

**Title:** Upstreamness, exports and international competitiveness: lessons from the case of China  
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**Abstract:** The last decades have witnessed significant changes on how the world production and international trade are organized, with countries becoming specialized in specific parts and tasks within global value chains (GVC). With that backdrop, this paper aims to provide for more and better evidence regarding the degree and nature of countries' interaction within GVC from metrics compatible with the international fragmentation of production, focusing on the Chinese specialization pattern in vertically integrated production networks. Particularly, we integrated the most widely accepted metrics based on the concept of trade in value added, that is, country's GVC participation, the relative GVC position, as well as an analysis of the different components within the total foreign and domestic content of gross exports by destination, the Revealed Comparative Advantage index in value-added terms and the Economic Complexity index. In doing so, the empirical exercise that follows 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) from 1995-2011. The results in this paper suggest that China's production has advanced to other stages located more at the beginning of GVC, while it has deepening its importance on the 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:** International Competitiveness; Fragmentation; Vertical Specialization Patterns; China; Global Value Chains.

**Resumo:** As últimas décadas foram marcadas por mudanças significativas na forma como a produção mundial e o comércio internacional estão organizados, tornando os países especializados em partes e tarefas específicas das cadeias globais de valor (CGV). Este artigo busca analisar o grau e a natureza da interação dos países nas CGV a partir de métricas compatíveis com a fragmentação internacional da produção, com foco no padrão de especialização da China nas redes de produção verticalmente integradas. Mais especificamente, integrou-se métricas baseadas no conceito de comércio em valor adicionado, i.e. a participação total e a posição relativa nas CGV, os diferentes componentes do valor adicionado estrangeiro e doméstico nos fluxos brutos de exportação por destino, o Índice de Vantagem Comparativa Revelada em valor adicionado, bem como o Índice de Complexidade Econômica. Para tanto, o exercício empírico realizado baseou-se nos dados da OECD-WTO Trade in Value-Added (TiVA), TiVA Nowcast Estimates, World Input-Output Database (WIOD) e Simões e Hidalgo (2011), para o período de 1995-2011. Os resultados indicam que a produção da China avançou para outras etapas localizadas mais no início das CGV, ao mesmo tempo em que o país aumentou sua importância no compartilhamento de produção entre países e tornou-se menos dependente das importações intermediárias incorporadas em suas exportações. O declínio nas importações intermediárias reexportadas na China não se traduziu em menor diversificação de suas exportações. Pelo contrário, a China subiu a escada da complexidade produtiva, ao mesmo tempo em que se tornou mais integrada ao comércio mundial e cada vez menos dependente de insumos importados, além de se tornar mais competitiva na produção de componentes intermediários.

**Palavras-chave:** Competitividade Internacional; Fragmentação; Padrões de Especialização; China; Cadeias Globais de Valor.

JEL Code: L00; L23; F14.

**Área 9 - Economia industrial e da Tecnologia**

## 1. Introduction

The last decades have witnessed significant changes on how the world production and international trade are organized, with countries becoming specialized in specific parts and tasks within global value chains (GVC). As a result, 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, GVC has 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 between industries in fragmented and internationally dispersed production networks have imposed the need to use more accurate empirical measures. Before the emergence of GVC, 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, it may lead to 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; ISHII; YI, 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 GVC. For instance, the import content of exports (HUMMELS; ISHII; YI, 2001), the method of disaggregation of gross exports (KOOPMAN; WANG, 2012; KOOPMAN; WANG; WEI, 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; RIFFLART; SCHWEISGUTH, 2011). The recursive concepts used in this paper 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 that are limited to the structure of a particular product network, input-output analysis covers all set of industries that compose an economy system, turning possible to identify the vertical structure of international production sharing. Thereby, our paper emphasizes the sequential, multiple-border crossing and the back-and-forth aspects of production processes that are increasingly fragmented geographically.

This paper aims to provide for more and better evidence regarding the degree and nature of countries’ interaction within 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, country’s GVC participation, the relative GVC position, as well as an analysis of the different components within the total foreign content, the Revealed Comparative Advantage index in value-added terms and the Economic Complexity index. The empirical exercise is based on data from OECD-WTO Trade in Value-Added (TiVA), TiVA Nowcast Estimates<sup>1</sup>, the World Input-Output Database (WIOD), and Simoes and Hidalgo (2011) from 1995-2011. Whenever the WIOD was used, we applied the method of decomposition of gross exports by Koopman *et al.* (2014), and *decompr* algorithm (QUAST; KUMMRITZ, 2015) applied in software R.

This paper is organized as follows. 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

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<sup>1</sup> In June 2017, the OECD-WTO initiative extended TiVA indicators to more recent years for 2012-2014 by using now-casting estimation techniques, named the *TiVA Nowcast Estimates*. Essentially, the approach estimates national IO tables by projecting relationships presented in the latest TiVA benchmark year (2011) into nowcast years (2012-2014) but constrained to official estimated of gross output and value-added and national accounts main aggregates of demand and trade, as well as supplemented by bilateral trade statistics. However, this database is only available for some indicators estimated in this paper.

the asymmetric patterns of specialization, and its changing nature, focusing on the Chinese experience. Section 4 concludes.

## 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 between 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 global value chains (GVC).

Tracing back the history of the concept of *value chain* before 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), and can be contained within a single geographic location or even a single firm. In a broader sense, a value chain can be understood as a set of business, activities and relationships engaged in creating a final product or service (UNIDO, 2009). It 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 manufacturing<sup>2</sup>. Therefore, a value chain does not necessarily reflect a physical transformation.

There was a change of perspective by adding “global” to the concept<sup>3</sup>, 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 emphasize the potential large distance 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 production; ii) sequential production decisions from buyer to suppliers; iii) high contracting costs; iv) global matching of goods, services, production teams and ideas (ANTRÁS, 2015). Thus, one can say that the key features of the phenomenon of GVC are the international dimension of production process and the “contractualization” of buyer and seller relationships (TAGLIONI; WINKLER, 2016).

To analyze the emerging pattern of global trade, which has been named a shift from “trade in goods” to “trade in value added” or “trade in tasks”, 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 parameter to other firms in the chain, the key concept for the *bottom-up* view is “upgrading”<sup>4</sup>, 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 improving their positions in the global economy (FREDERICK, 2014; GEREFFI; FERNANDEZ-STARK, 2011; GEREFFI; LEE, 2012).

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<sup>2</sup> When it comes to emphasize the manufacturing and the distribution-related steps, the concept commonly used is *supply chain*, which is also known as the industry-level value chain. According to the IMF (2013), an “industry” value chain is often performed by *networks of firms* and evolves a vast number of processes; meanwhile, ‘value chains’ are commonly referred to as a chain of activities that a ‘firm’ operates in a specific industry.

<sup>3</sup> Value chains are considered “global” when they include steps, processes, and actors from at least two countries (GEREFFI; HUMPHREY; STURGEON, 2005).

<sup>4</sup> This particular dimension is two-fold: the *economic* and *social* upgrading. For more details about its definitions and measures, see Marcato and Baltar (2017).

