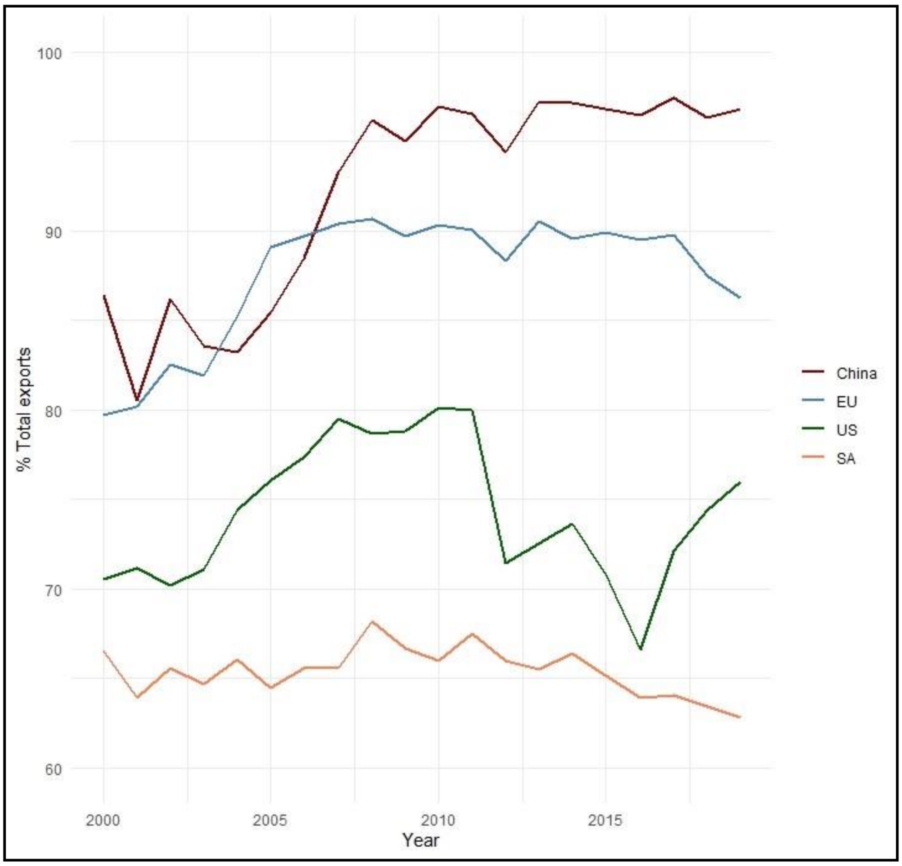


Figure 10: Exports of agricultural products, minerals, metals (% of total exports)
Source: Harvard Growth Lab (2024), authors' own depiction

3.4. What are the possible feedback connections between SAC retreating and China expanding?

After independently analysing the movement of China and SAC in the product space and how this is reflected in the pattern of trade between them, it is important to elaborate on some possible links between the two movements given their increasing trade integration. It is presumed that between China's industrialisation and SAC de-industrialisation connections exist, which feedback on the development of industrial processes in both trading partners. Importantly, these feedback connections are not deliberate decisions but rather two sides of the same coin which are presented in three aspects below.

First, China's export-driven industrialisation has created a need for China to secure inputs and raw materials to sustain its growth model. While this has opened a market window for SAC to benefit from the natural resources they possess, it has also generated incentives to further increase dependence on commodity exports due to high prices and constantly growing demand. An example of this can be seen in the continued expansion of soybean plantations and the cattle frontier in Brazil for export to China, which have become one of the main drivers of deforestation in the Amazon as shown by Fearnside and Figueiredo (2017) and Zu Ermgassen et al. (2020).

Secondly, some authors have argued that the commodity boom driven by Chinese demand may have affected the performance of manufacturing exports through a Dutch disease phenomenon (Palma, 2019; Wong and Petreski, 2014; Frenkel et al., 2012) referring to changes in the production structure to the detriment of traditional tradable sectors, especially industry, when deposits are discovered or there is a price boom in the natural resource sector. This change in the productive structure is mainly due to the relocation of productive factors towards the primary sector and due to the appreciation of the real exchange rate as summed up by Mien and Goujon (2022).

