Regionalising Global Chains in Critical Inputs: South America in the Face of Recent Transformations and Expected Effects on the Global North and South

Regionalización de cadenas globales en insumos críticos: Sudamérica ante las transformaciones recientes y los efectos esperados en el Norte y Sur Global

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Abstract

This article examines the slowdown of globalisation following the 2008 crisis and the growing significance of the Global South, focusing on value chain shortening and regionalisation in critical inputs. It analyses the general and sectoral performances of the Global North and Global South, with particular attention to South America's positioning. A multi-country input-output model is employed, incorporating hypothetical extraction exercises for critical inputs. The findings highlight challenges and opportunities for South American nations within the regionalisation process, offering key insights into its implications for macro-regional spaces and their evolving dynamics.

Keywords: Regionalisation, Globalisation, Global South, South America, Industrialisation.

Resumen

Este artículo analiza la ralentización de la globalización tras la crisis de 2008 y la creciente relevancia del Sur Global, enfocándose en el acortamiento de las cadenas de valor y la regionalización de insumos críticos. Examina los desempeños generales y sectoriales del Norte Global y el Sur Global, con énfasis en el posicionamiento de Sudamérica. Se emplea un modelo insumo-producto multi-país y ejercicios de extracción hipotética de insumos críticos. Los hallazgos identifican desafíos y oportunidades para los países sudamericanos en el proceso de regionalización, aportando elementos clave para comprender su impacto en los espacios macro-regionales.

Palabras clave: Regionalización, Globalización, Sur Global, Sudamérica, Industrialización.

JEL Classification/ Clasificación JEL: F02, F17, O14, O50.

1. Introduction

The global economic system has undergone profound and rapid transformations over recent decades, driven by a series of disruptive events that have shaped the trajectory of the world economy. In this context, two globally significant processes become prominent due to their impact on the reconfiguration of international production and trade dynamics: globalisation, marked by the expansion of global value chains, and the growing trend of regionalisation, driven by the shortening of these chains.

In the early part of this century, integration into global value chains was seen as a key tool for economic development (Gereffi, 2001). However, recent events—such as trade tensions, pandemics, financial crises, and advancements in emerging technologies linked to the energy transition—have reduced the hyper-globalisation momentum (Evenett, 2019; Escaith, 2022). As a result, a new scenario appears to be taking shape in which forms of internationalisation are evolving but do not necessarily vanish (Linsi and Gristwood, 2024).

Within this framework, regionalisation has gained ground in response to vulnerabilities in global value chains. Regionalisation aims to bolster resilience by shortening and diversifying supply chains, thereby enhancing their adaptability to abrupt shifts in the global environment (Bontadini *et al.*, 2022). This gradual and heterogeneous process reveals significant differences across sectors, macroeconomic regions, and specific regional contexts (UNCTAD, 2020). While our analysis focuses on macro-regional trends, it is important to recognise the underlying intra-national asymmetries that shape economic outcomes. South America (SA), for instance, exhibits pronounced territorial disparities (Brosio *et al.*, 2018; Gómez-Lobo and Oviedo, 2025), with industrial hubs concentrated in certain regions while others remain economically marginalised. These internal imbalances influence how the benefits of regionalisation materialise, as the integration of manufacturing sectors may reinforce pre-existing inequalities if not accompanied by targeted policies (González and Santos, 2020).

As regionalisation progresses, crucial questions arise regarding its impact on economic development and global integration. A key aspect of this process is the role of critical inputs—essential goods and services that sustain production across multiple industries and regions. These inputs are particularly relevant in the context of regionalisation, as their availability and trade patterns shape economic interdependencies. It is thus essential to analyse how different regions, particularly South America (SA), are positioned in this new scenario

marked by shorter supply chains. What are the implications of this process for SA's productive and trade dynamics? Can regionalisation unlock potential benefits for the region while addressing its internal asymmetries? These are some of the questions this article aims to explore through a quantitative analysis of interdependencies between critical inputs and global trade, utilising a multi-country input-output model.

This paper is organised as follows: the next section provides an overview of the broader transition from globalisation to its restraint and the rise of regionalisation, highlighting key aspects of the academic debate and exploring how these transformations manifest in the macro-regional contexts of the Global North (GN) and Global South (GS). The subsequent section details the methodology employed to address the research questions, followed by the main findings. These findings first analyse recent shifts in the use of extra-regional critical inputs in the GN and GS and then assess the anticipated effects of regionalisation through the hypothetical substitution of critical inputs. Finally, the paper concludes by summarising the key insights and discussing the implications of shorter value chains for SA within the current global landscape.

2. Recent transformation and positioning of macro-regional spaces

Since the second decade of the current century, capitalism has been shaped by a multitude of events occurring within the context of two global processes that are reshaping the world's geoeconomy. On the one hand, globalisation and the expansion of global value chains, alongside the need for integration into these chains as a tool for development (Gereffi, 2018), have been subjects of scrutiny (Evenett, 2019; Giammetti *et al.*, 2022). The wave of hyper-globalisation appears to be slowing, shaping a new scenario that may involve "new and adapted forms of internationalisation rather than the end of globalisation" (Linsi and Gristwood, 2024).

The convergence of events, including trade tensions, wars, pandemics, financial crises, and even new technologies associated with the energy transition, has opened the door to the emergence of a progressive process of regionalisation in this complex landscape of redefining relationships (O'Neill, 2022). A distinctive aspect of this process has been the shortening and diversification of supply chains to enhance their responsiveness and adaptability to abrupt global changes (Bontadini *et al.*, 2022).