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 this activities should be located (GEREFFI; HUMPHREY; STURGEON, 2005). In other words, when a firm decides where to locate their 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 (typically the lead firm) firm's 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 partners 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 transactions 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 allows for reducing costs and risks along the GVC (UNIDO, 2009). As GVC have developed, a multiplicity of lead firm-supplier relations has taken place<sup>5</sup>. Under a new scale of operations and increased technological sophistication, the suppliers have establish a new set of relations with lead-firms, which involves 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; HUMPHREY; STURGEON, 2005). Although chain-governance deals with power asymmetry and its abuse by certain agents, most of the analysis of chain-governance structures do not consider a wide range of relationships between firms and non-firms and restrict the analysis only to relationships between firms and suppliers. Furthermore, the reasons for deciding whether to integrate production of intermediate inputs or outsource it, and for supplier locations (offshoring), reveal that the firm's governance decisions go beyond mere transactions costs and core competencies, encompassing the search for greater flexibility, diversification of location to reduce risk, and lower 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 on 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 GVC analysis, since both have influence under the distribution of value among actors along the chain. In other words, GVC matter for economic development because “the ability of countries to prosper depends on their participation in the global economy”, which is largely told as their role in GVC (GEREFFI; LEE, 2012).

The GVC approach is build upon a set of analytical methods and it can focus on many aspects simultaneously, depending on the scholarly approach. In this sense, to analyze 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 consider different statistics and go beyond traditional analysis. The next section undertakes a deeper analysis for the case of China, providing evidence for the degree and nature of this country's interaction within the GVC.

### 3. Empirical evidence for the case of China

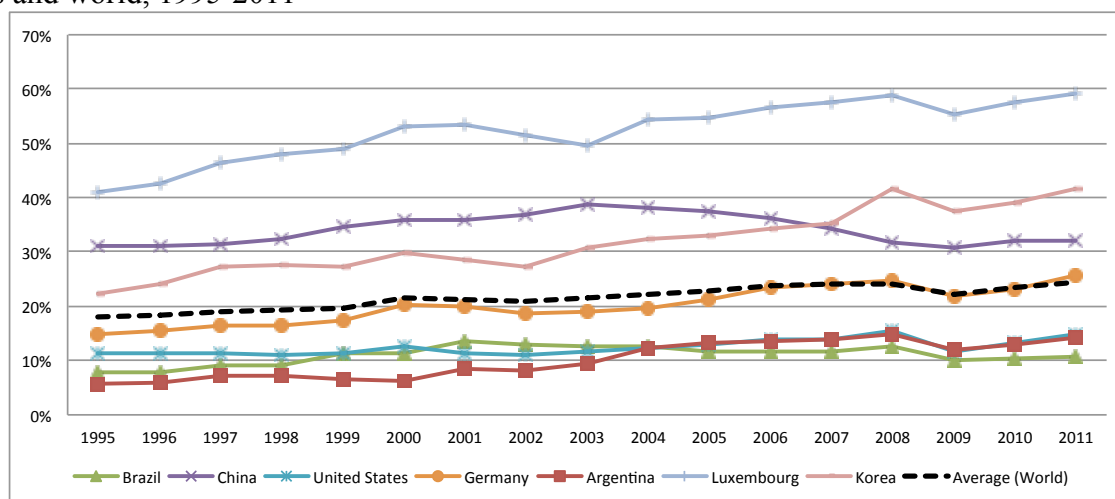
Traditional statistics based on gross exports tend to “double count” trade flows, as gross exports include the value of imported intermediates that are used in production, blurring the real distribution of value created within countries. In the absence of trade in intermediate inputs, this difference between gross

<sup>5</sup> 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*.

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 1995 to 2011 (Figure 1). In that sense, the case of Luxembourg illustrates that this difference as a share of gross exports is more important the more integrated the country is in GVC. Although this difference was small in nominal terms, it was not negligible when considering the 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 analyzed 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 is against this trend and has increased its ratio of domestic value added in exports to gross exports (DVAR). This intriguing exception has been showed by other studies (KEE; TANG, 2015; KOOPMAN; WANG; WEI, 2012). Investigating its potential causes, Kee and Tang (2015) found that the rising in Chinese DVAR is due to individual processing exporters replacing imported inputs with domestic products in terms of volume and varieties<sup>6</sup>, 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 across 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 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.

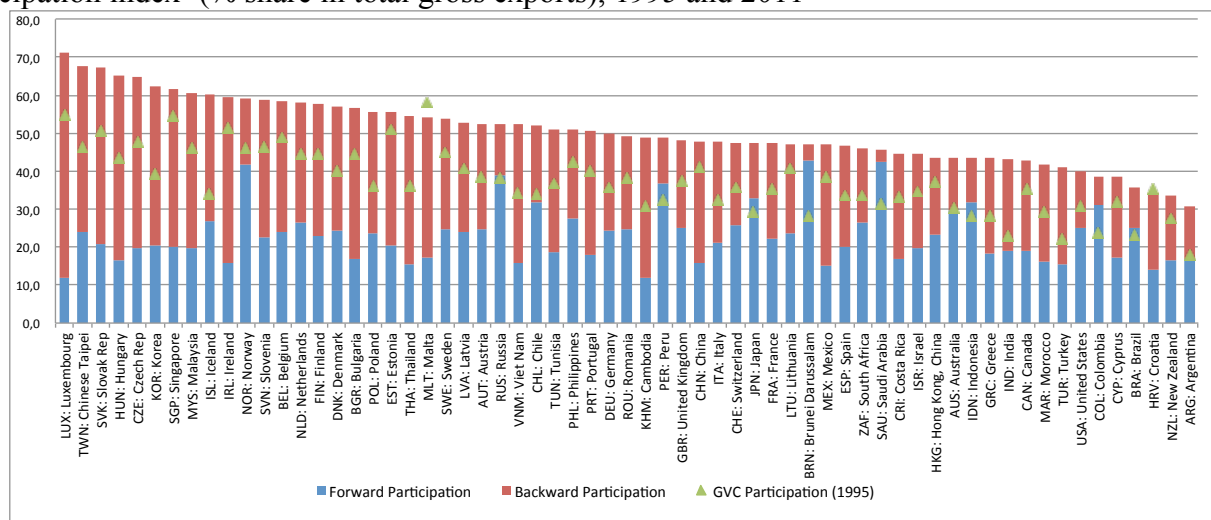
In 2011, the top positions with respect to GVC participation were held by small open economies, such as Luxembourg (71%), Taiwan (67.6%), the Slovak Republic (67.4%), Hungary (65.2%), Czech Republic (64.8%), and Korea (62.2%). All those countries increased their overall GVC participation mostly

<sup>6</sup>According to Kee and Tang (2015), other potential causes are: i) a changing composition of Chinese exports, which would indicate that the Chinese comparative advantage is moving towards industries with high domestic content; and ii) an upsurge of Chinese domestic production costs. But following their model, both causes cannot explain this rising trend.