Finally, it has also been argued in the literature that China's industrialisation has brought increased pressure on manufacturing sectors in SAC through two channels. First, as China has moved into the centre of the product space and gained competitiveness in manufacturing, competition from Chinese imports in local markets and in regional markets has increased (Gallagher, 2016; Jenkins et al., 2008). Second, as China has acquired more capabilities while maintaining its comparative advantages associated with low wages and production costs, the relocation of manufacturing firms to China may have intensified over these two decades too as argued by Jenkins (2015) in the representative case of Brazil. Thus, while not a deliberate decision by China, its industrialisation has permeated an already weakening South American industry without any ambitious industrial policy response.

4. Economic complexity and conventional trade theory - the gravity model of trade

This article's aim is to present a thorough, multifaceted and comprehensive analysis of Chinese-SAC trading and to outline their particularities. Much of this has been addressed in the previous sections. However, when moving beyond the descriptive sphere of the analysis and introducing quantitative, econometric tools, then canonical literature will quickly point towards the gravity model of trade as the most common statistical framework to analyse and predict bilateral trading patterns (Yotov, 2022). While a descriptive analysis provides insightful and relevant information, it can sometimes be lacking in terms of reproducibility. Therefore, this section attempts to build a bridge between the descriptive analysis part and the implementation of an econometric gravity estimation.

The gravity model of trade, often referred to as the *workhorse of trade analysis,* is most often used to assess bilateral trade relationships. It stems from a simple analogy to the Newtonian law of gravity and has first been introduced to a social science context by Ravenstein (1889). Refined for economic purposes, Isard (1954), and more prominently Tinbergen (1962) suggested that trade flows between two countries are directly related to their ‘economic mass’, thus their GDP, and inversely related to distance, as classically distance has provided a sufficient proxy for transportation costs.

The range of applications for the gravity model has since then been vastly expanded and revisited by a number of scholars including Yotov et al. (2016), Yotov (2022), Baier and Standaert (2020) and Silva and Tenreyro (2006) which inform the approach presented here.

4.1. Data

A dataset has been created using different available databases as well as own calculations based on research. The trade flow is taken from the Direction of Trade Statistics (DOTS) database of the IMF and bilateral trade flow database BACI of the CEPII (Gaulier and Zignago, 2010). The CEPII provides a database for gravity estimations, where many indicators which are regularly used in studies involving gravity estimations are collected. From this database, the distance as harmonised distance between the most populated cities of both countries has been taken as well. The GDP has also been gathered from the IMF database.

Figure 11 shows a plot of the product of the GDP of China and the respective SAC and the bilateral trade flow (both natural logarithm). It shows that one of the two main implications of the gravity model holds true, namely that the economic size in terms of GDP directly (positively) influences the trade flow.

