REVEALED COMPARATIVE ADVANTAGE AND INFANT INDUSTRIES IN LATIN AMERICA: 1962-2019

The history of economic development has shown that, with very few exceptions, only countries that managed to somehow sophisticate their production structure were able to reach a higher path of development. Given that Latin American economies set off their development journey from a basis with strong endowment of natural resources, there have been successive efforts to transit into a more sophisticated production matrix, with mixed results. As this sophistication process is given more at an industry- than a macroeconomic level, its success depends on the surge of infant industries that have the capacity to withstand economic cycles, achieve enough competitiveness to reach external markets, and form a production and export cluster around them. This paper aims to propose a systematic measurement of the surge of infant industries in the long run, using both the estimation of revealed comparative advantages and the concepts of economic complexity. It analyzes the long-run (1962-2019) performance of infant industries in six large Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico and Uruguay. Starting from a review of the theoretical background that supports the concepts of industrial policy and infant industries, it continues with the analysis of the contemporary state of the exports' matrix in each country, based on the product space network of the Atlas of Economic Complexity. Following the methodology proposed by Simae et al. (2024), I estimate the take-off and touch-down years of products that at some point during the 57-year period became a revealed comparative advantage for each country. Then, using the concepts of degree, betweenness and closeness of the product space network, I filter those products that offer a strong potential of becoming exports clusters in the long run. The classification of these products and their graphic evolution provides a powerful visual diagnostic of the long-term evolution of comparative advantage and infant industries for each of the six economies analyzed. The contributions of the paper are threefold: i) it offers a graphic and statistical characterization of the process of economic development and productive diversification of Latin American economies in the long run; ii) it provides statistical criteria to identify products and sectors with strong potential of becoming exports' clusters, and iii) it provides a new methodology that can be used to systematically analyze and identify the surge of exports' clusters and infant industries in developing economies, facilitating long-run comparative studies of the effectiveness of industrial policies in different contexts.

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1. INTRODUCTION

The history of economic development has shown that, with very few exceptions, only countries that managed to somehow sophisticate their production structure were able to reach a high path of development. This sophistication of the production matrix tends to be a gradual process, where countries start from a point where they have to consider activities associated to their existing relative comparative advantage, with the prospect of a gradual diversification into more added-value activities. However, it is also possible to make leaps into new industries, if there is a coordinated industrial policy that promotes the surge of new innovating firms and activities. In order for this strategy to be efficient, the short-term costs of protecting new industries should be lower than the low-term benefits of sophisticating the production matrix, although there is considerable uncertainty on both costs and benefits, and they have differing time horizons for their realization.

There is still an ongoing debate on the degree that a country should follow its relative comparative advantage when designing its development strategy, a concept proposed by David Ricardo (1817/1951) that consists in concentrating production and exports on sectors where the opportunity cost of production is lower than that of its trading partners (i.e., where each economy has stronger endowments of factors of production). On the one hand, some authors sustain that the key to insert an economy in the global market is to make use of the country's existing comparative advantage, i.e., using the factors of production already present in the economy, not the factors that it may have in the future (Chang, 2009). Encouraging the emergence of industries and sectors that can make an effective use of the current comparative advantage (e.g., focusing on labor- and resource-intensive types of production in regions like Latin America) might be the most efficient mechanism for a developing country to be able to reach competitiveness in external markets. As this measure offers a guideline to estimate how much a country is sacrificing by protecting other emerging sectors, a comparative-advantage defying strategy may incur in high costs, as it implies subsidizing or protecting industries that may not be viable without this government support. In the case of trade protectionist policies this issue is exacerbated, as this strategy can be effective only if the autarkic equilibrium production of a certain good is sufficiently large that can take advantage of economies of scale (Okuno-Fujiwara, 1988), a scenario that is less likely in developing economies with an incipient manufacturing sector.

On the other hand, other authors state that there have been few examples of successful countries that have succeeded by putting forth a development strategy purely based on a *laissez-faire* approach, as market failures prevent them from advancing from basic commodities to added-value products. In this sense, allocating resources according to the existing comparative advantage may ensure static efficiency in exploiting any given resources, but fails as a strategy that can guarantee dynamic efficiency, in the form of medium-term adjustment and long-term development in the long run (Lin, 2009). As Succar (1987) states, if there are asymmetric learning opportunities associated with the production of sophisticated goods, a comparative-advantage-following strategy may restrict and even hinder the path of economic growth for the country in the long run. Thus, countries prone to follow a strategy of productive diversification limited to related activities and products favored by the existing comparative advantage will confront lock-in issues, i.e., they will be restricted to the production of labor- and resource-intensive products, with few opportunities to reach competitiveness in industrial goods, where international demand tends to be more dynamic.

This issue is exacerbated when we consider that capital and labor accumulation do not act as an abstract process but respond to the specific needs of a particular industry's function of production. This means that, even if a country has the right capital-labor ratio to enter an added-value sector, it would not be able to enter this industry without an initial process of a concrete production experience. If the technological capabilities required to diversify an economy are acquired only through an industry-specific experience, it means that it is necessary to defy a comparative advantage if the initial conditions are associated with a long-term restriction to enter the most dynamic sectors in the world economy. Naturally, learning costs are lower if the industrial upgrading proceeds in a gradual manner, rather than if the country attempts a big leap with respect to its initial comparative advantage. In general, it might be possible to think there would be an inverted U-shape relationship between a country's growth rate and the degree of deviation from the initial comparative advantage scenario. If it does not deviate at all, it might reach the highest efficiency in the short run, but it will experience lock-in issues and have lower economic growth in the long run. Thus, until some point, increasing the deviation from initial comparative advantage may imply a stronger perspective of economic growth. However, the costs of deviating, in the forms of protection of certain industries (trade barriers, excessive learning costs, rent-seeking, etc.) will increase the higher the deviation from the initial comparative advantages, and they might reach a point where the costs of deviating will be higher than the benefits (Saure, 2007). This is where a properly designed industrial policy enters the picture.

In Latin America, despite economic growth rates having not been significantly low in the first quarter of the 21st Century, the economies of the region are exhibiting low levels of productivity growth, have strongly depended on the fluctuations of commodity prices and have yet to accomplish a further sophistication of their production matrix.

Low-quality jobs in primary sectors are still majority in many countries, and there is still an important potential to reap up the benefits of globalization through exports of increasingly added-value products. Industrial labor costs in many regional countries remain high relative to productivity, which is not rising enough. Also, the industrialization process nowadays demands some complementary priorities that were not present before, such as gender equality, reduced fossil energy use, employment of vulnerable populations and development of green technologies (Rodrik & Aiginger, 2020). This scenario suggests the need for alternative or complementary strategies for most countries in the region.

This paper intends to analyze the long-term process of diversification of the exports' matrix in Latin America for the period 1962-2019. With a combination of economic and statistical tools, I characterize the historical evolution of revealed comparative advantages in six large Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico and Uruguay. This typification process is made in three stages. The first one consists in the description of the current state of exports in each country, which is carried out based on the product space network of the Atlas of Economic Complexity. For the second stage I mapped the evolution for each country of the revealed comparative advantage sectors for the 57-year period under analysis. These patterns reflect both the initial comparative advantage sectors given factor endowments, and the diverse stages of productive and development policies in each country. Finally, based on Simae *et al*. (2024), I identify the precise year where each product that was found in the 2019 state of the product space network, started to become a revelaled comparative advantage for each country in the period 1962-2019.

The paper is organized in six sections, including this introduction. The second section provides a theoretical background of the concepts of industrial policy and infant industries, while the third one describes the data and methodologies that were developed for the research. The fourth part uses the Atlas of Economic Complexity to analyze the 2019 product space network for the six analyzed countries, which allows the identification of products where each economy has reached high competitiveness in international markets, i.e., productive and export clusters that were sustainable in the long term. In the fifth section I use these results as a basis for the historical analysis of revealed comparative advantage for the period 1962-2019, as well as the identification of the year when each of the identified products started to become a comparative advantage. The sixth and final section provides some concluding remarks.

