Upstreamness, exports and international competitiveness: lessons from the case of China

Upstreamness, exportações e competitividade internacional: lições do caso da China

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Abstract

This article aims to provide more and better evidence regarding the degree and nature of the interaction of countries within global value chains (GVCs), based on metrics compatible with the international fragmentation of production. The main focus is on the Chinese specialization pattern in vertically integrated production networks. Our results suggest that China's production has advanced to other stages located more at the beginning/bottom of the GVC, while increasing its importance in cross-country production sharing and becoming less dependent of intermediate imports embodied in its exports. The decline in re-exported intermediate imports in China was not translated into lesser diversification of its exports. On the contrary, China has climbed the ladder of production complexity, while becoming more integrated into world trade and relying less and less on imported inputs, as well as becoming more competitive in the production of components.

Keywords

global value chains, international competitiveness, vertical specialization patterns, China.

JEL Codes L00, L23, F14.

Resumo

Este artigo tem como objetivo fornecer mais e melhores evidências sobre o grau e a natureza da interação dos países nas cadeias de valor globais (CGV) a partir de métricas compatíveis com a fragmentação internacional da produção, com foco no padrão de especialização chinês em redes de produção verticalmente integradas. Nossos resultados sugerem que a produção da China avançou para outros estágios localizados mais no início das CGVs, enquanto o país aprofundou sua importância na divisão da produção internacional entre os países e tornou-se menos dependente de importações intermediárias incorporadas em suas exportações. A queda nas importações de intermediários reexportados na China não se traduziu em menor diversificação de suas exportações. Pelo contrário, a China galgou a escada da complexidade da produção, ao mesmo tempo que se integrou mais ao comércio mundial e dependeu cada vez menos de insumos importados, bem como tornou-se mais competitiva na produção de componentes.

Palavras-chave

cadeias de valor globais, competitividade internacional, padrões de especialização vertical, China.

Códigos JEL *L00, L23, F14.*

1 **Introduction**

The last decades have witnessed significant changes in how the world production and international trade are organized, with some countries becoming specialized in specific parts and tasks within global value chains (GVC). As a result, the final products are now considered "packages" of several nations' productive factors (Baldwin, 2011), turning the fact of a product being "completed" in a particular country into a narrow story about its specialization patterns. In today´s interconnected global economy, GVCs have become a practical and useful explanatory framework for understanding how firms and countries are engaged in the process of value creation, distribution and capture.

The interdependencies among industries in fragmented and internationally dispersed production networks have imposed the need to use more accurate empirical measures. Before the emergence of GVCs, it was possible to compare gross-trade data to data on value-added without overstating the amount of domestic value-added in exports. However, the use of traditional global trade statistics may lead to a significant amount of double counting, since exports increasingly rely on significant (direct and indirect) intermediate imports. When based on gross concepts, the analyses may present a misleading portrait of which country ultimately benefits from bilateral trade flows by exaggerating the importance of producing countries at the end of value chains, and, even more importantly, may lead to a misunderstanding regarding the relation between trade and macroeconomic variables. In this sense, most recent analyses are based on "factor content" or "value-added" trade that rely on international (or inter-country) input-output (IIO) data (Hummels *et al.*, 2001; Johnson, 2014; LOS; Timmer; De Vries, 2015; Timmer *et al.*, 2014).

There are many different ways to capture the degree and nature of trade interactions along the GVC, such as the import content of exports (Hummels; Ishii; Yi, 2001); the method of disaggregation of gross exports (Koopman; Wang, 2012; Koopman *et al.*, 2014); the value added exports (Johnson; Noguera, 2012); the "import to export" (I2E) and "import to produce" (I2P) (Baldwin; Lopez-Gonzalez, 2013); and the vertical specialization of (value-added) trade (Daudin *et al.*, 2011). The recursive concepts used in this contribution are strongly based on the macro level of this literature, which is set apart from case studies for single products or specific firms

and is concerned with a broad view of countries engagement in GVC. Differently from individual firms' micro-level data which are limited to the structure of a particular product network, input-output analysis covers all groups of industries that compose an economic system, making it possible to identify the vertical structure of international production sharing. Thereby, our article emphasizes the sequential, multiple-border crossings and the back-and-forth aspects of production processes that are increasingly fragmented geographically.

This article aims to provide more and better evidence regarding the degree and nature of countries' interaction within the GVC, focusing on the Chinese specialization pattern in vertically integrated production networks. How each country specializes in specific stages of a production sequence is a particular dimension of inter-country production linkages, which is commonly presented as vertical specialization in trade. Our empirical strategy is to integrate the most widely accepted metrics based on the concept of trade in value added, that is, the country's GVC participation, the relative GVC position, as well as an analysis of the different components within the total foreign content and the Economic Complexity index. The empirical exercise is based on data from OECD-WTO Trade in Value-Added (TiVA), TiVA Nowcast Estimates, the World Input-Output Database (WIOD), and Simoes and Hidalgo (2011) in the period of 1995-2011. Whenever the WIOD was used, we applied the method of decomposition of gross exports by Koopman *et al*. (2014), and the *decompr* algorithm (Quast; Kummritz, 2015) applied in software R.

This article is organized as follows. Following this Section 1, Section 2 introduces some general features of the GVC literature, focusing on the construction of the GVC concept and approach. Section 3 provides empirical evidence on the asymmetric patterns of specialization, and their changing nature, focusing on the Chinese experience. And lastly, Section 4 offers our conclusions.

2 The GVC literature: from concept to framework

One of the most striking features of the recent wave of globalization is the surge of production fragmentation into various stages internationally dispersed. In addition to its pure expansion, trade has changed with the

emergence of borderless production systems, and so has changed the linkages among trade, growth, and development. Whilst the fragmentation of production and the outsourcing of activities across countries are not new phenomena, the importance of internationally fragmented production has undoubtedly been growing over time. This vertically fragmented production structure is commonly associated with CGV.

Tracing back the history of the concept of *value chain* before its being widely used in the 1990s, we find the first value chain studies in the 1960s and 1970s, with the aim of identifying development options for mineral-exporting countries (Kaplinsky, 2000). The *value chain* describes "the full range of activities which are required to bring a product or service from conception, through the different phases of production, delivery to final consumers, and final disposal after use" (Kaplinsky; Morris, 2003, p. 4). These activities are not restricted by production *per se*, including others links, such as design, marketing, distribution, and recycling, which gradually add value, as described and popularized by Porter (1985). These activities can in turn be contained within a single geographic location or even a single firm. In a broader sense, however, a value chain can be understood as a set of businesses, activities and relationships engaged in creating a final product or service (UNIDO, 2009). The concept builds on the idea that the value chain describes how different economic actors, separated by time and space, aggregate value to products or services, step-by-step and beyond the actual manufacturing process. Therefore, a value chain does not necessarily reflect a physical transformation.

