



## Sustainable development: Theory and some simple simulations

JOSE EDUARDO ALATORRE, GABRIEL PORCILE, FERNANDO SOSSDORF, MIGUEL TORRES\*

### Abstract:

*This paper develops a unified framework to analyze the environmental, social, and economic dimensions of sustainable development within the context of a center-periphery international system. It introduces a three-gap model to address the challenges posed by the discrepancies among three key growth rates: the maximum growth rate compatible with external equilibrium, the minimum growth rate required for social inclusion, and the maximum growth rate consistent with environmental sustainability. Using updated theoretical and empirical insights, the paper applies the model to Latin American economies, highlighting the structural constraints and opportunities for achieving sustainable development in peripheral regions. By quantifying the interactions between technological capabilities, green investments, and social inclusion policies, the study offers policy recommendations to foster balanced and inclusive growth paths aligned with global sustainability commitments.*

Alatorre: Economic Commission for Latin America and the Caribbean (ECLAC), email: [jose.alatorre@cepal.org](mailto:jose.alatorre@cepal.org)  
Porcile: University of the Republic (UDELAR), Montevideo, Uruguay, email: [gabriel.porcile@cienciassociales.edu.uy](mailto:gabriel.porcile@cienciassociales.edu.uy)  
Sossdorf: University of Chile, Santiago, Chile, email: [fsossdor@uchile.cl](mailto:fsossdor@uchile.cl)  
Torres: Economic Commission for Latin America and the Caribbean (ECLAC), email: [miguel.torres@cepal.org](mailto:miguel.torres@cepal.org)

### How to cite this article:

Alatorre J.E., Porcile G., Sossdorf F., Torres M. (2025), "Sustainable development: Theory and some simple simulations", *PSL Quarterly Review*, 78 (312), pp. 115-134.

DOI: <https://doi.org/10.13133/2037-3643/18921>

### JEL codes:

O11, O44, F43, Q01, Q56

### Keywords:

sustainable development, social inclusion, technological capabilities, center-periphery

### Journal homepage:

[https://rosa.uniroma1.it/rosa04/psl\\_quarterly\\_review](https://rosa.uniroma1.it/rosa04/psl_quarterly_review)

In recent years, different contributions have sought to develop models integrating environmental, social, and economic sustainability within a unified framework (Grazini et al., 2024). In a center-periphery international system, the challenges to advance in a sustainable development path are especially daunting and are reflected in differences in three rates of growth—the maximum rate of growth compatible with external equilibrium, the minimum rate of growth necessary for social inclusion, and the maximum rate of growth compatible with a target level of CO<sub>2</sub> emissions. The distinction between “maximum” and “minimum” in these growth rates highlights the trade-offs

---

\* The views expressed in this text are the sole responsibility of the authors and do not necessarily represent those of the organizations with which they are affiliated. The authors are grateful to Jose Luis Oreiro, Giulio Guarini and the organizers of the International Workshop of the Research Group on Structuralist Macroeconomics and Development at the University of Brasilia, June 2024. They are also grateful to two anonymous reviewers. Any remaining errors are the responsibility of the authors. Corresponding author: Gabriel Porcile, [gabriel.porcile@cienciassociales.edu.uy](mailto:gabriel.porcile@cienciassociales.edu.uy).



inherent in achieving sustainable development. While the first-rate depends on international competitiveness, the second reflects internal social needs, and the third incorporates environmental limits. Addressing the gaps between these growth rates requires specific policies and institutional frameworks to enable their convergence, which is discussed in section 1 alongside the adjustment mechanisms that can facilitate this alignment.

This paper builds on and updates previous theoretical and empirical exercises with the three-gap model, using Latin American data to illustrate the challenges faced by peripheral economies. First, the Structuralist tradition in the center-periphery analysis is briefly reviewed, focusing on how the environment emerged as a key issue within this tradition. Secondly, a simple policy-oriented model is developed, linking the three dimensions of sustainable development – economic, social, and environmental – to specific policy interventions. Thirdly, a set of simulations is presented, using a more rigorous methodology than previous papers to estimate the trade parameters. These results provide a clearer picture of the trajectory that key variables should follow for sustainable development in Latin America. The paper concludes by discussing the policy implications of these theoretical and empirical exercises.

## 1. Sustainable development and the center-periphery system

### 1.1. The structuralist perspective on sustainable development

The first formulations of Latin American structuralism discussed the specific problems of economic development in the region and sought to overcome these problems through a program of state-led industrialization (Prebisch, 1950; Bielschowsky, 1998; Rodríguez, 2006). To this end, Prebisch first differentiated developed or central economies from underdeveloped or peripheral ones based on their main structural characteristics. Thus, a peripheral economy, in contrast to a central one, is characterized by low levels of productivity, specialization in commodities with scarce generation of technical progress, a heterogeneous productive structure (in the sense that a significant part of the labor force is in subsistence or in sectors with very low labor productivity), and institutions oriented more towards the maintenance of Ricardian or political rents than towards technological progress (Prebisch, 1950; Fajnzylber, 1983; Nochteff, 1996; Rodríguez, 2006). Thus, given these asymmetrical structural features, according to Prebisch (1950), the problems of Latin American industrialization (which was considered the path towards economic development) can be explained by deteriorating terms of trade, foreign exchange shortages, balance of payments imbalances, and inflationary pressures. This center-periphery system outlined by Prebisch constituted a general interpretation of global capitalism, characterized by two poles whose asymmetries gave rise to relations of dependence and subordination in favor of the central economies, resulting in a system of unequal development (Torres and Ahumada, 2022).

Initially, the focus of the Structuralist authors was only on the economic aspects of industrialization, without considering social and, especially, environmental elements until the early 1960s. The first mentions of the relationship between environment and development were in relation to the role of natural resources and their rents (Porcile and Torres, 2024). Subsequently, Prebisch expressed some concerns about the deterioration of biodiversity due to the action of private economic activity and the social effects of environmental pollution generated by such activity (Prebisch, 1963, 1970). According to Porcile and Torres (2024), the environmental perspective of structuralism began to take shape towards the end of the 1970s

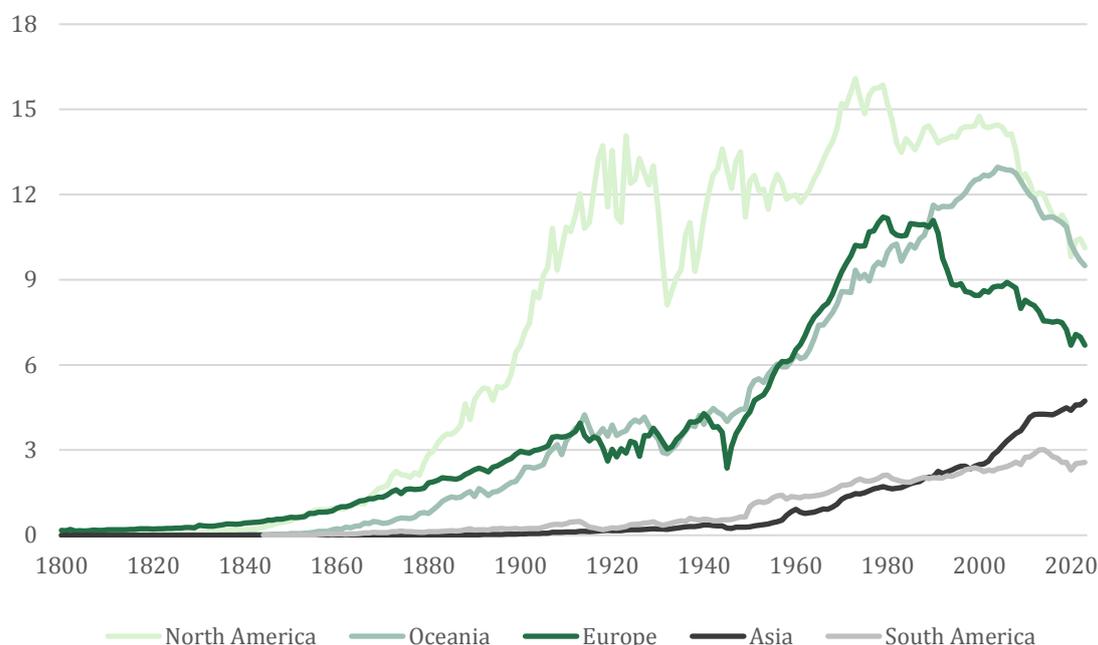
with a substantive contribution led by Osvaldo Sunkel and an interdisciplinary team of researchers who established this perspective within ECLAC. It is necessary, however, to mention some previous antecedents that helped to put the environment on the ECLAC agenda. First, the creation in 1971 of the United Nations Environment Programme (UNEP) and the studies by Meadows et al. (1972) on the limits of growth and the bioeconomic approach of Georgescu-Roegen (1971). These works laid the first analytical foundations for the relationship between the economy and the environment on a global scale. Secondly, Furtado (1974) argued that peripheral economies could not replicate the growth pattern of central economies because natural resource reserves are finite and incapable of reproducing such patterns at a global scale. He pointed out that environmental pollution and consequent increases in global temperature would put life on Earth at risk (see Lima et al., 2024).