The contributions of the paper are twofold: i) it offers a graphic and statistical characterization of the process of economic development and productive diversification of Latin American economies in the long run, and ii) it provides a new methodology that can be used to systematically analyze and identify the surge of exports' clusters in developing economies and infant industries, facilitating long-run comparative studies of the effectiveness of industrial policies in different contexts.

2. THEORETICAL BACKGROUND: INDUSTRIAL POLICY AND INFANT INDUSTRIES

Broadly speaking, industrial policy can be defined as any type of selective government intervention that attempts to alter the structure of production, propending to promote sectors that are expected to offer better prospects of economic growth, that would not expand in the absence of such policy (Saggi & Pack, 2006). Although the traditional theory saw industrial policy as the measures to protect emerging industries, previous experiences have highlighted the distortions generated by these policies, demanding an evolution of the tools at disposal to promote new added-value industries. Thus, this concept has evolved into a more complex set of instruments established to create a proper ecosystem of innovation for new industries.

In this matter, Rodrik (2004) argues that the traditional view of industrial policy, based on technological and pecuniary externalities, cannot capture the complexities of industrialization; therefore, what is needed is to elicit information from the private sector to set a strategic collaboration between private and public sectors with the objective of determining the best areas in which an economy can develop new comparative advantages. In the same line, Rodrik & Aiginger (2020) state that industrial policy should not focus only on industry and manufacturing sectors (as de-industrialization employment is virtually inevitable in medium and advanced economies), but on any modern sector that exhibits the same positive externalities, which are often associated with manufacturing. In this sense, industry should not be understood as a narrowly defined activity but as a sector with blurred boundaries towards other related activities, such as modern services and even the public sector. Given this broader definition, the narrow concept 'industrial policy' should be changed for the more general 'productive development policy', 'structural transformation policy', or 'innovation policy'. It also should be understood less as top-down incentives and more as a sustained collaboration between the public and private sectors to coordinate innovation, regional and trade policy with the objective of strengthening upstream and down-stream industries to promote positive structural change and prevent and alleviate market failures.

Among the main market failures that might reduce the optimality of a purely market approach to economic development and might demand some degree of government intervention, three can be highlighted. First, the coordination failure argument states that many projects, activities and even industries demand the existence of simultaneous investments by independent agents for them to be viable; in this context, there is little guarantee that each agent, acting for its own interest, would choose to make that investment (Saggi & Pack, 2006). This is particularly true under the scenario of reciprocal pecuniary externalities in the presence of increasing returns to scale (e.g., manufacturing sectors), as the coordination of investment decisions requires some kind of signaling to transmit information about present plans and future conditions, a role that the pricing system is not able to assume (Scitovsky, 1954). Second, there are

information-externality problems generated as innovators start to face the conditions of international demand and get to know the difficulties of exporting to external markets, such as demands on product quality; as this information can spread, followers can take advantage of this knowledge without having to face the difficulties of the first mover. This asymmetry might generate an undersupply of investment, as there are few incentives to be the first to move into international markets given the risk of competing with potential imitators who would not bear this cost; in this scenario, government subsidies could act as an effective incentive to promote internationalization (Haidar, 2023). Finally, a third argument against a purely laissez-faire approach states that capital and labor accumulation do not act as an abstract process, as those concepts are economic constructs but there is no such thing as 'general capital' that can be deployed whenever is necessary. On the contrary, physical capital is accumulated in concrete forms, such as specific machines, and human capital needs specialized training to be able to enter a specific industry's function of production. This means that, even if a country has the right capital-labor ratio to enter an added-value sector, it would not be able to enter this industry without an initial process of a concrete production experience (Chang & Lin, 2009). In this scenario, a proactive State industrial policy may be the only way a country can enter new industries it had not produced beforehand.

In this new scenario, among the facilitators of industrial policy we can include excellence and pertinence of tertiary education, an innovation ecosystem fostering applied innovation in emerging sectors, and strong state capacity, understood as the state's ability to steer business, entrepreneurship, and investment in socially desirable directions. In general, every factor that favors innovation and may facilitate climbing up the ladder on sophistication of the production' and exports' matrixes should be promoted, including organization building accumulation of technological capabilities through R&D investment, and training and production experiences. On the contrary, subsidies for ailing industries or national champions, import protections, subsidies for fossil energy, or low costs or standards may be detrimental to a high-road strategy, as they tend to stick and strengthen existing comparative advantage sectors and may hinder productive diversification and the surge of infant industries (Rodrik & Aiginger, 2020).

Infant industries can be understood in this context as the corollary of a successful industrial policy approach. First formulated by Alexander Hamilton (1791) and Friedrich List (1841), the ideal history of an infant industry is that of a firm producing tradable goods at an initial cost disadvantage caused by a limited industrial history of a country, learning to become more efficient, then competing with imports in the local markets to finally be able to export with high competitivity in the external market (Saggi & Pack, 2006). One of the most famous theoretical supports for infant industries comes from the Mill-Bastable test: while John Stuart Mill stated that there must be dynamic learning effects that are external to firms, Charles Francis Bastable declared that the cumulative net benefits provided by the protected industry should exceed the

cumulative costs of protection (Melitz, 2005). However, the inherent uncertainty on the returns of industrial policy and on the success of eventual infant industries, might leave unviable the estimation of the Mill-Bastable test before the actual implementation of the industrial policy. However, according to Baldwin (1969), there are four more nuanced versions of the infant industry argument: i) subsidize acquisition of knowledge (R&D investment) to prevent undersupply of innovation; ii) promote workers training to construct the capacity to diversify into new, more sophisticated sectors; iii) subsidize the investment required to determine the profitability of a new industry, as the results could become freely available to new incomers, and iv) static positive externalities in the production of a good may still justify specific trade protection.

More broadly, the general idea of an infant industry policy is that the State should focus on reducing the market and network failures that prevent an economy to diversify into more sophisticated sectors that are not initially aligned with the country's relevant comparative advantages. Network failures refer to the fact that nowadays innovation and production require sustained collaboration among multiple agents, such as suppliers, final assemblers, technology labs, universities and labor training facilities. The sophistication of the production matrix of an economy demands the synchronic presence and interaction of knowledge, skills, innovation, finance and institutions, and assuring the existence and interaction of this ecosystem should be the purpose of an effective industrial policy that can promote successful infant industries (Rodrik & Aiginger, 2020). In this sense, Klepper (2007) demonstrates the essential role of spin-offs, startups and even incumbents in stablishing new industries.

Finally, it is worth highlighting one of the main topics of the current state of debate on infant industries, on an alternative policy that may obtain similar benefits of a successful industrial policy: the insertion of an economy into global supply chains. This argument states that multinationals' investment and Foreign Direct Investment -FDI have the capacity to overcome market failures in the same way that a successful industrial policy does. For example, in small developing countries a large-scale investment by a multinational can create sufficient demand for intermediates and solve the coordination problem (Rodriguez-Clare, 1996); this demand-creating FDI may generate similar positive externalities and help to break the barriers to a successful insertion into the global economy (Markusen & Venables, 1999). As Saggi & Pack (2006) address, in the 21st Century there has been a shift in the institutional mechanism of international trade, with the evolution of two types of organizations: i) international production networks -or global supply chains-, where a producing firm organizes large numbers of suppliers in several locations, with standardized requisites of product quality; ii) buyer-led networks, where large retail chains provide specifications for the desired final product and encourage suppliers in developing countries to standardize their own production system, including local subcontractors. Given that this paper focuses on a long-term historical perspective in which industrial policy takes center stage, the emergence of alternative development paths driven by

private initiative is acknowledged as a significant and promising trend, even if not explored in detail here.

3. DATA AND METHODOLOGY

The development of new export products is often related to existing ones that establish the prerequisites and capabilities needed for their production. As discussed earlier, this process can be driven either by private initiatives related to the existing comparative advantage activities, or industrial policy efforts that may try to protect or subsidize new strategic sectors. To understand whether the emergence of relevant export products in Latin America has been the result of a natural process of related products or more proactive industrial policy initiatives, and to what extent, it is first necessary to define what constitutes a new relevant export product and assess its importance in fostering the capabilities required to produce other goods.