There was a change of perspective by adding "global" to the concept[1], pointing out that a value chain can be more or less extended, besides being divided among multiple firms and geographic spaces. In this sense, the concept of GVC emphasizes the potential for large distances between the local producer of goods and services and its global consumer (Bair, 2005). GVC became an expression of an unprecedented fragmentation of production processes in an increasingly interconnected global economy, where the production of most goods relies on several stages located in different countries and intermediate inputs are crossing borders multiple times. In a general sense, GVC involve four features that differentiate them from traditional production and trade: i) customization of produc-

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1 Value chains are considered "global" when they include steps, processes, and actors from at least two countries (Gereffi *et al.*, 2005).

tion; b) sequential production decisions from buyer to suppliers; c) high contracting costs; and d) global matching of goods, services, production teams and ideas (Antràs, 2015). Thus, one can say that the key features of the phenomenon of GVC are the international dimensions of the production process and the "contractualization" of buyer and seller relationships (Taglioni; Winkler, 2016).

To analyse the emerging pattern of global trade, the GVC approach provides a view of global industries from two contrasting vantage points: *top down* and *bottom up*. While the main concept for the *top-down* view is "governance", which focuses mainly on the power relationships between firms that set the parameters for other firms in the chain, the key concept for the *bottom-up* view is "upgrading"[2], which refers to the possibility of moving up in the value chain and focuses on the strategies used by countries, regions or firms to maintain or improve their positions in the global economy (Frederick, 2014; Gereffi; Fernandez-Stark, 2011; Gereffi; Lee, 2012).

In the context of chain-governance, the key questions are which activities and technologies a firm should keep in-house and which should be outsourced and, furthermore, where these activities should be located (Gereffi *et al.*, 2005). In other words, when a firm decides where to locate its activities and with whom to partner, the decisions that have been made are on where to invest and from where to trade (UNCTAD, 2013). These decisions impact the process of value creation and capture in host countries and have to be considered under the firm's (typically the lead firm) coordination of their GVC. Accordingly, GVC involves a trade-investment nexus that includes: first, cross-border intra-company trade within the network of foreign affiliates (*Foreign Direct Investment – FDI*); second, contractual partner-firms (*non-equity modes of investment – NEMs*); and third, cross-border intercompany *arm's length* transactions. Each one, or a combination of them, is chosen as an optimal mode of managing complex GVCs given an equation that involves elements such as: transaction costs, power relations and the risks of outsourcing.

More than simply random interactions or the obligation of a single agent of the GVC, chain-governance is collective and ensures that the interactions between firms allow for reducing costs and risks along the GVC (UNIDO, 2009). As GVCs have developed, a multiplicity of lead

2 This particular dimension is two-fold: the *economic* and *social* upgrading. For more details about its definitions and measures, see Marcato and Baltar (2020).

firm-supplier relations has taken place[3]. Under a new scale of operations and increased technological sophistication, the suppliers have established a new set of relations with lead-firms, involving several degrees of investment, technical support and long-term contracting and monitoring (Taglioni; Winkler, 2016).

From a developing perspective, the study of chain-governance is crucial for understanding how firms in those countries can gain access to global markets, the benefits and risks associated to becoming more integrated, and how it is possible to increase the net of gains from participation in GVC (Gereffi *et al.*, 2005). Although chain-governance deals with power asymmetry and its abuse by certain agents, most of the analyses of chain-governance structures do not consider a wide range of relationships between firms and non-firms and are restricted to relationships between firms and suppliers. Furthermore, the reasons for deciding whether to integrate the production of intermediate inputs or outsource it, and to define supplier locations (offshoring), reveal that the firm's governance decisions go beyond mere transaction costs and core competencies, encompassing the search for greater flexibility, diversification of location to reduce risk, and the reduction of production costs (Milberg; Winkler, 2013).

In recent years, the GVC approach has been adopted by several international organizations concerned with economic development. Understanding that one of the central hypotheses of the GVC framework is that "national development requires linking up with the most significant lead firms in an industry" (Gereffi; Memedovic, 2003, p. 4) reveals an important perspective of the GVC analysis: it is not about the profits of the companies in each segment of the value chain, but the whole value created and how it is distributed along the chain (UNIDO, 2009). This is exactly why governance and upgrading are the two central analytical tools of the GVC analysis since both have influence on the distribution of value among actors along the chain. In other words, GVCs matter for economic development because "the ability of countries to prosper depends on their participation in the global economy", which is largely measured as their role in the GVC (Gereffi; Lee, 2012).

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3 To address the hybrid patterns of relationships between firms in GVC, Gereffi *et al.* (2005) elaborated a more nuanced scheme of governance relationships, a five-categories typology: *market, modular, relational, captive* and *hierarchy*.

The GVC approach is built upon a set of analytical methods, and it can focus on many aspects simultaneously, depending on the scholarly approach. In this sense, to analyse countries' exports and international competitiveness, evaluating their importance on the cross-country production sharing and their dependence on intermediate imports embodied in their exports, it is crucial to go beyond traditional statistics. The next section undertakes a deeper analysis for the case of China, providing evidence of the degree and nature of this country's interaction within the GVC.

3 Empirical evidence for the case of China

Traditional statistics based on gross exports tend to a "double counting" of trade flows, as gross exports include the value of imported intermediates that are used in production, blurring the real distribution of value created within countries. In the absence of trade in intermediate inputs, this difference between gross and value-added analyses would not be that relevant. Related to gross exports, the average error in traditional analyses has been around 20 per cent and it has increased over the period of 1995 to 2011 (Figure 1). In that sense, the case of Luxembourg illustrates that this difference as a share of gross exports gains more importance as a function of country's integration in the GVC. Although this difference was small in nominal terms, it was not negligible when considering its proportion to the total value exported. In contrast, this gap was lower for countries that were more intensive in commodities, such as Brazil and Argentina. In addition to the United States, these three countries showed that the extent of their differences related to gross exports are less prominent than the world average.

The Chinese contribution to international trade flows is heavily overestimated when analysed in gross terms. However, this difference as a share of gross exports has narrowed since 2003 (Figure 1). While most countries are relying less on domestic inputs for production, China goes against this trend and has increased its ratio of domestic value added in exports to gross exports (DVAR). This intriguing exception has been corroborated by other studies (Kee; Tang, 2015; Koopman *et al.*, 2012). Investigating its potential causes, Kee and Tang (2015) found that the rise in Chinese DVAR is due to individual processing exporters replacing imported inputs with domestic

products in terms of volume and varieties[4], and this would mean that China became more competitive, especially in the intermediate input sectors.