In addition to the above, some ECLAC structuralist authors introduced an important and useful concept that would complement the analytical tools of Structuralism: development styles. Thus, Pinto (1976) defined a development style as how society organizes itself to allocate human and material resources to solve the problem of production, consumption, and distribution of the fruits of growth. He stressed that the interaction between economic structure and distributive dynamics tended to generate a perverse development style in peripheral societies, reproducing a regressive income distribution. Graciarena (1976) defines development style as the concrete and dynamic modality adopted by a social system in a defined sphere and at a given historical moment. This modality is influenced by conflicts between groups with diverse class interests, resulting in a dialectical process between power relations and social conflicts. These derive from the dominant forms of capital accumulation, the structure and trends of income distribution, the historical conjuncture, external dependence, and prevailing values and ideologies.

The concept of development styles elaborated by these authors contributed to build a bridge between the environmental aspects of development and the economic discussion of the Structuralist school. Indeed, when Sunkel and his team began to study the environmental dimension in development, they used the concept of development style (Sunkel, 1980, 1981). Thus, the fundamental aspects that will shape Sunkel's thinking on sustainable development can be summarized in the following points: 1) the recognition of the concrete effects that economic growth has on biodiversity in terms of pollution and waste generation; 2) the relationship between environmental damage and poverty; 3) ecosystemic biocapacity as an asset and as an economic resource; 4) environmental deterioration as a costly inefficiency in the development process; 5) the inter- and intra-generational distributive implications of the destruction of the environment; and 6) environmental management as a requirement for a functional development style (see Porcile and Torres, 2024; Lima et al., 2024).

Finally, from a historical and structural perspective, it is extremely important to point out that center-periphery relations generate not only economic asymmetries but also geopolitical subordination of the global South to the global North. These phenomena are also adversely replicated at the environmental level. If the fruits of the economic process are distributed unequally between the peripheral and central poles, the distribution of the environmental damage generated by global capitalism is also regressive, as can be seen in figure 1, which shows the long-term evolution of per capita CO<sub>2</sub> emissions for selected central and peripheral regions. The accelerated and sustained growth in the level of emissions generated in North America, Europe, and Oceania since 1800, and the gap between them and South America and Asia is striking. This stylized fact undoubtedly poses a complex international political economy puzzle to enable a sustainable development style in the periphery in harmony with the central growth style. An analytical model that addresses these asymmetries is presented in subsection 1.2.

Figure 1 – *A center-periphery environmental asymmetry*  
(per capita CO<sub>2</sub>\* emissions by world region 1800-2023, in tonnes)



Source: own elaboration based on Our World in Data (<https://ourworldindata.org/co2-and-greenhouse-gas-emissions>).

\* Carbon dioxide (CO<sub>2</sub>) emissions from fossil fuels and industry. Land-use change is not included.

## 1.2. A policy-oriented model of sustainable development

### *The competitiveness function: economic sustainability*

Sustainable growth must meet three fundamental conditions: (a) it should be consistent with the balance of payments (BOP)-constrained growth rate, ensuring external equilibrium; (b) it must reduce inequality and foster social inclusion; and (c) it must comply with environmental commitments, particularly those established under the Paris Agreements. As argued by Porcile (2024), these three dimensions of sustainability—economic, social, and environmental—are crucial to defining a sustainable growth path.

These conditions can be captured by three distinct growth rates: i)  $y^P$  is the maximum rate of growth compatible with external equilibrium, where the rate of growth of exports matches that of imports, keeping the current account in a stable position (assuming no initial external debt); ii)  $y^S$  is the minimum rate of growth necessary to create formal employment, reduce poverty, and foster income redistribution, thereby promoting social inclusion and equality; and iii)  $y^e$  is the maximum rate of growth that aligns with a target level of emissions ( $e^*$ ), reflecting the tendency for GDP growth and emissions growth to move in tandem (more on this below).

Achieving these three conditions simultaneously poses a complex challenge, as these objectives often compete or entail trade-offs. This highlights the need for an analytical framework that captures the interactions between economic, social, and environmental dimensions of sustainable development.

Various models in the literature explore these interactions, placing environmental sustainability and social inclusion at the center of economic analysis (Magacho et al., 2023, 2024; Stark et al., 2023; Grazini et al., 2024). All these models offer valuable insights and stress different aspects of sustainable development. We will build on the three-gap model because it allows us to focus on center-periphery technological and productive asymmetries that strongly condition the growth path of the economies of the global South. Our analysis is empirically grounded in Latin American data. This allows us to extend prior research (e.g., Althouse, 2020; ECLAC, 2020; Porcile et al., 2023; Alatorre et al., 2024) and provide a comprehensive perspective on the challenges faced by peripheral economies in achieving sustainable development.

Economic sustainability, in this context, is defined using the BOP-constrained growth model. Here,  $y^P$  represents the long-run growth rate determined by the external equilibrium, described by the following equation:

$$y^P = \frac{\varepsilon}{m} y^C = f[h, \mu, \omega] y^C \quad (1)$$

The long-run equilibrium rate of growth equals the ratio between the income elasticity of the demand for exports ( $\varepsilon$ ) and the income elasticity of the demand for imports ( $m$ ), multiplied by the growth rate of the rest of the world ( $y^C$ ). Considering a center-periphery system from the perspective of the periphery, the “home” economy in equation (1) refers to the periphery. In contrast, the rest of the world corresponds to the center – denoted by the superscripts  $P$  and  $C$ , respectively. This equation implies that if the periphery grows at a rate exceeding the one consistent with external equilibrium, it will accumulate unsustainable levels of foreign debt. Eventually, this imbalance would necessitate reducing the periphery’s growth rate to avoid external and exchange rate crises (for a detailed discussion, see Blecker and Setterfield, 2019; Blecker, 2022). In this context,  $y^P$  represents the maximum growth rate compatible with external equilibrium.

Moreover, equation (1) incorporates the idea that the income elasticity ratio between the demand for exports and imports depends on key variables that shape a country’s ability to compete globally across different sectors.

