

New insights on the relationship between the involvement of countries in global value chains, and intra- and inter-country inequalities

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ABSTRACT

Recent economic growth cannot be understood without considering the emergence of Global Value Chains (GVCs). However, recent literature has highlighted that economic upgrading cannot be taken as a granted result of the involvement in GVCs, and it does not necessarily lead to positive social outcomes. We explore whether the recent performance of countries in the GVCs has significantly conditioned the intra- and inter-country inequalities. Using a combined multisectoral-multiregional (MRIO) and econometric approach, we analyze 67 countries during 1995–2018. Regarding involvement in GVCs, we look into “smile curves”, in reference to the quadratic relation between position and inequality. The results show different geographical patterns. For intra-country inequality, we find significant “smile curves” in Developed, African, Latin American, and Asian countries, so these can reduce internal inequalities by moving to intermediate positions in GVCs. For inter-country inequality, results suggest opportunities for catching-up in Latin America and Africa by specializing in the tails.

1. Introduction

During the last three decades, the process of globalization has intensified to the extent that the world we live in is fully interconnected. In this sense, the phases of production are internationally fragmented (OECD, 2011), as commodities are not entirely produced in one country (Feenstra, 1998). In that sense, production is represented by the so-called Global Value Chains (from now GVCs), and “linking into GVCs” has become one of the important new development challenges for many developed and developing economies (Banga, 2016; Ojala et al., 2008). As noted in Gereffi (1995), Rodrik (2018) and Meng et al. (2020), the engagement of countries in GVCs allows countries to participate in the global economy exploiting their comparative advantages concentrating in specific production processes and contributing in this way to creating employment and boosting technology transfer. In general, the country’s specialization in relatively upstream versus downstream stages of GVCs has been related with higher value-added shares and increased technological complexity (Hagemeyer and Ghodsi, 2017; Hummels et al., 2001; Kummritz et al., 2017), allowing economic upgrading. Other literature supports the “smile curve” hypothesis (see Meng and Ye 2022, Mudambi 2008, and Shin et al. 2012), finding differential benefits in the two tails of the production chains.

However, recent literature has also highlighted that international competition is not an easy task, achieving economic upgrading cannot be taken as granted (Bernhardt and Pollak, 2016), and that economic upgrading does not necessarily lead to positive social outcomes. Even more important, different authors point out that positive outcomes are neither equally distributed among countries nor social groups (Barrientos et al., 2011; Meng et al., 2020; Rossi, 2013). In other words, the configuration of the global economy around the GVCs and the potential benefits of countries’ involvement in them shed lights and shadows on what the effect has been on inequality trends between and within countries. In this sense, the process of globalization has generated an interesting debate concerning whether countries are net losers or winners (Shepherd, 2013). Kaplinsky (2000) determined that integration in GVCs can yield heterogeneous and complex effects on income distribution, while Dollar et al. (2017) showed that the outcomes of this processes are indeed unequally distributed among countries. The most usually commented negative effect is that of international competition provoking outsourcing of low-skilled occupations to developing countries, while pushing down wages in developed countries (Krugman, 1995).

In this context, our work explores how the performance of countries in the GVCs conditions the levels of intra- and inter-country inequality.

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The question is to what extent the “upgrading” of countries in the GVCs (i.e. moving up in the value chain), that has allowed countries to improve their economic outcomes (Baldwin, 2013; Gereffi and Fernandez-Stark, 2016), has also led to social upgrading in terms of income inequality reductions. There also remains to answer which are the roles of structural and technological factors mediating this process.

Our paper suggests a multiregional and multisectoral framework to address these questions in order to capture how structural, technological and trade patterns in the countries influence their economic and social outcomes. The paper aims to shed light on the nature of inequality as a global phenomenon, considering its two perspectives (one related to inequality between countries, and the other linked to inequality within countries), exploring recent trends in the context of GVCs.

In this regard, according to Bourguignon (2016) and Milanovic (2016), total global inequality, understood as the disparities in the international distribution of income in relation to each country's contribution to global value added, has slightly decreased since the fall of the Berlin Wall. This phenomenon can be explained by the convergence between developed and developing countries, that is to say, by decreases in the inter-country component of global inequality (Chen and Ravallion, 2010; Morelli et al., 2015; Ravallion, 2016). On the contrary, inequality within countries has increased along these years, explained by the impressive increase of top incomes that has been experienced throughout the world (Piketty, 2020). Both outcomes are major consequences of the new configuration of the global economy.

Economic literature has studied the connection of global inequality to the process of globalization, (Dreher, 2006; Zhou et al., 2011). Globalization has been alluded as one of the possible factors behind inequality, among others (Atkinson, 2003). Namely, the phenomenon of globalization, which has accentuated over the past few decades, implies that competition is an international process. As a result, companies outsource activities to developing countries where labor costs are low, which also puts a pressure on wages in the countries of origin (Autor et al., 2014). Furthermore, in this competing globalized world, as processes are externalized and countries are increasingly specializing, commodities and services are not fully produced in one country (Eckel, 2008). This international distribution of production determines the way in which part of global value added or income is appropriated by each country. Hence, the configuration, performance and evolution of GVCs might notably explain the global distribution of income. The study of these relationships is the main focus of this paper.

The multisectoral and multiregional framework has attracted increasing attention to define different metrics to capture the involvement of countries in these GVCs, mainly approaching their participation and positioning in GVCs. Broadly speaking, the concept of participation in GVCs makes reference to the capacity of a sector/country to integrate in these chains, through the generation of value added embodied in their exported goods and services. This degree of participation can either be captured in different ways. For instance, being related to the country's per capita GDP (Los et al., 2015), approaching in this way the benefits of trade openness; over global value added, which would be a measure of the country's competitiveness (Bolea et al., 2022); or by using backward and forward linkages, which would respectively indicate participation and strength of imports and exports relationships (Szymczak and Wolszczak-Derlacz, 2022).

Meanwhile, position defines a country's specialization regarding its “upstreamness”, or the distance of its production to final demand. This can either be measured in terms of the distance of intermediate inputs to final use (Antràs et al., 2012; Antràs and Chor, 2018), or by calculating the average length of backward to forward linkages (Szymczak and Wolszczak-Derlacz, 2022).