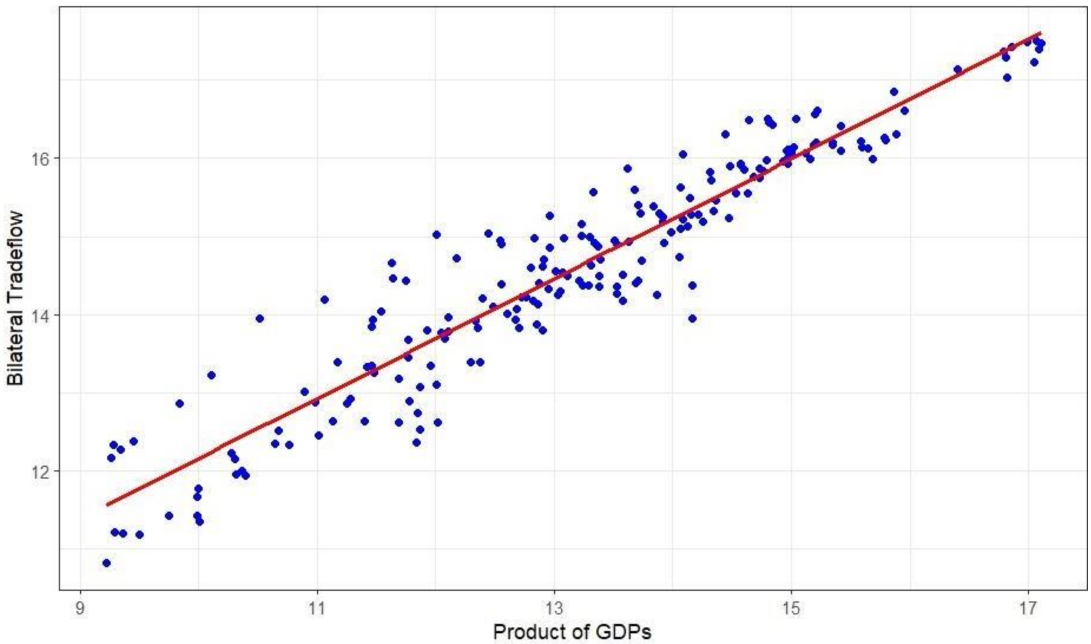


Figure 11: Tradeflow and product of GDPs

Source: Authors’ own depiction

The second implication of gravity models, the inverse relationship between, is not met, as Figure 12 shows ambiguous results without any relevant trend. This hints towards the hypothesis that distance in the geographical sense does not play a significant role for this analysis as mentioned by Capoani (2023), referring to the decline in relevance of distance as a factor in general. This stresses the importance of introducing additional variables that will be able to better predict trade flows.

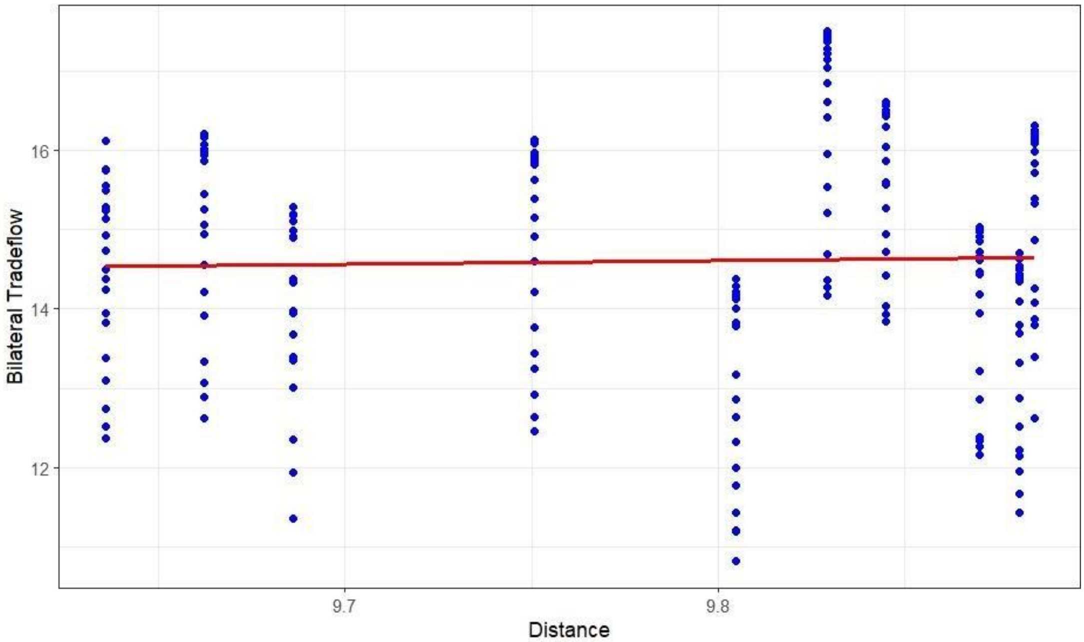


Figure 12: Tradeflow and distance

Source: Authors' own depiction

In many recent studies, which implement gravity estimations, much importance has been paid to regional or preferential trade agreements and memberships in free trade areas such as the EU. Additionally, tariffs as well as non-tariff trade measures such as quotas, regulations or rules of origin are increasingly important in gravity estimations (Kinzius et al., 2019). However, these seemingly important factors cannot be included in this article's analysis due to a lack of differentiation. All ten underlying SAC as well as China are members of the World Trade Organization (WTO).

4.2. Methodology

Applying the natural logarithm yields a more adjustable form of the gravity equation, making it suitable for econometric regressive analysis. To the 'classic' variables of country size in terms of GDP and distance, more factors can be added as elaborated on in the preceding subsection, generally summarised by the vector *X*. This transformation is displayed in equations 1 - 3.

$$lnF_{ij} = ln(A) + \beta_1 ln(Y_i) + \beta_2 ln(Y_j) + \beta_3 lnD_{ij} \quad (1)$$

$$lnF_{ij} = ln(A) + \beta_1 ln(Y_i) + \beta_2 ln(Y_j) + \beta_3 lnD_{ij} + \epsilon_{jij} \quad (2)$$

$$lnF_{ij} = ln(A) + \beta_1 ln(Y_i) + \beta_2 ln(Y_j) + \beta_3 lnD_{ij} + \beta_4 X_{ij} + \epsilon_{jij} \quad (3)$$