To do this, this study relies on two main sources of information. First, I constructed a panel dataset on international trade at the product level[1] using the United Nations Commodity Trade Statistics Database (UN Comtrade) from 1962 to 2019 for six large Latin American economies: Argentina, Brazil, Chile, Colombia, Mexico, and Uruguay. For each of these countries, I identify the products in which they have demonstrated export strength on a yearly basis. After identifying the relevant products in the final year of the sample (2019), I trace the evolution of these products over time to pinpoint the year when each product became relevant, which can serve as a guide to investigate whether their emergence was driven by an active industrial policy.

Second, I identify key products that generate significant linkages using the Product Space network developed by Hidalgo et al. (2007). The Product Space connects products that are frequently co-exported by countries, suggesting shared underlying production capabilities. It is constructed by identifying products that countries export above the global average and linking those commonly specialized by the same countries. This network reveals clusters of products that require similar capabilities. By incorporating this framework, we refine our initial selection of relevant products based on trade data, focusing on those that contribute most to increasing a country's economic complexity and are therefore more likely to be associated with industrial policy interventions.

3.1 Identifying comparative advantage

The concept of comparative advantage, initially formulated by Ricardo (1817/1951), originates in a purely theoretical scenario, and cannot be measured directly. As a result, the traditional approach is to follow the seminal work of Balassa (1965) and infer

[1] Three-digit level of the Standard International Trade Clasification (SITC).

them indirectly using trade patterns. Given that exports reflect such advantages, it is argued that the exports' structure can be used to calculate an index of revealed comparative advantage of a given country for a given product in a given period of time (Britto et al., 2019). Therefore, the concept of revealed comparative advantage is an analytical tool to measure an economy's capacity to produce a good or service with higher productivity or greater differentiation than its trading partners (Jaimovich and Merella, 2015).

The initial revealed comparative advantage equation developed by Balassa (1965) was estimated as the weight of each product in a country's exports compared with the share of that product in world trade. An export product p becomes relevant in country c when it is considered to gain a Revealed Comparative Advantage (RCA). This occurs when its share in the export basket of country c is higher than the proportion of exports of that product in the global export basket. This can be expressed as:

$$R_{cp} = \frac{\frac{x_{cp}}{\sum_{cp\prime} x_{cp\prime}}}{\frac{x_{c\prime p}}{\sum_{c\prime p\prime} x_{c\prime p\prime}}}$$

Where *x* are the exports of product *p* from country *c*, p' represents all export products of the country other than p, and c' represents all countries other than c. In other words, it divides each country's export share for a specific product into the world's share to total trade, to measure the product's RCA for that country. Thus, a product will achieve RCA when $R_{cp} > 1$.

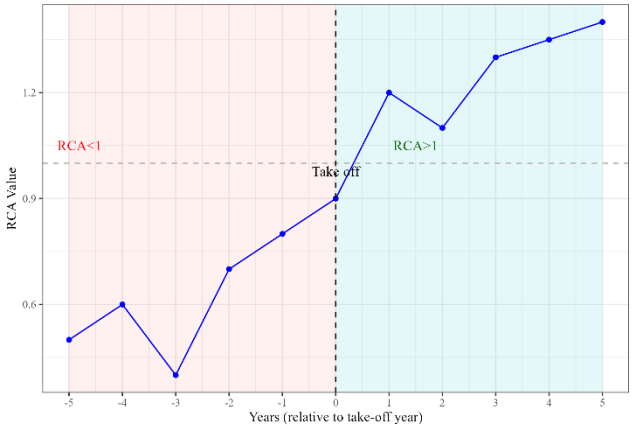
Since trade data is subject to large annual variations, an algorithm must be developed to determine when a new product becomes a revealed comparative advantage. Following Simae et al. (2024), a new relevant export product can be defined as a product that:

i. Sustains an RCA lower than 1 for five consecutive years.
ii. Obtains an RCA greater than 1 in the sixth year and maintains RCA greater than 1 for an additional four consecutive years.

The sixth year in this criterion is known as the take-off year (Figure 1)[2].

[2] Since the database begins in 1962, part 1 of the take-off criterion can be ignored for identifying products that may have taken off before 1962.

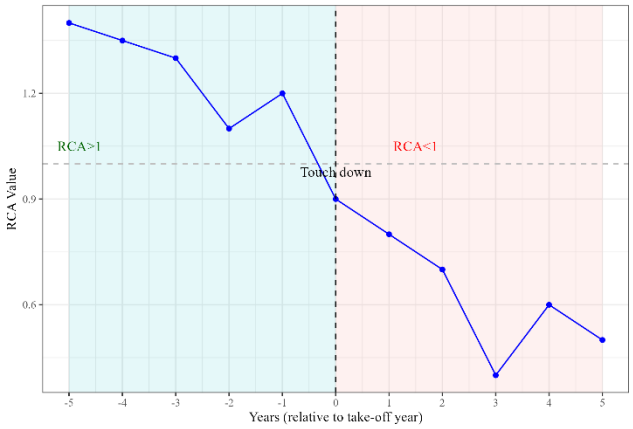
Figure 1. Example of take-off criteria



Similarly, a product can be defined as failing when:

i. It sustains an RCA greater than 1 for five consecutive years.
ii. In the sixth year, the RCA falls below 1, and the RCA never again reaches the take-off criterion (Figure 2).

Figure 2. Example of touch-down criteria



3.2 Identifying key complexity products

The previous criteria allows for the identification of the most relevant export products. Once these products are identified, a second criterion is the selection of export products with the highest degree of sophistication, that drive the development of new added-value sectors. These are the products that are closest to the core and have the most connections in the product space[3] (Hidalgo et al, 2007). The characterization of the most desirable export products in this way is done by their identification through

[3] The product space is a network of products related by their degree of proximity. Proximity is the conditional probability that a country exports a product given that it exports another product.

centrality measures in the product network, which can include degree, closeness centrality, and betweenness.

The degree is a measure of the number of direct connections at a given node, assigning equal importance to each connection. On the other hand, closeness is the inverse of the average distance from a node to all others. Finally, betweenness centrality captures the significance of a node in establishing connections between various segments of the network as a measure of the proportion of times the node appears on the shortest paths between every other node in the network. Ordinal interpretation is applied to these three measures. In general, the orderings derived from the centrality of intermediation may differ from those generated by the other two measures (Jackson, 2008).

4. CONTEMPORARY PRODUCT SPACE NETWORK

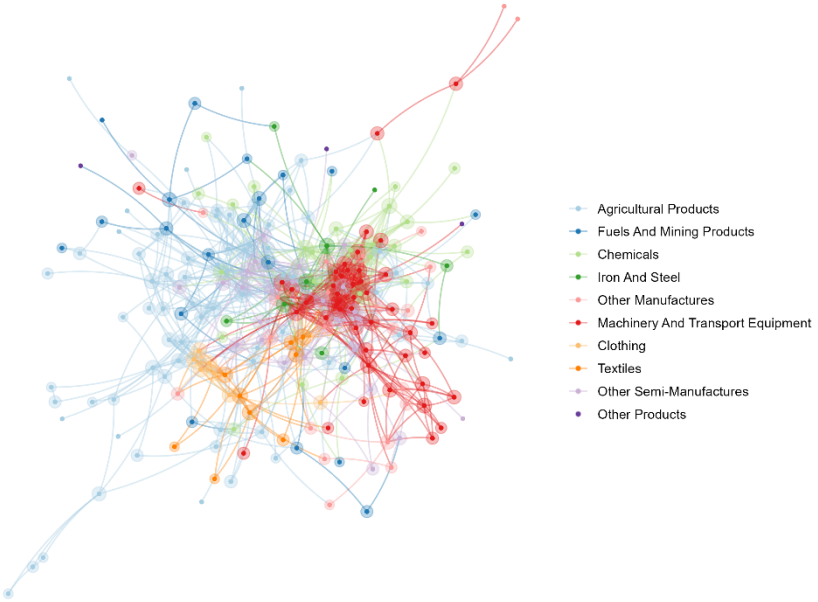
Broadly speaking, the Economic Complexity Index (ECI) is an indicator of countries' know-how and knowledge intensity. It is based on two indicators estimated from global trade patterns: diversity and ubiquity. On the one hand, diversity refers to the quantity of goods exported by each country; a large number of goods produced and a more diversified exports matrix makes it more likely that a country has achieved a sophisticated production structure. On the other hand, ubiquity measures how common is a good in global exports; the less frequent a good can be found in countries' exports, the less ubiquitous it is. However, a low level of ubiquity can reflect either a scarce good (e.g. uranium) or a very sophisticated good (e.g. batteries for electric cars); in order to classify the good among these two options, it is necessary to combine it with the diversity measures to see if the countries that export it are concentrated in few primary products (scarce), or if in contrast they tend to be diversified (sophisticated).