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, these small countries have lower availability of domestically sourced intermediates, resulting in higher imports of intermediates. The data for Luxembourg and Hungary depicts 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 **Erro! Nenhum texto com o estilo especificado foi encontrado no documento.** - The GVC Participation index<sup>7</sup> (% share in total gross exports), 1995 and 2011



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

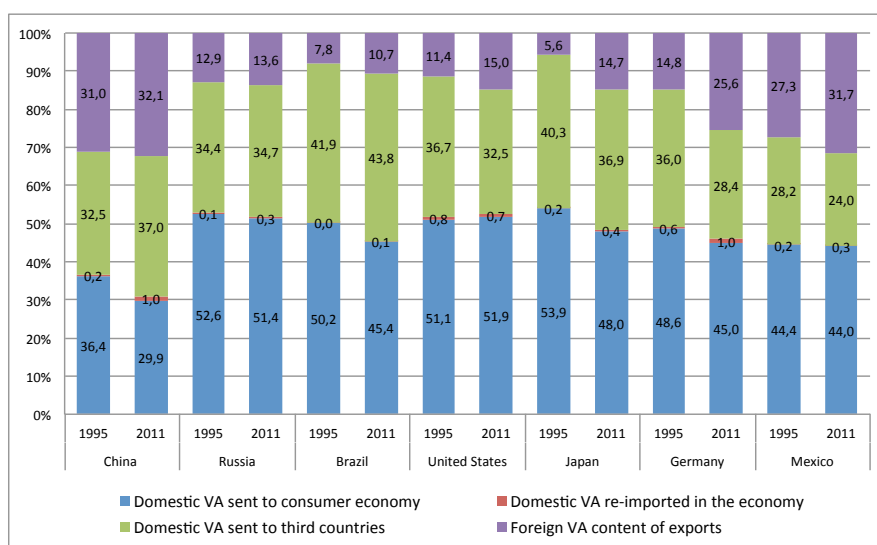
In contrast, large markets show lower rates of participation in GVC mostly because of lower backward participation, given its higher domestic production of inputs and thus relatively small need to seek for intermediate inputs from abroad. But this is only a partial view of GVC, as the GVC participation index also takes into account 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: 1) domestic VA sent to consumer economy, 2) domestic VA sent to third countries, 3) domestic VA re-imported in the economy; and 4) foreign VA content of exports. Components (1) through (3) depict the value of gross exports that is created domestically and component (4) indicates the value of exports that is created abroad. Component (1) 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 (2) and (3), as *upstream* linkages, and component (4), as *downstream* linkages, are taken into consideration as value-added in exports generated by supply chains.

<sup>7</sup>Considering TiVA's nomenclature, the "forward participation in GVCs" is measured by the EXGR\_DVAFXSH (c,i) presents country c, industry i, *domestic value added content of gross exports* by foreign countries as a percentage of total gross exports by country c, and the "backward participation in GVCs" is measured by the *foreign value added share of gross exports*, for domestic industry i in country c, EXGR\_FVASH (c,i), defined as foreign value added embodied in gross exports EXGR\_FVA (c,i), as a percentage of total gross exports, EXGR (c,i), which is a 'FVA intensity measure' often referred to as "import content of exports". Thus, the GVC participation index is the sum of both forward and backward participation in GVCs.

Overall, the role of supply chain linkages (components 2-4) 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, with the exception of the United States. This indicator reflects the value-added created in upstream domestic industries providing indirect intermediate inputs via international value-chains<sup>8</sup>. The United States are also an exception regarding the decreasing trend in domestic VA sent to consumer economy, showing a slight increase from 1995 to 2011.

Figure 3 - The VA components of gross exports, selected countries, 1995 and 2011 (% share in total gross exports)



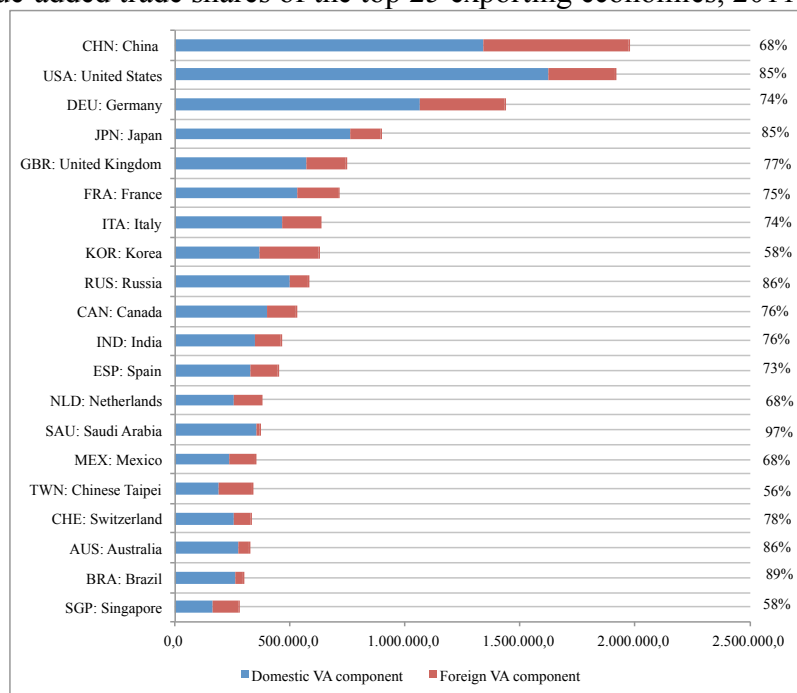
Source: Own elaboration based on OECD-WTO TiVA database (December 2016).

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<sup>9</sup> (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 top 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.

<sup>8</sup> This indicator, by industry, provides a measure of how protectionist measures may affect domestic industries that provide inputs to imports. See Background Notes at: [http://www.oecd.org/sti/ind/TIVA\\_FAQ\\_Final.pdf](http://www.oecd.org/sti/ind/TIVA_FAQ_Final.pdf).

<sup>9</sup> 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.

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).

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<sup>10</sup>, such as *geographical location* (i.e. proximity to neighboring 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; SENEVIRATNE; ZHANG, 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.

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 GVC that create higher overall value, with higher levels of technological sophistication or higher wages and better labor conditions, even though it depends on increasing shares of foreign value added in exports.

#### ***Upstreamness versus downstreamness: great changes in relative GVC position are unusual across time.***

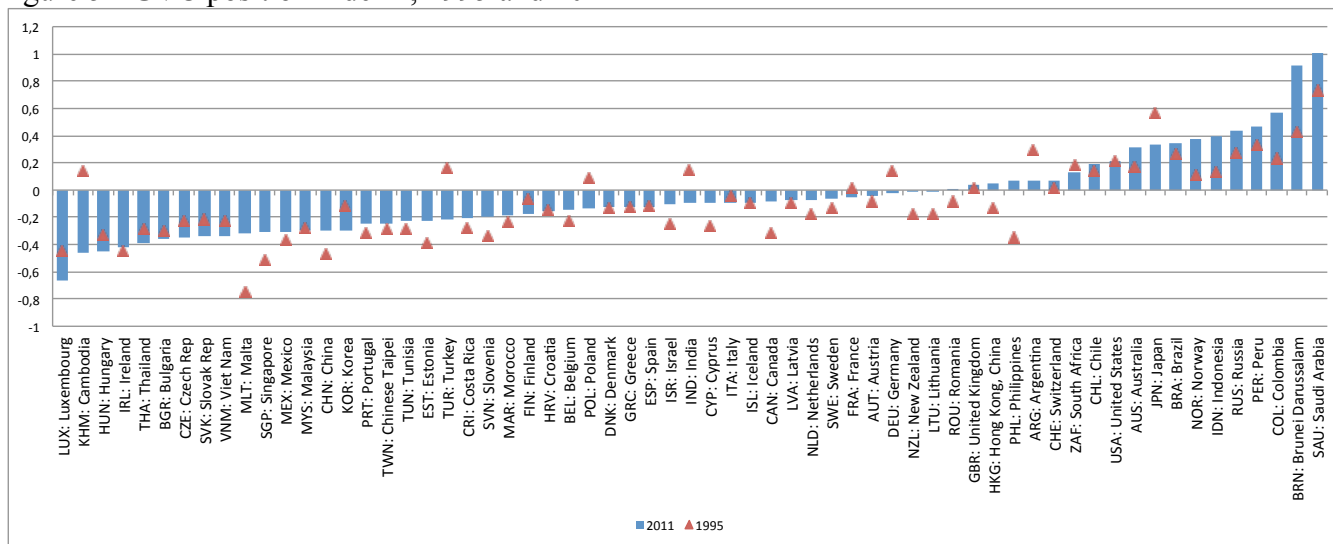
Upstreamness (or downstreamness) refers to where a country is located in a GVC. One measure, developed by Koopman *et al.* (2010), is the GVC position index. Countries with high forward relative to backward participation present a positive GVC position index, suggesting a country that lies upstream in 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.