The first critical variable is the technological capabilities in the periphery ( $h$ ). Extensive literature underscores the key role of technological competitiveness in driving long-run growth and exports (Dosi et al., 1990; Dosi and Nelson, 1994; Fagerberg and Verspagen, 2002; Freeman, 2004; Cimoli and Porcile, 2011; Dosi et al., 2010, 2015). Higher technological capabilities enhance the degree of diversification and sophistication of the production structure, improving the  $\varepsilon/m$  ratio. Technological capabilities evolve as a function of the technology gap between the center and periphery, defined as  $H = \frac{h^C}{h^P}$ . Following Basilio et al. (2019), we assume that building technological capabilities in the periphery is a linear negative function of the gap:

$$\hat{H} = \hat{h}^C - \hat{h}^P = \underbrace{-(h_0 + h_1 H)}_{-\hat{h}^P} + \hat{h}^C, \hat{h}^C > h_0 \quad (2)$$

In equation (2),  $\hat{h}^C$  represents the exogenous rate of growth of technological capabilities in the center,  $h_0$  is the autonomous component of technological learning in the periphery (hence the term  $\hat{h}^C - h_0$  is the difference in the growth rate of autonomous technical change in center and periphery), and  $h_1 H$  is the technological learning in the periphery associated with technological spillovers from the center. The higher the technology gap between the two regions, the higher the technological spillovers to the periphery, given the parameter  $h_1$ , which reflects the ability of the periphery to learn out of the stock of technology in the center. The equilibrium technology gap is given by:

$$\hat{H} = 0 \rightarrow h^* = \frac{\hat{h}^C - h_0}{h_1} \quad (3)$$

The level of the gap will increase when the international technological frontier (represented by the technological capabilities in the center) moves faster and decrease when the periphery steps up its efforts at catching up, as represented by a higher  $h_0$  and  $h_1$ . These parameters, in turn, depend on the strength of the National System of Learning in the periphery (Lundvall, 2007). This specification of the technology gap dynamics is extremely simple but allows us to focus on the institutional conditions for sustainable development.<sup>1</sup>

The second critical variable is the share of green capabilities in total technological capabilities ( $\mu$ ). The inclusion of  $\mu$  reflects growing global concerns about environmental sustainability in international trade negotiations and the possibility of trade barriers targeting carbon-intensive exports (e.g., carbon border taxes, as discussed in the European Union). This is related to the “Porter Hypothesis”, which posits that pro-environment regulations can evolve into a competitive advantage. As Dávila-Fernández and Sordi (2020) argue, disseminating pro-environment sentiments across economic actors, driven by the increasing awareness of the negative consequences of climate change becoming common knowledge, reinforces this hypothesis. Green capabilities are increasingly seen as a competitive advantage not only by trade officials and the international bureaucracy, but also in the political debate, as climate change has become an important topic in public opinion.

The prospect of a carbon tax on the border increases with heightened environmental concerns among consumers and governments. Moreover, the role of  $\mu$  in competitiveness may also stem from technological externalities associated with investments in green technological capabilities. Green energy, greener production processes, and green products are more technology-intensive than most of the “brown” goods the periphery exports. Romero and Gramkow (2021) show that emissions per unit of GDP tend to be negatively correlated with economic complexity, an indicator of advanced and diversified technological capabilities. This underscores a significant connection between competitiveness, technology, and environmental sustainability.

The third critical variable is the wage share in GDP ( $\omega$ ), which affects the specialization pattern. Under certain conditions, it is possible to show that  $\omega$  and the real exchange rate ( $q = P^*E/P$ ) exhibit a negative association: higher  $\omega$  leads to a lower  $q$ . These conditions may include imperfect competition with a variable mark-up factor (Blecker and Setterfield, 2019, pp. 190-191). A similar conclusion is reached if the relative real unit labor costs between the center and

---

<sup>1</sup> In particular, a nonlinear specification of the catching-up function would be a more realistic representation of technological spillovers to the periphery (see Verspagen, 1993). However, to maintain the model’s simplicity, we adopt a linear specification, which still effectively conveys the key message: the importance of active policies in building the institutions and technological infrastructure necessary for catching-up. For more on absorptive capabilities and the catching-up process, see Cohen and Levinthal (1990), Criscuolo and Narula (2008), and Bianchi et al. (2023).

periphery is taken as an indicator of price competitiveness. The real unit labor cost in the periphery is  $RULC^P = \frac{W}{VP}$ , where  $W$  is nominal wages,  $P$  is the price level,  $W/P$  is the real wage, and  $V = \frac{Y}{L}$  is labor productivity. The real unit labor cost in the center is  $RULC^C = \frac{W^C}{V^C P^C}$ . Defining the wage share in GDP as  $\omega = \frac{WL}{PY}$ , it is straightforward that the real unit labor cost equals the wage share. Therefore, the periphery-center relative real unit labor cost is the inverse of the periphery-center wage share  $RRULC = \omega/\omega^C$ . If  $\omega^C$  is exogenous (which is true if the periphery is a small country),  $\omega$  can be used as a proxy for the periphery's price competitiveness. A higher  $\omega$  reduces price competitiveness. The importance of the real exchange rate as a source of export growth, and its interactions with technical change and industrial policy have been extensively discussed in the literature (Ocampo, 2016; Palazzo and Rapetti, 2017; Oreiro, 2020; Guarini and Oreiro, 2022; Palazzo, 2024).

### *Employment and productivity*

The rate of employment growth in this economy is the difference between the rate of economic growth and labor productivity growth, as expressed in equation (4):

$$\hat{L} = y^P - v \quad (4)$$

Equation (5) defines the rate of labor productivity growth. It is assumed to be a function of labor-saving technical change, which depends positively on the economic growth rate (Kaldor-Verdoorn effect) and the wage share (Carnevali et al., 2020). A higher wage share increases the incentives in this economy to introduce labor-saving innovations (see Storm and Naastepad, 2012, chapter 5; Marquetti et al., 2024, pp. 43-44).

$$v = v_0 + v_1 y^P + v_2 \omega \quad (5)$$

Using equations (1), (4), and (5), we derive:

$$\hat{L} = y^P - v = f[h, \mu, \omega] = y^P(1 - v_1) - v_0 - v_2 \omega \quad (6)$$

As generally accepted in Post-Keynesian and Structuralist models, income distribution depends on the relative power of capitalists and workers in labor and product markets. Formally:

$$\omega = \omega(\hat{L}, \emptyset), \omega'(\hat{L}) > 0, \omega'(\emptyset) > 0 \quad (7)$$

Equation (7) states that the wage share  $\omega$  responds positively to two forces. The first is the rate of growth of labor demand in the “modern” sector,  $\hat{L}$ , which strengthens workers' bargaining power in the labor market. The second force arises from social conventions regarding what is considered a socially acceptable consumption basket for workers ( $\emptyset$ ). These conventions are embedded within institutions that provide social protection, monetary transfers, and other forms of income redistribution to promote equality. In this sense,  $\omega$  can be understood as a form of

“social wage” that emerges from labor market dynamics and political decisions related to the welfare state and labor protection.

Finally, environmental sustainability is represented by CO2 emissions, as expressed by the following equation:

$$e = E(y^P, \mu), \quad E_{y^P} > 0, E_{\mu} < 0 \quad (8)$$

The rate of growth of emissions is positively influenced by economic growth and negatively influenced by green capabilities within total capabilities.

### *Defining the conditions for sustainable development and the space of social, technological, and environmental policies*

The above equations allow us to identify the conditions required for sustained development. While these conditions are defined at a theoretical level, they will be quantitatively specified in the next section.

First, we define the desired social wage of the economy,  $\omega^S$ , based on social norms consistent with a stable democratic political system. Given  $\emptyset$ , equation (7) returns the rate of growth of employment consistent with the desired wage share:

$$\hat{L}^S = y^P - v = f[h, \mu, \omega^S]y^C(1 - v_1) - v_0 - v_2\omega^S \quad (9)$$

Here, given  $\emptyset$  and the parameters of technical progress ( $v_0, v_1, v_2$ ) the focus necessarily shifts to the growth rate  $y^S$ ,<sup>2</sup> that generates the desired level of employment  $L^S$ . However, this growth rate implies a certain level of emissions, as per equation (8). This level of emissions may be higher than the one required for sustainability from an environmental point of view. In other words, the growth rate necessary for creating jobs could lead to higher emissions levels than those required for environmental sustainability.

Thus, it is necessary to find the combination of values for  $\mu$  and  $h_1$  that simultaneously satisfy  $e = e^*$  and  $y^P = y^S$ . This results in a system of two equations with two unknowns: the structural parameters related to technological capabilities and competitiveness ( $h_1$ ) and the resources allocated to building the green capabilities required to curb emissions ( $\mu$ ). Given the positive correlation between emissions and GDP growth, it is always possible to find a maximum rate of growth  $y^e$  that is compatible with the rate of growth of emissions  $e^*$ . However, this growth rate is likely much lower than the growth rate necessary for social equilibrium, i.e.,  $y^e < y^S$ .