Where:

F_{ij} = Trade flow between countries *i* and *j*

A = Normalising constant

$Y_{i/j}$ = GDP of countries *i* or *j*

D_{ij} = Distance between countries *i* and *j*

X_{ij} = Vector containing control variables

In addition to the classic variables of *GDP* and *distance*, the two variables *remote* (equation 4) and *GDPpc* have been added. *Remote* refers to the relative distance of the countries in terms of economic remoteness (Wei, 1996) as calculated in equation 5. While the remoteness indicator provides more insight into the general integration of a country into the global economic geography, the difference in per capita GDPs gives insight into different levels of economic development within the respective countries.

$$REMOTE_{ij} = DIST_{ij} \times \frac{GDP_i}{GDP_{global}} \quad (4)$$

$$GDPpc_{ij} = ln\left[\frac{GDP_i}{POP_i} - \frac{GDP_j}{POP_j}\right] \quad (5)$$

A common variable of gravity models is a binomial variable describing membership in trade organisations such as the WTO or participation in trade agreements such as regional trade agreements. Due to the tendency of homogeneity of the countries in this specific regard, these types of variables have been omitted for the sake of this analysis. For the specific indicators *ECI*, *PCI*, *HHI* and *GLI*, the (logarithmic) values for the country of destination (SAC) are used exclusively, as the values for the country of origin (China) do not change for alterations of bilateral pairing. This results in the full equation (6) as the basis for statistical analysis.

$$\begin{aligned} lnF_{ijt} = \beta_0 + \beta_1 ln(GDP_{it}) + \beta_2 ln(GDPjt) + \beta_3 ln(DIST_{ij}) + \\ \beta_4 ln(REMOTE_{ijt}) + \beta_5 ln(GDPpc_{ijt}) + \beta_6 ECI_{ijt} + \beta_7 PCI + \\ \beta_8 HHI + \beta_9 GLI + \epsilon_{jij} \end{aligned} \quad (6)$$

Three different estimation methods are employed and compared. Many traditional gravity analyses utilise Ordinary Least Squares (OLS) estimators, while more recent studies often resort to fixed effects models. As a third estimation method, the Poisson Pseudo Maximum Likelihood (PPML) has been deemed especially sufficient for structural gravity models as outlined by Silva and Tenreyro (2006).

4.3. Results

Figure 13 shows the results for all three estimation methods. From the estimations a few implications can be derived. The R2 of over 0.95 suggests some viability of the model as a significant portion of the variation of the endogenous variable is explained by the exogenous variables. For the Poisson regression, the zero standard errors could hint towards an overfitting of the regression. The coefficients of the different variables tell a story aligning with the standard implications of a gravity model. The size of GDP showcases a direct relationship to the trade flow, with the coefficient of the GDP of the SAC having a much bigger effect, as would be expected due to the specifications of this analysis.

	GLS/RE	Fix. Effects	Poisson
	(1)	(2)	(3)
GDP Destination	0.763***	1.867***	0.038
	(0.161)	(0.155)	(0.102)
GDP China	0.773***	0.257***	0.060
	(0.089)	(0.085)	(0.057)
GDP Distance	−1.160***	−0.298*	−0.068
	(0.246)	(0.167)	(0.153)
Geographical Distance	1.642***		0.102
	(0.504)		(0.317)
Econ. Remoteness	0.117	−2.239***	0.052
	(0.504)	(0.394)	(0.322)
ECI	−0.007	0.008	−0.001
	(0.009)	(0.005)	(0.005)
PCI	1.929***	1.679**	0.115
	(0.493)	(0.740)	(0.310)
HHI	1.540***	−0.327	0.102
	(0.491)	(0.428)	(0.315)
GLI	−1.989*	4.022***	−0.104
	(1.083)	(0.995)	(0.674)
Intercept	−16.776***		0.623
	(4.698)		(2.957)
Observations	194	194	194
R^2	0.928	0.963	
Adjusted R^2	0.924	0.960	
Note:			*p<0.1; **p<0.05; ***p<0.01

Figure 13: Regression results

Source: Authors' own depiction

Distance shows to have a minor negative impact, which suffers from insignificance in some estimations, most likely due to the time-invariant nature of the variable and the small differences in between the different SAC.