This dynamic of regionalisation, driven by the shortening of supply chains, is marked by its graduality and considerable heterogeneity. This heterogeneity not only includes sectoral differences and variations in value chains (UNCTAD, 2020) but also the diverse ways in which different macro-regional spaces are integrating into the new landscape.

On the one hand, the GN, centred in the United States of America (USA) and the European Union (EU), has experienced a process combining a decline in manufacturing employment with an increasing trend towards financialization

(Temouri *et al.*, 2023)[1].   In response, there has been a resurgence of mercantilist policies characterized by the implementation of protectionist and unilateral measures, alongside a revival of industrial policies (Petricevic and Teece, 2019; Evenett, 2019; Milner, 2021; Kim, 2024; Mercurio, 2024) and a revaluation of manufacturing. This has involved a focus on reshoring (along with its variants, nearshoring and friendshoring) and a trend towards the shortening of supply chains (Bailey, Corradini and De Propris, 2018). This process has been accompanied by financialization, which has permeated the practices of Global Value Chains (GVCs) (Milberg, 2008; Hujo and Lupo, 2022), extending its influence from the USA to the EU, where it has transformed the traditional banking system (Beck, 2022).

The Sino-Asian regional space, on the other hand, follows a strategy of expanding its value chains, particularly regional ones, in response to growing tensions between the USA and China (Scholvin *et al.*, 2022; Hugot and Platitas, 2023). This strategy continues the technological industrial base initially led by Japan and South Korea in the latter half of the 20th century, and subsequently by China from the 21st century onwards. Despite trends towards financialization (Cao and Wang, 2023), there has been a predominance of the subordination of financial capital to national objectives linked to the development of the industrial production system, under state control (Kalinowski, 2015; Gruin, 2019; Petry, 2020). This approach has solidified the region not only as the world's factory but also as an expander of its regional and global chains, led by its global firms.

The differences among macro-regional spaces—marked by the shortening of chains—are not only related but also partly explain the second macro-process: a shift in "tectonic plates" in the global system seen as a whole. This is a result of the disruptive role of Sino-Asia and, associated with this, the increased dynamism of the GS compared to the GN, represented by the USA and the EU (Nayyar, 2013; Calla, 2023). This scenario has created new inequalities and subordinate relationships within the GS, particularly between the Sino-Asian space and other regions, such as Latin America and Africa (Jenkins, 2012; Gallagher, 2015).

Although the identification of strategic sectors within productive networks has long been a focus of the Input-Output (IO) literature, the issue of sudden and global supply shortages of certain inputs has gained prominence since the COVID-19 pandemic (Pichler et al., 2021). Drawing on IO models initially developed for analysing the economic impact of natural disasters (Hallegatte, 2008), several approaches have emerged to incorporate supply constraints resulting from the first measures taken to address the pandemic (Barrot et al., 2021; Bonadio et al., 2021; Guan et al., 2020). These studies have contributed to the distinction between "critical" and "non-critical" inputs—unlike the

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1 'So here we will cast the net widely and define financialization quite broadly: for us, financialization means the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies' (Epstein, 2005: p. 3).

classification of sectors as essential or non-essential about lockdown policies, this distinction is based on whether an input is necessary for production in the short term.

This article contributes to the literature by addressing the production of critical strategic inputs within GVCs and Regional Value Chains (RVCs) from an Input-Output (IO) perspective, a dimension that remains underexplored, particularly about regional value chains in South America. In this context, special attention is given to the asymmetric responses of regions to ongoing regionalisation processes. These responses are shaped by structural differences in production networks, trade dependencies, and institutional frameworks, leading to heterogeneous impacts on supply chain resilience and economic performance. Understanding these dynamics is essential to designing more effective policies that enhance regional integration while mitigating vulnerabilities in global production systems.

The role of these critical inputs in supply chain reconfiguration has become increasingly relevant, particularly in discussions on economic resilience and the adaptation of production structures to external shocks. In this context of transformation, a series of questions arise from which we seek to establish an empirical platform that offers answers: What has been the scope of the regionalisation process driven by the shortening of supply chains, and what could be the effects if this phenomenon continues and accelerates in various macro-regional contexts? More specifically, what have been, and what could be, the impacts of the reduction of chains in different macro-regional spaces as a result of strategies to substitute "critical inputs" in these contexts? How have these transformations affected, and how could they affect, the macro-regional space of SA and its main national economies? What effects would a deepening of regionalisation through the shortening of chains bring? Are there potential benefits for SA in this process?

To our knowledge, few studies have addressed these questions, exploring the extent of the regionalisation process in the context of globalisation stagnation. The effects of this regionalising dynamic, linked to the shortening of chains, could contribute to an increasingly oriented structure towards a "North America-Europe-Asia" tripolar arrangement (Zeng and Zhang, 2019; Hulke and Revilla Diez, 2022) while the GS rises under Sino-Asian leadership.

Moreover, while there is a growing interest in analysing regional value chains as a reality and an alternative to strengthen South-South relations (Pasquali *et al.*, 2021), much remains to be investigated to understand the positioning, limitations, and potentials of the South American scenario in the context of the processes of recent decades and the potential outcomes of deepening regionalisation through the spatial shortening of value chains.