<sup>10</sup> 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.



Overall, there are no substantial changes among countries regarding their relative position on 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 most downstream. As it is 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.

Figure 5 - GVC position index<sup>11</sup>, 1995 and 2011



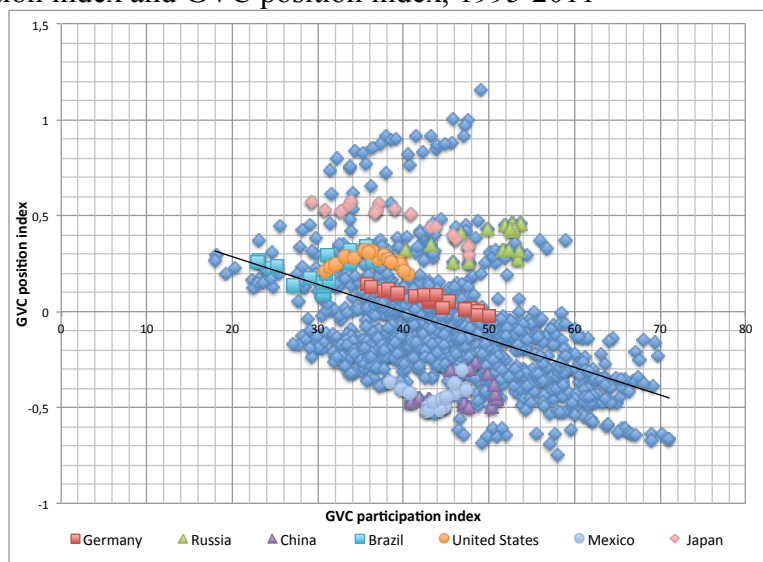
Source: Own elaboration based on OECD-WTO TiVA database (December 2016).

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 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 index 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*).

<sup>11</sup> 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 6 - GVC participation index and GVC position index, 1995-2011



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

***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)<sup>12</sup>, which are: i) *foreign value in final goods exports* (FVA\_FIN); ii) *foreign value in intermediate goods exports* (FVA\_INT); and iii) *double counted intermediate exports produced abroad* (FDC)<sup>13</sup>; each one with different economic meanings and illustrating different arrangements of cross-country production sharing (WANG; WEI; ZHU, 2014). According to the 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.

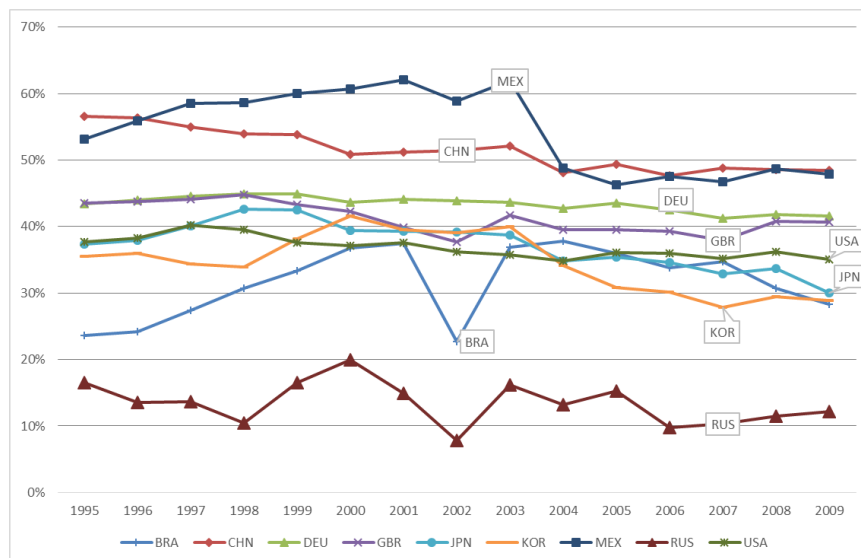
To understand what is behind the general increase of VS in a country's gross exports, Figures 7, 8, and 9 show the relevance of each component and their trajectory over time. Figure 7 shows the share of FVA\_FIN in VS for nine selected economies from 1995 to 2009. At the beginning of the series, China 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 occupied 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.

<sup>12</sup> 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; WEI; ZHU, 2014, p. 34).

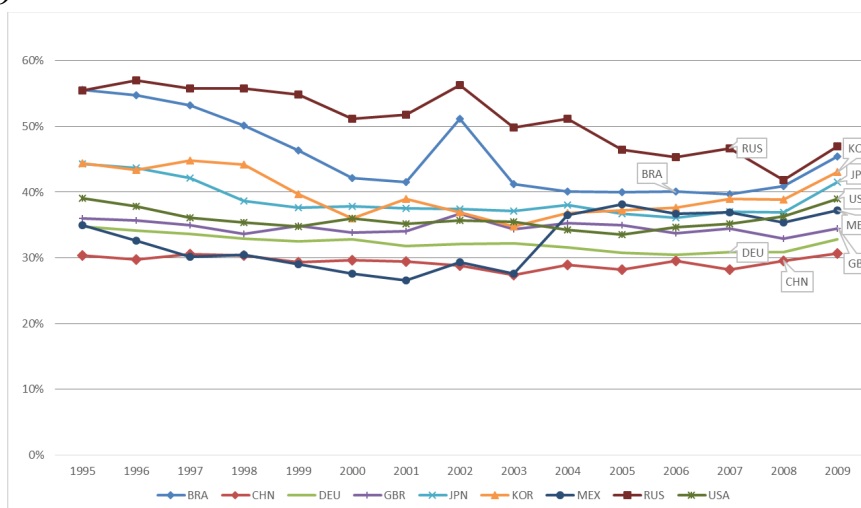
<sup>13</sup> FDC indicates the "pure double counting from foreign sources", which can be divided in MDC ("due to the direct importer exports production") and ODC ("due to other countries exports production").

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.