Economic remoteness however shows a more substantial inverse effect on trade, as it depicts the relative distance between China and the respective SAC. This is especially pronounced in the fixed effects model where the conventional distance parameter is omitted. Regarding the different indices, the results are less pronounced and somewhat ambiguous. The ECI shows little significance and a coefficient close to zero, the HHI and GLI both show varying results. Carefully stating an assumption, economic complexity (ECI) and intra-industry trade (GLI) are expected to positively influence bilateral trade between China and SAC. This expectation can be derived for the GLI index from the OLS estimation. For the ECI however, no clear results can be derived. For the product capacity (PCI) the expected positive coefficient can be observed, supporting the assumption that higher product capacity of SAC positively influences the bilateral trade flow. In context of the market concentration (HHI), no clear, significant pattern can be identified. A cautious hint towards a positive coefficient can be observed, however not entirely robust, so a statistical refining is recommended.

5. Discussion

Before discussing the implications of the analysis' results, it is important to critically reflect on the methodology. As could be noted in the preceding section, the gravity analysis provided a first glimpse into the conceptualisation of a statistical framework, however the results were not sufficient enough to present a standalone model for the sake of this analysis. The concluding section will pay closer attention whether the gravity model itself was the right tool to generally extend this kind of trade analysis in general. Before that, the shortcomings specific to this model will be outlined in order to formulate recommendations on how to improve the methodology.

5.1. Methodological limitations

Comparing the bilateral trading patterns of China with the ten SAC relevant for this analysis produces a total of 100 observations per variable (20 years per country pair). There is no prescribed number of observations for an econometric analysis, instead the minimum of observations would be rather dependent on the structure of the data which is examined. The data sets of other studies implementing a gravity model range from rather small data sets as for example in Sapa and Droždz (2019), to much wider data sets as for example in Serlenga and Shin (2007). For this analysis, the number of observations seems to be suitable, however a different characteristic of the underlying data set could possibly cause a skewed estimation.

The ten SAC showcase a similar trend in many of the included variables over time. This can lead to limited cross-sectional variation of the exogenous variables resulting in less explanatory power to the endogenous variable. In fact, a lack of heterogeneity can be one of the major obstacles when implementing a gravity model and therefore data should be controlled for homogeneity and potentially expanded by additional variables or observations to ensure a sufficient degree of variation (Cheng and Wall, 2005).

In addition to this homogeneity, three statistical weaknesses could be identified. Firstly, statistical tests point towards heteroscedastic tendencies and a certain degree of serial correlation in the data set. This affects the explanatory value of the model and should therefore be approached twofold. To begin with, a refining of the underlying data set is recommended. Secondly, different estimation methods could be implemented. For example, Mnasri and Nechi (2019) have developed a version of a PPML model utilising Heckman estimators specifically addressing the problem of heteroscedasticity in gravity models. A third problem that occurs, is that of overfitting. Though no statistical test has been conducted in order to confirm this issue, it is assumed that this dataset shows at least idiosyncratic tendencies suggesting some degree of overfitting.

5.2. Policy implications

The preceding sections have identified the trade relation between China and the SAC as highly asymmetrical, mainly due to differences in productive structures and capacities. Not only SAC but also EME in general face the question on how to successfully integrate into the global economy and with China rising as one of the biggest potential trading partners, finding the answer to this question has not become easier. The structural trade patterns that have been outlined in this article's analysis bear the risk of 'trapping' SAC in asituation in which they are forced to stick to their one-dimensional, commodity sector focused role in international trade relations. This invokes the question, how sustainable the relationship in terms of trade is between SAC and China, but also between SAC and the USA and EU. While the current state of affairs is not necessarily harmful for SAC, it could turn out to be in the future, once peripheral trade patterns convert trade surpluses into trade deficits. It is important to note that this does not imply a strategic alignment of Chinese actors, but rather comes as the consequence of endogenous productive characteristics of SAC and the role they assume vis-à-vis bigger economies.

The question now arises, what the implications of this could be for the SAC. If important trade relations lack sustainable promises and potentially foreshadow a disadvantageous role in the global economy, then sustainability has to be generated through domestic, intrinsic strategies.

In terms of economic policy implications, much focus lies on the role of complexity in the SAC economies. Productive capabilities have to be accumulated and economic complexity needs to be increased through a thorough and forward-looking strategic framework. This way, the role SAC currently plays in trade relations can be improved. Another key-aspect, closely interlinked with complexity of production, is diversification.