Using a quantitative methodology based on a multi-country input-output model and hypothetical extraction exercises on the intermediate transaction's matrix, this article aims to provide answers to the posed questions and contribute to filling this gap through an analysis of the behaviour of extra-regional critical inputs in global trade.

As previously mentioned, this analysis is organised in the results section through two axes. The first evaluates the process of shortening value chains and how regions—and sectors—have behaved from 1995 to 2020, while the second observes the consequences of deepening these processes for different macro-regional spaces and their relationships. In both subsections, the general and sectoral performances of the USMCA (United States, Mexico and Canada Agreement) and the EU in the GN and Asia in the GS are first examined, followed by an assessment of the positioning of SA within each macro-regional scenario.

3. Methodology

The methodological design is based on a multi-country Input-Output approach. Specifically, the following model is constructed according to the notation of Miller and Blair (2009). A demand-pull multi-country model is proposed, establishing an identity relationship between the total for each row of final demand F, the total for the rows of the intermediate transaction's matrix Z, and the output x. Final demand is represented by a row vector of sectors and countries, while output is a row vector comprising the Gross Value of Production by sectors and countries.

$$\mathbf{x} = \mathbf{Z}i + \mathbf{F}i \qquad (1)$$

Here, x is the vector of order n for goods and p countries; Z is the transaction matrix of size $(n \times p) * (n \times p)$, matrix F is of size $(n \times p)$ rows and $(c \times p)$ columns (where c corresponds to the components of demand); and we use i to represent a column vector of 1's of appropriate dimension –here $n \times p$ for Z and $c \times p$ for F–. In particular, with $A = Zx^{-1}$ as the matrix of global technical coefficients, a functional relationship is established through the global Leontief matrix $((I\text{-}A)^{-1}$ or $L)$, such that output responds to changes in final demand.

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{F}i \qquad (2)$$

$$\mathbf{x} = \mathbf{L}f \qquad (3)$$

Where L is the Leontief inverse matrix of order $n \times p$ and f is the column vector of final demand, sized $(n \times p) * 1$.

Considering recent empirical advances on critical inputs, this study defines critical inputs as those sectors whose utilisation determines production feasibility over a short period (e.g., shortages preventing production beyond two months). Additionally, based on expert evaluations, these sectors demonstrate a significance above the average threshold. Following the advancements by Pichler *et al*. (2020; 2021) and aligning the industrial classification with the OECD's 45 sectors, the critical inputs consist of 17 activities:

- Primary: Mining (D05 to D09)
- Secondary: Refined Petroleum (D19), Chemicals (D20), Rubber and Plastics (D22), Electrical Equipment (D27), Machinery and Equipment (D28)
- Tertiary: Electricity, Water, Trade, Land Transport, Warehousing, Telecommunications, ICT, Support Services.

3.1. Simulation of regionalisation scenarios

Recent trends can be further developed at various levels. Specifically, scenarios are proposed to explore transformations in globalisation using hypothetical extraction exercises (Dietzenbacher *et al.*, 2019; Giammetti *et al.*, 2022) based on the latest available input-output tables (2019, avoiding issues contingent on the pandemic year).

The exercise assumes a complete substitution of extra-regional critical inputs. Four main country groups are defined:

- USMCA: United States, Mexico, and Canada
- EU: 27 members of the European Union
- ASEAN3: Association of Southeast Asian Nations plus China, Japan, and Korea
- South America: Argentina, Brazil, Colombia, Chile, and Peru

The first two scenarios aim to examine the potential for nearshoring critical inputs within the Global North's major consumer hubs through a process of extra-regional import substitution. Specifically, it is assumed that each of the main economic hubs replaces extra-regional inputs with domestic and regional ones by adjusting the A matrix. For example, suppose the United States automotive sector relies on steel as a critical input, with 35% sourced domestically, 20% from Mexico, 10% from Canada, and 35% from the rest of the world. Substituting this final share with regional steel involves an equal increase in inputs from the USMCA countries to reach the original total for intermediate purchases (in this case, implying a 53.8% increase in purchases from each country). This adjustment alters the A matrix and, consequently, the global Leontief matrix *L*, which may affect the positioning, proximity, and production of South America as a critical input supplier.

The second scenario focuses on the regionalisation of critical inputs within the Global South. This includes examining the Asian and South American regions and simulating a scenario where foreign inputs are replaced with regional ones. Here, the same substitution exercise is applied to ASEAN3 in Asia and Argentina, Brazil, Colombia, Chile, and Peru in SA.

3.2. Example of the hypothetical global extraction method

To illustrate the application of hypothetical extraction using the previous equations, a simple example is provided. Assume there are three countries (r, s, and t), where r and s belong to the same region, and only two industries (sc and nc; critical and non-critical sectors).

In this context, the system consists of a 3×2 matrix , a final demand matrix with 3×2 rows and 3 columns, and a total output vector of size 3×2. The elements of the system are given by the following matrix and vectors:

$$
Z = \begin{bmatrix} Z^{rr} & Z^{rs} & Z^{rt} \\ Z^{sr} & Z^{ss} & Z^{st} \\ Z^{tr} & Z^{ts} & Z^{tt} \end{bmatrix}, \quad F = \begin{pmatrix} F^{rr} & \cdots & F^{rt} \\ F^{sr} & \ddots & F^{st} \\ F^{tr} & \cdots & F^{tt} \end{pmatrix} \text{ and } x = \begin{bmatrix} x^r \\ x^s \\ x^t \end{bmatrix} \tag{4}
$$