However, while the characterization of countries in global chains, their evolution and their relationship to economic performance (economic upgrading) has been widely discussed in the literature, it is only recently that the implications for social upgrading have been studied (Smichowski et al., 2021; Marcato and Baltar, 2017). And as far as we

know, there are very few studies that have connected metrics of GVC participation with income inequality. Timmer et al. (2014) approached income distribution in GVCs by decomposing total value added in labor and capital and finding an increasing contribution of high-skilled labor and capital to the generation of value added from 1995 to 2008, the former being concentrated in high-income countries, while the latter concentrated in emerging countries. Furthermore, studies such as López-González et al. (2015) and Szymczak and Wolszczak-Derlacz (2022) have specifically focused their analyzes on effects on the labor market, mainly in employment and wages. More recently, Carpa and Martínez-Zarzoso (2022) study the relationship between participation in GVCs and intra-country income inequality, finding that a higher degree of backward participation (purchases) increases income inequality in developed countries in the short run, while it decreases in the long run.

Our paper builds on this literature and delves into the relationship between the positioning of countries in the GVCs and their impact on inter- and intra-country inequality. More specifically, our paper aims to address whether the positioning of countries in GVCs, in more upstream/downstream positions, has allowed them to obtain substantial earnings in terms of value added, allowing them to close the income gap to other countries, or to achieve a more equal internal distribution of income. In other words, to check not only if economic upgrading, understood as integration into GVCs, has been translated into social upgrading, but also to study what are the specific ways of achieving a successful integration. To the best of our knowledge, this is the first paper addressing the potential effects of position in GVCs on the different dimensions of income inequality, leaving a promising line of research ahead.

We are also interested in exploring spatial and temporal patterns, as well as the role of other mediating factors such as participation (the other great indicator of GVCs performance), tertiary education, employment, foreign direct investment or corruption.

Empirically, our paper takes advantage of the extensive information provided by 2021 Release of the Inter-Country Input-Output (ICIO) database, published by the OECD. These tables cover a long term and relevant period of time (1995–2018), with a detail of 45 industries for 66 countries (plus a Rest of the World account). See Table A.1 in the Annex for a detailed list of the countries in our sample, and a classification according to the geographical and economic criteria of the United Nations WESP report that we used to classify our sample by geographical areas.

The empirical strategy combines both the input–output approach for the definition of GVCs variables and the econometric estimation to capture the relationship between the proposed inequality measures and the variables referred to global supply chains.

Our variables of interest include Gini indexes, that are synthetic measures of internal inequality within countries as well as the share of income held by the top 1% over the bottom 50% share, which is a complementary and transparent measure of intra-country inequality (Piketty, 2022). For inter-country inequality, the proportion of each countries' value added per capita over the world average (which is a measure of international income dispersion, as seen in Chancel et al. (2022)) is also considered.

The rest of the paper is structured as follows. In Section 2, the methodological approach and the data are presented. In Section 3, we discuss the main results of the analysis. First, recent trends of inequality, according to the proposed measures of inter-country and intra-country are discussed and, second, the relationship with the measures of involvement in GVCs is explored. Section 4 closes the paper with the main conclusions and some policy recommendations.

2. Methodology and data

2.1. MRIOs and GVCs measures

As noted above, the involvement of countries (positioning and

participation) in GVCs is explored through measures obtained in a MRIO framework. Our starting point is the equilibrium equation in a MRIO model for the world economy, with m countries and n sectors in each country (Isard, 1951; Leontief, 1936, 1941; Miller and Blair, 2009)

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{y} \rightarrow \mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} = \mathbf{L}\mathbf{y} \quad (1)$$

Where $\mathbf{A} = (a_{ij}^{rs})$ is the matrix of technical coefficients and each element a_{ij}^{rs} represents the volume of intermediate input i sourced from country r that is needed to produce a unit of output j in country s , \mathbf{x} is the output vector and $\mathbf{y} = (y_i^r)$ is the vector of total final demand of countries, where each element y_i^r represents the worldwide final demand for products of the industry i produced in country r . In this MRIO framework $\mathbf{L} = (\mathbf{L}_{ij}^{rs})$ is the well-known Leontief inverse in which each representative element \mathbf{L}_{ij}^{rs} captures all the production generated in sector i in country r to fulfil the demands of inputs incorporated in all the steps of the production chain and ending in the final demand y_i^r . Let us denote by \mathbf{V} the value added matrix and by $\mathbf{v} = (v_j^r)$ the associated vector of unitary coefficients of value added.

On the basis of this model, we calculate the position and participation of countries in GVCs as follows. To summarize information at country level, the matrices and vectors in Eq. (1) are aggregated using an \mathbf{E} matrix of zeros and ones with the adequate structure and dimensions.

After this aggregation, following Antràs et al. (2012), the position (P_1^r) of each country in GVCs can be computed as follows:

$$P_1^r = \frac{y^r}{x^r} + 2 * \frac{\sum_s a^{rs} y^s}{x^r} + 3 * \frac{\sum_s \sum_k a^{rk} a^{ks} y^s}{x^r} + 4 * \frac{\sum_s \sum_k \sum_t a^{rk} a^{kt} a^{ts} y^s}{x^r} + 5 * \frac{\sum_s \sum_k \sum_t \sum_d a^{rk} a^{kt} a^{td} a^{ds} y^s}{x^r} \quad (2)$$

According to this measure, higher values represent more upstream economies. That is, countries/regions are more involved on the production of intermediate inputs in GVCs. This is explained by the fact that, in expression (2), each addend calculates the weighted average of intermediate inputs transactions, normalized by total output, so a higher value means a greater incorporation of inputs into production, and thus, a higher distance from final demand. By contrast, those countries/regions with lower values are more “downstream”, closer to final demand, that is, more involved in finalist goods and services in the GVCs.