The product space of the world economy in 2019 reveals a dense core where machinery and transport equipment products, as well as other types of manufactures, are located. Overlapping this core are iron and steel products together with chemicals, along with other semi-manufactures such as those made of leather, plastics, or glass, which serve as important precursors for more complex manufactures. The rest of the products, characterized by a more basic process of production, are in more distant sections of the network. Textiles and clothing are located on the lower left area, while agricultural products and fuels and mining products tend to concentrate on the upper left area of the network. Scattered throughout the network are other products that do not fit neatly into these categories, such as non-legal tender and war vehicles.

This configuration of the product space reflects the complexity of each type of product. Given that basic goods tend to have lower connections with other products, they are less proximate to the rest of the network. Consequently, they are less proximate to the rest of the network and are confined to its periphery. Conversely, more sophisticated products such as manufactures require links and capabilities across sectors such as

minerals, metals, and chemicals, and thus tend to be concentrated at the center of the network (Figure 3).

Figure 3. World product space in 2019



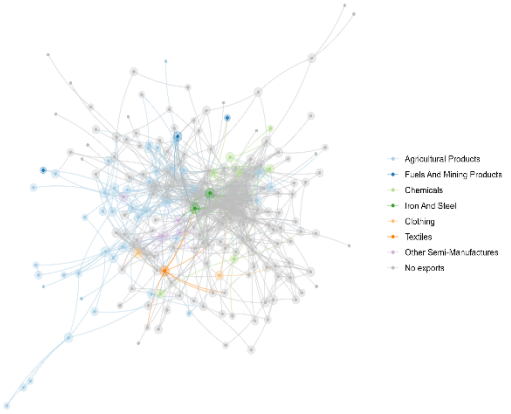
Source: Own construction based on the Atlas of Economic Complexity (2013)

Analyzing the network of Latin American countries reveals different emphases within the product space for each country. In the case of Argentina (Figure 4, panel A), the product space is skewed toward products located on the periphery of the network, such as agricultural products, along with some fuels and mining products and textiles. Since these industries do not require extensive linkages with other sectors, the network appears dispersed, lacking the manufacturing core observed in the global network. In contrast, Brazil (penal B) exhibits a strong presence of core products such as machinery and transport equipment, which also requires the development of related industries like iron and steel, chemicals, and fuels and mining products. In the case of Colombia (Panel C), there are no products located at the core of the network, although there are some machinery and transport equipment products situated on its border. Instead, there is a strong presence of clothing and textile products, agricultural products and fuels and mining products. This reflects a peripheral pattern similar to Argentina, but with a more diverse product basket. On the other hand, Chile (panel D) shows a strong peripheral emphasis with less variety, its product space is mainly composed of fuels and mining products, agricultural products, and a few industries of intermediate complexity, such as chemicals and iron and steel products, which tend to be directly linked to its basic goods production. In sharp contrast, Mexico (Panel E) exhibits a pattern similar to that of Brazil, with a strong presence of products at the core of the network, particularly in machinery and transport equipment and other manufactures. It also features the presence of precursor industries such as fuels and mining products, chemicals, and iron and steel. Additionally, Mexico produces textiles and clothing, making it the country with the greatest variety in its export basket,

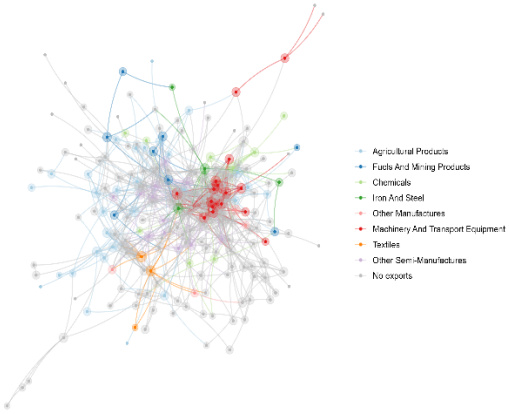
followed closely by Brazil. In comparison, Uruguay (Panel F) has a product basket more like that of Colombia, with the presence of other manufactures and textiles and clothing, as well as fuels and mining products. However, unlike Colombia, Uruguay has a strong development of iron and steel products.

Figure 4. Latin American product space by country (2019)

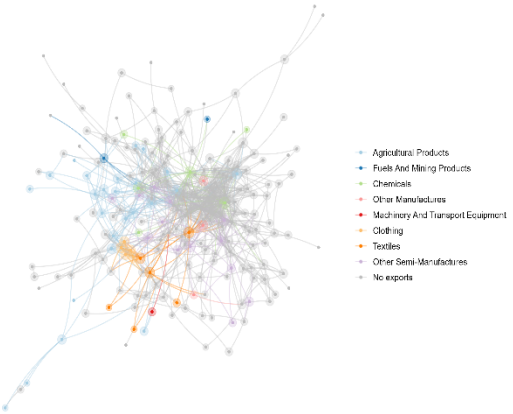
a) Argentina



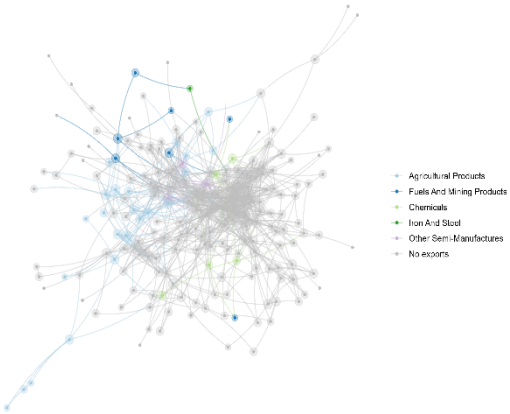
b) Brazil



c) Colombia



d) Chile



e) Mexico

f) Uruguay

Source: Own construction based on the Atlas of Economic Complexity (2013)

In brief, the Atlas of Economic Complexity applied to the Latin American economies shows how the countries in the region have struggled to develop a strong and sophisticated exports' composition. The role of the size of the economy as a catalyst for the sophistication of the production matrix, given that it is easier to develop economies of scale with large domestic markets, is confirmed by the relative sophistication of the two largest economies, Brazil and Mexico, which are the only ones that have been able to export goods located at the core of the product space network. Except for these two economies, the export patterns of the rest of the countries tends to concentrate in basic goods, although both Colombia and Uruguay, and somehow Argentina, exhibit the presence of some important semi-manufactures, such as chemicals and iron and steel products, as well as some basic manufactures, such as clothing. Chile, on the other hand, shows the most basic export pattern of the sample.

5. ESTIMATION OF REVEALED COMPARATIVE ADVANTAGE

As explained in section 3.1, the concept of revealed comparative advantage captures the logic that if the share of a given product in a country's share is higher than the one observed in the rest of the world, then this country has a better capacity to export it than the rest of the countries. This means that if the RCA index is higher than the neutral value of 1, it implies that the production of a given product in that country is more competitive than the average country.