Note that, based on these elements, it is also possible to present equation (2), where *A* takes the form:

$$
A = \begin{bmatrix} A^{rr} & A^{rs} & A^{rt} \\ A^{sr} & A^{ss} & A^{st} \\ A^{tr} & A^{ts} & A^{tt} \end{bmatrix} \tag{5}
$$

In the case of a regionalisation process in r, attention should be paid to the first block of columns in A, which contains the global technical coefficients of r to r, s, and t. Specifically, given that r and s belong to the same region, critical inputs purchased from t should be removed from matrix A^{tr} and increased in critical inputs acquired by r from s (i.e., A^{sr}). These simultaneous changes result in a new coefficient matrix (A') fully consistent with the column totals of A. The final effects are derived from equation (2), generating variations in production across the affected countries.

$$
x' = (I - A')^{-1} F i \tag{2'}
$$

3.3. Data and limitations

The data used in this study relate to the Inter-Country Input-Output (ICIO) tables, which are constructed by the Organisation for Economic Co-operation and Development (OECD) for 77 economies (76 countries plus the rest of the world). For Latin America, the dataset includes seven countries: five from South America (Argentina, Brazil, Chile, Colombia, and Peru), along with Costa Rica and Mexico. The coverage period extends from 1995 to 2020 (2023 edition), and the sectoral classification consists of 45 sectors according to the fourth revision of the International Standard Industrial Classification (ISIC). It is important to note that, within this Multi-Regional Input-Output (MRIO) framework, the ICIO database does not provide intersectoral flows and value-

added in constant prices. As a result, the observed evolution is expressed in current terms.

However, the methodology, in addition to presenting limitations due to the use of data in current prices, may also have deficiencies regarding trade and transport margins, as well as the dual definition of critical inputs, such as industries and sectors. These issues are not addressed in the present article but represent important areas for future research.

4. Results

4.1. Recent transformations in the use of extra-regional critical inputs: behaviour in the Global North and South

As previously mentioned, in recent years, instability in trade-based supply chains has become a significant driver of change for global and regional production networks. Processes that formerly expanded the use of goods and services from a diverse array of distant suppliers have shown a shift towards shorter, more regionally concentrated supply chains. As illustrated in Figure 1, this shift is reflected in changes in the use of extra-regional critical inputs. The trend for these inputs demonstrated sustained growth from 1995, peaking in 2012 at over 3.8 trillion US dollars. Since then, their volume has declined in both absolute and relative terms. Specifically, the proportion of extra-regional inputs as part of total critical inputs decreased from 59% in 2012 to 53% in 2020. In other words, within just eight years, the gains achieved over the preceding 18 years were effectively reversed, with the 2020 volume falling to approximately 3 trillion US dollars in current terms[2].

Beyond aligning with general trade patterns, this shift also reflects recent structural, geoeconomic, and geopolitical transformations that position the Sino-Asian region as an emerging epicentre of global production and trade. In this context, Figure 1 underscores the growth in critical input purchases by the ASEAN3 bloc, which has shown consistent expansion from 1995 to 2020, both in absolute and relative terms. In 1995, the trade in critical inputs was dominated by the EU (35%), followed by ASEAN3 (31%), USMCA (29%), and SA (5%). By 2020, ASEAN3 had emerged as the leader in this market, accounting for 44%, while the EU represented 31%, USMCA approximately 20%, and South America 4%. In absolute figures, ASEAN3's purchases in 2020 reached nearly 1.3 trillion USD, compared to 0.9 trillion USD for the EU, 0.6 trillion USD for USMCA, and a mere 0.1 trillion USD for South America.

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2 This deceleration trend is also evident when examining foreign critical inputs relative to the total inputs. However, according to this indicator, the reversal is more gradual (see Appendix, Table 5), suggesting that insularisation processes or an increase in domestic supply may be taking place. While this aspect falls beyond the scope of the article, it is consistent with the dynamics identified in the analysis.

Figure 1. Extra-regional critical inputs, 1995-2020, major trade blocs
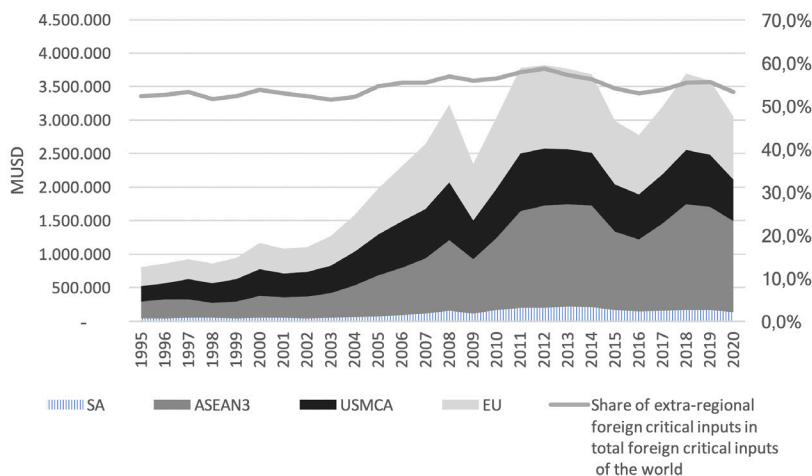
Source: Own elaboration based on ICIO-OECD.