Second, the involvement of country r in GVCs can be also calculated within this MRIO framework, following Bolea et al. (2022) as follows:

$$VE = \mathbf{E}'\hat{\mathbf{v}}(\mathbf{I} - \mathbf{A})^{-1}\hat{\mathbf{y}}\mathbf{E}, \text{ with } \mathbf{E} \text{ being the aggregation matrix} \quad (3)$$

On the basis of this expression, we can calculate each country's share of value added embodied in exports over the total value added embodied in exports in the global economy as follows:

$$P_2^r = \frac{\sum_{s \neq r} VE^{r,s}}{\sum_r \sum_{s \neq r} VE^{r,s}} \quad (4)$$

A higher value is interpreted as an increase in a country's market share of global value added exported, so participation is understood here as a proxy for the country's competitiveness in GVC.¹

¹ Although we refer to participation in the sense that this measure captures the representativeness of each country's exports in the global value flows, there are different measures which focus on the value added achieved by countries through trade. For instance, propose measures based on the ratio of value added embodied exported by each country over their total value added or per capita GDP. On the other hand, measure the relationship between value added embodied in exports and value added embodied in imports.

2.2. Inequality measures

As noted before, our interest is to empirically test the potential relationship between the position of countries in GVCs (measuring in this way the economic upgrading), and the intra- and inter-country measures of income inequality (our proxies for social upgrading).

In order to approximate the latter variables, we will use both, information provided by the MRIO in terms of VA distribution and complementary information on intra-country income inequality. Thus, as a first approach to inter-country inequality ($W_{_INTER1}^r$), we use the ratio of each country's value added per capita over the world's total (Chancel et al., 2022), directly obtained from our tables. That is:

$$W_{_INTER1}^r = \frac{\frac{V^r}{population^r}}{\sum_r \frac{V^r}{population^r}} \quad (5)$$

where V^r is the total value added of country or region r , and $W_{_INTER1}^r$ is normalized at unity. $W_{_INTER1}^r$ measures the differences in per capita income of each country with respect to the world average; moreover, the higher (lower) the concentration of $W_{_INTER1}^r$ around the world average, the lower (higher) inequality between countries will be. However, the interpretation of this measure for each country r in terms of international inequality might not be so straightforward. If $W_{_INTER1}^r$ increases for a country/region r that is below the world average, it can close the gap, decreasing inter-country inequality. Meanwhile, an increase in the indicator if a country/region is far above the world average, can be translated into an increase in inter-country inequality. To avoid ambiguities, we suggest a simple transformation of expression (6) as follows:

$$W_{_INTER2}^r = |W_{_INTER1}^r - 1| \quad (6)$$

Thus, Eq. (6) shows that, when the second measure of inter-country inequality increases, inequality between countries rises (all regions, whether these are above or below the world average, increase their gap with respect to it, as values are expressed in absolute terms).

Moreover, two measures are considered for intra-country inequality. First, we will consider Gini indexes for each country ($W_{_INTRA1}$). Second, we use the income share held by the top percentile over that of the bottom 50%, which is a measure of income concentration ($W_{_INTRA2}$). The formers are calculated from the data available in the World Income Database (WID), while the latter are extracted directly from the aforementioned database. The specific formula for the Gini index used here is:

$$W_{_INTRA1}^r = \left| 1 - \sum_{k=0}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k) \right| \quad (7)$$

where Y_k represents the accumulated proportion of income up to income category k , while X_k stands for the accumulated proportion of population up to income class k .

2.3. Variables and econometric strategy

Our database consists of a panel data sample of 67 countries, covering the period 1995–2018. Multiregional input-output tables come from the November 2021 Inter-Country Input-Output (ICIO) tables, released by the OECD.

As stated above, our objective is to study whether the upgrading of countries in the GVCs (in terms of position in GVCs) has implied a reduction in the levels of inequality within and between countries, as well as to study what structural, technological or institutional factors may mediate these relationships.

Dependent variables for our models are the four measures of inequality, which we correlate with our variable of interest, the position in GVCs. Note that, in line with the “smile curve” literature (as previously stated), economic outcomes seem to hold a convex relationship with the

position measures (Meng et al., 2020; Shih, 1996). This convexity is also explored for our variables of social outcome. In this regard, to control for potential non-linearity, the variables position P_1^* , and squared position $(P_1^*)^2$ are considered.

In addition to this variable, we also consider the variable P_2^* of participation in GVCs as explicative variable. These two variables, participation and position, offer different but complementary sides of the involvement of countries in GVCs.

These variables are complemented with a set of control variables which attempt to capture different mediating factors in the relationships studied. These factors have to do with usual explicative causes of inequality, as well as the control of spatial and temporal differences.

As control variables, we first include unemployment rates (World Bank, estimated from ILO), which provide some insights about global employment, which is important considering that an important facet of increasing inequality is found in decreasing labor shares of income (ILO and OECD, 2015; Karabarbounis and Neiman, 2014). Moreover, differences in education are also important determinants of international inequalities in labor (Bertocchi and Dimico, 2014), so we include enrollment rates in tertiary education, extracted from World Bank data. Following OECD (2008), Foreign Direct Investment in the country is also considered and taken from World Bank data. As a way for controlling institutional effects, we include Corruption control indexes, again from the World Bank (Policardo and Carrera, 2018). Finally, controlling for technological changes in manufacturing and services, which could also be important determinants of inequality and skill-biased compensations (López-González et al., 2015; OECD, 2011), we include specialization indexes in high-technology industries and services (Balassa, 1965). As an additional proxy of innovation, we also use the number of patents, obtained from World Development Indicators (Law et al., 2020). Finally, to account for differences between countries with a more rural versus urban population distribution, we include the variable urban population, extracted from the World Bank (Young, 2013). It accounts for the proportion that urban population represents over total. Thus, higher values represent urban areas.

Moreover, five main geographical areas are considered in order to capture geographical and development heterogeneity, following the country classification provided by UN's 2022 WESP Report (see Table A.1 in the Annex). Dummy variables for the different areas are defined. In order to capture differences not only in the constant term but also in the slopes these dummies are also included in a multiplicative way with the position and the squared position variables. Fixed effects for each country are also considered in the estimation. Finally, a time dummy for controlling possible structural breaks around the 2008 crisis is included (D_2008). It takes value 0 from 1995 to 2007, and value 1 otherwise.