Although the Balassa's RCA index fulfills the Kunimoto-Vollrath principle[4], it is important to mention some of its weaknesses. The first one is its asymmetry: while comparative advantages can take any value in the range]1,∞], comparative disadvantages have an upper bound, as they only range from [0,1[. Second, given that

[4] The Kunimoto-Vollrath principle, fist stated by Kunimoto (1977) and extended by Vollrath (1991), states that the specialization of a country *i* relative to another country *j* is measured by comparing the value of exports from *i* to *j* with a theoretical value, defined as a country *i* global exports weighted by country *j* share in world's trade.

it does not introduce GDP levels in the equation, it is subject to small-country bias, referring to the tendency of countries with low levels of exports to reflect high values of the RCA index. The third one is its lack of additivity, given the impossibility to combine two or more RCA indices for different countries to establish the RCA index for a group of countries. Finally, by focusing only on exports the RCA index can only reflect on comparative advantages in terms of supply, it leaves out the demand side that could be captured by the inclusion of imports in the analysis; this restriction prevents it from measuring not only productivity differentials, but also the country's capacity to differentiate a product qualitatively with respect to foreign competition.

On the possibility of overcoming these weaknesses, Stellian and Danna-Buitrago (2022) estimate alternative versions of the RCA index, either symmetric, normalized with mean zero, or estimated through contribution to trade balance, among others. After comparing the results in terms of trend stationarity, symmetry, and consistency in intercountry comparisons, the authors end up concluding that there is no RCA index that can overcome all weaknesses and fulfill the criteria better than the traditional version of the RCA index. Thus, the traditional Balassa version of the RCA index will be used in this research to identify the surge of infant industries.

5.1 Emergence of products with key linkages

Products in certain industries tend to require the prior development of other industries for their production, which enables the creation of more complex production chains. These complex production chains, in turn, facilitate the development of other products, as they foster the building of production capabilities that can be applied to different types of goods. This is the case of manufactures, chemicals, textiles, and other types of manufactures and semi-manufactures. As shown in Table 1, the associated network metrics are higher in these industries, as is their economic complexity. This makes the development of such products desirable within the export basket of these countries.

Table. Network and complexity metrics for industries

Industry	Betweeness	Closeness	Degree	Complexity
Agricultural Products	227,2	0,00128	6,1	
Chemicals	365,3	0,00139	9,9	
Clothing	230,5	0,00141	12,4	
Fuels And Mining Products	101,2	0,00118	4,0	
Iron And Steel	228,4	0,00136	8,0	
Machinery And Transport Equipment	267,6	0,00145	14,3	
Other Manufactures	211,8	0,00132	7,9	
Other Products	58,8	0,00105	1,3	
Other Semi-Manufactures	465,5	0,00151	14,9	
Textiles	322,0	0,00140	10,1	

5.2 Identification of clusters' surge moment for six Latin American countries

In this section each of the six analyzed Latin American economies is characterized based on the estimation of the revealed comparative advantage for the period 1962-2019. In order to do this, I first identify all the products that took off at some point in time as revealed comparative advantage, grouping them by their WTO classification. This allows the construction of long-term figures that provide a graphic description of the sectors and activities where each country has shown international competitiveness, and how this pattern has evolved during the 57-year period. For the second step, I use two criteria to filter the most relevant products: only the goods that are currently (2019) a revealed comparative advantage, and those that show a higher level of centrality measures, including degree, closeness and betweenness. For these products, I pinpoint the precise year when they took off as revealed comparative advantages, which can serve as a guide to determine whether their emergence was the result of an industrial policy initiative or a natural evolvement of an existing comparative advantage.

First, for the case of Argentina, its comparative advantages in the 1960's focused on agricultural products such as live animals, meat, hides and animal derivatives, and certain cereals. This allowed an incipient development of related industries such as chemicals, particularly in tanning and dyeing, and semi-manufactures like leather and fur clothing. In the 1970s, Argentina gained a comparative advantage in manufactures such as railway vehicles and road vehicles, but it did not last long, as they all disappeared by the beginning of the 1990s with the process of deindustrialization. However, since the 1980s, it developed comparative advantages in the iron and steel industry with products like tubes and pipes, steel bars, and inorganic chemicals, as well as in fuel and mining products such as aluminum and lead. As Figure 8 shows, comparative advantages in manufactures and clothing were lost in the 1980s and 1990s, respectively, while the comparative advantage in the remaining industries consolidated until 2019.

Figure 8. Argentina's industry development, 1962-2019

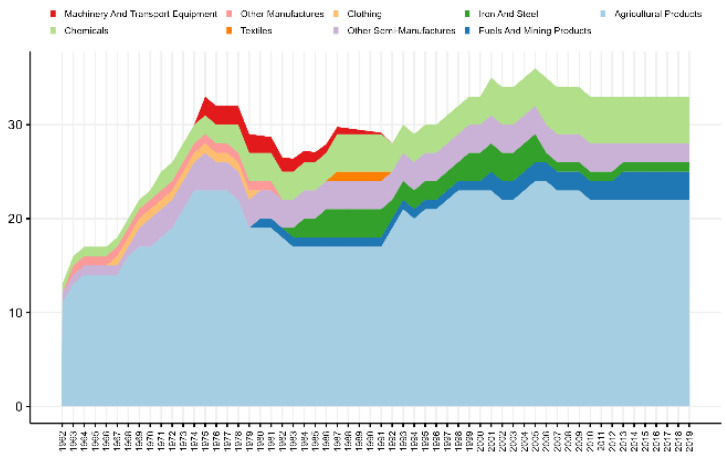
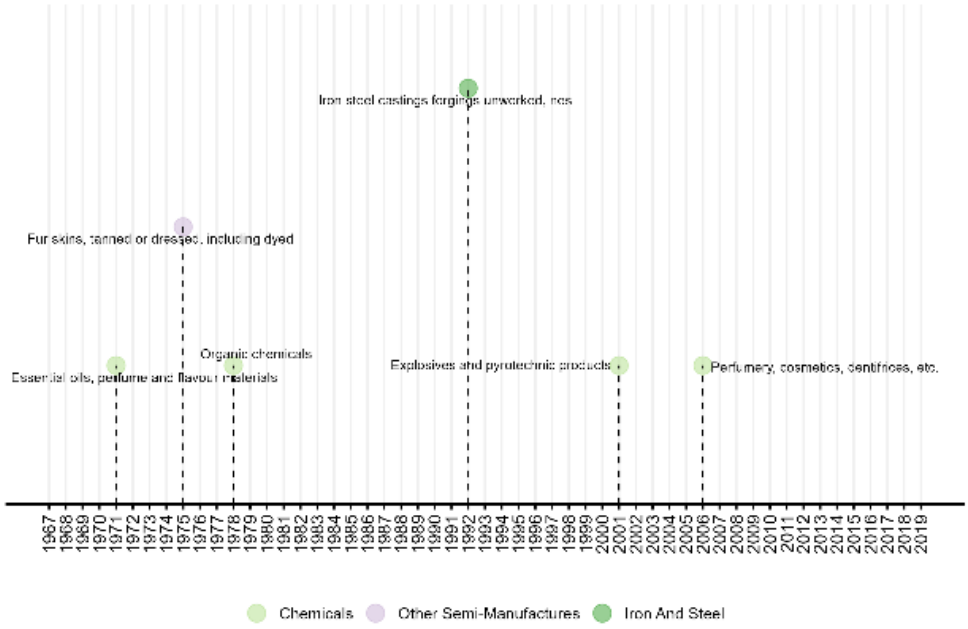


Figure 9. Take-off of Argentinian Products with Revealed Comparative Advantage (RCA) as of 2019



In the case of Brazil, the country exhibited a significant comparative advantage in agriculture during the 1960s and 1970s, with products such as sugar, cotton, coffee, tobacco, live animals, meat, and other animal derivatives. At the same time, between 1960 and 1970, it developed a comparative advantage in the chemical industry with related products such as those used in dyeing and tanning, explosives, and in semi-manufactures like leather. During that period, there was also incipient development in iron and steel products such as pig iron, and in the fuels and mining industry with iron ore. These early capabilities in these industries expanded during the 1980s to include silver and platinum ores, aluminum, as well as additional iron and steel products. These, in turn, enabled the manufacture of power-generating machinery, agricultural machinery, railway and road vehicles, ships, and boats, among others. In the 2000s, new comparative advantages emerged in products such as various types of cereals and electrical appliances. In sharp contrast with Argentina, the development of revealed comparative advantages in added-value sectors during the State-led industrialization period did not disappear for the most part in the following decades. In fact, it is the country with the highest number of products showing revealed comparative advantages, with a relatively well diversified pattern.