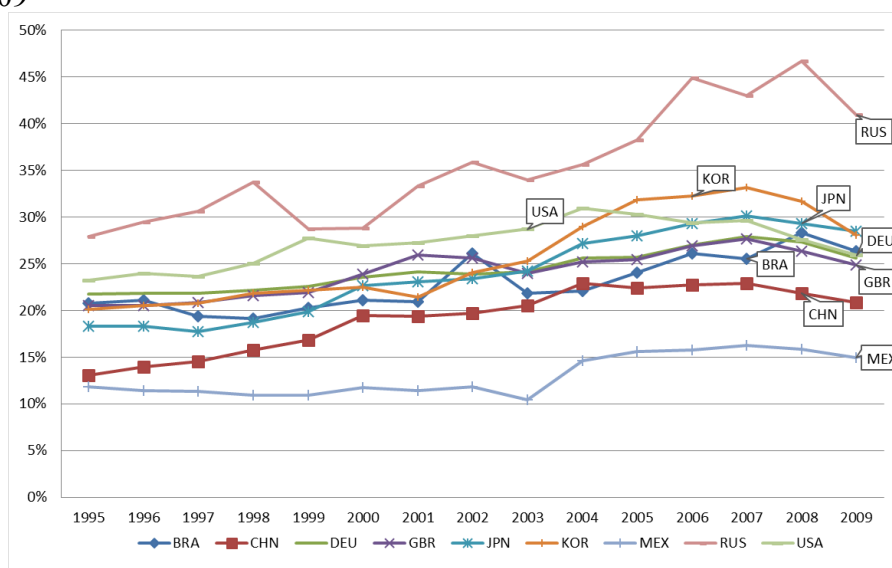
Figure 8 - Foreign value in intermediate goods exports (FVA\_INT) as % of VS, selected major economies, 1995-2009



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 deepening its importance on 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 showed signs of weakening trade in GVC prior to the 2009 crisis. Therefore, 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, analyzing the structure of the VS adds new empirical evidence about a country's position on 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 *decomp* algorithm (QUAST; KUMMRITZ, 2015) applied in software R.

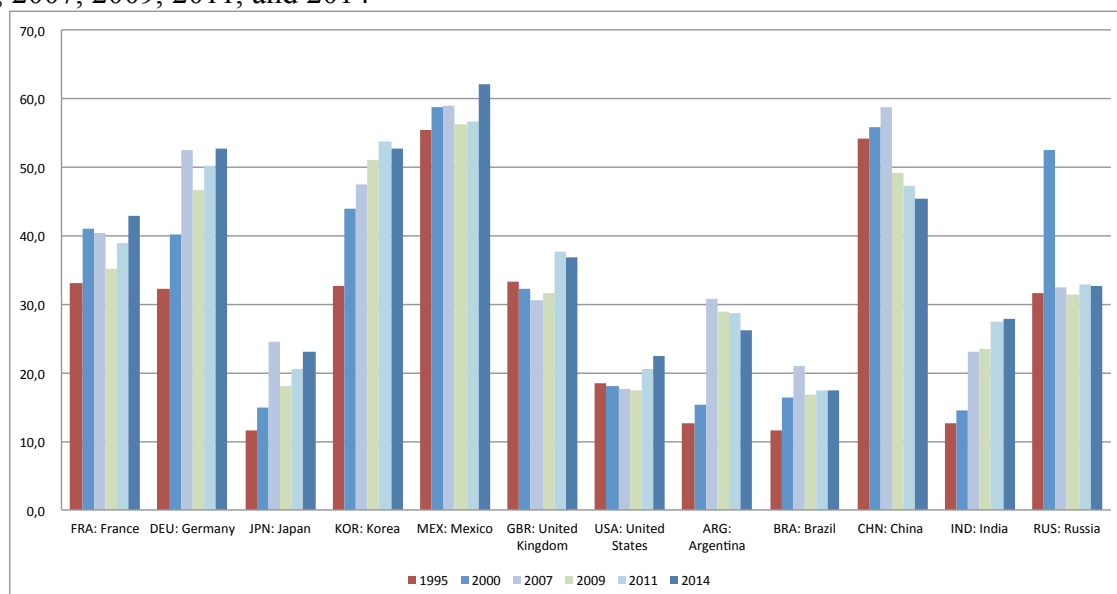
***China and Mexico are crossing roles regarding the use of intermediate imports as source of international competitiveness to their exports.***

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 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. But 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 behaviors over time, with Mexico becoming more dependent of intermediate imports embodied in their exports and China running 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 declined 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 can 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 East and Southeast Asian economies, but 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.

***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 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 account. 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 it simply, it is possible to measure a country’s economic complexity from the mix of products that it is able to make<sup>14</sup>.

Figure 11 shows a positive correlation between GVC participation and a country’s economic complexity index (ECI)<sup>15</sup>. 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 on a step above China in terms of the complexity of its production, which despite being more integrated into CGVs, has an ECI level relatively close to the Brazilian one.

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.

<sup>14</sup> 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 difficult to obtain and transfer, it is argued that new capabilities are easily accumulated whether 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. Hence, the set of all proximities is a network that connects pairs of products highly likely to be jointly exported by several countries, which is named *product space*. A country’s position in the product space reveals its current productive knowledge and its ability to learn by moving into other bordering products. One can analyze a country’s position in the product space by measuring its *opportunity value*, i.e. the distance to alternative and more complex products. Overall, countries with low levels of ECI tend to produce products that are peripheral in the product space, showing a few opportunities available.

<sup>15</sup> See Hausmann *et al.* (2011) for how the ECI is constructed.

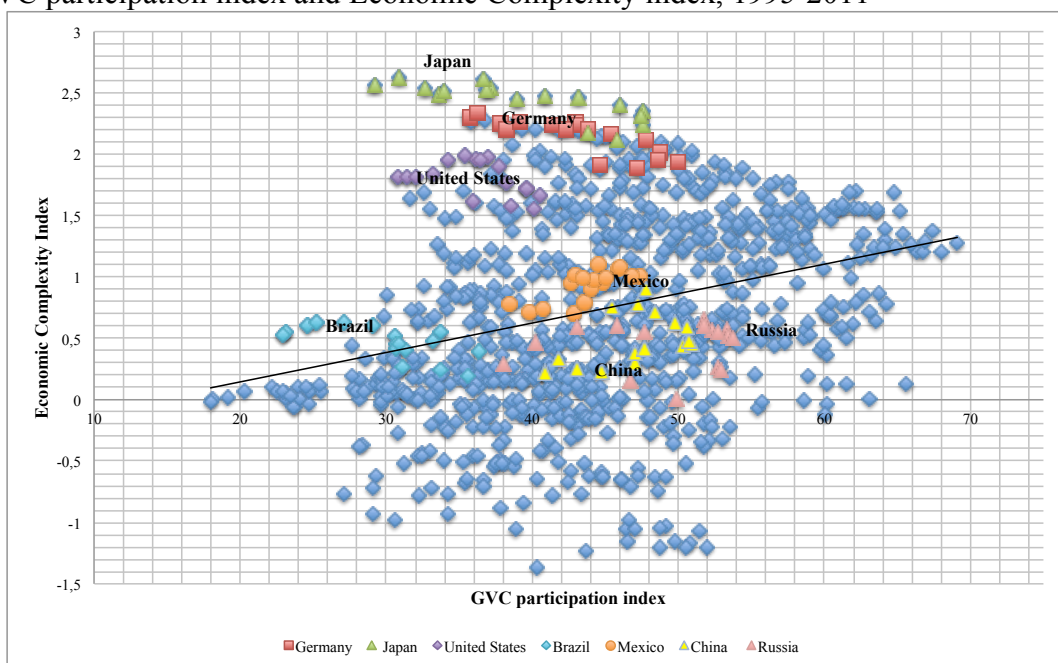


countries' relative upgrading in complexity of production) on the y-axis and changes in GVC participation index on the x-axis between 1995 and 2011. South Korea almost doubled both its ECI and its GVC participation index over the period, leaping from 22<sup>nd</sup> to 7<sup>th</sup> place in the ECI ranking. Mexico has also climbed the ladder of complexity of production (from 25<sup>th</sup> to 22<sup>nd</sup>), 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 42<sup>nd</sup> to 27<sup>th</sup>). 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 hand in hand with scaling them up.