To sum up, two sets of regressions are performed. First, we run a global test for all the countries in our sample. Then, regressions are performed distinguishing by geographical areas. Being W_i the four inequality measures and the endogenous variables, our regressions read as follows:

$$GLOBAL_W_i = \alpha + \beta_1 P_1 + \beta_2 (P_1)^2 + \beta_3 P_2 + \dots + \beta_j control_j + \dots + \varepsilon$$

$$REGIONS_W_i = \alpha + \beta_1 (P_1 * D_{developed}) + \beta_2 (P_1)^2 * D_{developed} + \beta_3 (P_1 * D_{transition}) + \beta_4 (P_1)^2 * D_{transition} + \beta_j P_2 + \dots + \beta_j control_j + \varepsilon$$

3. Stylized facts: recent trends in global inequality

Before moving on to the empirical analysis of the relationship between position in GVCs and inequality, we are first presenting a general overview of the recent trends in intra and inter-country inequality observed worldwide and captured with our available information.

3.1. Intra-country inequality: income shares and Gini indexes

Changes in intra-country inequality during our period, as measured by Gini indexes, are shown in Fig. 1 (see Table A.2 in the Annex for detailed results of the evolution of Gini indexes from 1995 to 2018, and Figs. A.1 and A.2 for values in 1995 and 2018, respectively). As shown in the two maps below, internal inequalities have generally increased along the period, especially in Central & Latin America, Africa, Eastern Europe, and some specific countries, such as the United States, India, and China. On the contrary, Southeastern Asia economies seem to have performed well in terms of internal inequality, showing lower Ginis in 2018, in general.

At a country level, inequality decreased along the period in only 20 countries out of the 65 that are present in our sample. The lowest average value is found in the Netherlands, 0.21, while the highest values are in Chile, 0.47. We can further group countries regarding the average values of internal inequality. The countries with a moderate level of inequality, which we identify with Ginis lower than 0.25, are European. On the contrary, extreme levels of inequality, higher than 0.35, are concentrated in Latin America, Central & East Asia, Middle East, and Africa. It should also be remarked that these are all developing areas, alongside the United States, which constitutes a noteworthy case.

As a complementary measure, Table A.3 shows the income shares held by the richest 1% over the share of the poorest 50% in each country. This indicator shows that income is globally highly concentrated in the hands of the richest, during the entire period and for almost all countries. This concentration only decreased in 24 countries out of the 67 in sample. It is outstanding that the highest differences are found in Latin American countries, but also in South Africa, Saudi Arabia, and some Asian countries (as Cambodia or Myanmar). There, we find cases where, in average, the income held by the top 1% is 100 higher than that of the bottom 50%. In short, inequality within countries seems to be generally higher in 2018 than in 1995.

3.2. Inter-country inequality: income per capita gaps between geographical areas

Our first measurement for inter-country inequality is the per capita income in each country over world average. In order to get a first picture of international income distribution and its evolution over time, countries are grouped by geographical areas. Results are represented in Fig. 2 below.²

Looking at Fig. 2 above, there can be seen some signal of reduction in inter-country inequality and convergence to the world average per capita income (the average value is 1), along this period. First, there are some areas that have been notably increasing their per capita income levels. On the one hand, Eastern Europe have increased its income per capita levels over the world average and Russia & Central Asia have achieved this world average. On the other hand, Middle East countries and South & South-East Asia, which already were over the world total in 1995, have continued their processes of convergence towards Europe and North America. Second, Latin America and Africa keep under the world average, with no signs of convergence. And finally, Western & Central Europe and North America, the two areas with the higher levels of income per capita in 1995, have sharply reduced their position above the world income average in this century, especially since the international recession in 2008. The same happened in East Asia, with a convergence to the world average from the beginning of the period

² The descriptive analysis further disaggregates the regions we are using in the econometric analysis. Developed countries are divided into Central & Western Europe, North America, and Eastern Europe. Furthermore, in the Asian region, here we distinguish between East Asia (China, South Korea, Hong Kong, and Taiwan) and South & Southeast Asia. Finally, Russia & Central Asia fully corresponds to what in the UN's classification is called Transition economies.