Moreover, beyond this broader and regional trend seen in essential goods, another aspect highlighting their behaviour is the heterogeneity in the technical dependency of each region and its evolution over time. As widely recognised, dependence on primary, secondary, or tertiary critical inputs varies according to the level of development and regional production structures. In this sense, recent structural and geopolitical changes, alongside active policies to strengthen Sino-Asian industrial complexes, are expected to align with the data, potentially reducing reliance on these inputs. However, it is also true that the trend is not linear, given the emergence of new production forms and the Sino-Asian advancements in leading global manufacturing chains.

As shown in Figure 2, the analysis reveals both common patterns and significant differences among major regions. In line with the points raised earlier, when focusing on the largest axes of commercial integration, there is a widespread shift away from global sourcing beginning in the second decade of the 21st century. In particular, ASEAN3 reflects two simultaneous processes. On the one hand, there is a continuous reduction in the use of critical inputs in high-tech industries, indicating a deliberate, state-supported reduction in technical dependence on highly complex products, regardless of external conditions. On the other hand, while the relative use of extra-regional inputs has not declined, it has plateaued in most other sectors.

In the Global North, there are both continuities and contrasts compared to the Sino-Asian outlook. In USMCA, for instance, there is a similar trend of reduction or slowed growth in the use of extra-regional inputs. However, the opposite is seen in high-tech sectors, where there has been a steady increase in

technical dependence over time, partly accounting for certain industrial policy efforts that contrast with the global configuration of its leading industries.

Finally, the EU shows a similar situation to North America, with lower technical dependence across most industries since the early 2000s. Nevertheless, an exception is observed in medium-high industries, typically dominated by chemical and automotive complexes. Here, there is a persistent trend towards globalisation in sourcing, driven by weaker regional integration and increased Sino-Asian trade ties.

Beyond these general trends, it is interesting to note specific sectoral nuances in terms of technical dependence. For instance, the evolution of mining and energy dependence is a strategic dimension in recent changes. In mining and refining (medium-low tech), the USMCA exhibits a significant reduction in technical dependence due to progress in new energy self-sufficiency technologies. In contrast, ASEAN3 and the EU have managed only to stabilise their dependence on critical mining inputs from distant suppliers without achieving a decrease. It is also worth noting that certain sectors maintain high levels of dependence due to the nature of their activity, trade relations, and geography, which means their relative value remains high regardless of regional self-sufficiency. For example, low-tech industries often require significant transport and trade margins to connect distant regions.

Figure 2. Extra-Regional critical inputs as a proportion of total inputs by technology and trade partners, 1995-2020
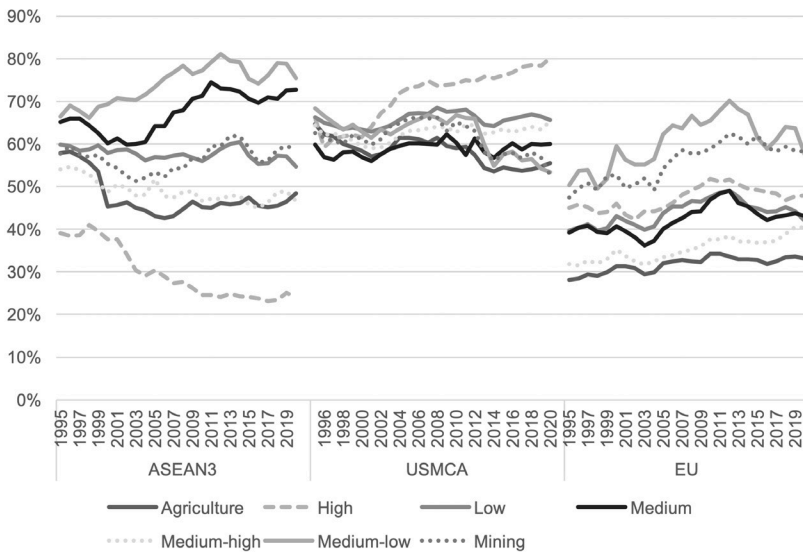
Source: Own elaboration based on ICIO-OECD.

To specify sectoral beyond the technological level, the five sectors with the highest use of extra-regional critical inputs, on average over the last five years (2016-2020), are highlighted in Table 1. Notably, refined coke and petroleum lead the list (19%), followed by basic metals (7%), electricity and gas (7%), chemicals (6%), and computing and electronic products (6%). As shown in Table 1, this dependency varies across regions. While all regions rely on extra-regional supplies of refined petroleum, they differ in other dependent activities. Asia's dependency is more focused on basic metals and electricity, North America's on computer manufacturing, and Europe's on electricity, gas, and chemicals. However, ASEAN3 surpasses the average in four of these five sectoral variables, except for computers and electronic-optical equipment.

Table 1. Sectoral concentration of extra-regional critical inputs. Ranking based on 2016-2020 values

Sector	ASEAN3	USMCA	EU	Total
Coke and refined petroleum products	25%	11%	17%	19%
Basic metals	13%	1%	3%	7%
Electricity, gas, steam and air conditioning supply	10%	2%	8%	7%
Chemical and chemical products	8%	4%	6%	6%
Computer, electronic and optical equipment	6%	7%	4%	6%

Source: Own elaboration based on ICIO-OECD.

4.2. Regionalising through hypothetical extraction of critical inputs: effects of deepening for different macro-regional spaces and their relationships

What happens if the shortening supply chains is deepened through strategies for substituting critical inputs employed by each macro-region? What effects occur on these regions and the rest of the world due to the substitutive actions of each?