Figure 1 **Difference between Gross Exports and Domestic Value Added (% of gross exports), selected countries and world, 1995-2011**
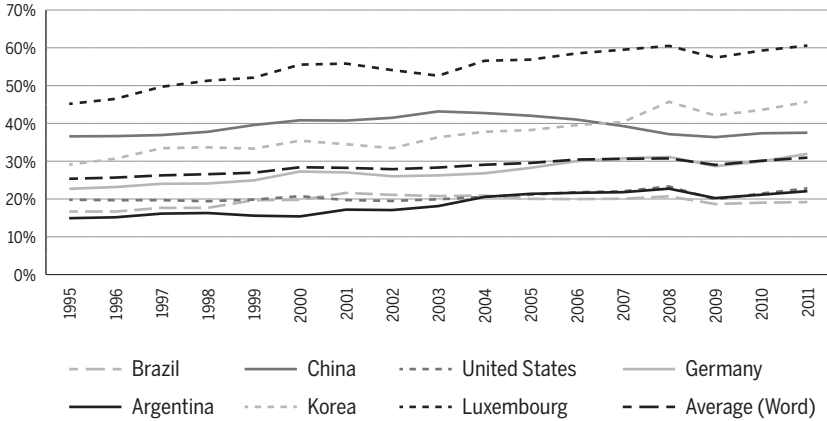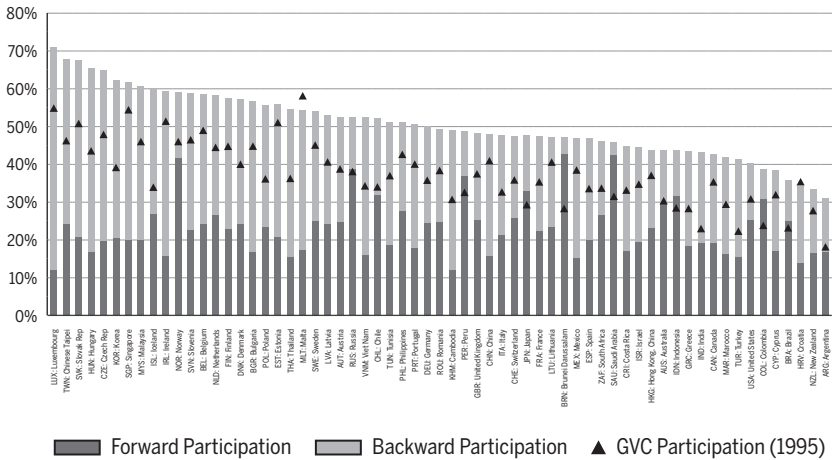

Source: Own elaboration based on OECD-WTO TiVA database (December 2016).

Apart from the Chinese case, most countries increasingly rely on foreign value added for their own exports, which may then be further processed in partner countries. Figure 2 presents the magnitude of the overall GVC participation across countries in 1995 and 2011, as proposed by Koopman *et al.* (2010, 2014). The GVC participation index combines both *backward* (the share of foreign inputs) and *forward* (domestically produced inputs that are used in third countries' exports) participation in GVC, and it is expressed as a percentage of gross exports. Looking at the change over time, all countries apart from Malta and Croatia increased their participation in GVC. Iceland, Korea, Hungary, Chinese Taipei, and India increased their participation the most. A cross-country comparison reveals that the East-Asian economies such as Korea, Singapore, and Malaysia showed relatively high GVC participation indexes. In that sense, although China's participation grew significantly over the period, it is relatively lower than the average of its Asian partners.

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4 According to Kee and Tang (2015), other potential causes are: a) a changing composition of Chinese exports, which would indicate that the Chinese comparative advantage is moving towards industries with high domestic content; and b) an upsurge of Chinese domestic production costs. But following their model, both causes cannot explain this rising trend.

In 2011, the top positions with respect to GVC participation were held by small open economies, such as Luxembourg (71%), Taiwan (67.6%), the Slovak Republic (67.4%), Hungary (65.2%), Czech Republic (64.8%), and Korea (62.2%). All these countries increased their overall GVC participation mostly based on the expansion of the foreign value-added share of their gross exports, *i.e.*, reinforcing their role as buyers of foreign inputs (*backward linkages*). Compared to large economies, such as United States, India, and Brazil, those small countries have lower availability of domestically sourced intermediates, resulting in higher imports of intermediates. The data for Luxembourg and Hungary depict that small countries can depend heavily on international trade whilst relying more on buying goods and services needed for production on the international market.

Figure 2 **The GVC Participation index (% share in total gross exports), 1995 and 2011**

Source: Own elaboration based on OECD-WTO TiVA database (December 2016).

In contrast, large markets show lower rates of participation in GVC, mostly because of lower backward participation, given their higher domestic production of inputs and thus relatively small need to seek for intermediate inputs from abroad. But this is only a partial view of GVC, as the GVC participation index also considers their prominence as sellers of inputs into value chains (*forward linkages*). For example, the foreign content of Brazilian exports was 10.7%, while Brazilian participation in GVC increased to almost 36% when Brazilian intermediates in third countries' exports were

considered. Further on, the bottom positions in the overall GVC participation were occupied by Argentina (30.8%), New Zealand (33.4%), Croatia (34.1%), and Brazil (35.6%) in 2011. Among others, because raw materials are a relatively great part of its exports, Brazil tends to show a large share of domestic value added both sent to consumer economy (*direct* domestic value-added, "direct DVA") and sent to third countries (*indirect* domestic value-added, "indirect DVA") (Figure 3).

To enrich this analysis, Figure 3 decomposes the sources of value-added in gross exports into four components by their destination: a) domestic VA sent to consumer economy, b) domestic VA sent to third countries, c) domestic VA re-imported in the economy; and d) foreign VA content of exports. Components (a) through (c) depict the value of gross exports that is created domestically, and component (d) indicates the value of exports that is created abroad. Component (a) is not considered as value-added generated by supply chains, indicating how much of a country's exports are created as stand-alone exports, *i.e.* outside any supply chain (Rahman; Zhao, 2013). Hence, it is important to note that, given the definition of the GVC participation index, only components (b) and (c), as *upstream* linkages, and component (d), as *downstream* linkages, are taken into consideration as value-added in exports generated by supply chains.

Overall, the role of supply chain linkages (components b-d) increased over time. This was heavily driven by an increase in the domestic VA sent to third countries in the case of China (32.5% to 37%). While Japan, Germany, and Mexico showed larger decreases in that indicator, these countries most expanded the share of foreign VA in exports. Overall, foreign value added in exports is higher in countries where processing industries account for a significant part of exports, such as Mexico. Further on, the domestic VA re-imported in the economy as a share of gross exports increased for almost all countries, except for the United States. This indicator reflects the value-added created in upstream domestic industries providing indirect intermediate inputs via international value-chains[5]. The United States are also an exception regarding the decreasing trend in domestic VA sent to the consumer economy, showing a slight increase from 1995 to 2011.

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5 This indicator, by industry, provides a measure of how protectionist measures may affect domestic industries that provide inputs to imports.