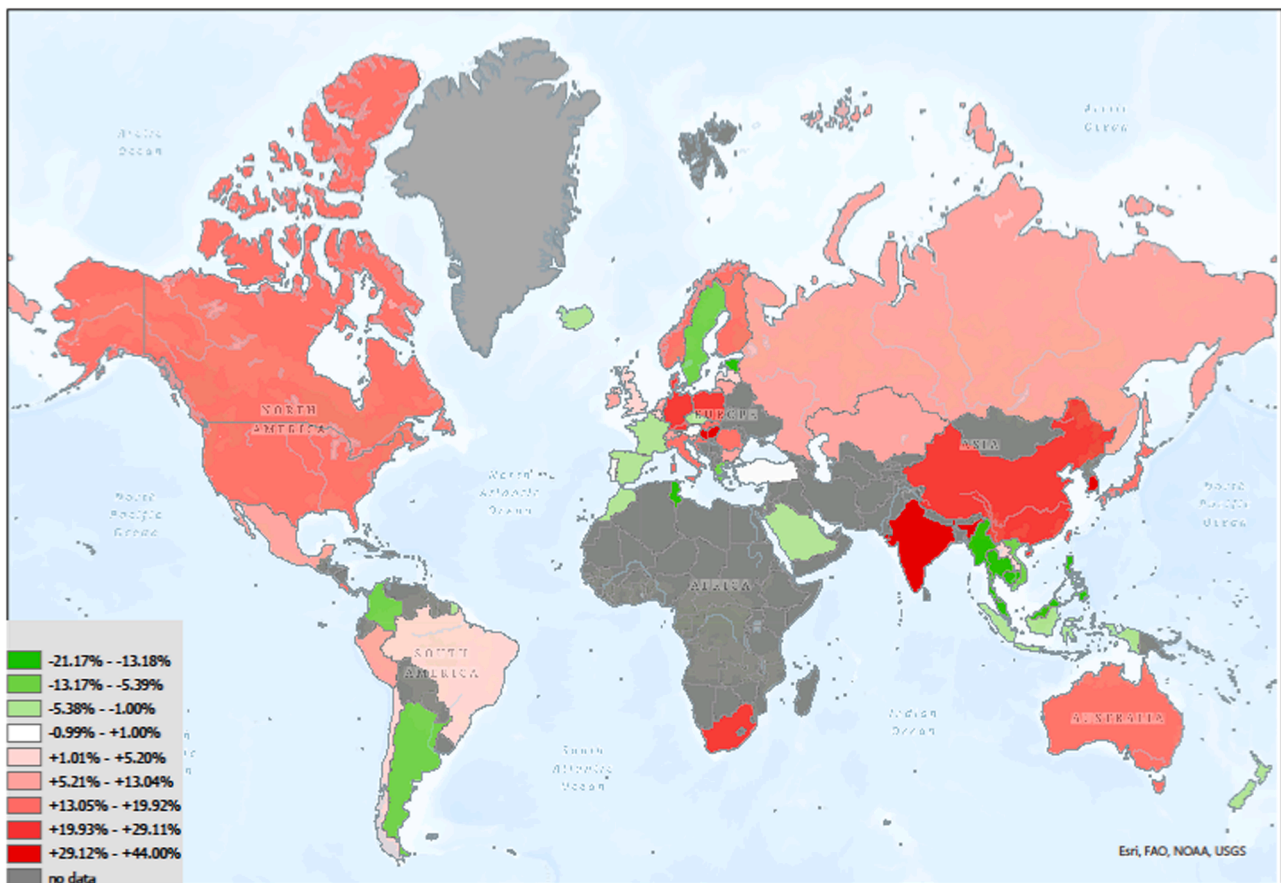


Fig. 1. Percentual changes in global Gini indexes from 1995 to 2018. Source: own elaboration using data from [World Inequality Lab \(2022\)](#).

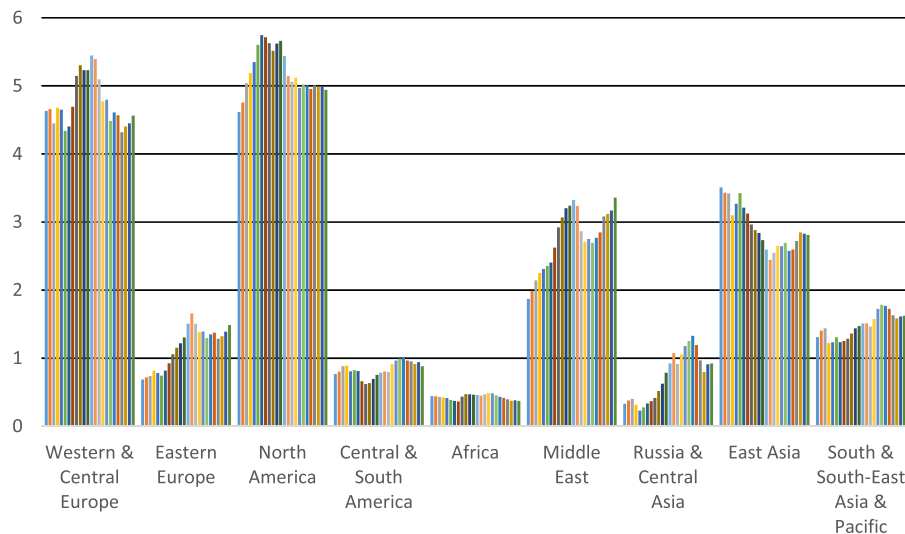


Fig. 2. Inter-country inequality by geographical areas, Value Added per capita over world average (in \$), 1995–2018. Source: own elaboration using data from ICIO tables (OECD, November 2021 release).

although there seems to be a slight recovery after the 2008 recession.

To sum up, inter-country inequality could be considered to have fallen from 1995 to 2018, while intra-country inequality has generally increased. The world seems to be relatively more equal in terms of geographical distribution of income, as it is shown by the fact that the geographical areas with higher levels of income per capita have been losing weight, while some other areas have increased it, closing the gap.

Data also show the endemic problem of Latin America and Africa which keep under the world average and without a clear trend to close the income gap.

Global inequality is then a contemporary problem, and to unveil how globalization and the fragmentation of production play a role in this, could help us to make some recommendations, which should differ by types of countries.

4. Results: globalization and inequality

In order to check the relationship between the involvement of countries in GVCs and the proposed measures of inter and intra-inequality, a set of regressions are formulated. As previously explained, we are interested in testing four different aspects, namely, a) if the advance in the positions in GVCs (upstream/downstream) has a significant relationship with the evolution of inter and intra-country inequality, b) if this relation adopts different functional forms (in particular a quadratic form), c) if significant different geographical patterns can be described and, d) the role of other structural and institutional factors at the country level mediating these relationships. Global results for the complete sample appear in Table 1 below. Results from the regressions controlling position by geographical areas are shown in Table 2 below.

4.1. Global results

We first take a look at the global results in Table 1. Here, we are mainly focusing on the relationship between *Position* and the inequality measures, as the results obtained for the control variables do not significantly change from that obtained for the results in the following sub-sections, where the effect of *Position* is split into geographical/development areas. Then, we can confirm that, at a global level, the relationship between intra-country inequality and *Position* is shaped as a concave “frown curve”, as shown by the positive sign of the coefficient accompanying the position variable and the negative sign of the coefficient corresponding to the squared-position variable.³ This means that, globally, internal inequality in countries can be reduced when countries move to either tail of the supply chain.