Figure 10. Brazil's industry development, 1962-2019

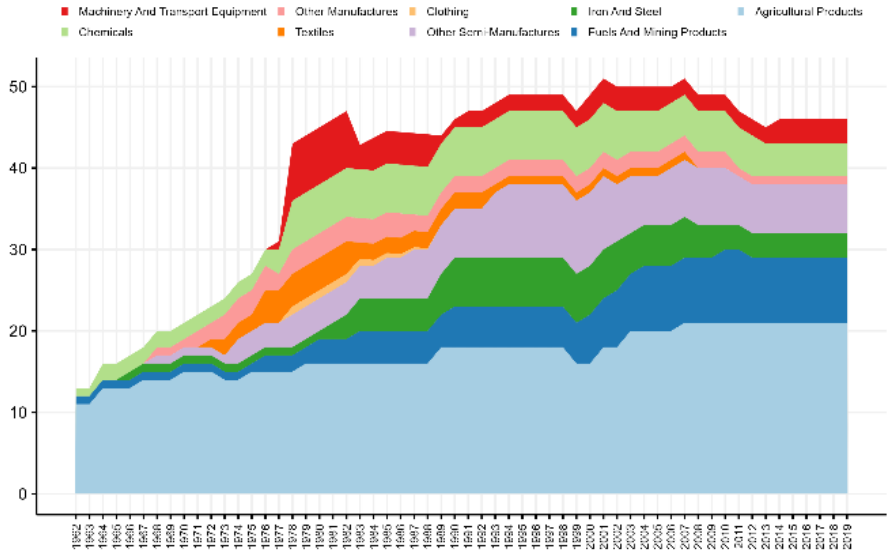
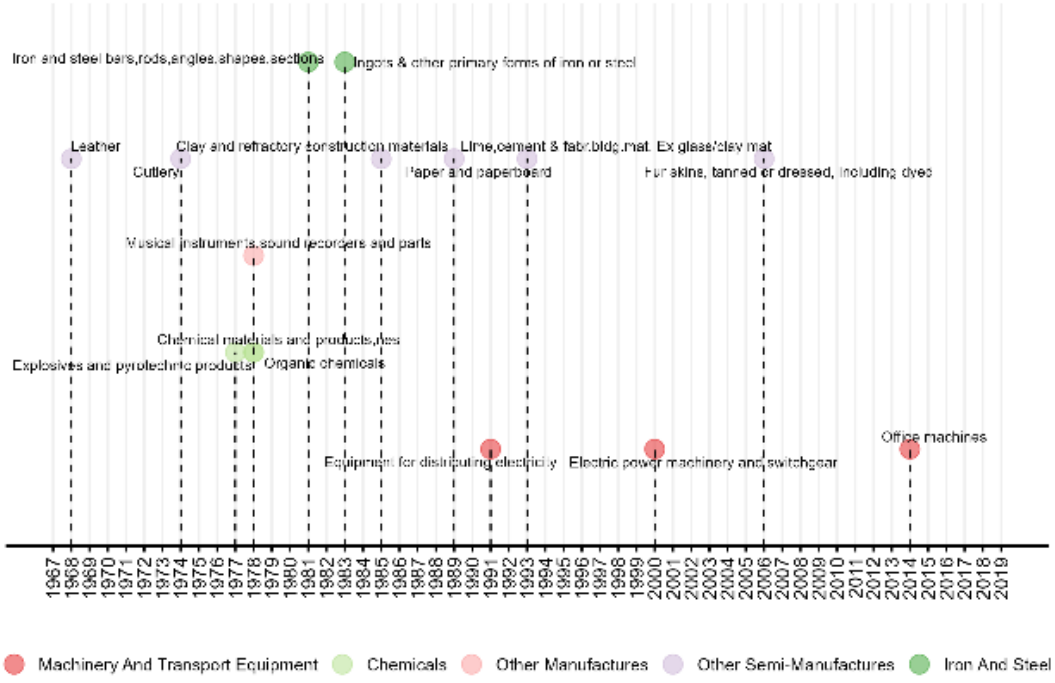


Figure 11. Take-off of Brazilian Products with Revealed Comparative Advantage (RCA) as of 2019



For the case of Colombia, during the 1960s it had a comparative advantage in agricultural products such as coffee, sugar, and cotton, as well as in certain fuel and mining products like silver and platinum. During this period, the country also showed strengths in textiles, particularly cotton fabrics, and in semi-manufactures such as

glassware. In the 1970s, comparative advantages in related industries began to emerge, especially in clothing and textiles, including garments, tapestries, and textile yarns, along with other semi-manufactures such as paper, cutlery, and precious stones. This period also saw the emergence of advantages in manufactured goods like handbags and printed matter. In the 1980s, although short-lived, there was a brief comparative advantage in power-generating machinery. Additionally, during this decade, iron and steel products such as pig iron, and fuel and mining products like coal, began to emerge. In the 1990s, the chemical industry gained comparative advantage in products such as paints, essential oils, soaps, and cosmetics. Although the small comparative advantage of manufacturing products was lost by the end of the 1990s, most of these industries continued to consolidate their position until 2019, with the exception of clothing, which lost its comparative advantage in the 2000s. It is also evident the negative effect of the upward phase of the super cycle of commodity prices in the first decade of the 2000s, where Colombia lost a great part of its revealed comparative advantage (especially in semi-manufactures), which was not recovered in the most recent years.