The equilibrium technological gap in equation (2) is determined as  $h^* = \frac{\hat{h}^C - h_0}{h_1}$ , where  $\hat{h}^C - h_0$  is the difference in the autonomous rate of growth of technological capabilities in the center and periphery, respectively, and  $h_1$  captures the periphery’s rate of catching-up through international technological spillovers. We assume that the autonomous components are given and focus on how changes in  $h_1$  (the ability of the periphery to learn from the center) affect technological competitiveness.

<sup>2</sup> Note that if there are social policies that succeed in improving welfare for a given level of employment growth, then a lower  $y^S$  will be consistent with the desired  $\omega^S$ .

$$e^*(\mu, y^S) = y^S(h_1, \mu, \omega^S) \quad (10)$$

$$y^S = \epsilon[h_1, \mu, \omega^S]y^C \quad (11)$$

Theoretically, it is possible to find a set of values for the parameters  $\mu, \emptyset, h_1$  that ensures that the economy moves along a sustainable development path, represented by  $e^*, y^S, \omega^S$  – the desired rate of emissions, economic growth and wage share, respectively, that define the sustainable development path – given all the other parameters,  $h_0, \hat{t}^C, v_0, v_1, v_2$ , and the functions  $\epsilon(\cdot)$  and  $\omega(\cdot)$ . In economic policymaking, advancing towards this path would be a complex process (from a technological, productive and political point of view) – mired by difficulties and based on trial-and-error learning – that would probably fail to comply with all the required conditions most of the time (for a stylized discussion of the political economy of this transition see Gatti, 2022). Nevertheless, those parameters and functions provide broad indications of the direction investment policies and institutional building should take.

The purpose of this policy-oriented model is to emphasize the institutional and policy changes required to attain certain objectives rather than to find a set of equilibrium values for the variables given the values of the institutional and policy parameters.

We highlight the model parameters where institutions and policies could make a difference (see also Alatorre et al., 2024; Grazini et al., 2024). For simplicity, we assume  $\emptyset$  is given and then sequentially find the required values for the other parameters. However, a more realistic model should explore the potential interactions among all variables. The possibility that  $\emptyset$  (the welfare function) could have a significant impact on learning and, consequently,  $h_1$  is extremely important and well-documented in the literature (Evans and Heller, 2015). Virtuous feedback loops between  $\mu, \emptyset, \omega$  may exist, enhancing the feasibility of achieving a sustainable development path.

## 2. Simulations: a set of quantitative goals for sustainable development in Latin America

### 2.1. Estimating the rate of growth for social sustainability, $y^S$

The following estimations focus on Latin America as a region, aggregating the economies of the entire area. As defining and measuring the desired social wage share ( $\omega^S$ ) for social sustainability is complex, we approximate it using a more straightforward indicator, namely what it takes to achieve the total eradication of poverty. This is an imperfect measure of the welfare implications of growth but a powerful one in countries that show such high poverty levels in total population, as is the case for most Latin American economies. In 2022, the percentage of people living in poverty was 29% of Latin America's total population (181 million). In 2022, about 39% of the total households in the region (54.2 million) depended exclusively on informal employment (ECLAC, 2023a).

A combination of monetary transfers and the expansion of formal employment can eliminate poverty. We first define a certain amount of monetary transfers representing the parameter  $\emptyset$  in the model. Then, we estimate the growth rate of the economy that generates the desired level of employment,  $y^S$ , which, combined with the transfers, allows for the eradication of poverty in 2030. Two growth scenarios are considered for the 2024 to 2030 period. The first scenario

assumes that the region keeps the rate of growth from 1990 to 2023 at approximately 2.5% per year, while the second scenario assumes a yearly regional economic growth of 4%. The method for estimating the elasticity of poverty to growth can be found in Appendix A at the end of the article.

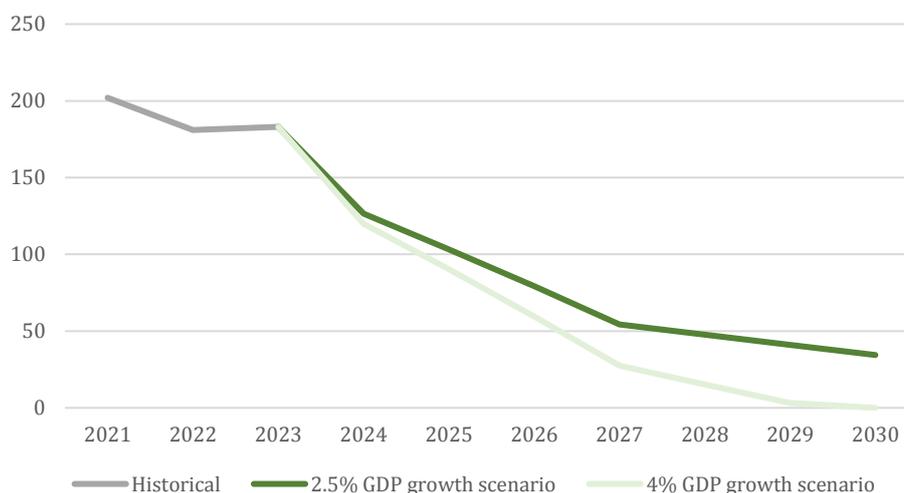
The redistribution strategy (which defines  $\emptyset$  in equation (7)) is to tax the richest 10% and use the taxes to transfer an amount equivalent to one monetary poverty line to the poor. The initial tax and transfers equal 1.5 percentage points of the income share in GDP of the richest 10%.<sup>3</sup> The tax and transfers then increase 0,5 percentage points every year until reaching 3 percentage points in 2027. Taxes and transfers remain at the same level thereafter.

Table 1 – Poverty levels by different growth and redistribution scenario, 2030

| Economic growth (%) | Poverty levels, 2030 (million people) | Poverty levels including a redistribution policy, 2030 (million people) |
|---------------------|---------------------------------------|---|
| 2.0                 | 166                                   | 49  |
| 2.5                 | 156                                   | 34  |
| 3.0                 | 146                                   | 19  |
| 3.5                 | 136                                   | 5   |
| 4.0                 | 128                                   | 0   |

Source: authors' calculations.

Figure 2 – Poverty levels by GDP growth scenario, 2021 – 2030



Source: authors' calculations.

Note: the estimates of the fall in poverty assume the gradual redistribution of three percentage points of the income of the top 10 % towards the poor.

<sup>3</sup> The top decile receives 21 times as much income as the bottom decile in 2022 (ECLAC, 2023a).

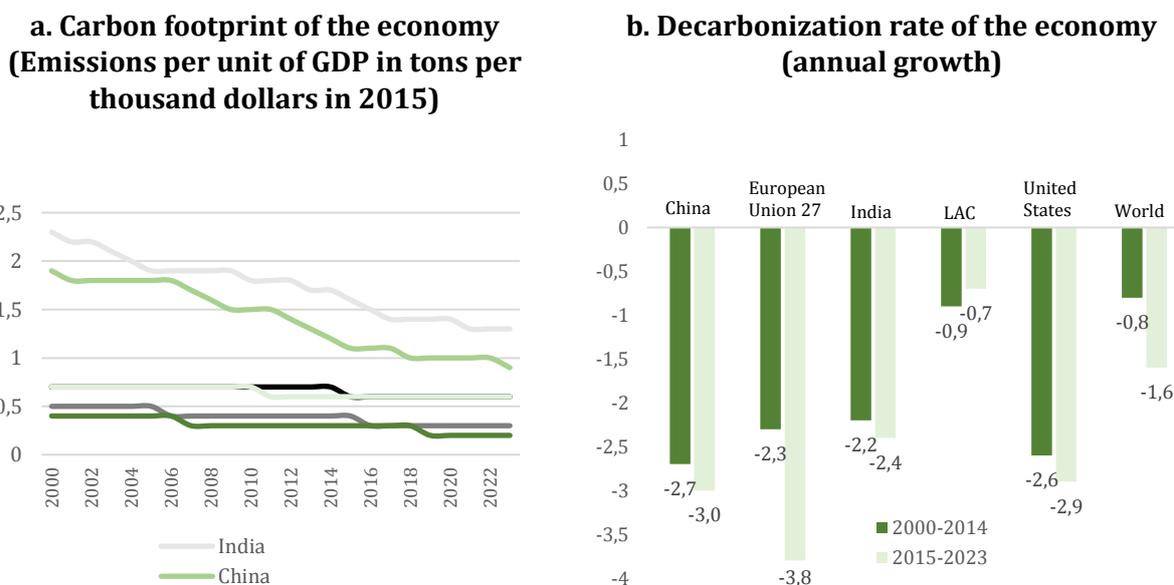
Table 1 and figure 2 show that “pure” income redistribution is not enough to eradicate poverty; growth also plays a critical role. Indeed, the simulations suggest that a rate of growth of approximately 4% is the minimum growth rate required to create formal jobs that – along with income distribution – eradicate poverty by 2030. In other words, the rate of growth consistent with the objective of social sustainability  $y^S$  is approximately 4%.