On the contrary, the relationship between the *Position* variable and the inter-country inequality indexes is shaped as a convex “smile curve”, as shown by the negative sign of the coefficient of the position variable and the positive sign of the coefficient corresponding to the squared-position variable. This shape is found for the two measures of inter-country inequality. For the first measure, W_{INTER1} , this result suggests that increasing per capita GDP with respect to the world average can be achieved by positioning in either upstream or downstream positions, that is, when countries/regions are specialized on the production of initial production stages in GVCs (upstream economies) or its production is closer to final demand, more involved in finalist goods and services in the GVCs, downstream economies, confirming that intermediate stages offer less opportunities for economic upgrading. Our second measure W_{INTER2} , which is more strictly an index of inequality between countries, shows that reductions in inter-country inequality or convergence (reductions in the index) are achieved in the tails, while increases take place in the middle positions of GVCs.

Participation exhibits positive and significant effects on both intra-country inequality variables, meaning that a higher share of a country's exported value added over the world total is not translated into a more equal distribution of income within the country. This is consistent with the results obtained by Carpa and Martínez-Zarzoso (2022), who found that increasing participation in GVCs can lead to a worse internal distribution of income in the short run. Moreover, the relations with

both inter-country inequality measures are also significant and positive, meaning, on the one hand, that increasing participation improves a country's situation in respect with global average income per capita, which is not surprising, as participation is another facet of economic upgrading; on the other hand, when a country increases participation, inter-country inequality, as measured by the second measure, worsens, which is also reasonable, as an improvement in a country's comparative advantage automatically means that other countries are worse-off in relative terms.

Regarding the rest of the control variables, we find that *Tertiary Education* has a negative effect on income concentration, meaning that tertiary enrollment is translated in more equality of opportunities. In a similar vein, the country's *Specialization in High technology services* (HTS) is also a source of reduction of intra and inter-country inequality. On the contrary, a higher *Specialization in high technology industries* (HTI) lead countries to distance with respect to the world income average, thus increasing inter-country inequality. The negative effect of *Patents* on the concentration of incomes in the top 1% and on both inter-country inequality measures also highlight this importance of innovation. Moreover, a higher control of *Corruption* does not seem to significantly affect intra-country inequality, while it broadens the gap between countries. Regarding *Foreign Direct Investment*, it has a positive effect on both measures of intra-country inequality, showing that capital inflows are not necessarily an equalizer of income, and that capital liberalization might have worsened distribution, especially that of primary shares of factor incomes. In any case, this effect is only significant in the case of the intra-country inequality indexes, at the 90% and 95% of confidence level, respectively. Meanwhile, *Urban population* reduces internal inequalities, probably associated to the fact that living in cities might present a wider variety of opportunities for improving life conditions than in rural areas. This variable presents a positive sign in the case of W_{INTER1} , suggesting that is also a factor of divergence between countries. Finally, *Unemployment* does not significantly affect internal inequalities, while it is a clear factor of economic downgrading, as well as of downward convergence.

Focusing on the territorial dummies, being Asia the control group, it can be seen that structural inequality within countries has been significantly higher in Africa, Latin American, and Middle East countries, while it was lower in Developed and Transition countries. In terms of inter-country inequalities, these controls also show that Developed, Transition, and Middle East countries have also performed better than Latin America, in terms of economic upgrading. Finally, a comment following the inclusion of a temporal dummy controlling for possible structural breaks in 2008 must follow. It can be seen that this variable is significant and positive for both intra-country measures, while it does not significantly affect inter-country inequality. This result confirms a structural leap in internal inequalities from the 2008 crisis onwards. As it is usually acknowledged, the recession had serious global implications on production and income, affecting to the social distribution of that income, and increasing the levels of internal inequality. Moreover, the globalism of the 2008 crisis also justifies that there are not significant structural differences in inequality between countries as a consequence, once the other economic and institutional factors are controlled for.

In sum, the results suggest that countries upgrading is compatible with strategies of specialization in the two tails of the production chains, also allowing reductions in their levels of internal inequality. Nevertheless, the full sample of countries is heterogeneous enough to provide a clear picture of potential geographical and development biases in these relationships. In order to go deeper into the characteristics of this heterogeneity, we explore how the described results are modulated by geographical areas (the world regions previously defined). These extensions are performed in the following sub-section.

4.2. Intra- and inter-country inequalities by areas

First, we look at the relationship between intra-country inequality

³ A frown curve has to fulfil two conditions: (1) a negative sign of the squared-position variable, and (2) the maximum belongs to a positive range of values, that is, a positive sign of the linear variable. The smile curve must fulfil two similar conditions: (1) a positive sign of the squared-position variable and, (2) the minimum value belongs to the positive range of values, that is, a negative sign of the linear variable. If condition (3) fails in any of the two cases, only the decreasing part of the function is significant in the former case, while only the increasing part of the function matters in the latter. In either way, a significant relationship is important, but the interpretations change and must be carefully addressed.

Table 1
General results, 1995–2018.

VARIABLES	(1)	(2)	(3)	(4)
P ₁	W_INTRA1 0.283*** (0.0886)	W_INTRA2 1.604 (1.272)	W_INTER1 -16.47*** (2.035)	W_INTER2 -12.22*** (1.924)
(P ₁) ²	-0.0758*** (0.0213)	-0.435 (0.298)	4.131*** (0.519)	3.015*** (0.490)
P ₂	0.622*** (0.0677)	5.603*** (0.548)	18.64*** (1.883)	18.61*** (1.866)
D_Developed	-0.108*** (0.00433)	-0.713*** (0.0422)	0.447*** (0.101)	-0.129 (0.101)
D_Africa	-0.0282*** (0.00697)	-0.202*** (0.0754)	0.818*** (0.134)	0.360** (0.151)
D_CentralLatinAm	0.0267*** (0.00706)	0.231*** (0.0897)	0.163 (0.142)	0.292** (0.140)
D_MiddleEast	0.0505*** (0.00587)	0.773*** (0.0693)	-0.633*** (0.133)	-1.011*** (0.133)
D_EastSouthEastAsia	0.0467*** (0.00484)	0.470*** (0.0531)	0.244** (0.113)	-0.427*** (0.110)
Terc_edu	-	-	-	-
SI_HTI	-5.31e-05 (6.72e-05)	-0.00194*** (0.000669)	-0.00248 (0.00190)	-0.00609*** (0.00194)
SI_HTS	0.00275 (0.00318)	-0.0199 (0.0285)	0.869*** (0.140)	0.878*** (0.144)
Corruption	-0.0223*** (0.00245)	-0.196*** (0.0252)	-0.207*** (0.0763)	-0.0393*** (0.0737)
Unemp	-0.00321 (0.00201)	-0.00594 (0.0210)	1.290*** (0.0605)	1.151*** (0.0618)
Patents	-0.000333 (0.000245)	-0.00471 (0.00303)	-0.0807*** (0.00684)	-0.850*** (0.00720)
Urban	6.26e-10 (2.35e-08)	-3.59e-07*** (1.15e-07)	-1.75e-06*** (4.35e-07)	-1.60e-06*** (4.33e-07)
In_FDI	-0.000511*** (0.000108)	-0.00566*** (0.00111)	0.0121*** (0.00274)	0.000962 (0.00267)
D_2008	0.00177** (0.000760)	0.0136* (0.00700)	0.0148 (0.0242)	0.0148 (0.0242)
Constant	0.00631** (0.00256)	0.0771*** (0.0270)	-0.0209 (0.0684)	-0.0209 (0.0684)
Observations	0.146 (0.0927)	0.312 (1.374)	16.55*** (1.956)	13.52*** (1.848)
R-squared	1495	1495	1495	1495
	0.752	0.659	0.790	0.697