The top-ranked countries invalidate a linear relationship between the two measures. Over time, Japan, Germany, and Switzerland saw its ECI fall in absolute terms, while increasing its 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 14<sup>th</sup> 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 30<sup>th</sup> to 48<sup>th</sup>) while Germany fell one place (2<sup>nd</sup> to 3<sup>rd</sup>). 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.

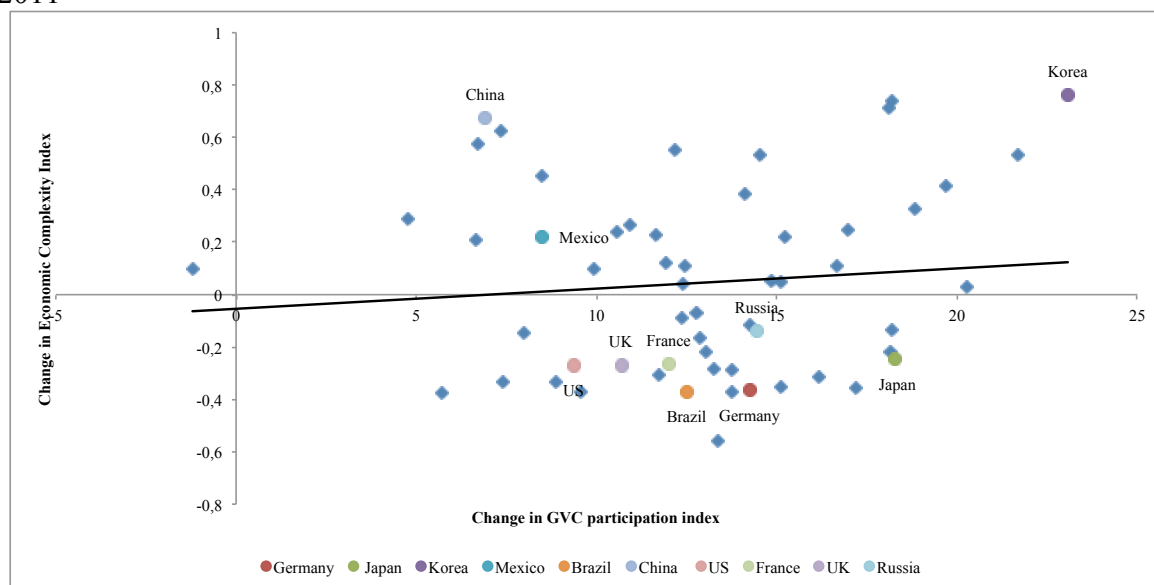
The relationship between economic complexity and the GVC participation index has to be interpreted carefully. First, the reader should not confuse such an association with a causal relationship. But beyond that, the ECI is based on gross trade statistics, so countries that integrate low-value processing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

Figure 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 12 - Change in the GVC participation index and change in economic complexity index between 1995 and 2011



Source: Own elaboration based on OECD-WTO TiVA database (December 2016) and Simoes and Hidalgo (2011). Note: (1) 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.

***RCA in value added: not all countries that have deepen their domestic value added to their exports have gained competitiveness, but they remained competitive.***

The revealed comparative advantage (RCA) is a widely used measure of sector competitiveness and specialization patterns. While the traditional measure of RCA is based on gross exports, the RCA in value-added terms nets out foreign value added imported into the economy. Based on domestic value added embodied in gross exports, as in Koopman *et al.* (2014), this indicator considers international production sharing and avoids the problems of multiple counting. For our purposes, we selected four sectors - *machinery and equipment, nec*<sup>16</sup>; *electrical and optical equipment*; *transport equipment*; and *total business sector services*. The difference between the RCA index in gross and value-added terms may vary according to the sector analyzed, being more significant in those most influenced by GVC, such as transport equipment and electrical and optical equipment.

Such difference varies according to the country's position in the value chain. Countries located more in the downstream part of the value chain (i.e. closest to final demand) show higher values of RCA in gross terms than in value-added terms (ESCAITH, 2014). This reflects the problem of multiple counting of intermediate inputs, i.e. countries may incorporate in their apparent comparative advantage the re-exported value added of upstream suppliers (WTO, 2014). This is the case of the United States and Mexico in machinery and equipment, and transport equipment and electrical and optical equipment sectors for the latter country, and Japan in the total business sector services. On the other hand, countries show higher values of RCA in value-added terms whether located more upstream in the value chain (R&D; production of components). For instance, Germany and Japan in all selected sectors, except for business services for the latter, and Brazil in transport equipment and electrical and optical equipment.

Given such relationship with a country's GVC position, and considering *Figure 1*, one may say that China has become more competitive in the production of components, since the country had higher RCA indexes in gross terms until 2001 (year that marked its entry into the WTO), and since then has had higher RCA indexes in value-added terms in all manufactured sectors.

By comparing the share of a given industry in a country's export to the world share of the industry in world exports, a country is considered to have comparative advantage in a sector if its RCA is greater than one. Considering all TiVA countries that showed revealed comparative advantage, among the largest

<sup>16</sup> Nec = not elsewhere classified.

countries, Germany, Japan, Korea, and Mexico reveal comparative advantage in all three manufacturing sectors. As it was expected, Asian countries stand out among those with comparative advantage in electrical and optical equipment. Based on gross exports, Germany, Sweden, Romania and Finland's RCA index is lower than 1, but when domestic value-added is used it becomes greater than 1 in electrical and optical equipment, while Vietnam has comparative advantage in gross but not in value-added terms, reflecting the importance of intermediate imports. In the case of transport equipment, when the foreign content of exports is disregarded, Italy has comparative advantage, and on the contrary, Slovenia and Portugal no longer have RCA larger than 1. In the business sector services, Japan and Norway lost their comparative advantage whether it is calculated in value-added, while Bulgaria and Thailand show signs of becoming more specialized in that sector, and this latter country has also lost its fallacious comparative advantage in machinery and equipment. In the case of total business services, there was a considerably higher number of countries with comparative advantage (34 of 63 countries in the sample).

Table 1 shows the difference between the RCA (traditional and value-added) between 1995 and 2011. Considering both gross and value-added RCA, countries such as Mexico, Indonesia, Germany, and India have become more specialized in all manufactured sectors analyzed, with the latter two also gaining in the business services sector. On the contrary, Belgium and Hong Kong have lost comparative advantage in manufacturing and gained in services sector. More importantly, Table 1 shows substantial changes in the distribution of RCA across countries and industries over time whether calculated based on gross or value-added terms (countries in bold indicate variations between gains and losses). For example, according to the traditional measure, France lost RCA, however it has gained in value-added terms in machinery and equipment, as well as Denmark, Finland, and Philippines in the case of electrical and optical equipment.