### 2.2. Promises and actual trends in the decarbonization rate

Emissions are strongly linked to economic activity, especially GDP growth. This relationship has been weakened by technical change over time, leading to fewer emissions generated per unit of global production. This decoupling is due to improvements in energy efficiency, the greater proportion of renewables in the energy matrix, and the penetration of electromobility, among other factors. However, the rate of decoupling is far from the rates needed to achieve the goals mentioned above (ECLAC, 2023b).

In 2023, the world emitted an average of 0.6 tons per thousand dollars. This indicator is a measure of the carbon footprint of the economy and, in general, has been falling over time, which implies that a decarbonization process is indeed taking place (see figure 3a). Decarbonization should be expected to gain momentum after the signing of the Paris Agreement in 2015. Globally, this has been the case: between 2000 and 2014, the economy decarbonized at a rate of 0.7% per year, and from 2015 it doubled this speed (see figure 3b). However, this did not happen in Latin America. While the region generates practically the same number of emissions per unit of GDP as the global average, the trend is not promising, as the speed of decarbonization has decreased slightly.

Figure 3 – Carbon footprint and decarbonization trends by countries and regions



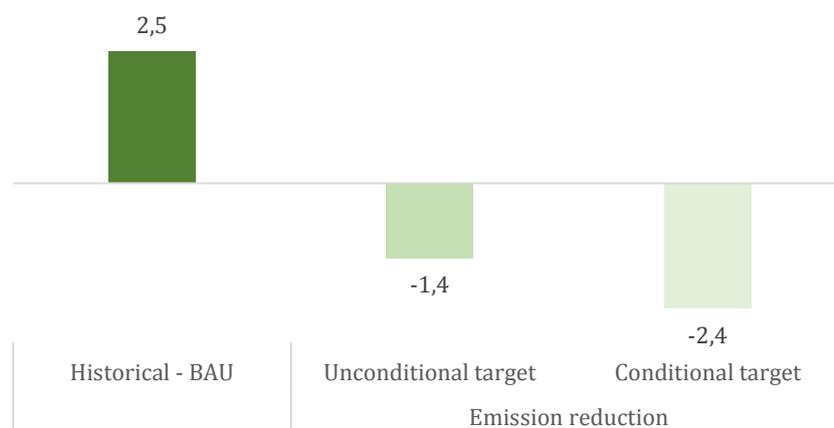
Source: authors’ elaboration based on World Bank World Development Indicators and European Commission and others (2023), GHG emissions of all world countries – 2023, Publications Office of the European Union.

Note: Emissions exclude land use change.

The commitment Latin America has made after the Paris Agreements in the National Determined Contributions (NDCs) is to reduce emissions by 24% in 2030 concerning a business-as-usual scenario; in case there is international assistance to development, the target would be a 29% reduction in emissions (ECLAC, 2023b). We will use these benchmarks (set by the Latin American countries themselves) to define the growth rate consistent with environmental sustainability. Therefore, we estimated the growth rate consistent with this emission reduction (NDCs of 24% and 29 %), assuming that the historical decarbonization rate of 0.7% per year remains, i.e., that there are no additional efforts towards decarbonization.

Figure 4 shows that without a more aggressive investment in reducing emissions – i.e. if the decarbonization rate continues to evolve as in the past 10 years – attaining the climate targets of the region would imply degrowth, which is inconsistent with the social objectives mentioned above. For the economy to keep growing at 2.5% per year and, at the same time, achieve the climate targets, the decarbonization rate should increase 7 times in the unconditional scenario and by 8 times in the conditional scenario with respect to the historical rate. If the economy aims to grow at 4 % per year, the decarbonization rate must be 9 and 10 times as fast as the historical rate for the unconditional and conditional scenarios.

Figure 4 – GDP growth consistent with emission reduction, 2024-2030



Note: author's calculations.

### 2.3. Structural change and the BOP-constrained rate of growth

There is no endogenous mechanism in the economic system that ensures attaining either the rate of growth consistent with social goals or the rate of decarbonization necessary to comply with the promises made in the NDCs (as discussed in the previous section). On the other hand, there are endogenous mechanisms that will make the economy converge towards the growth rate consistent with external equilibrium. The rise of external debt, an exchange rate crisis, or a higher risk premium on new loans to a country already heavily indebted to foreign currency are forces that curb economic growth when it runs beyond the BOP-constrained growth rate. This is

especially valid in a world with high capital mobility and open capital accounts (Kaltenbrunner and Paineira, 2015; Hein and Truger, 2012; De Paula et al., 2017).

Table 2 – *Observed and estimated rates of growth using the BOP-constrained rate of growth*

|                      | <b>Observed rate of growth,<br/>1962-2023</b> | <b>Estimated rate of growth,<br/>1962-2023</b> |
|----------------------|---|--|
| Argentina            | 2.2%  | 2.3%   |
| Brazil               | 3.7%  | 3.6%   |
| Chile                | 3.8%  | 4.3%   |
| Colombia             | 3.9%  | 3.6%   |
| Mexico               | 3.5%  | 3.4%   |
| Peru                 | 3.2%  | 3.3%   |
| <b>Latin America</b> | <b>3.2%</b>                                   | <b>3.4%</b>                                    |

*Source:* authors' elaboration based on the United Nations, *UN Comtrade database*, and World Bank World Development Indicators.

*Note:* in estimating the Latin American aggregate income elasticity of exports, each country's income elasticity is weighted by its share of the total regional GDP.

Table 3 – *Income elasticity of the demand and Lall's typology of technological intensity*

|                      | <b>Primary<br/>products</b> | <b>Resource-based<br/>manufactures</b> | <b>Low-technology<br/>manufactures</b> | <b>Medium-technology<br/>manufactures</b> | <b>High-technology<br/>manufactures</b> |
|----------------------|-----------------------------|--|--|---|---|
| Argentina            | 0.605                       | 0.631                                  | 0.999                                  | 1.393                                     | 3.272                                   |
| Brazil               | 0.635                       | 0.631                                  | 2.019                                  | 2.718                                     | 2.628                                   |
| Chile                | 1.342                       | 1.716                                  | 1.923                                  | 2.278                                     | 3.062                                   |
| Colombia             | 0.934                       | 1.745                                  | 1.736                                  | 2.170                                     | 2.646                                   |
| Mexico               | 0.647                       | 0.943                                  | 1.654                                  | 2.845                                     | 4.165                                   |
| Peru                 | 0.918                       | 1.081                                  | 1.481                                  | 1.973                                     | 2.422                                   |
| <b>Latin America</b> | <b>0.692</b>                | <b>0.851</b>                           | <b>1.707</b>                           | <b>2.466</b>                              | <b>3.199</b>                            |

*Source:* authors' elaboration based on the United Nations, *UN Comtrade database*.