From a logical standpoint, each scenario presents a series of positive and negative effects, depending on the region considered. For the macro-region that successfully "regionalises" critical inputs, the impacts tend to be favourable as it substitutes foreign production with regional production. Conversely, for external suppliers affected by regional substitution, the effects are generally adverse.

According to the analysis of these large regional spaces, as indicated in Table 2, the region most benefit from such a process would be ASEAN3, with an estimated growth of 5.9% in its Gross Value Added (GVA). In contrast, following the main diagonal of Table 2, USMCA would experience the lowest increase among all processes, with a growth close to 3% in its GVA. Positioned between these extremes, the European Union and SA display behaviour similar to that of ASEAN3, with increases of 5.6% and 5.1%, respectively.

This suggests that when evaluating the benefits promoted by the regionalisation of these inputs among competing poles, the macro-regional

space outside of Asia finds itself in a more advantageous position if it embarks on these processes. Alternatively, from another perspective, it is currently more dependent on extra-regional critical inputs, meaning that regional substitution could yield considerable internal effects. However, this does not imply that there are no other incentives for regionalisation in North America, where increasingly protectionist and reshoring strategies over the past decade have been driven by economic and social dimensions aimed at strengthening the productive system and recreating employment, alongside geopolitical dimensions focused on curbing Sino-Asian expansion (Gur and Dilek, 2023).

Nonetheless, based on the economic incentives outlined, there appear to be asymmetric benefits that can be interpreted in terms of regions being more or less favourable to deepening their regionalisation processes. For instance, if we focus on North America and Sino-Asia, assuming a process of regionalisation of similar intensity, the economic benefit from initial conditions is much lower for northern countries (+3%) than the probable increases in production in Asia (+5.9%).

The inverse analysis regarding the relative benefits of the respective regional spaces is the consideration of the impact that the substitutive strategies of different macro-regional spaces would have on other regions. In this case, it is relevant to observe which macro-regions would be most strongly affected and which would experience a smaller impact. Here, the substitution undertaken by ASEAN3 would have a relatively negative impact on North America and the EU (NG), with a similar reduction for USMCA and the EU of -1.1% of their base GVA. In contrast, SA (along with the Rest of the World, RoW) would be severely affected, experiencing a decrease of -2.7% in its Gross Value Added. This implies, on the one hand, that ASEAN3 is concentratedly dependent on certain regions (SA and RoW) but at the same time highlights a strong economic interdependence between those regions.

Regarding the regionalisation of the Global North, the scenario is different. USMCA emerges as the macro-region generating the least negative effects (less than half of those of ASEAN3) and does so in a more homogeneous manner. On average, it impacts other blocs by -1.1%, with a deviation of only 0.2%. In other words, the negative impacts of its regionalisation are more evenly distributed, suggesting that there is no strong dependence on any particular region, nor is there a concentration of power resulting from it. Specifically, the hypothetical extraction exercise in cases where the substitutive action is driven by USMCA and the EU indicates that, after RoW, the most adversely affected region is ASEAN3, with decreases of -1.3% and -1%, respectively.

In summary, these data are noteworthy as they reflect a certain asymmetry in technical dependence between the West and the East, where both North America and Europe have minimal negative effects on Asia due to their substitutive processes, stemming from their lower dependence on critical inputs from these countries. In contrast, Asia's substitution efforts distribute their adverse effects more intensively toward the rest of the Global South,

framing this within a tightening relationship inside that large area of the world system.

Considering these cross-regional effects, from a geopolitical reading, Asia appears more dependent on the GS for its development than North America does. This indicates a fundamental difference between the competing powers. As was recognised by structuralists (Prebisch and Cabañas, 1949), despite the trends observed in most technologies, the Northern centre remains more autonomous, which limits the South to a less influential trade positioning. In contrast, the Sino-Asian power's configuration shows a strong dependence on other regions of the South, enabling an autonomy process vis-à-vis the GN.

Table 2. Regionalisation via hypothetical extraction (HE) and affected region. Relative variation of total gross value added, 2019

Hypothetical Extraction of	Affected Region				
	SA	ASEAN3	USMCA	EU	RoW
SA	5,1%	-0,1%	-0,2%	-0,2%	-0,3%
ASEAN3	-2,7%	5,9%	-1,1%	-1,5%	-5,2%
USMCA	-1,0%	-1,3%	3,0%	-0,9%	-1,4%
EU	-0,8%	-1,0%	-0,7%	5,6%	-3,6%

Source: Own elaboration based on ICIO-OECD.

4.2.1. Productive integration in South America: country-level effects

The analysis of SA as a regional space reveals significant diversity in the conditions of integration and vulnerability among countries, particularly in the substitutive critical input context. This disaggregated approach highlights inequality patterns that would not be observed in a more general analysis. Table 3 indicates that the benefits of the regionalisation process in SA are not distributed uniformly. In this scenario, Argentina and Colombia find themselves in relatively favourable positions, with projected growth in Value Added (VA) of 11.1% and 9.7%, respectively. This suggests that more diversified economic structures and national policies may facilitate their integration into regional value chains. Peru and Chile also show significant increases in VA, at 6.1% and 7.7%, respectively.

In contrast, Brazil, despite being the largest economy in the region, shows the lowest projected growth, with an increase of only 2.2% in its VA. This outcome may be attributed to persistent internal structural problems or a lower reliance on regional integration, which often reflects asymmetric economic incentives in such processes. The losses arising from external regionalisation processes also show disparities among South American countries. The expansion of the ASEAN3 bloc would severely impact Chile and Peru, with reductions in VA of -6.4% and -6.8%, respectively, due to competition in industrial sectors. In contrast, Colombia, Brazil, and Argentina would face smaller negative impacts, with reductions of -1.8%, -2.3%, and -1%, respectively.