A central role for successful diversified exports of the SAC could be achieved through the intensification of regional economic integration. Thus, free trade areas or RTA/PTA represent a crucial potential instrument for the SAC. The role that distance, especially relative distance in economic terms, plays is not to be neglected, as this factor, which negatively influences trade flows, could be drastically reduced through the intensification of economic integration in between the SAC.

However, the need for a more complex and diverse economic structure of SAC does by no means necessarily concur with a strategic disentanglement from China. On the contrary, as China represents the most successful case of effective industrialisation and global market integration within the last decades, the SAC do well maintaining or expanding their economic relationships. China will remain in a position in which it has a massive influence on global economic development, but also in which it showcases remarkable political presence. The SAC - and the rest of the emerging world - will likely face a global economic order which is significantly determined by the three economic powerhouses of the USA, EU and China. The crucial point for the SAC is, how they will be affected by their economic relationship towards China and where they will be able to position themselves in this worldwide economic system. Therefore, industrial policy will play an important role for the SAC to rearrange themselves economically.

6. Conclusion

This article wants to provide a thorough and comprehensive analysis of the trade relations of China and South American Countries. In order to create a unique perspective, a descriptive analysis focused around the phenomena of complexity and productive capacities has been conducted and further merged with the quantitative approach of an econometric gravity analysis.

The economic complexity approach incorporates a theoretical background for assessing the productive capabilities of SAC and China determining their productivity and thus their export structure. The general export structure indicates that the trade relation of SAC to China exhibits core-periphery dynamics, similar to that of the relation towards core industrial economies Additionally, the particularities of SAC-Chinese trade can be further explained by looking at the development of the productive structures, as indicated by the product space across time. The specific characteristics of this trade relation yield certain implications for future industrial policies and the economic relations of SAC, as has been outlined in the discussion section. While it is important to note that China is not being demonised in the context of international trade, SAC need to enact caution as to how their position in the global trade evolves in light of China's outgoing strategy.

The additional endeavour of introducing the descriptive analysis' results to the framework of gravity modelling turned out challenging yet promising. While the estimations exhibited some statistical issues, gravity analysis generally seems appropriate for building on the findings of a descriptive analysis. Additional research is heavily recommended to fine tune the model and to define the included variables, countries and the time frame of analysis.

References

Bahar, D., Hausmann, R., & Hidalgo, C. A. (2014). Neighbors and the evolution of the comparative advantage of nations: Evidence of international knowledge diffusion? Journal of International Economics, 92(1), 111–123. https://doi.org/10.1016/j.jinteco.2013.11.001

Baier, S., & Standaert, S. (2020). Gravity models and empirical trade. In Oxford Research Encyclopedia of Economics and Finance. Oxford University Press.

Balassa, B. (1965). Trade liberalisation and “revealed” comparative advantage1. Manchester School, 33(2), 99–123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x

Bolinaga, L. D. (2013). China-Latinoamérica: ¿Cooperación Sur-Sur o reprimarización productiva? Global Asia Magazine , 32, 32–35.

Capoani, L. (2023). Review of the gravity model: origins and critical analysis of its theoretical development. SN Business & Economics, 3(5). https://doi.org/10.1007/s43546-023-00461-0

Castillo, M., & Martins, A. (2016). Premature deindustrialization in Latin America, Desarrollo Productivo.

Cheng, I.-H., & Wall, H. J. (2005). Controlling for heterogeneity in gravity models of trade and integration. Federal Reserve Bank of St. Louis Review, 87(59–63).

Farooki, M., & Kaplinsky, R. (2013). The impact of China on global commodity prices: The global reshaping of the resource sector. Routledge. https://doi.org/10.4324/9780203155912

Fearnside, P. M., & Figueiredo, A. M. R. (2017). China’s influence on deforestation in brazilian amazonia: A growing force in the state of mato grosso. In R. Ray, K. Gallagher, A. Lopez, & C. Sanborn (Eds.), China and sustainable development in Latin America: The social and environmental dimension (pp. 229–265). Cambridge University Press.

Frenkel, R., & Rapetti, M. (2012). External Fragility or Deindustrialization: What is the Main Threat to Latin American Countries in the 2010s? World Social and Economic Review, 1(37).

Gallagher, K. P. (2016). The China triangle: Latin America’s China boom and the fate of the Washington consensus. Oxford University Press.