Table 1 - RCA gains and losses in gross and value-added terms, 1995-2011

Industry	Countries that gain RCA (in gross terms)	Countries that gain RCA (in value-added terms)	Countries that lose RCA (in gross terms)	Countries that lose RCA (in value-added terms)
C29: Machinery and equipment, nec	Austria, Canada, Chile, Czech Republic, Finland, Germany, Hungary, Iceland, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Turkey, Brazil, Bulgaria, China, Croatia, India, Indonesia, Peru, Philippines, Romania, Saudi Arabia, Singapore, South Africa, Thailand, Tunisia, Viet Nam	Austria, Canada, Chile, Czech Republic, Finland, <b>France</b> , Germany, Hungary, Iceland, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, <b>Spain</b> , <b>Sweden</b> , Turkey, Brazil, Bulgaria, China, Croatia, India, Indonesia, <b>Malta</b> , Peru, Philippines, Romania, Saudi Arabia, Singapore, South Africa, Thailand, Tunisia, Viet Nam	Australia, Belgium, Denmark, <b>France</b> , Greece, Ireland, Israel, Italy, Latvia, Luxembourg, <b>Spain</b> , <b>Sweden</b> , Switzerland, United Kingdom, United States, Argentina, Brunei Darussalam, Cambodia, Colombia, Costa Rica, Cyprus, Hong Kong, Lithuania, Malaysia, <b>Malta</b> , Morocco, Russia, Taiwan	Australia, Belgium, Denmark, Greece, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Switzerland, United Kingdom, United States, Argentina, Brunei Darussalam, Cambodia, Colombia, Costa Rica, Cyprus, Hong Kong, Lithuania, Malaysia, Morocco, Russia, Taiwan
C30T33: Electrical and optical equipment	Austria, <b>Canada</b> , Chile, Czech Republic, Estonia, Germany, Greece, Hungary, Iceland, Israel, Italy, Korea, Latvia, Luxembourg, Mexico, New Zealand, Norway, Poland, Slovak Republic, Slovenia, Switzerland, Turkey, Bulgaria, Costa Rica, Croatia, Cyprus, India, Indonesia, <b>Malaysia</b> , Morocco, Romania, Saudi Arabia, Taiwan, Tunisia, Viet Nam	Austria, Chile, Czech Republic, <b>Denmark</b> , Estonia, <b>Finland</b> , Germany, Greece, Hungary, Iceland, Israel, Italy, Korea, Latvia, Luxembourg, Mexico, New Zealand, Norway, Poland, Slovak Republic, Slovenia, <b>Sweden</b> , Switzerland, Turkey, Bulgaria, Costa Rica, Croatia, Cyprus, India, Indonesia, Morocco, Romania, Saudi Arabia, <b>Philippines</b> , Taiwan, Tunisia, Viet Nam	Australia, Belgium, <b>Denmark</b> , <b>Finland</b> , France, Ireland, Japan, Netherlands, New Zealand, Portugal, Spain, <b>Sweden</b> , United Kingdom, United States, Argentina, Brazil, Brunei Darussalam, Cambodia, Colombia, Hong Kong, Lithuania, Malta, Peru, <b>Philippines</b> , Singapore, Russia South Africa, Thailand	Australia, Belgium, <b>Canada</b> , France, Ireland, Japan, Netherlands, New Zealand, Portugal, Spain, United Kingdom, United States, Argentina, Brazil, Brunei Darussalam, Cambodia, Colombia, Hong Kong, Lithuania, Malta, Peru, <b>Malaysia</b> , Russia, Singapore, South Africa, Thailand,
C34T35: Transport equipment	Austria, Chile, Czech Republic, Estonia, France, Germany, Hungary, Israel, Italy, Japan, Korea, Luxembourg, Mexico, New Zealand, Poland, Slovakia, Slovenia, Switzerland, Turkey, United Kingdom, United States, Argentina, Bulgaria, Cambodia, China, Colombia, Costa Rica, Croatia, India, Indonesia, Morocco, Philippines, Romania, Saudi Arabia, Singapore, South Africa, Thailand, Tunisia, Viet Nam	Austria, Chile, Czech Republic, Estonia, France, Germany, Hungary, Israel, Italy, Japan, Korea, Luxembourg, Mexico, New Zealand, Poland, Slovakia, Slovenia, Switzerland, Turkey, United Kingdom, United States, Argentina, Bulgaria, Cambodia, China, Colombia, Costa Rica, Croatia, India, Indonesia, Morocco, Philippines, Romania, Saudi Arabia, Singapore, South Africa, Thailand, Tunisia, Viet Nam	Austria, Belgium, Canada, Denmark, Finland, Greece, Iceland, Ireland, Latvia, Netherlands, Norway, Portugal, Spain, Sweden, Brazil, Brunei Darussalam, Cyprus, Hong Kong, Lithuania, Malaysia, Malta, Peru, Russia, Taiwan	Austria, Belgium, Canada, Denmark, Finland, Greece, Iceland, Ireland, Latvia, Netherlands, Norway, Portugal, Spain, Sweden, Brazil, Brunei Darussalam, Cyprus, Hong Kong, Lithuania, Malaysia, Malta, Peru, Russia, Taiwan
C50T74: Total Business Sector Services	Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Israel, Luxembourg, Netherlands, Portugal, Slovenia, Sweden, Switzerland, United Kingdom, United States, Bulgaria, Cambodia, Costa Rica, Croatia, Cyprus, Hong Kong, India, Malta, Morocco, Philippines, Romania, Singapore, Taiwan,	Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Israel, Luxembourg, Netherlands, <b>Poland</b> , Portugal, Slovenia, Sweden, Switzerland, United Kingdom, United States, Bulgaria, Cambodia, Costa Rica, Croatia, Cyprus, Hong Kong, India, Malta, Morocco, Philippines, Romania, Singapore, Taiwan,	Australia, Austria, Chile, Hungary, Italy, Japan, Korea, Latvia, Mexico, New Zealand, Norway, <b>Poland</b> , Slovakia, Turkey, Argentina, Brazil, Brunei, China, Colombia, Indonesia, Lithuania, Malaysia, Peru, Russia, Saudi Arabia, South Africa, Thailand, Tunisia, Viet Nam	Australia, Austria, Chile, Hungary, Italy, Japan, Korea, Latvia, Mexico, New Zealand, Norway, Slovakia, Turkey, Argentina, Brazil, Brunei, China, Colombia, Indonesia, Lithuania, Malaysia, Peru, Russia, Saudi Arabia, South Africa, Thailand, Tunisia, Viet Nam

Source: Own elaboration based on OECD-WTO TiVA database (December 2016). Note: (1) countries highlighted in bold indicate alternation of gain or loss depending on whether the RCA measure is in gross or value-added terms.