The greater autonomy of USMCA would have a more severe impact on Colombia, which would experience a VA decrease of -2.8%, compared to reductions of approximately -1% in other countries in the region. This may reflect Colombia's dependency on oil sales to specific sectors with higher exposure to regionalisation pressures. The regionalisation of the EU would generate a more uniform effect, with reductions of approximately -1% in VA across all South American countries, which may be attributed to the broad globalisation of their trade relations.

In summary, neither the regional integration process nor the external ones appear to promote effective collective actions for significant structural change. The lack of a coordinated regional strategy leaves SA and its member countries vulnerable to global dynamics. However, the European context presents an opportunity for the development of coordinated policies, suggesting potential for regional cooperation that remains largely untapped.

TABLE 3. HYPOTHETICAL EXTRACTION OF (HE) TRADE BLOCS BY COUNTRY EFFECT IN SOUTH AMERICA, 2019

HE	ARG	BRA	CHL	COL	PER
SA	11,1%	2,2%	6,1%	9,7%	7,7%
ASEAN3	-1,0%	-2,3%	-6,4%	-1,8%	-6,8%
USMCA	-0,7%	-0,7%	-1,1%	-2,8%	-1,1%
EU	-0,8%	-0,7%	-0,9%	-0,8%	-1,4%

Source: Own elaboration based on ICIO-OECD.

4.2.2. SECTOR-LEVEL EFFECTS

At the sectoral level, it is essential to highlight the potential complexity and productive structures that could emerge from the regionalisation process of critical inputs in SA. This analysis is crucial for understanding, firstly, the extent of the most pressing needs in the region, and secondly, for assessing whether this process could trigger significant qualitative changes in South American economies. In other words, it is vital to identify which industries and countries would benefit the most and whether it would be possible to develop an industrial profile that facilitates regional integration with higher income levels, as envisioned by early structuralists decades ago. The regionalisation of SA would be significant not only from a quantitative perspective but also for its potential to promote structural changes in the regional economy.

As illustrated in Table 4, among the activities that would benefit the most from this process in SA are medium and high-tech manufacturing industries (+19% and +21%, respectively), as well as the mining sector (+21%) and non-manufacturing industries linked to medium-high technologies (+11%). These sectors could become fundamental pillars of a new regional productive profile, capable of enhancing economic integration and strengthening the

competitiveness of the region through regional value chains that drive more complex and dynamic production processes.

On the other hand, when focusing on SA, external regionalisation processes that involve substituting South American inputs with those from other regions would have a significant negative impact. This is primarily due to the strategic role that SA plays in providing essential mining inputs. The dependency on these resources is particularly pronounced in the Asian process (-36%), highlighting the region's vulnerability to the substitution of South American mining inputs. To a considerably lesser extent, there is also dependency in the process that could be undertaken by GN actors, which is more pronounced in the North American context (-9%) and relatively less in the European context (-6%).

Table 4. Sectoral effects of the regionalisation of critical inputs in South America. Analysis by trade blocs, 2019

HE	Industry	Technology	Δ% VA	HE	Industry	Technology	Δ% VA
SA	Manufacturing	High	19%	USMCA	Manufacturing	High	0%
		Medium	6%			Medium	-1%
		Medium-high	21%			Medium-high	-2%
		Medium-low	5%			Medium-low	-1%
	Non-manufacturing	Agriculture	1%		Non-manufacturing	Agriculture	0%
		High	5%			High	-1%
		Low	3%			Low	-1%
		Medium-high	11%			Medium-high	-1%
		Medium-low	4%			Medium-low	0%
		Mining	21%			Mining	-9%
ASEAN3	Manufacturing	High	-1%	EU	Manufacturing	High	0%
		Medium	-1%			Medium	-1%
		Medium-high	-2%			Medium-high	-1%
		Medium-low	-1%			Medium-low	0%
	Non-manufacturing	Agriculture	0%		Non-manufacturing	Agriculture	0%
		High	-3%			High	-1%
		Low	-1%			Low	-1%
		Medium-high	-1%			Medium-high	-1%
		Medium-low	-1%			Medium-low	-1%
		Mining	-36%			Mining	-6%

Source: Own elaboration based on ICIO-OECD.

5. Conclusions

Since 2012, a series of geo-economic and geo-political transformations have been observed that have favoured greater regionalisation of production. In this context, we first aim to analyse the general and sectoral scope of these trends based on the behaviour of critical inputs, paying particular attention to

the main macro-regional spaces of the Global North (represented by USMCA and the EU) and the Global South (ASEAN3 and SA), identified as trade blocs. Secondly, we assess the possible consequences of deepening this process through a hypothetical substitution of extra-regional critical inputs.

An essential aspect to highlight is the significance of critical inputs; a shortage lasting just two months could potentially halt all production, underscoring the vulnerabilities in supply chains. This category encompasses not only raw materials but also industrial goods and services. Therefore, our analysis not only delineates the current landscape but also outlines the pathways for the most critical actions required to reduce these regional vulnerabilities.