Gaulier, G., & Zignago, S. (2010). BACI: International trade database at the product-level (the 1994-2007 version). SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1994500

Giordano, P., & Ortiz de Mendívil, C. (2019). Making the most of connectivity: Unlocking the trade potential of Latin America and the Caribbean in Asia. Inter-American Development Bank.

Greenaway, D., & Milner, C. (1983). On the Measurement of Intra-Industry Trade. Economic Journal , 93(372), 900–908.

Greenaway, D., & Milner, C. (1987). Intra-industry trade: Current perspectives and unresolved issues. Review of World Economics, 123(1), 39–57. https://doi.org/10.1007/bf02707781

Grubel, H. G., & Lloyd, P. J. (1971). The empirical measurement of intra-industry trade. The Economic Record, 47(4), 494–517. https://doi.org/10.1111/j.1475-4932.1971.tb00772.x

Harvard Growth Lab. (2024). The Atlas of Economic Complexity. https://atlas.cid.harvard.edu/rankings

Hausmann, R., & Hidalgo, C. (2010). Country diversification, product ubiquity, and economic divergence. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1724722

Hausmann, R., & Hidalgo, C. A. (2011). The network structure of economic output. Journal of Economic Growth, 16(4), 309–342. https://doi.org/10.1007/s10887-011-9071-4

Henrique Cardoso, F., & Faletto, E. (1979). *Dependency and development in Latin America* (1st edition). University of California Press.
Herfindahl, O. (1950). Concentration in the U.S. Steel Industry. Columbia University.

Hidalgo, C. A., Klinger, B., Barabási, A.-L., & Hausmann, R. (2007). The product space conditions the development of nations. Science (New York, N.Y.), 317(5837), 482–487. https://doi.org/10.1126/science.1144581

Hidalgo, César A. (2021). Economic complexity theory and applications. Nature Reviews. Physics, 3(2), 92–113. https://doi.org/10.1038/s42254-020-00275-1

Hidalgo, César A. (2023). The policy implications of economic complexity. Research Policy, 52(9), 104863. https://doi.org/10.1016/j.respol.2023.104863

Hidalgo, César A., Balland, P.-A., Boschma, R., Delgado, M., Feldman, M., Frenken, K., Glaeser, E., He, C., Kogler, D. F., Morrison, A., Neffke, F., Rigby, D., Stern, S., Zheng, S., & Zhu, S. (2019). Correction to: The principle of relatedness. In Springer Proceedings in Complexity (pp. C1–C1). Springer International Publishing.

Hidalgo, César A., & Hausmann, R. (2009). The building blocks of economic complexity. Proceedings of the National Academy of Sciences of the United States of America, 106(26), 10570–10575. https://doi.org/10.1073/pnas.0900943106

Hirschman, A. (1945). National power and the structure of foreign trade. University of California Press.

Hirschman, A. O. (1958). *The Strategy of Economic Development*. Yale University Press.

Isard, W. (1954). Location theory and trade theory: Short-Run analysis. The Quarterly Journal of Economics, 68(2), 305. https://doi.org/10.2307/1884452

Jenkins, R. (2011). The "China effect" on global commodity prices and Latin American export earnings. CEPAL Review, 103(73–87).

Jenkins, R. (2015). Is Chinese competition causing deindustrialization in Brazil? Latin American Perspectives, 42(6), 42–63. https://doi.org/10.1177/0094582x15593553

Jenkins, R., Peters, E. D., & Moreira, M. M. (2008). The impact of China on Latin America and the Caribbean. World Development, 36(2), 235–253. https://doi.org/10.1016/j.worlddev.2007.06.012

Jun, B., Alshamsi, A., Gao, J., & Hidalgo, C. A. (2020). Bilateral relatedness: knowledge diffusion and the evolution of bilateral trade. Journal of Evolutionary Economics, 30(2), 247–277. https://doi.org/10.1007/s00191-019-00638-7

Kinzius, L., Sandkamp, A., & Yalcin, E. (2019). Trade protection and the role of non-tariff barriers. Review of World Economics, 155(4), 603–643. https://doi.org/10.1007/s10290-019-00341-6

Krugman, P. R. (1979). Increasing returns, monopolistic competition, and international trade. Journal of International Economics, 9(4), 469–479. https://doi.org/10.1016/0022-1996(79)90017-5

Krugman, P. (1980). Scale Economies, Product Differentiation, and the Pattern of Trade. *The American Economic Review*, *70*(5), 950–959.