Figure 10. Colombias's industry development, 1962-2019

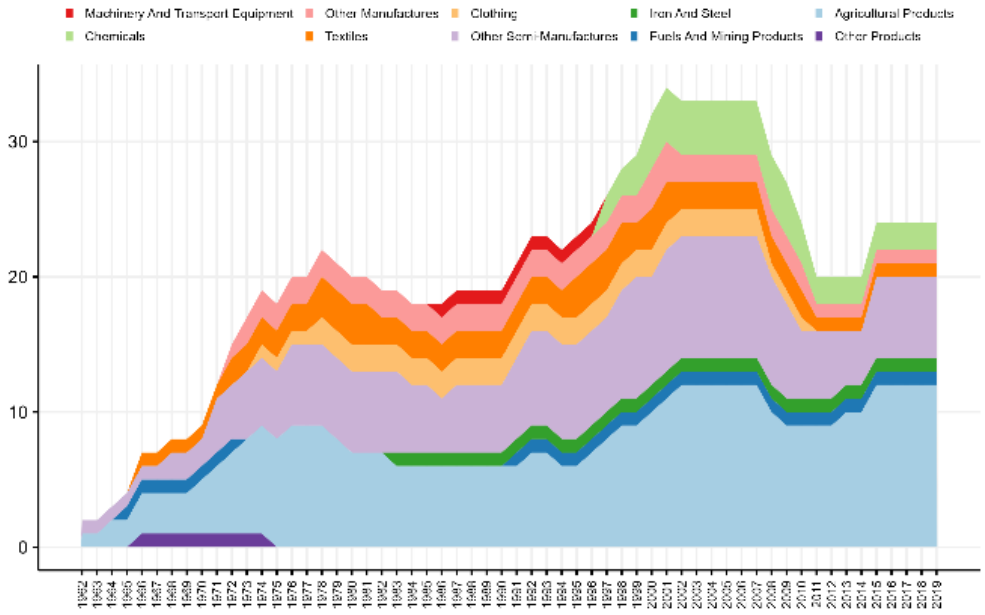
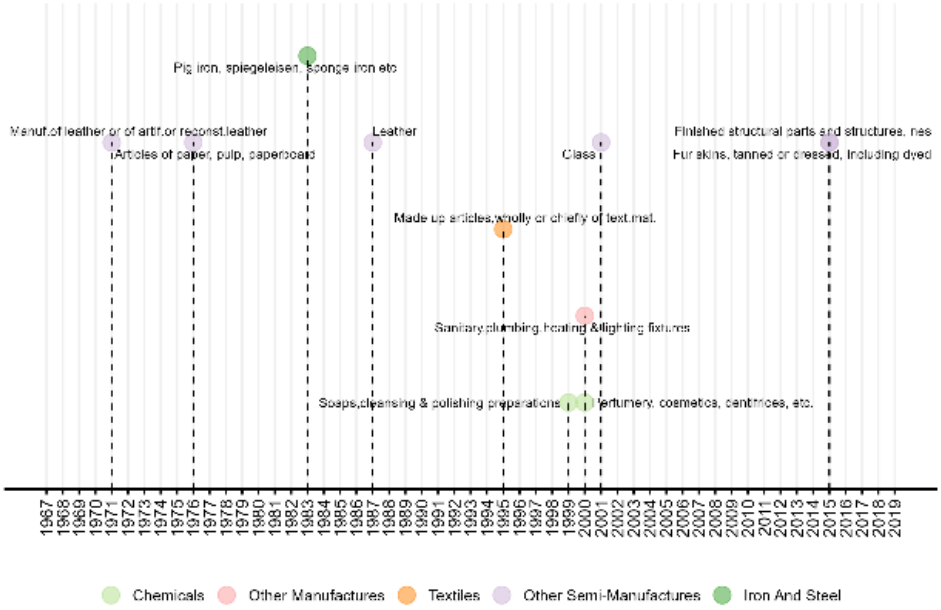


Figure 11. Take-off of Colombian Products with Revealed Comparative Advantage (RCA) as of 2019



Chile, on the other hand, had a strong initial comparative advantage in fuels and mining products, particularly copper, iron, and various types of ores. It also showed a modest advantage in agricultural goods such as feedstuff and paper pulp, along with certain inorganic chemicals. Over the 1970s and 1980s, these latter sectors consolidated, and Chile's comparative advantage expanded to include additional agricultural products such as vegetables, seafood, fruits, wood and pulpwood, animal oils, and cereals, as well as chemicals including plastic and chemical materials. During this period, the country also developed advantages in semi-manufactures such as rubber articles, paper and paperboard, and pig iron. In the 1990s, Chile further diversified its agricultural advantage by adding products like sugar, spices, maize, and chocolate. Some of these advantages lasted only until the 2000s, a pattern also observed with several chemical products. In the 2010s, Chile added new advantages in semi-manufactured goods including cork products and rubber tires. However, Figure 12 shows that it is the less diversified country of the sample, both in the number of sectors and in the quantity of products that exhibit revealed comparative advantage.

Figure 12. Chile's industry development, 1962-2019

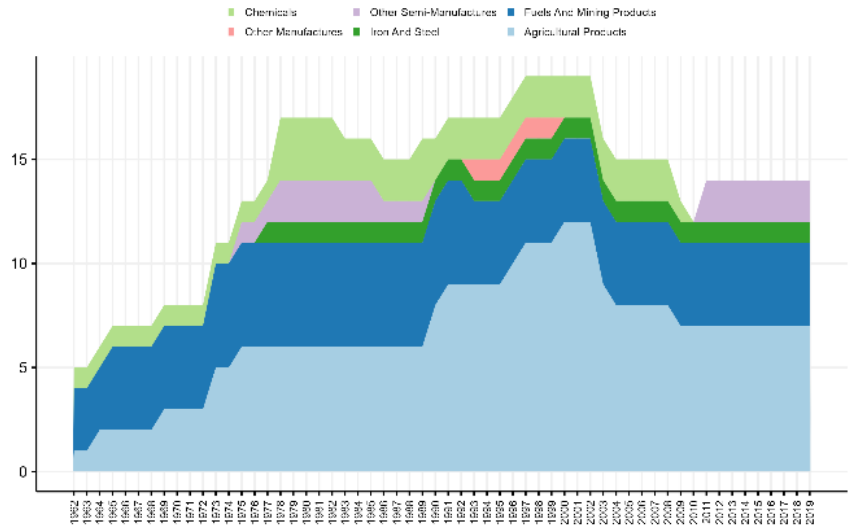
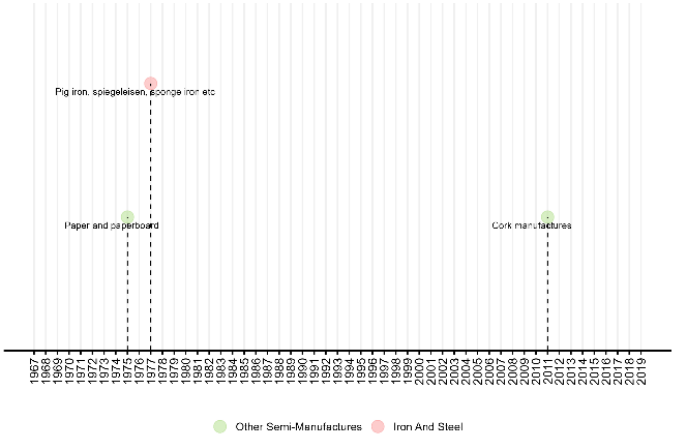


Figure 13. Take-off of Chilean Products with Revealed Comparative Advantage (RCA) as of 2019



Unique among the countries analyzed, Mexico began the 1960s with a wide range of comparative advantages across many different industries. Its strongest advantages were concentrated in agricultural products such as live animals, meat, vegetables, coffee, cotton, chocolate, and cereals like maize, among others. The country also had a comparative advantage in fuels and mining products, including stone, gas, silver, and various types of ores and non-ferrous metals. Additionally, Mexico exhibited international competitiveness in chemicals, particularly inorganic chemicals and pharmaceuticals, as well as in clay and construction materials, textile yarn, glassware, essential oils, and jewelry, among other semi-manufactures. These industries continued to consolidate through the 1970s, with notable growth in the chemical sector, which added products such as organic chemicals, dyes and tanning materials, and plastic materials. As other countries, during the 1980s and 1990s Mexico lost many of its comparative advantages in agricultural products, mainly because of the large oil

boom by the middle of the 1980s. However, it is the only country in the sample that regained its international position with new advantages in manufactured goods, including road vehicles, ships, electrical equipment, and other types of machinery, reflecting the importance of the maquila agreements with USA and its insertion in global supply chains. The fuel and mining sector also expanded, incorporating crude petroleum, petroleum gases, and iron and steel products such as iron castings, ores, and copper. Many of these industries remain relevant today, despite the relative importance of fuels and mining having declined since the 2000s.