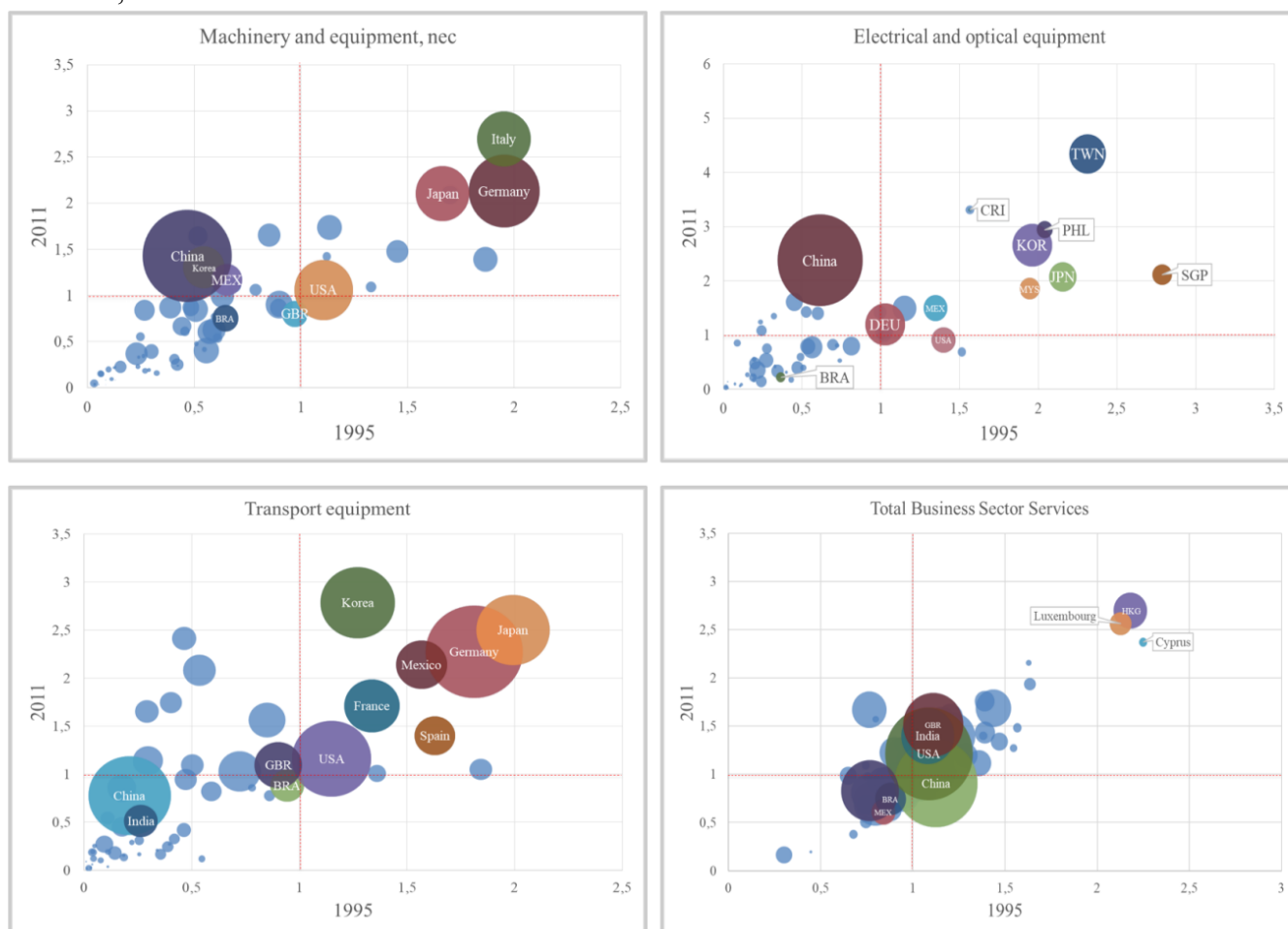
Further on, one of the questions that arise is whether higher levels of domestic value-added in gross exports are positively associated with higher levels of RCA. More specifically, are the countries that most added domestic value to their exports the ones that have made the most gains in sector competitiveness? Or would countries be doomed to gain competitiveness from higher imported content? Figure 13 shows RCA indexes in value-added terms for all TiVA countries and the four selected industries, with the year 1995 on the x-axis and 2011 on the y-axis, and the size of the bubble as the difference between domestic value-added content of sector's gross exports in the year of 2011 and 1995.

The first countries in the RCA ranking for 2011, respectively, in the case of machinery and equipment, are Italy, Germany, and Japan. These countries are among those that added the highest domestic value in the period analyzed, although they already played a prominent role in the 1995 ranking. In addition, China has boosted its sector competitiveness, showing a considerable RCA gain (0.46 for 1.42) at the same time that it was the country that most added domestic value from the sample. It is interesting to note that other countries also added a substantial amount of domestic value in their exports, but failed to advance in the gains of specialization such as the Chinese example. This is the case of the US economy that remained practically with the same RCA index. Despite higher sums of DVA in 2011, most countries remained with low RCA indexes.

In the case of electrical and optical equipment, the countries of Southeast Asia occupy the first places of the ranking 1995 (Singapore, Taiwan, Japan, Philippines, Korea, and Malaysia). In 2011, Taiwan becomes the first in the ranking, followed by the one Latin American exception, Costa Rica, and other Asian countries - Philippines, Korea, China, Singapore, Japan, and Malaysia, respectively. Ireland and the United States are the only two countries that have lost RCA between 1995 and 2011. Once again, China becomes internationally competitive while adding enormous amounts of domestic value. Different from what happens in the sector of transport equipment, in which although the Chinese economy has a greater RCA index in 2011 when compared to 1995, it does not yet have an RCA greater than one. The United States, while considerably increasing its domestic value-added in exports, failed to translate this increase into competitiveness in the case of transport equipment. In that sector, Japan, Germany and Mexico are among the top five countries in the ranking of 1995 and 2011, and the countries with the highest increases in domestic value-added remained at RCA levels above one. In total business sector services, the top three places are between Hong Kong, Luxembourg, and Cyprus, while most Latin American countries are lagging behind in terms of competitiveness gains. It also worth noting that this was the only sector in which China has dropped its RCA below one in 2011. In general, most countries were unable to move towards higher levels of RCA, even though there were considerable sums of domestic value being added.

However, those countries with the highest domestic value-added increases already had comparative advantages in the manufacturing sectors in 1995, and continued to have it in 2011, China aside. Over this period, China has been able to become more competitive internationally, while relying less and less on imported inputs. Overall, countries may not be doomed to resort to greater imported content to leverage their international competitiveness, but the positive relationship between higher levels of domestic value-added and higher levels of RCA is a possibility restricted to a select group of countries.

Figure 13 - RCA in value-added terms and domestic value-added content of gross exports, selected industries, 1995 and 2011



Source: Own elaboration based on OECD-WTO TiVA database (December 2016). Notes: (1) the size of the bubble is the difference between domestic value-added content of sector's gross exports in 2011 and 1995.

#### 4. Concluding remarks

This paper 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, it was 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 vertically fragmentation of production has changed our ability to analyze countries' patterns of specialization based on gross trade flows. That is because parts and components are crossing borders several times until they compose 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 on 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 them up.

In particular, 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 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 showed how the use of traditional trade statistics can lead to errors in estimating the gains of international competitiveness at the sector-level. In particular, we found no evidence of a worldwide positive association between higher levels of domestic value-added in gross exports and gains in sector competitiveness. But, more importantly, we found that the countries that already showed relative gains in international competitiveness among manufacturing sectors in 1995, and continued to show it in 2011, are those that most increased the domestically added value of exports throughout this period.

One country has proved to be an exception in terms of the changing patterns of trade specialization, that is China. While most countries are relying less and less on domestic inputs for production, China is against this trend and it 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 it has deepening its importance on the cross-country production sharing and becoming less dependent of intermediate imports embodied in its exports. China has declined its role as the final point 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 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.

As we have showed, the widespread 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 geopolitical environment. A wide range of national policies areas, such as trade, labor market, innovation, education, infrastructure, and investment regulations, can affect the chances of success in 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 some 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 has generally been taught that the greater the country's participation in world trade, the better. Hence, another field that deserved to be further developed is the policy options to guarantee the mechanisms through which countries can maximize the benefits from GVC participation.

However, GVC analysis does not tell the whole story. Even in theoretical terms, a systematic framework on 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 must not be taken 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 if compared to gross trade, value-added analysis provide a more revealing perspective on how countries are integrated into GVC and how they are interacting with its 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. Thus, it is not possible to assume which are the potential trajectories to follow without having a reliable map in hands, which clearly could not be build based on traditional gross trade in the current phase of globalization.

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