The results confirm the trend toward regionalisation, particularly after 2012, when the presence of extra-regional critical inputs diminished. While the trends are widespread and concentrated in raw materials, exceptions are identified in some key industries, particularly in high and medium-high technology sectors, where central economies seem to maintain globalised dynamics. When introducing hypothetical exercises on substituting extra-regional inputs, the expected effects of regionalisation vary according to the intensity with which each bloc drives it. Notably, ASEAN3 emerges as the most benefited region from its regionalisation efforts, with an estimated growth of 5.9% in its base Gross Value Added (GVA), contrasting with a more moderate increase of 3% for USMCA.

A significant finding has been the increasing autonomy of the main powers in dispute, highlighting the greater dependence of the Sino-Asian region on the Global South, especially concerning raw materials, compared to the lesser dependence of North America. This structural feature underscores the economic power of the Global North—with its greater control over the economic cycle and capacity for regional isolation—parallels the opportunities and vulnerabilities of Global South economies, stemming from the increasing interrelations of their macro-regional spaces and the driving dynamism of the Sino-Asian macro-regional scenario.

Within this general dynamic at the level of major blocs, SA would be a space significantly impacted if the regionalisation process were to intensify in Sino-Asia. However, this process would not generate homogeneous effects, with the main losers being Chile and Peru due to their role as strategic suppliers of mining resources. The only case where negative effects are more evenly distributed across the region is Europe, which could encourage the adoption of joint trade policies in response to that bloc.

Within SA, the regionalisation through the substitution of critical inputs presents both opportunities and limitations. Opportunities arise from the positive effects that could be generated in the production of goods. In particular, the industries that would benefit the most from this process include medium and high-tech manufacturing, with estimated increases of 19% and 21% in base GVA, respectively, as well as the mining sector (+21%) and non-manufacturing industries linked to medium-high technologies (+11%).

On the other hand, limitations are both economic and political. From an economic standpoint, challenges are highlighted in substituting these goods and services, even those related to mining that are essential for their manufacture. Politically, the asymmetries in the distribution of benefits, concentrated in countries like Argentina and Colombia while being scarcely present in Brazil, the region's main economy, pose significant obstacles that challenge the impetus for integration from Brazil's perspective.

Beyond coordination challenges, this article aims to provide a foundational framework for strategic regionalisation, enabling each country's participation in different stages of production within strategic sectors. In this regard, some ideas for policy formulation could take into account aspects such as the selection of strategic sectors (e.g., the industrialisation of natural resources, the development of local battery industries, or electronic circuit manufacturing for lithium- or copper-related production), the formulation of multi-scalar industrial policies, the establishment of minimum regional content requirements for foreign direct investment, and the provision of regional funding to support Research and Development (RandD).

Additionally, as initially stated, the South American region presents significant economic-spatial asymmetries at the intranational level. While macro-regional integration through manufacturing may generate positive effects, it does not inherently reduce these disparities. Without state intervention that specifically addresses these territorial imbalances, economic dynamics could potentially exacerbate them rather than correct them. For instance, there is a persistent gap between the more lagging areas in northern Argentina and Brazil and their respective industrial centres (González and Santos, 2020).

Regarding this institutional and political dimension and the role of this national space, the promotion of a stronger and integrated macro-region could help alleviate internal tensions and enhance SA's positioning in a global scenario of increasing disputes. A facilitating environment for regional value chains, centred on strategic sectors like the highlighted high-tech industry, would offer clear internal and external benefits. Domestically, it can contribute to strengthening and reducing the productive heterogeneity that dominates the macro-region, fostering a more inclusive and equitable social and economic dynamic. On an international level, this could be a leveraging tool in negotiating with other macro-regional scenarios in the contested and changing global landscape that demands less fragmentation and isolation.

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APPENDIX

TABLE 5. SHARE OF FOREIGN CRITICAL INPUTS IN TOTAL INPUTS DISTINGUISHED BY REGIONS

SA	ASEAN3	USMCA	EU	ALL
4,8%	6,3%	5,4%	8,8%	6,9%
4,9%	6,9%	5,4%	9,0%	7,1%
5,4%	7,4%	6,2%	9,2%	7,5%
5,4%	6,8%	6,0%	9,2%	7,3%
6,1%	6,9%	6,3%	9,5%	7,6%
6,0%	8,0%	7,0%	10,9%	8,5%
6,5%	7,9%	6,4%	10,6%	8,2%
6,6%	8,4%	6,5%	10,2%	8,3%
6,5%	9,0%	6,7%	10,2%	8,6%
7,0%	10,0%	7,3%	10,6%	9,3%
6,6%	10,9%	7,9%	11,5%	10,0%
6,8%	10,9%	8,3%	12,1%	10,4%
7,0%	10,6%	8,3%	12,2%	10,4%
8,0%	11,2%	9,1%	12,8%	11,1%
6,3%	8,7%	7,4%	11,3%	9,1%
7,1%	10,3%	8,4%	13,7%	10,7%
7,1%	10,7%	9,0%	14,5%	11,2%
7,4%	10,0%	8,7%	14,7%	10,8%
7,6%	9,7%	8,4%	14,3%	10,5%
7,4%	9,1%	8,0%	14,0%	10,0%
7,6%	7,3%	7,1%	13,9%	8,8%
6,7%	7,3%	6,6%	13,5%	8,6%
6,8%	8,4%	6,9%	14,1%	9,3%
7,5%	8,8%	7,1%	14,0%	9,6%
7,3%	8,3%	6,7%	14,0%	9,2%
7,3%	7,6%	5,7%	13,1%	8,4%

Source: Own elaboration based on ICIO-OECD.