Recall that the BOP-constrained growth model suggests that the equilibrium rate is  $y^P = \frac{\varepsilon}{m} y^C$ , where  $\frac{\varepsilon}{m}$  is the income elasticity ratio. Table 2 shows the observed growth rates in the 1962-2023 period and the estimated rates using the BOP-constrained growth model for different Latin American economies and the Latin American region. It can be seen that the growth rates predicted by the model approach the observed rates very well. For the technical details of the econometric estimation of the income elasticity ratio, see Appendix B.

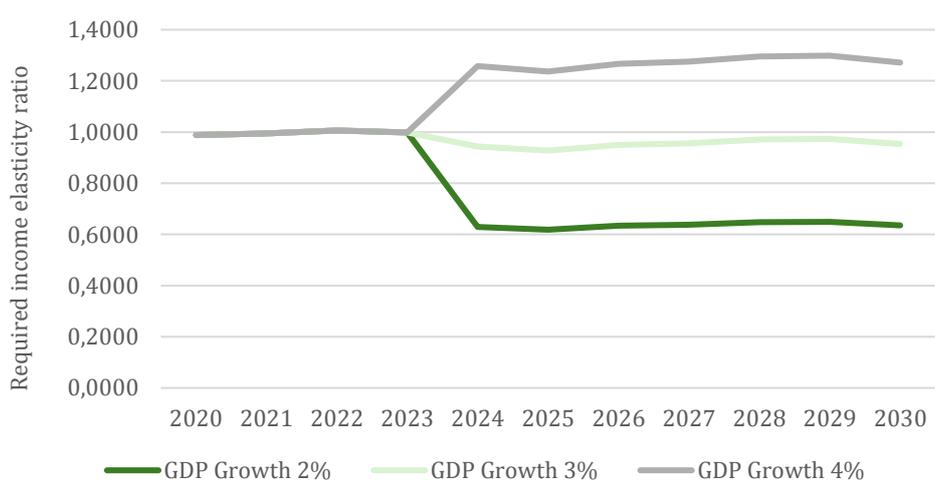
It was mentioned that the income elasticity ratio is a function of the importance of technology-intensive sectors in the production structure. The idea that technology-intensive sectors show a higher income elasticity of exports is vital to establish a link between specialization and long-run growth – and, clearly, a link between the Schumpeterian/Structuralist view on technology and international competitiveness and the Keynesian view about the role of demand (more specifically, the demand for exports and imports) as an explanation of economic growth. Using the well-known Lall typology (Lall, 2000), table 3 shows that those more technology-intensive sectors also show a higher income elasticity of export demand.

Table 4 – *Growth, poverty, and the required income elasticity ratio*

| <b>Economic growth in Latin America (%),<br/>2024-2030</b> | <b>Required elasticity ratio</b> |
|--|----------------------------------|
|  | $\varepsilon/\pi$                |
| 2  | 0.64                             |
| 2.5  | 0.79                             |
| 3  | 0.95                             |
| 3.5  | 1.11                             |
| 4  | 1.27                             |

Source: authors' elaboration based on the United Nations, UN Comtrade database, and IMF, World Economic Outlook data, and IMF staff estimates.

Figure 5 – *Required Elasticity Ratios for Different GDP Growth Scenarios in Latin America, 2024–2030*



Source: authors' elaboration based on the United Nations, UN Comtrade database and IMF, World Economic Outlook data, and IMF staff estimates.

This positive association between technological capabilities and the dynamism of demand can be identified at each country's level and the Latin American region as a whole.

Finally, table 4 shows the desired rate of growth and the associated income-elasticity ratios that would allow for attaining those rates without facing external unbalances. All the exercises assume a cumulative global economy growth rate of 3.5 % annually.

Figure 5 shows that the historical income-elasticity ratio is close to unity. This ratio does not allow for convergence with the center countries – since, to keep the external balance, the region should grow at the same rate as the center, implying that the income per capita difference between the center and periphery would persist over time. We are particularly interested in the income elasticity ratio required for a 4% growth rate, which is required to eradicate poverty ( $y^S$ ). This ratio is about 1.2, significantly higher than the unity, which in turn implies that a major transformation of the pattern of specialization would be required (in the direction of a higher share of sectors more technology-intensive in GDP and export) if the Latin economies are to achieve the desired rate of 4%.

### 3. Concluding remarks

The policy-oriented model presented in this paper focuses on the structural and institutional changes required to transition towards a sustainable development path in Latin America. In line with other exercises made with the same model, the minimum growth rate necessary for social sustainability was estimated to be about 4% per year. This growth would create the formal jobs required (in parallel with a process of income redistribution) to lift the poor from below the poverty line in the region.

However, to attain this growth rate without creating external imbalances that could eventually compromise the continuity of growth, the income elasticity ratio should increase from about unity to 1.2. This, in turn, implies a significant process of structural change to transform the production structure in the direction of more technology-intensive sectors, which would allow the periphery to participate in more dynamic international markets. However, even if this transformation is attained, growth can be sustained at the desired 4%; in a business-as-usual scenario, this would be incompatible with the NDCs. Technical change must have a direction: the building of technological and productive capabilities and the efforts at innovation and catching up should have decarbonization and the protection of the environment at its core. Our estimates indicate that the rate of decarbonization in Latin America should be multiplied by a factor of 9 to 10 if the region is to comply with the NDCs and grow at 4%.

Addressing the multiple challenges of sustainable development requires a broad array of policies and institutions, carefully coordinated, long-term strategies for structural change, and constructing a welfare state that supports social inclusion and the positive impacts on innovation and learning associated with universal education and health services. The model presented gives a sense of the magnitudes and direction of the changes required. Still, the key problems are probably not on the technical side of the transition (although they are certainly important) but on the political side. A transition towards sustainable development implies a strengthening of the strategic role of the state and a redistribution of power and income that would certainly face resistance. It also needs levels of international cooperation that are at odds with the rise of geopolitical rivalry and the collapse of multilateral institutions, which make these policies less likely and effective.

## Appendix A

### Estimating the elasticity of poverty to economic growth

The elasticity of poverty to growth for Latin American countries,  $\eta$ , is obtained from a standard model, which includes, in addition to the change in income or consumption, changes in income distribution, represented by the Gini index:

$$\Delta p_{it} = \eta * (1 - Gini_{it-1})\Delta y_{it} + v_{it} \quad i = 1, \dots, N \quad t = 1, \dots, T \quad (A1)$$

where lowercase letters represent the natural logarithm of the variables, therefore  $\Delta p_{it}$  represents the annual growth rate of the poverty count index in the country  $i$  in year  $t$ ,  $\Delta y_{it}$  symbolizes the growth rate of GDP per capita, or average income or consumption per person,  $Gini_{it-1}$  is the Gini index by country, in this case the initial measure of inequality. Finally,  $v_{it}$  is the error term.

Information on poverty data, GDP per capita, and the Gini index were obtained from ECLAC's statistical database, CEPALSTAT.<sup>4</sup> The final database contains 247 observations from 18 countries<sup>5</sup> from 2000 to 2019. In the case of Argentina, poverty measurements are used for the urban area; for the rest of the countries, the poverty indicator is national. The results are presented in table A1.

Table A1 – Regressions of poverty and economic growth

|                                  |                                  |
|----------------------------------|----------------------------------|
| $(1 - Gini_{it-1})\Delta y_{it}$ | Elasticity<br>-3.37***<br>(0.59) |
| R <sup>2</sup>                   | 0.34                             |
| Adj. R <sup>2</sup>              | 0.34                             |
| Obs                              | 247                              |
| Countries                        | 18                               |

Note: robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

<sup>4</sup> [http://estadisticas.cepal.org/cepalstat/WEB\\_CEPALSTAT/Portada.asp](http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp)

<sup>5</sup> Argentina, Bolivia (Est. Plur.), Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela (Rep. Bol.).