Figure 3 **The VA components of gross exports, selected countries, 1995 and 2011 (% share in total gross exports)**
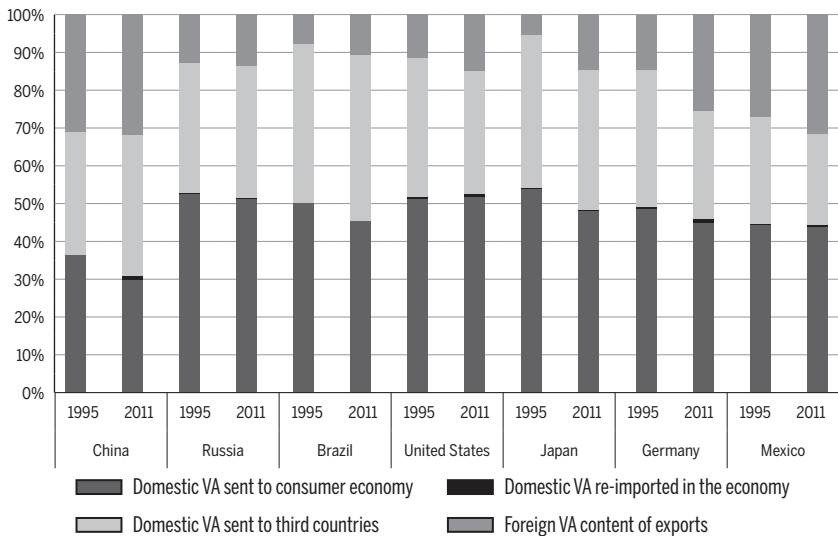
Source: Own elaboration based on OECD-WTO TiVA database (December 2016).

Considering the top 25 exporting economies in 2011, Figure 4 shows the decomposition of gross exports in domestic and foreign value added and its share of domestic value added in exports, *i.e.*, the VAX ratio[6] (on the right side of the Figure). On the one hand, Saudi Arabia (97%), Brazil (89%), Russia (86%), Australia (86%), United States (85%), and Japan (85%) are the countries with the largest ratios of value added to gross exports (*i.e.*, domestic content of exports). On the other hand, Taiwan (56%), Singapore (58%), and Korea (58%) are the main bottom countries regarding the shares of domestic value-added trade, showing that East and Southeast Asian countries have the highest shares of foreign value-added trade.

The involvement of countries as users of foreign inputs to produce exports varies across countries and regions. In part, this heterogeneity reflects differences in several factors[7], such as *geographical location* (*i.e.* proximity to

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6 Following the measure proposed by Johnson and Noguera (2012), which is defined as the ratio of value added to gross exports and can be thought as a metric of the domestic content of exports.

7 See Kowalski *et al*. (2015) to an empirical analysis on the relationship between the characteristics of GVC participation and different factors, such as market size, level of development, openness to trade, and investment performance.

neighbouring markets), *economic size* (*i.e.* the ability to source intermediates from domestic suppliers and the ability to draw on larger domestic markets for their intermediates and final goods and services), *infrastructure aspects and domestic policies in the countries* (such as how open and liberal is the trade policy regime), as well as *different patterns of specialization* (countries that export a lot of raw materials commonly have a high degree of domestic value added, since they specialize in upstream activities (*e.g.* mining and agriculture) that are in the beginning of GVC) (Cheng *et al.*, 2013; Kowalski *et al.*, 2015; Unctad, 2013; World Bank, 2014). However, this complex mix of determinants of a country's engagement in GVC is not reflected in the GVC participation index, as one may find countries with structural differences regarding these features and similar degrees of participation.

Figure 4 **Domestic value-added trade shares of the top 25 exporting economies, 2011**
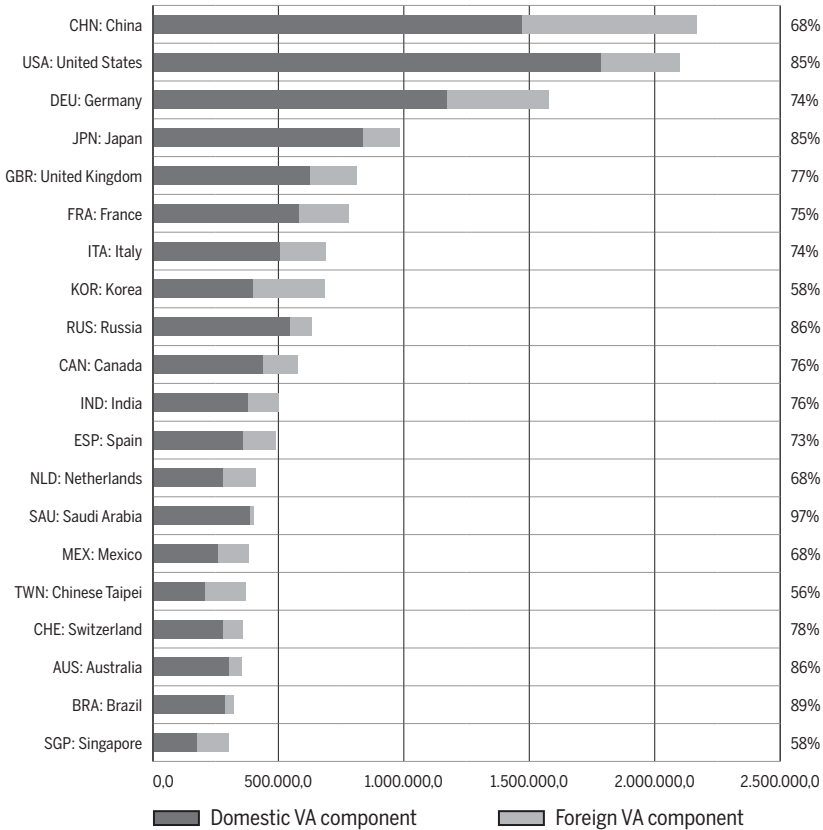
Source: Own elaboration based on OECD-WTO TiVA database (December 2016).

Thus, the question is whether countries are better off having a bigger share of domestic value added in their exports. However, there is no simple answer. The share of domestic value added in exports gives an indication of how a country is integrated into GVC, but the goods and services that are being exported can be completely different, and so can be the benefits associated to them. In other words, *increasing the portion of domestic value added in exports is not the same as upgrading*. A country can present decreasing shares of domestic value added in exports and still be on an upgrading path, whether it participates in the GVC that create higher overall value, with higher levels of technological sophistication or higher wages and better labour conditions, even though it depends on increasing shares of foreign value added in exports.

3.1 Upstreamness versus downstreamness: great changes in relative GVC position are unusual across time

Upstreamness (or downstreamness) refers to where a country is located in a GVC. One measure, developed by Koopman *et al.* (2010), is the GVC position index[8]. Countries with high forward relative to backward participation present a positive GVC position index, suggesting a country that lies upstream in a supply chain. Figure 5 illustrates whether a country remained specialized in the first (*i.e.*, upstream stages) or last stages of production relative to the rest of the world.

Overall, there are no substantial changes among countries regarding their relative position in GVC between 1995 and 2011. The Saudi Arabia, Brunei Darussalam, and Colombia, are the countries that lie relatively more upstream in 2011. As expected, other natural resource-abundant economies, such as Peru, Russia, Indonesia, Norway, and Brazil also lie upstream. On the other hand, Luxembourg, Cambodia, and Hungary are the mostly downstream participants. As may be expected, Asian emerging market economies, such as India, China, and Vietnam, are generally located downstream. Looking at the trajectories across time, only a few countries, such as Turkey, Poland, India, and Cambodia, were able to move from being relatively upstream to downstream.