Leamer, E. E. (1995). The Heckscher-Ohlin Model in theory and practice. Technical Report 77, International Finance Section, Department of Economics, Princeton University, Princeton, N.J.

Lin, J. Y. (2011). China and the global economy 1. *China Economic Journal*, *4*(1), 1–14. https://doi.org/10.1080/17538963.2011.609612

Men, J. (2012). The EU and China: Mismatched partners? *Journal of Contemporary China*, *21*(74), 333–349. https://doi.org/10.1080/10670564.2012.635934

Mien, E., & Goujon, M. (2022). 40 years of Dutch disease literature: Lessons for developing countries. Comparative Economic Studies, 64(3), 351–383. https://doi.org/10.1057/s41294-021-00177-w

Mnasri, A., & Nechi, S. (2019). New approach to estimating gravity models with heteroscedasticity and zero trade values. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3367440

Observatory of Economic Complexity. (2024). Country Profiles. https://oec.world/en

Ocampo, J. A. O. (2019). The Transformation of Latin American Economies. In C. Monga & J. Y. Lin (Eds.), The Oxford Handbook of Structural Transformation. Oxford University Press.

Palma, J. G. (2019). Desindustrialización, desindustrialización "prematura" y "síndrome holandés." El Trimestre Económico, 86(344), 901–966. https://doi.org/10.20430/ete.v86i344.970

Rama, J., & Hall, J. (2021). Raúl Prebisch and the evolving uses of 'centre-periphery' in economic analysis. *Review of Evolutionary Political Economy*, *2*(2), 315–332.

Ravenstein, E. G. (1889). The Laws of Migration. Journal of the Royal Statistical Society, 52(2), 241–305.

Rodrik, D. (2016). Premature deindustrialization. Journal of Economic Growth, 21(1), 1–33. https://doi.org/10.1007/s10887-015-9122-3

Roy, D. (2022). China's Growing Influence in Latin America, Council on Foreign Relations, https://www.cfr.org/backgrounder/china-influence-latin-america-argentina-brazil-venezuela-security-energy-bri#chapter-title-0-1

Sapa, A., Droždz, J., Sapa, A., & Droždz, J. (2019). Polish agri-food trade with non-Eu countries – a gravity model analysis. Unknown. https://doi.org/10.22004/AG.ECON.302852

Serlenga, L., & Shin, Y. (2007). Gravity models of intra-EU trade: application of the CCEP-HT estimation in heterogeneous panels with unobserved common time-specific factors. Journal of Applied Econometrics (Chichester, England), 22(2), 361–381. https://doi.org/10.1002/jae.944

Silva, J. M. C. S., & Tenreyro, S. (2006). The log of gravity. The Review of Economics and Statistics, 88(4), 641–658. https://doi.org/10.1162/rest.88.4.641

Tinbergen, J. (1962). Shaping the World Economy; Suggestions for an International Economic Policy. Twentieth Century Project.

Tregenna, F. (2016). Deindustrialization and premature deindustrialization. In E. S. Reinert, J. Ghosg, & R. Kattel (Eds.), Handbook of Alternative Theories of Economic Development (pp. 710–728). Edward Elgar Publishing.

UNCTAD. (2021). Productive Capacities Index: Methodological Approach and Results. https://unctad.org/publication/unctad-productive-capacities-index-methodological-approach-and-results

Vadell, J. A. (2019). China in Latin America: South-South cooperation with Chinese characteristics. Latin American Perspectives, 46(2), 107–125. https://doi.org/10.1177/0094582x18815511

Wei, S.-J. (1996). Intra-National Versus International Trade: How Stubborn are Nations in Global Integration? NBER Working Paper, w5531.

Wong, S. A., & Petreski, M. (2014). Dutch Disease in Latin American countries: De-industrialization, how it happens, crisis, and the role of China. Technical Report University of Munch MPRA.

Yotov, Y. (2022). Gravity at sixty: The workhorse model of trade. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4037001

Yotov, Y. V., Piermartini, R., Monteiro, J.-A., & Larch, M. (2016). An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model. WTO iLibrary.

zu Ermgassen, E. K. H. J., Godar, J., Lathuillière, M. J., Löfgren, P., Gardner, T., Vasconcelos, A., & Meyfroidt, P. (2020). The origin, supply chain, and deforestation risk of Brazil's beef exports. Proceedings of the National Academy of Sciences of the United States of America, 117(50), 31770–31779. https://doi.org/10.1073/pnas.2003270117

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