Robust standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

and GVCs measures (see columns 1 and 2 in Table 2). As in the previous analysis, *Participation* has positive and significant effects on both intra-inequality variables which means that, all other things constant, a higher share of the global value in the countries does not lead to more equal societies.

In order to control for the existence of different smile or frown curves in the relationship between *Position* of countries in GVCs and intra-country inequality indexes, regional dummy variables are included affecting both the linear and the quadratic relationship of the *Position* variables. This allows to control not only for differences in the constant term but also different shapes and slopes in the functional forms.

As we can see, the way in which the country is involved in the GVCs, in relative more upstream or downstream positions, is related with inequality in different way depending on the geographical area of study. On the one side, we find that the relationship between internal inequality and quadratic position is positive (smile curve) in Developed countries, Latin America, Middle East, and Asia (just in the case of top 1% income concentration), meaning that occupying intermediate positions in the chains is related to lower levels of inequality in these areas.

Furthermore, in Central & Latin America downstream positions suppose higher intra-country inequality. Otherwise, the story of success when reducing internal inequalities in Eastern & Southeastern Asia, except in India and China (see Fig. 1), might also be related to the general upgrade that these countries have achieved during these years in the sense of integration into the chains, generally occupying

intermediate positions in the chains.

Finally, a significant negative relation (frown curve) is found between quadratic position and intra-country measures of inequality in Transition economies. Thus, in this area, internal inequality is lower for countries that occupy positions in the extremes of the chains. The downgrades from upstream to intermediate positions that Russia have been experiencing along this period might explain its increasing inequality.

We now move on to the analysis of inter-country inequality (see columns 3 and 4 in Table 2). While we have seen that *Participation* negatively affected intra-country inequality, it presents a positive effect on inter-country inequalities (20.67 and 22.73, respectively), meaning that it favors economic upgrading, but also increases disparities between countries. Increasing competitiveness is then a crucial step on achieving economic upgrading (Jangam and Rath, 2020). Nonetheless, its translation into social upgrading, measured in terms of convergence, is not so clear.

More interesting, regarding *Position*, “smile curves” are found in Developed, Middle Eastern, Transition, and Asian countries (for the last two regions, only in INTER1). This means that, for these regions, extreme positions in the global production chains promote economic upgrading, while intermediate positions decrease inter-country inequality.

On the other side, “frown curves” or negative quadratic relations are found in Africa (only in INTER1) and Latin America, demonstrating

Table 2
Position and inequality measures by geographical areas, 1995–2018.

VARIABLES	(1)	(2)	(3)	(4)
Developed_P ₁	-0.623*** (0.119)	-3.655*** (0.823)	-57.37*** (4.852)	-51.85*** (4.842)
Developed_ (P ₁) ²	0.146*** (0.0297)	0.869*** (0.203)	14.76*** (1.232)	13.47*** (1.229)
Transition_P ₁	2.436** (1.130)	25.69** (10.58)	-14.23* (8.029)	0.227 (13.18)
Transition_P ₁ ²	-0.563** (0.258)	-5.945** (2.424)	3.542* (1.834)	0.543 (3.036)
Africa_P ₁	-0.950 (0.611)	1.001 (9.636)	11.30** (5.089)	1.520 (6.573)
Africa_ (P ₁) ²	0.306* (0.158)	0.641 (2.468)	-2.660** (1.310)	-0.503 (1.740)
CentralLatinAm_P ₁	-1.861*** (0.469)	-26.65*** (6.220)	10.55 (8.610)	34.77*** (11.40)
CentralLatinAm_ (P ₁) ²	0.516*** (0.121)	7.322*** (1.603)	-3.892* (2.217)	-10.06*** (2.928)
MiddleEast_P ₁	-0.106 (0.307)	-1.801 (3.716)	-20.85*** (6.965)	-28.70*** (7.747)
MiddleEast_ (P ₁) ²	0.0232 (0.0762)	0.544 (0.929)	5.276*** (1.716)	6.997*** (1.998)
EastSouthEastAsia_P ₁	0.0336 (0.104)	-5.932*** (1.420)	-8.774*** (2.295)	5.800*** (1.998)
EastSouthEastAsia_ (P ₁) ²	-0.0281 (0.0239)	1.164*** (0.321)	2.034*** (0.581)	1.138** (0.500)
P ₂	0.515*** (0.0624)	4.368*** (0.472)	20.67*** (1.984)	22.73*** (2.022)
D_Developed	0.512*** (0.160)	-3.988** (1.704)	46.18*** (5.352)	42.04*** (5.186)
D_Africa	-2.703** (1.236)	-35.07*** (11.59)	5.478 (8.992)	-9.947 (14.33)
D_CentralLatinAm	0.691 (0.593)	-10.86 (9.371)	-20.87*** (5.308)	-7.958 (6.687)
D_MiddleEast	1.672*** (0.468)	17.68*** (6.218)	-16.24* (8.507)	-37.91*** (11.14)
D_EastSouthEastAsia	0.118 (0.328)	-5.284 (4.012)	11.14 (7.341)	21.38*** (8.039)
Terc_edu	-	-	-	-
SI_HTI	-3.97e-05 (6.58e-05)	-0.00135** (0.000640)	0.000850 (0.00177)	-0.00296 (0.00183)
SI_HTS	-0.0150*** (0.00242)	-0.0932*** (0.0221)	-0.257*** (0.0828)	0.231* (0.133)
Corruption	-0.00825** (0.00343)	-0.103*** (0.0288)	0.274** (0.131)	-0.450*** (0.00797)
Unemp	-0.00658*** (0.00199)	-0.0687*** (0.0202)	1.483*** (0.0612)	1.361*** (0.0629)
Patents	-0.00181*** (0.000257)	-0.0241*** (0.00269)	-0.0776*** (0.00745)	-0.0720*** (0.00797)
Urban	-8.57e-10 (1.80e-08)	-3.85e- 07***	-1.43e- 06***	-1.33e- 06***
In_FDI	-0.000183* (0.000103)	(7.85e-08) -0.000618	(3.70e-07) 0.0119***	(3.84e-07) 0.00178
D_2008	0.00191*** (0.000723)	(0.00102) 0.0141**	(0.00266) 0.00789	(0.00266) 0.0105
	0.00773*** (0.00241)	(0.00655) 0.0758***	(0.0229) 0.0126	(0.0234) -0.0492
Constant	0.443*** (0.111)	8.730*** (1.542)	10.16*** (2.227)	8.811*** (1.950)
Observations	1495	1495	1495	1495
R-squared	0.789	0.748	0.819	0.741

Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

different paths of economic growth and economic convergence. Their negative performances in terms of economic catching-up (see Fig. 2) can then be linked to the difficulties of developing countries to move up the chain, as previous literature has shown (Palpacuer et al., 2005; Rodrik, 2018). In fact, as said before, these countries generally specialize in downstream positions, with productions based on low-skilled and resources-intensive productions. As Rivera-Basques et al. (2021) suggest, the unequal exchange of Latin America with other countries is even more intensive in the current context of international fragmentation of

production.

It should then be concluded that, in order to achieve economic upgrading (and then, converge to the world average from below), intermediate positions in global chains should be promoted in Africa (e.g., upgrades in Morocco and Tunisia) and Latin America, which means domestic industrialization policies in these areas. Finally, the passive convergence of Developed countries towards global average income can be explained by European countries moving towards intermediate positions, as could be the case of east European countries or Germany specializing in the automotive sector.

To end this section, let us comment that the effects found in the control variables are similar to those seen in the global results (Table 1), and need no further comments.

5. Conclusion

The main aim of this paper is to explore the relationship between inequality, both at inter-country and intra-country levels, and the involvement of countries in GVCs. A particular focus on the *Position* variables, that is, on the more downstream or upstream specialization of countries in the different production stages, and its impact both on internal inequality and inter-country divergences. We are interested in studying if there is room for different but compatible specialization patterns of the economies to achieve social outcomes (in terms of reducing social inequality), in the context of catching-up processes. As we observe different inequality patterns along the world, we do the analysis for different geographical groups.

Our findings suggest that *Position* is relevant explaining inequality in some world regions. In the case of intra-country inequality (measured through Gini indexes and ratios of top 1% incomes over the bottom 50%), we find significant “smile curves” in Developed countries, Latin America, and East & Southeast Asian countries (just for the INTRA2 measure). That means that, in these areas, intermediate positions in the chains (that is associated with the development of medium technology, and high technology industries such as plastics, chemicals, or electrical equipment) contribute to reduce internal inequality, while the opposite happens in the tails. In fact, internal inequality is especially high in Latin American countries, which could be explained by their downstream character. The success of most Southeast Asia countries in reducing inequality can also be related to their good performances in achieving economic upgrades in terms of moving up the chains into intermediate positions; by contrast, the increasing inequality in China and India is linked respectively with its upstream and downstream character. For Transition economies, we get a “frown curve”, that is, being in the extremes of the chains favors low values of inequality. Thus, being located in the first or last steps of the production process benefits these economies in terms of internal equality: namely, high internal inequality in Russia could be explained by its intermediate positioning.

If we focus on inter-country inequality, first measured as economic upgrading, position is significant in all our geographical areas. We find “smile curves” in Developed countries, Transition economies, Middle East, and Asia. Meanwhile, “frown curves” appear in Latin America and Africa. In other words, extreme positions in the GVCs would increase income with respect the world average in the former areas, while intermediate positions are recommendable in order to achieve economic upgrading in the latter. As we have seen the case of Middle East and Southeast Asia countries has been an example of a successful stories of upgrading, while the contrary has happened in Africa and Latin America, its countries being trapped in low-income levels in comparison to the global average, as well as in downstream positions in the GVCs.

Furthermore, measuring inter-country inequality as an indicator of social upgrading (difference of value added per capita with the world average), we find “smile curves” in Developed and Middle East countries, and “frown curves” in Latin America. Therefore, we have found that convergence can be achieved when Developed and Middle East countries occupy intermediate positions, while many Developing

countries should move to the extremes. Here, the case of Latin America is outstanding, as these countries would converge by moving to downstream or upstream positions.

All in all, this paper opens a promising line of research linking inequality with globalization, exploring this relation from the perspective of GVCs. As this paper has shown, the MRIO framework reveals as a powerful instrument to study the anatomy and evolution of GVCs and the associated socioeconomic and environmental impacts. Further future research is expected in the design of integrated indicators capturing different perspectives of the social upgrading of countries and the relationship with the current and future globalization perspectives.

Declaration of Competing Interest

The authors have no competing interests to declare that are relevant to the content of this article. Besides, this manuscript is not being considered for publication elsewhere.

Data Availability

Data will be made available on request.

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Supplementary materials

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