8 Koopman *et al.* (2010) define the GVC position index as the log ratio of a country's supply of intermediates used in other countries' exports to the use of imported intermediate goods in its own production.

Figure 5 **GVC position index, 1995 and 2011**
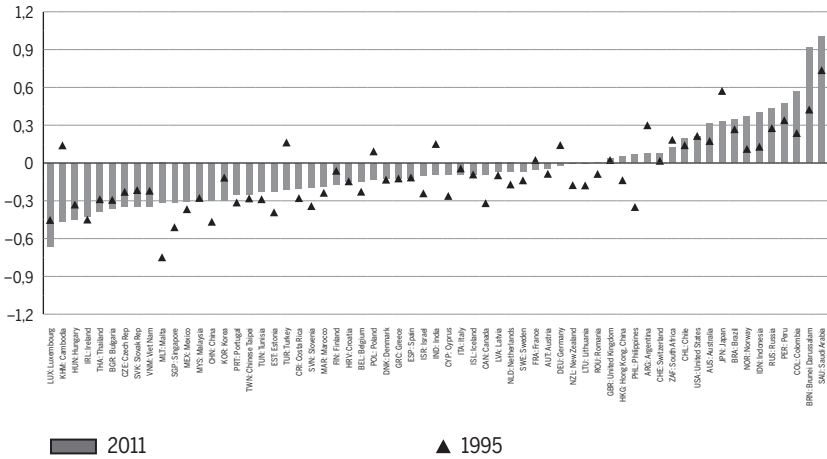
Source: Own elaboration based on OECD-WTO TiVA database (December 2016).

However, this analysis presents some limitations. Two countries can have identical GVC participation indexes but their position along the GVC may vary significantly, reflecting different patterns of specialization, *i.e.*, more activities upstream or downstream in the production network. At the same time, two countries may clearly present similar GVC position indexes, but very different degrees of participation in the GVC (Koopman *et al.*, 2010). Brazil and Japan, for example, present very similar GVC position indexes and considerably different degrees of participation in GVC. Furthermore, considering countries with similar forward participation indices that are located upstream in the chain, one may observe that they can be specialized in completely different activities. For instance, the USA is upstream in the chain due to activities such as design, R&D, and branding, while countries like Brazil and Russia are also considered upstream but are exporting mostly primary sector commodities.

Figure 6 shows the GVC participation index on the x-axis and the GVC position index on the y-axis for all countries in OECD-WTO TiVA dataset from 1995 to 2011 (each dot represents a specific country in a specific year). The negative correlation between the two measures indicates that the countries specialized in downstream activities saw an increase in their participation rate. In other words, most countries are taking a deeper part

in GVC by trading inputs that are imported from abroad (*backward linkages*) rather than producing domestically goods and services that are being exported by third countries (*forward linkages*).

Figure 6 **GVC participation index and GVC position index, 1995-2011**
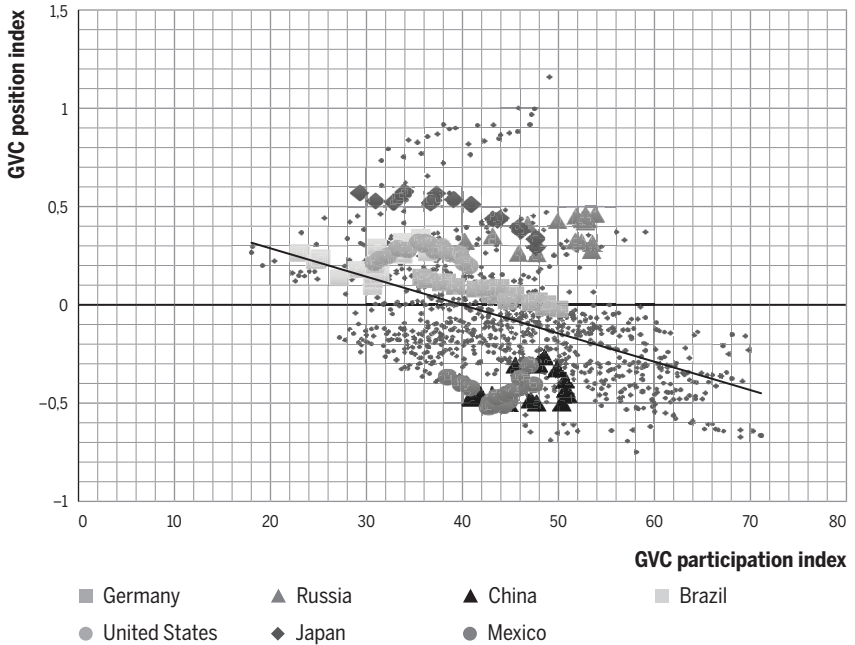
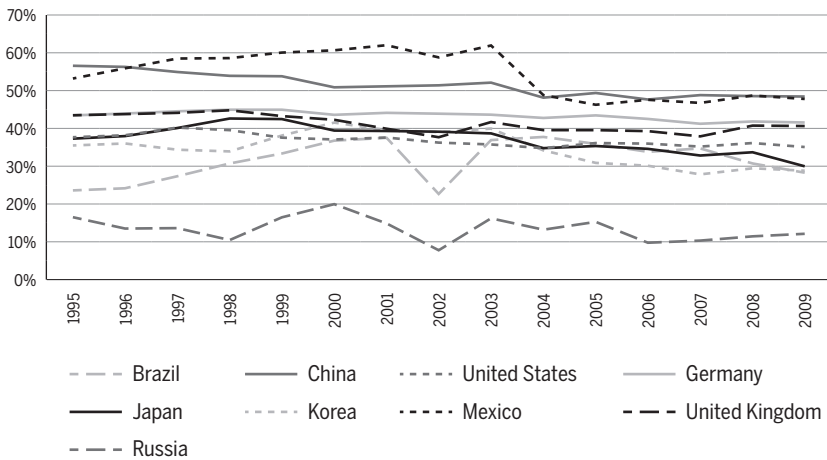Source: Own elaboration based on OECD-WTO TiVA database (December 2016).

3.2 **The relevance of the "double counted" part of VS**

The overall increase in the total foreign content was mainly driven by an increase of the "double counted" intermediate exports produced abroad. There are three different components within the total foreign content (VS)[9], which are: a) foreign value in final goods exports (FVA_FIN); b) foreign value in intermediate goods exports (FVA_INT); and c) "double counted" in-

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9 It worth noting that "the difference between foreign value-added (FVA) and VS share is the share of pure double counting due to the back-and-forth intermediate goods trade originated from foreign countries" (Wang *et al.*, 2014, p. 34).

termediate exports produced abroad (FDC)[10]; each one with different economic meanings and illustrating different arrangements of cross-country production sharing (Wang; Wei; Zhu, 2014). According to these authors, a country with a large share of FVA_FIN may be engaged in final assembling activities based on imported inputs, participating in cross-country production sharing mostly on the low end of a GVC, while an increasing FVA_INT may be a sign that the country is no longer at the beginning of the GVC.