## Appendix B

### Estimating the income elasticity ratio

We use a Multi-sectoral Thirlwall's Law to estimate the income elasticity ratio (Araujo and Lima, 2007). The model postulates that a country produces a range of goods with different elasticities. This defines the equilibrium growth rate as:

$$y_{BMS_t} = \frac{z_t \cdot \sum_{i=1}^n w_{xi} \cdot \varepsilon_i}{\sum_{i=1}^n w_{mi} \cdot \pi_i}$$

Where  $\varepsilon_i$  is the income elasticity of exports of sector  $i$ ,  $\pi_i$  is the income elasticity of imports of sector  $i$ ,  $w_{xi}$  and  $w_{mi}$  are the shares of exports and imports of the sector  $i$  in total exports and imports.  $z_t$  is the growth rate of the rest of the world.

To estimate  $\varepsilon_i$  and  $\pi_i$  for each technological sector, we have the following equations:

$$\ln M_{it} = \psi_i \cdot \ln R_t + \pi_i \cdot \ln Y_t + \mu_{it}$$

$$\ln X_{it} = \eta_i \cdot \ln R_t + \varepsilon_i \cdot \ln Z_t + \vartheta_{it}$$

where  $M$ ,  $X$ ,  $R$ ,  $Y$ , and  $Z$  represent imports, exports, the real exchange rate, domestic GDP, and the GDP of the rest of the world, respectively.  $\psi_i$ ,  $\pi_i$ ,  $\eta_i$  and  $\varepsilon_i$  are the parameters to be estimated, and  $\mu_{it}$  and  $\vartheta_{it}$  are the errors of the model.

Using the classification of Lall (2000), we proceed to make a classification based on the technological intensity of imports and exports based on the data of SITC revision 1. Given this, there are six types of exporting/importing sectors: i) primary products, ii) resource-based manufactures, iii) low-technology manufactures, iv) medium-technology manufactures, v) high-technology manufactures, and vi) other manufactures. Lall (2000) classified trade data by technological intensity based on SITC revision 2 from 1983 to 2001. Therefore, Lall's classification was adapted using correspondence tables from SITC 2 to SITC 1.

Since the series may be non-stationary, OLS estimation of the equations could yield spurious results and fail to reflect long-term relationships between the variables. To determine whether the series are stationary, unit root tests are conducted. A model reduction procedure selected the appropriate number of lags in the Augmented Dickey-Fuller (ADF) Test. At the same time, the structure of the deterministic component was specified using a general-to-specific approach, beginning with an auxiliary regression including both trend and drift.

Our series are integrated of order 1 (I(1)), indicating that they are non-stationary in levels but become stationary after first differencing. Therefore, we apply cointegration techniques to capture the long-term relationships between variables, using the Johansen method to test for the presence of cointegrating vectors.

The Johansen analysis uses the maximum likelihood principle, which assumes that the data distribution is constant over time. To select the optimal order for each system, we estimated a Vector Autoregressive model (VAR) for each country's real GDP, exports, and imports (all in natural logs). The lag (order) that maximized the Schwarz Bayesian (SBC) or Hannan-Quinn (H-Q) criterion for each country was selected as the optimal order for the VAR.

After estimating the VAR model, we tested the hypothesis of cointegrating vectors within the system of real GDP growth, exports, and imports using the procedures of Johansen (1988) and Johansen and Juselius (1990). The trace test was applied to assess the number of cointegrating relationships.

The sample period covers annual data from 1962 to 2023 to test the multi-sectoral Thirlwall's Law. GDP data was obtained from the World Development Indicators. The real exchange rate is the nominal exchange rate for each country multiplied by the ratio between the US consumer price index and that of each country. The real exchange rate was constructed using World Development Indicators data. Trade data have been collected from the United Nations Commodity Trade Statistics Database (COMTRADE) according to the Standard International Trade Classification (SITC) Revision 1. We have data for Argentina, Brazil, Chile, Colombia, Mexico, and Peru. These six economies accounted for 85% of Latin America's GDP in 2023.

## References

- Araújo R.A. and Lima G.T. (2007), "A Structural Economic Dynamics Approach to Balance-of Payments-Constrained Growth", *Cambridge Journal of Economics*, 31(5), pp. 755-774.
- Alatorre J.E., Juárez J., Moreno-Brid J.C. and Porcile G. (2024), "Political conflict, green capabilities and growth patterns in a Kaleckian small open economy", 7<sup>th</sup> ASTRIL Conference, 25-26 January 2024, Rome. [Available online](#).
- Althouse J., Guarini G. and Porcile G. (2020), "Ecological macroeconomics in the open economy: Sustainability, unequal exchange and policy coordination in a center-periphery model", *Ecological Economics*, 172, 2 March, art. 106628.
- Basilio J., Cimoli M. and Porcile G. (2019), "A Technology Gap Interpretation of Growth Paths in Latin America and Asia", *Research Policy*, 48, pp. 125-136.
- Bianchi C., Galaso P. and Palomeque S. (2023), "Absorptive capacities and external openness in underdeveloped innovation systems: a patent network analysis for Latin American countries 1970-2017", *Cambridge Journal of Economics*, 47(6), pp. 1139-1170.
- Bielschowsky R. (1998), "Cincuenta años del pensamiento de la CEPAL: una reseña", in *Cincuenta años de pensamiento en la CEPAL: textos seleccionados* (LC/G.2699), vol. I, Santiago: Comisión Económica para América Latina y el Caribe (CEPAL)/Fondo de Cultura Económica.
- Blecker R. (2022), "New Advances and Controversies in the Framework of Balance-of-Payments-Constrained Growth", *Journal of Economic Surveys*, 36(2), pp. 429-467.
- Blecker R. and Setterfield M. (2019), *Heterodox Macroeconomics: Models of Demand, Distribution and Growth*. Cheltenham (UK) and Northampton (MA, USA): Edward Elgar.
- Botta A., Porcile G., Spinola D. and Yajima G. (2023), "Financial integration, productive development and fiscal policy space in developing countries", *Structural Change and Economic Dynamics*, 66(2023), pp. 175-188.
- Carnevali E., Godin A., Lucarelli S. and Veronese Passarella M. (2020), "Productivity growth, Smith effects and Ricardo effects in Euro Area's manufacturing industries", *Metroeconomica*, 71, pp. 129-155.
- Cimoli M. and Porcile G. (2011), "Global growth and international cooperation: A Structuralist perspective", *Cambridge Journal of Economics*, 35(2), pp. 383-400.
- Crisuolo P. and Narula R. (2008), "A Novel Approach to National Technological Accumulation and Absorptive Capacity: Aggregating Cohen and Levinthal", *The European Journal of Development Research*, 20(1), pp. 56-73.
- Cohen W.M. and Levinthal D.A. (1990), "Absorptive Capacity: A New Perspective on Learning and Innovation", *Administrative Science Quarterly*, 35(1), pp. 128-152.
- Dávila-Fernández M.J. and Sordi S. (2020), "Attitudes towards climate policies in a macrodynamic model of the economy", *Ecological Economics*, 169, art. 106319.
- De Paula L., Fritz B. and Prates D. (2017), "Keynes at the Periphery: Currency Hierarchy and Challenges for Economic Policy in Emerging Economies", *Journal of Post Keynesian Economics*, 40(2), pp. 183-202.
- Dosi G., Pavitt K. and Soete L. (1990), *The Economics of Technical Change and International Trade*, New York: Harvester Wheatsheaf.
- Dosi G. and Nelson R.R. (1994), "An introduction to evolutionary theories in economics", *Journal of Evolutionary Economics*, 4, pp. 153-172.