Figure 13. Mexico's industry development, 1962-2019

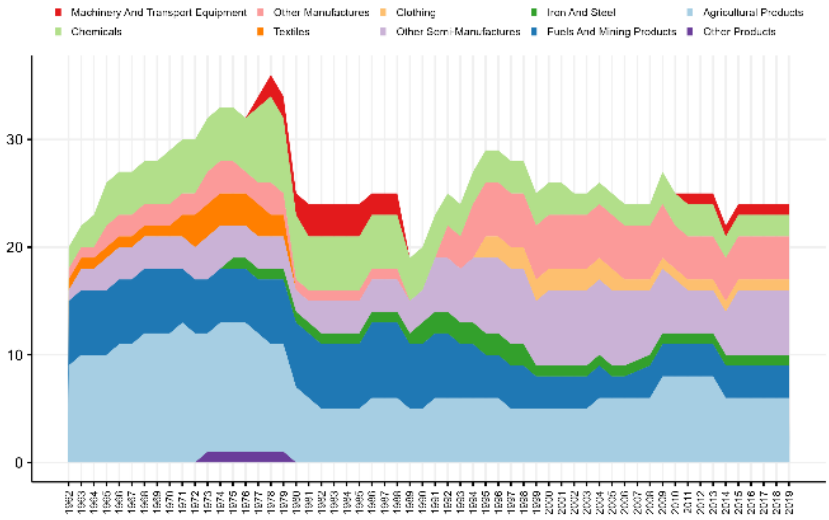
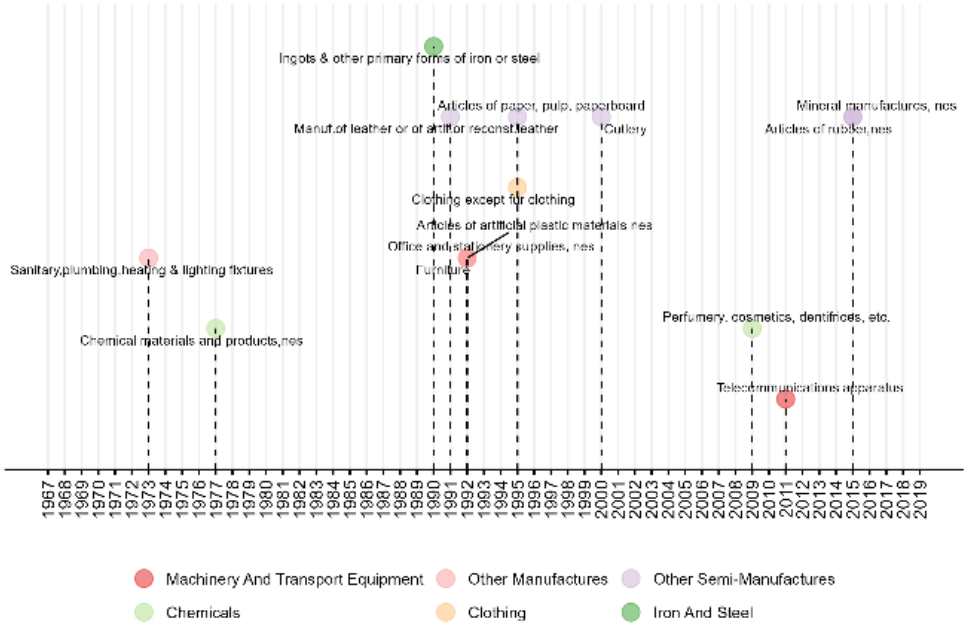


Figure 14. Take-off of Mexican Products with Revealed Comparative Advantage (RCA) as of 2019



Finally, Uruguay began the 1960s with a strong comparative advantage in agricultural products, particularly meat and animal derivatives such as hides and skins, as well as cereals like rice. The strength of the livestock sector also enabled the country to develop advantages in semi-manufactures, including leather goods, clothing and other products like rubber articles, glassware, and pottery. In textiles, Uruguay showed strengths in products such as yarn and thread. The country also engaged in the extraction of materials such as stone, sand, and gravel. In the 1970s, Uruguay expanded its comparative advantages to include chemical products, particularly organic chemicals, pigments, and soaps. Despite losing the comparative advantages on clothing by the change of the century and textiles one decade later, the rest of these industries remained relatively stable over time, gradually incorporating new products such as additional types of grains, animal derivatives like cheese, butter, and feedstuff, as well as pesticides, seeds, women's and girls' clothing, various textiles, rubber tires, and other rubber-based products. Most of these sectors have remained stable to the present day.

Figure 15. Uruguay's industry development, 1962-2019

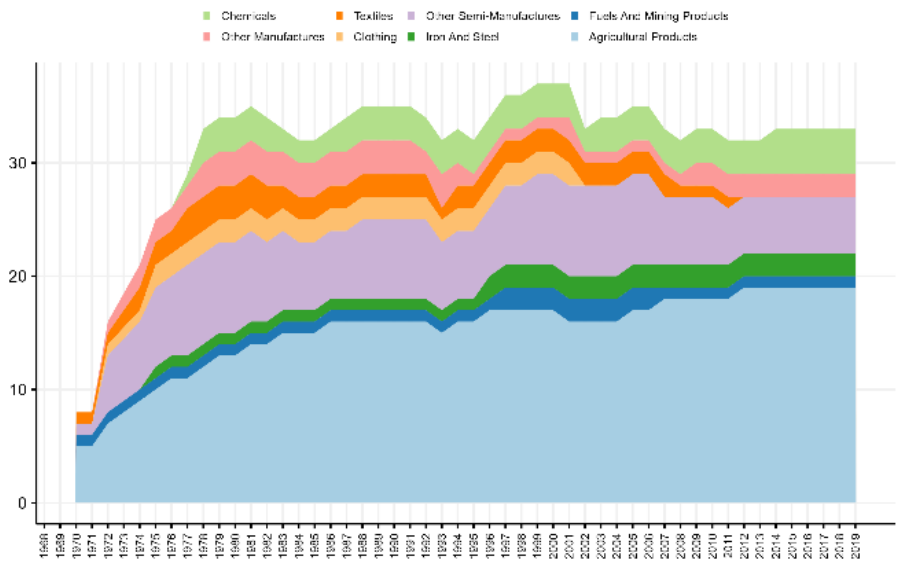


Figure 16. Uruguay's Products with Revealed Comparative Advantage (RCA) as of 2019

6. CONCLUSIONS

Latin America continues to exhibit low productivity, limited technological upgrading, and heavy reliance on commodity exports. The central debate on whether to follow or defy comparative advantage reveals the limitations of a purely market-driven approach to long-term economic development. While exploiting existing advantages may yield static efficiency, long-term growth requires dynamic efficiency that can only be achieved through learning, innovation, and the accumulation of new capabilities. Market failures such as coordination problems, information externalities, and capability gaps continue to justify selective government interventions. However, these interventions must be strategic, time-bound, and performance-based. Rather than protecting inefficient firms or sectors indefinitely, modern industrial policy should focus on enabling ecosystems of innovation, training, and linkage creation, especially in sectors with potential to catalyze diversification.

This research provides a new systematic methodology to analyze the long term evolution of comparative advantage, applied in this case for the period 1962-2019 for six large Latin American countries: Argentina, Brazil, Colombia, Chile, Mexico and Uruguay. By combining the estimation of revealed comparative advantage, the measures of centrality of the Atlas of Economic Complexity, and a criteria based on the work of Simae et al. (2024), I have identified the precise moment when relevant products surged as revealed comparative advantage for each of the six countries. The

results confirm the high degree of sophistication of Brazil and Mexico, the medium level of development of Colombia, Argentina and Uruguay, and the more primary exports' matrix of Chile. Furthermore, the long-term analysis shows how these comparative advantages have evolved during the 57-year period.

Apart from that, the analysis of revealed comparative advantages and export patterns carried out in this paper shows that most Latin American economies remain concentrated in low-complexity products, with limited integration into the dense cores of the global product space. Apart from Mexico and in a lesser degree Brazil, there have been few cases of successful new, potentially transformative export goods. Mexico stands out as the only economy that reinvented itself after the Lost Decade of the 1980s to develop new added-value products different from the ones present before. In the rest of the cases, most revealed comparative advantage products were developed during the State-led industrialization period, highlighting the importance of proactive industrial policies and suggesting that state intervention can play a pivotal role in driving the generation of positive structural change in the region.

In sum, escaping the trap of commodity dependence and low growth requires a pragmatic approach that combines market signals with strategic state action. Once relevant products and precise surge periods are identified, it is possible to expand this research by acknowledging what kind of industrial policies were set in place for these relevant products to be able to develop as sustainable comparative advantages. However, it is clear that nowadays a renewed industrial policy focused on learning, innovation, and productive transformation can become the cornerstone of a new development model for the region. To be successful, this agenda must be embedded in strong institutions and must be supported by a long-term vision for economic diversification.

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