Figure 7 **Foreign value in final goods exports (FVA_FIN) as % of VS, selected major economies, 1995-2009**

Source: Own elaboration based on WIOD (release 2013) data. Note: We use Koopman et al. *(2014) method of decomposition of gross exports, and* decompr *algorithm (QUAST; KUMMRITZ, 2015) applied in software R.*

To understand what is behind the general increase of VS in a country's gross exports, Figures 7, 8, and 9 show the relevance of each component and their trajectory over time. Figure 7 shows the share of FVA_FIN in VS for nine selected economies from 1995 to 2009. At the beginning of the series, China held the largest portion of FVA_FIN in VS relative to other countries. Since then, this indicator has been losing importance, in what can be understood as the advance of China's production to other stages located more at the beginning of the CGV. Meanwhile, Mexico has occu-

10 FDC indicates the "pure double counting from foreign sources", which can be divided in MDC ("due to the direct importer exports production") and ODC ("due to other countries exports production").

pied a space previously occupied by China, increasing its presence at the low end of GVC. Except for Brazil, all countries saw a decline of about 5% between 1995 and 2009, with China showing the largest decrease (8%).

Figure 8 shows the share of foreign value in intermediate goods exports in VS, and it suggests that only Mexico showed signs of being no longer at the bottom of the GVC between 1995 and 2009. During that period, this indicator was almost constant for all selected countries, and considering the last two years of the series, all countries showed signs of upgrading its industries to start producing intermediate goods for other countries.

Figure 8 **Foreign value in intermediate goods exports (FVA_INT) as % of VS, selected major economies, 1995-2009**
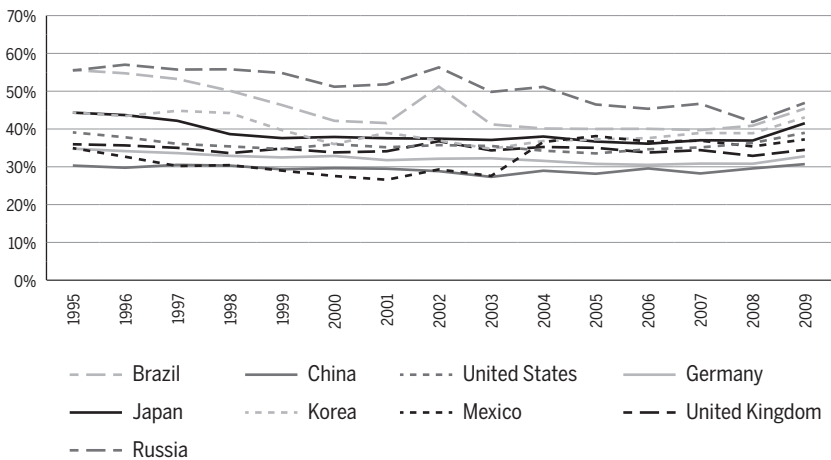
Source: Own elaboration based on WIOD (release 2013) data. Note: We use Koopman et al. *(2014) method of decomposition of gross exports, and* decompr *algorithm (QUAST; KUMMRITZ, 2015) applied in software R.*

Further on, a larger share of FDC in VS suggests that a country is deepen increasing its importance in the cross-country production sharing, as FDC is a reflection of the back and forth trade of intermediate goods (Wang; Wei; Zhu, 2014). Overall, all selected countries increased their double counted intermediate exports produced abroad as a share of VS, of which Japan and Russia increased by around 10 percentage points between 1995 and 2009, with the latter in a considerably higher level than the other countries (Figure 9). It is also interesting to note that this indicator has

shown signs of weakening trade in GVC prior to the 2009 crisis. There-fore, the increase in the share of VS in exports was mainly driven by the increase in FDC share. However, this is clearly not a homogeneous process among countries and sectors. For China, it was driven by the increasing FDC, while FVA_INT stayed relatively stable and FVA_FIN decreased. For Brazil, both FVA_FIN and FDC shares increased during this period, while FVA_INT has declined, which may be consistent with moving from the upper stream part of the GVC to a downstream position. Finally, analys-ing the structure of the VS adds new empirical evidence about a country´s position in the GVC.

Figure 9 **Double counted intermediate exports produced abroad (FDC) as % of VS, selected major economies, 1995-2009**
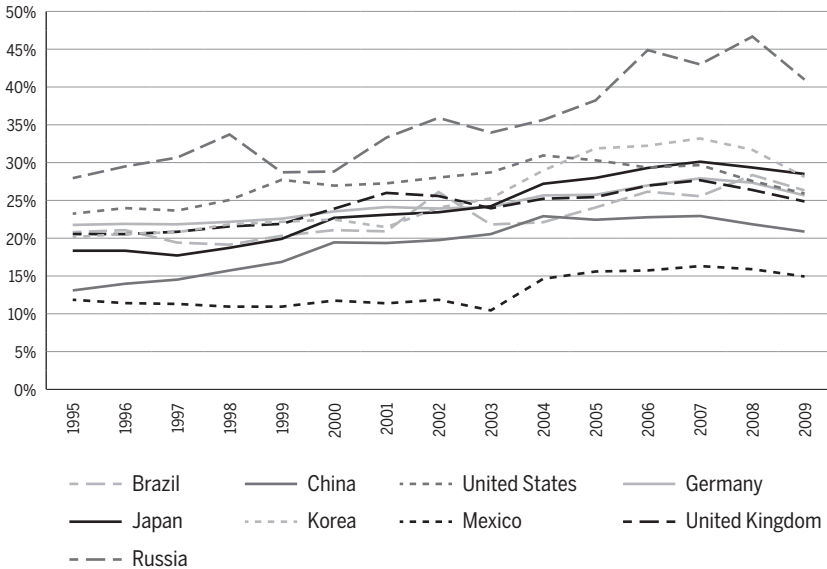
Source: own elaboration based on WIOD (release 2013) data. Note: we use Koopman et al. (2014) method of decomposition of gross exports, and decompr algorithm (Quast; Kummritz, 2015) applied in software R.

3.3 Intermediate imports as a source of international competitiveness: China *vs.* Mexico

China and Mexico are crossing roles regarding the use of intermediate imports as source of international competitiveness for their exports. The increasing use of intermediate imports embodied in exports is usually posed as a source of international competitiveness. To assess the importance of intermediate imports to produce goods and services for export, Figure 10 depicts the imported intermediate inputs embodied included in exports as a share of total intermediate imports for selected countries in the years of 1995, 2000, 2007, 2009, 2011, and 2014. Among the selected countries, Germany, France, Japan, Mexico, India, and Korea showed an upsurge trend over most of the period. However, all countries suffered with the global trade shock during the financial crisis, except for UK and India that showed a slight increase, and Korea, which maintained a steady upward trend until 2011. Brazil, United States, and Japan are among the countries with the lowest levels.

This indicator has an economy size bias, since the smaller the country the larger the share of imported intermediates that are used in production as a share of total intermediate inputs. However, this does not explain completely its magnitude or trend, as changes over time can also reflect changes in specialization. China and Mexico are the countries with the largest extensions, but they showed distinct behaviours over time, with Mexico becoming more dependent of intermediate imports embodied in their exports and China moving in the opposite direction. The share of re-exported intermediate imports in China fell between 2007 and 2014, from 58.8% to 45.4%. Although this pattern differs across industries, overall, China has reduced its role as the final point in "Factory Asia".