- Dosi G., Fagiolo G. and Roventini A. (2010), "Schumpeter meeting Keynes: A policy-friendly model of endogenous growth and business cycles", *Journal of Economic Dynamics and Control*, 34(9), pp. 1748-1767.
- Dosi G., Grazzi M. and Moschella D. (2015), "Technology and Costs in International Competitiveness: From Countries and Sectors to Firms", *Research Policy*, 44, pp. 1795-1814.
- ECLAC – Economic Commission for Latin America and the Caribbean (2020), *Building a New Future: Transformative Recovery with Equality and Sustainability*, Santiago: United Nations.
- ECLAC – Economic Commission for Latin America and the Caribbean (2023a), *Social Panorama of Latin America and the Caribbean, 2023: Labour inclusion as a key axis of inclusive social development* (LC/PUB.2023/18-P/Rev.1), Santiago: ECLAC. [Available online.](#)
- ECLAC – Economic Commission for Latin America and the Caribbean (2023b), *The economics of climate change in Latin America and the Caribbean, 2023: Financing needs and policy tools for the transition to low-carbon and climate-resilient economies* (LC/TS.2023/154), Santiago: ECLAC. [Available online.](#)
- Evans P. and Heller P. (2015), "Human Development, State Transformation and the Politics of the Developmental State", in Leibfried S., Nullmeier F., Huber E., Lange M., Levy J. and Stephens J.D. (eds), *The Oxford Handbook of Transformations of the State* (pp. 691-713). Oxford: Oxford University.
- Fagerberg J. and Verspagen B. (2002), "Technology gap, Innovation-Diffusion and Transformation: An Evolutionary Interpretation", *Research Policy*, 31, pp. 1291-1304.
- Fajnzylber F. (1983), *La industrialización trunca de América Latina*, Ciudad de México: Editorial Nueva Imagen.
- Freeman C. (2004), "Technological Infrastructure and International Competitiveness", *Industrial and Corporate Change*, 13(3), pp. 541-569.
- Furtado C. (1974), *O mito do desenvolvimento econômico*, Rio de Janeiro: Editora Paz e Terra.
- Georgescu-Roegen N. (1971), *The Entropy Law and the Economic Process*, Cambridge (MA): Harvard University Press.
- Graciarena J. (1976), "Power and development styles", *CEPAL Review*, 1976(1), pp. 173-194.
- Johansen S. (1988), "Statistical analysis of cointegration vectors", *Journal of Economic Dynamics and Control*, 12(2-3), pp. 231-254.
- Johansen S. and Juselius K. (1990), "Maximum likelihood estimation and inference on cointegration—with applications to the demand for money", *Oxford Bulletin of Economics and Statistics*, 52(2), pp. 169-210.
- Gatti D. (2022), "Going green and (un)equal? Political coalitions, redistribution, and the environment", *Economic Modelling*, 116, art. 105996.
- Guarini G. and Oreiro J.L. (2022), "An ecological view of new developmentalism: a proposal of integration", *Brazilian Journal of Political Economy*, 42(1), pp. 244-255. [Available online.](#)
- Grazini C., Guarini G. and Porcile G. (2024), "Institutional change and ecological structural change", *Structural Change and Economic Dynamics*, 71 (Dec), pp. 354-368. [Available online.](#)
- Hein E. and Truger A. (2012), "Finance-dominated capitalism in crisis—the case for a global Keynesian New Deal", *Journal of Post Keynesian Economics*, 35(2), pp. 187-213.
- Kaltenbrunner A. and Paineira J.P. (2015), "Developing Countries Changing Nature of Financial Integration and New Forms of External Vulnerability: the Brazilian Experience", *Cambridge Journal of Economics*, 39(5), pp. 1281-1306.
- Lall S. (2000), "The Technological Structure and Performance of Developing Country Manufactured Exports, 1985-98", *Oxford Development Studies*, 28(3), pp. 337-369.
- Lima L., Torres M., Romeiro A. and Bueno C. (2024), "O neoestruturalismo ecológico e as três lacunas do desenvolvimento sustentável", *Revista Economistas*, 15(53): pp. 48-53. [Available online.](#)
- Lundvall B. (2007), "National Innovation Systems—Analytical Concept and Development Tool", *Industry and Innovation*, 14(1), pp. 95-119.
- Magacho G., Espagne E., Godin A., Mantes A. and Yilmaz D. (2023), "Macroeconomic exposure of developing economies to low-carbon transition", *World Development*, 167, art. 106231. [Available online.](#)
- Magacho G., Godin A., Yilmaz S.D. and Spinola D. (2024), "Recycling carbon taxes for reindustrialization", *AFD Research Papers*, no. 311, Paris: Éditions Agence française de développement. [Available online.](#)
- Marquetti A., Miebach A. and Morrone H. (2024), *Unequal Development and Capitalism: Catching Up and Falling Behind in the Global Economy*, London: Routledge.
- Meadows D., Meadows D., Randers J. and Behrens W. (1972), *The Limits to Growth. A Report for the Club of Rome's Project of the Predicament of Mankind*, New York: Universe Book.
- Nochteff H. (1996), "The Argentine experience: Development or a succession of bubbles", *CEPAL Review*, 1996(59), pp. 111-126. [Available online.](#)
- Ocampo J.A. (2016), "Balance-of-Payments Dominance: Implications for Macroeconomic Policy", in Damill M., Rapetti M. and Rozenwurcel G. (eds), *Macroeconomics and Development: Roberto Frenkel and the Economies of Latin America* (pp. 211-228), New York: Columbia University Press.
- Oreiro J. (2020), "New Developmentalism: Beyond Competitive Exchange Rate", *Brazilian Journal of Political Economy*, 40(2), pp. 238-242.

- Pinto A. (1976), "Styles of Development in Latin America", *CEPAL Review*, 1976(1), pp. 99-130. [Available online.](#)
- Palazzo G. (2024), "Real Exchange Rate and Export Surge Episodes: What Sectors Take Advantage of the Real Exchange Rate Stimulus?", *Structural Change and Economic Dynamics*, 68, pp. 446-467.
- Palazzo G. and Rapetti M. (2017), "Real exchange rate and export performance in Argentina, 2002–2008", *Journal of Post Keynesian Economics*, 40(1), pp. 75-94.
- Porcile G. (2024), "Sustainable development in a center-periphery model", *LEM Papers Series*, 2024/10, Pisa (Italy): Sant'Anna School of Advanced Studies, Laboratory of Economics and Management. [Available online.](#)
- Porcile G. and Torres M. (2024), "The evolution of the ecological perspective in Latin American Structuralism", in Schincariol V.E. (ed.), *Environment and Ecology in the History of Economic Thought* (pp. 181-197), Abingdon (UK): Routledge.
- Porcile G., Alatorre J.E., Cherkasky M., Gramkow C. and Romero J. (2023), "New directions in Latin American Structuralism: a three-gap model of sustainable development", *European Journal of Economics and Economic Policies: Intervention*, 20(2), pp. 266-281. [Available online.](#)
- Prebisch R. (1950), *The Economic Development of Latin America and Its Principal Problems*, Santiago: United Nations/ECLAC. [Available online.](#)
- Prebisch R. (1963), *Hacia una dinámica del desarrollo latinoamericano*, Ciudad de México: Fondo de Cultura Económica.
- Prebisch R. (1970), *Transformación y desarrollo: la gran tarea de América Latina*, Ciudad de México: Fondo de Cultura Económica.
- Rodríguez O. (2006), *El estructuralismo latinoamericano*, Ciudad de México: Siglo XXI.
- Romero J.P. and Gramkow C. (2021), "Economic Complexity and Greenhouse Gas Emissions", *World Development*, 139, art. 105317.
- Stark A., Gale F. and Murphy-Gregory H. (2023), "Just Transitions' Meanings: A Systematic Review", *Society & Natural Resources*, 36(10), pp. 1277–1297. [Available online.](#)
- Storm S. and Naastepad C.W.M. (2012), *Macroeconomics Beyond the NAIRU*, Cambridge (MA) and London: Harvard University Press.
- Sunkel O. (1980), "The Interaction Between Styles of Development and the Environment in Latin America", *CEPAL Review*, 1980(12), pp. 15–49. [Available online.](#)
- Sunkel O. (1981), *La dimensión ambiental en los estilos de desarrollo de América Latina*, Santiago de Chile: ECLAC/PNUMA.
- Torres M. and Ahumada J.M. (2022), "Las relaciones centro-periferia en el siglo XXI", *El Trimestre Económico*, 89(353), pp. 151-195.
- Verspagen B. (1993), *Uneven Growth between Interdependent Economies: An Evolutionary View of Technology Gaps, Trade and Growth*, Aldershot (UK): Avebury, Ashgate.