This would be one of the key dimensions of a much broader structural transformation in China, which is mostly discussed in terms of its change from investment-led growth to consumption-led growth (Lee; Park; Shin, 2016). Further on, intermediate imports may play a crucial role as a determinant of export diversification, especially for producing products located downstream along the GVC (Benguria, 2014). Thus, the decline in re-exported intermediate imports in China may have impacts not only on the exports of Chinese trade partners, especially those of the East and Southeast Asian economies, but also on the Chinese capacity of producing new products.

Figure 10 **Re-exported intermediate imports as % of intermediate imports, selected major countries, 1995, 2000, 2007, 2009, 2011, and 2014**
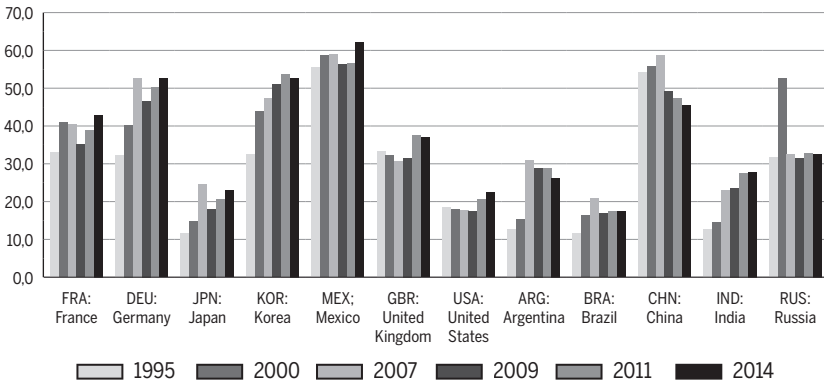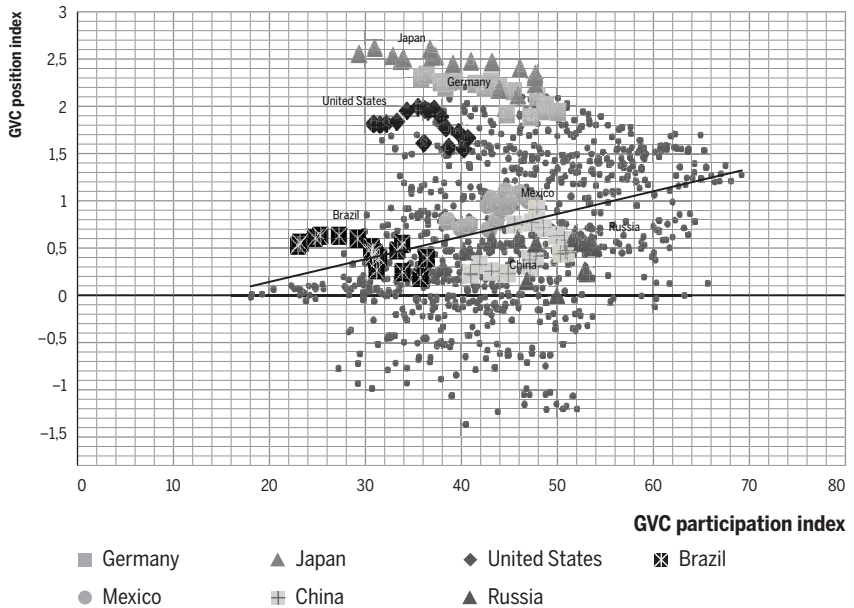

Source: Own elaboration based on OECD-WTO TiVA database (December 2016) and TiVA Nowcast Estimates.

3.4 **GVC integration patterns and upgrading in complexity of production: hundred-to-one shot**

A limited number of countries had the ability to become more integrated into GVC hand-in-hand with upgrading in complexity of production. The rise of measures of "economic complexity" has extended our ability to capture the new patterns in the structural transformation of countries. Even though there is a vast body of literature about the relationship between a country's productive structure and its ability to generate economic growth, emphasizing the importance of industrialization in its development strategies, most of the traditional metrics of a country's productive structure fail to capture the sophistication of the products into the equation. In that sense, the complexity of an economy, which is expressed in the composition of a country's productive output, is related to the multiplicity of useful knowledge embedded in it and reflects its capability set (Hausmann *et al.*, 2011). Put simply, it is possible to measure a country's economic complexity from the mix of products that it is able to make[11].

11 As one of the main concerns of the *Atlas of Economic Complexity* is to understand how complexity evolves over time and across countries, it is important to consider the limits of increasing the amount of knowledge embedded in an economy. Because this tacit knowledge is

Figure 11 **GVC participation index and Economic Complexity index, 1995-2011**

Source: Own elaboration based on OECD-WTO TiVA database (December 2016) and Simoes and Hidalgo (2011). Notes: (1) each dot represents a country-year combination. Due to unavailability of ECI data, six countries (Taiwan, Malta, Cyprus, Brunei, Luxembourg, and Iceland) were withdrawn from the sample, which was based on all other TiVA countries.

Figure 11 shows a positive correlation between GVC participation and a country's economic complexity index (ECI)[12]. Among the selected countries, Japan is the economy with the highest level of economic complexity, followed by Germany and the United States, respectively. Curiously, Mexico is a step above China in terms of the complexity of its production, which, despite its being more integrated into GVCs, has an ECI level relatively close to the Brazilian one.

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difficult to obtain and transfer, it is argued that new capabilities are easily accumulated when they are combined with others that are already available. An intuitive implication is that countries tend to diversify towards products that require a similar set of capabilities. Instead of identifying the precise technical and institutional requirements of each product, which would require a large volume of information, the authors measure the *proximity* between all pairs of products in the dataset. The idea is that the probability of a pair of products to be co-exported reveals that they have related characteristics and, more importantly, require similar productive knowledge.

12 See Hausmann *et al*. (2011) for how the ECI is constructed.

Over time, the measure of economic complexity provides a broad indication of a country's upgrading relative to other countries (Hausmann *et al.*, 2011). Figure 12 shows the changes in ECI ranking (*i.e.*, countries' relative upgrading in complexity of production) on the y-axis and changes in GVC participation index on the x-axis between 1995 and 2011. South Korea almost doubled both its ECI and its GVC participation index over the period, leaping from 22nd to 7th place in the ECI ranking. Mexico has also climbed the ladder of complexity of production (from 25th to 22nd), while becoming more integrated into GVC. Surprisingly, going against what Figure 10 would lead us to believe, China became more integrated into world trade while advancing 15 places in the ECI ranking (from 42nd to 27th). This means that China has achieved a greater diversification of its exports, although relying less and less on imported inputs. However, Figure 12 shows that a limited number of countries had the ability to become more integrated into GVC while at the same time scaling up the GVCs.

The top-ranked countries invalidate a linear relationship between the two measures. Over time, Japan, Germany, and Switzerland saw their ECI fall in absolute terms, while increasing their GVC participation, but relative to other countries, they remained ranked as first, second, and third most of the period. Other countries have experienced a similar process in which higher levels of GVC participation were not reflected in relative upgrading in complexity of production. For instance, France increased its GVC participation index by 12 per cent and fell from ninth to 14th in the ECI ranking, United Kingdom increased 11% and scaled down three places, and the United States increased 10% and dropped four places. Although Brazil and Germany experienced a similar ECI decrease in absolute terms, as well as a close increase in the GVC participation index, Brazil plunged 18 positions (from 30th to 48th) while Germany fell one place (2nd to 3rd). Therefore, it cannot be said that there is a simple positive association between larger GVC participation and upgrading, at least in terms of the complexity of production of the top-ranked countries.

The relationship between economic complexity and the GVC participation index has to be interpreted carefully. First, the reader should not confuse such an association with a causal relationship. But beyond that, the ECI is based on gross trade statistics, so countries that integrate low-value processing tasks at the end of complex products will show higher economic complexity measures (Ahmad; Primi, 2017).

Figure 12 **Change in the GVC participation index and change in economic complexity index between 1995 and 2011**
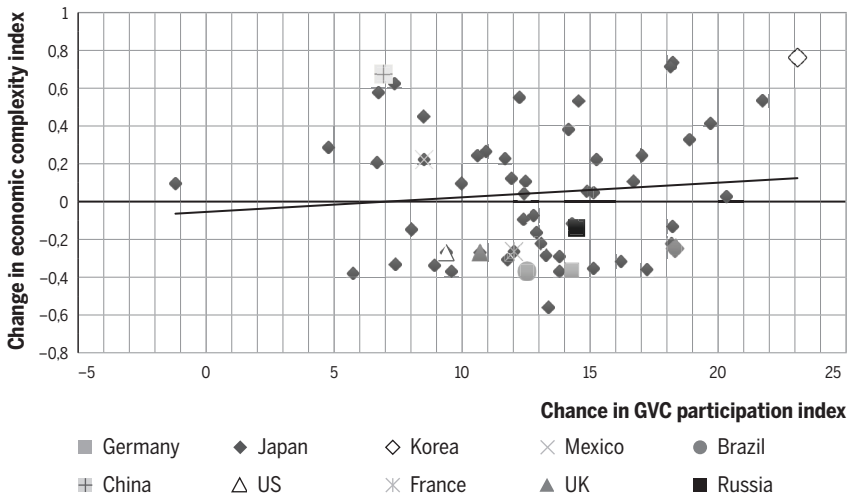
4 **Concluding remarks**

This article has explored some of the value-added trade measures to provide details about countries' asymmetric patterns of specialization, focusing on the Chinese specialization pattern in vertically integrated production networks. In doing so, we have illustrated the changing nature of international trade within GVC, drawing on selected evidence since 1995 and discussing the degree and nature of countries' interaction within GVC.

In general, our empirical findings confirm our previous assumption that the vertical fragmentation of production has changed our ability to analyse countries' patterns of specialization based on gross trade flows. That is because parts and components are crossing borders several times until they compose the final goods, causing a multiple-counting effect. Overall, countries have increasingly relied on foreign value added for their own exports, which may then be further processed in partner countries, but there were no substantial changes among countries regarding their relative

position in the GVCs between 1995 and 2011. Vertical specialization was mainly driven by an increase in the double counted intermediate exports produced abroad, as a reflection of the multiple-border crossing and the back-and-forth aspects of production processes. Furthermore, we found that a limited number of countries had the ability to become more integrated into GVCs hand-in-hand with scaling up the GVCs

We have shown that countries with the largest GVC participation were mostly small economies, which have lower availability of domestically sourced intermediates, and have expanded their overall GVC participation underpinning their role as buyers of foreign inputs. For instance, Southeast Asian economies showed relatively high GVC participation indexes and were generally located downstream in a supply chain, boosting the importance of its backward linkages rather than its forward linkages over time. Most countries have increasingly used intermediate imports as a source of international competitiveness to their exports. But we have found no linear relationship between GVC participation and a country's relative upgrading in complexity of production.

We have shown that one country has proved to be an exception in terms of the changing patterns of trade specialization, and that is China. While most countries are relying less and less on domestic inputs for production, China has moved counter to this trend, and is increasingly adding domestic value to its exports. Our results suggest that China's production has advanced to other stages located more at the beginning of GVC, while increasing its importance on the cross-country production sharing and becoming less dependent of intermediate imports embodied in its exports. China has reduced its role as the final point of manufacture in Factory Asia, which is a key dimension of a much broader structural transformation in the country. However, the decline in re-exported intermediate imports in China has not translated into lesser diversification of its exports. On the contrary, China has climbed the ladder of production complexity, while at the same time becoming more integrated into world trade and relying less and less on imported inputs, as well as becoming more competitive in the production of components.

As we have shown, the wide spread of GVC trade does not reflect an equal involvement in GVC across all countries. In fact, the concept of "global" value chain hides different regional patterns of trade integration. In other words, value chains are not really global. Nor are the benefits

from GVC integration spread equally among and within economies. Firms are the actual actors that have to face the outsourcing and offshoring decisions, which can decrease the cost of production and increase competitiveness; meanwhile, they can also raise other costs by increasing the complexity and uncertainty associated with internationally dispersed activities (Taglioni; Winkler, 2016). Nevertheless, the outsourcing and offshoring decisions of firms are influenced by national policies and the geopolitical environment. A wide range of national policy areas, such as trade, labour market, innovation, education, infrastructure, and investment regulations, can affect the chances of success in the GVC. Thereby, some developing countries have benefited from the movement of parts and components, technology, knowledge, and know-how, and others were able to improve the density of their production structure, while still other economies did not achieve either. These issues are particularly relevant for developing and emerging country firms and countries that aim to capture a bigger share of the dynamic gains from trade and who have generally been taught that the greater the country's participation in world trade, the better. Hence, another field that deserves to be further developed refers to the policy options to guarantee the mechanisms through which countries can maximize the benefits from GVC participation.

Despite providing interesting insights, the GVC analysis does not tell the whole story. Even in theoretical terms, a systematic framework of the specificities of GVC is still missing. In general lines, there is a significant number of empirical studies of different value chains, without any substantial causal explanation for understanding economic development within this new geographical pattern of value creation and capture in the global economy. In this sense, it is important to understand that the GVC framework has several limitations and should not be viewed as a panacea for economic development.

In summary, even though the value-added measures are less up-to-date and require simplifying assumptions in their construction when compared to gross trade, value-added analysis provides a revealing perspective on how countries are integrated into the GVC and how they are interacting with their trade partners. Understanding these metrics is crucial for building development strategies consistent with the current global trade dynamics, allowing the identification of sources of competitiveness and the challenges regarding developing new competitive areas.

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Marília Bassetti Marcato: data collection, data analysis, text writing.
Carolina Troncoso Baltar: data collection, data analysis, text writing.
Fernando Sarti: data collection, data analysis, text writing.

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