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Mapping Global Value Chains

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Abstract

Mapping Global Value Chains

World trade and production are increasingly structured around "global value chains" (GVCs). The last few years have witnessed a growing number of case studies describing at the product level how production is internationally fragmented, but there is little evidence at the aggregate level on the prevalence of GVCs. The main objective of this paper is to provide for more and better evidence allowing the examination of countries' position within international production networks. We propose a number of indicators that give a more accurate picture of the integration and position of countries in GVCs, as well as a more detailed assessment of the value chain in six broad industries: agriculture and food products, chemicals, electronics, motor vehicles, business services and financial services.

Keywords: global value chains, fragmentation of production, production stages, vertical specialization, backward linkages, forward linkages, input-output, supply chains, trade in intermediate inputs.

JEL classification: F14, F23, L16, L23

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Executive Summary

World trade and production are increasingly structured around "global value chains" (GVCs). A value chain identifies the full range of activities that firms undertake to bring a product or a service from its conception to its end use by final consumers. Technological progress, cost, access to resources and markets and trade policy reforms have facilitated the geographical fragmentation of production processes across the globe according to the comparative advantage of the locations. This international fragmentation of production is a powerful source of increased efficiency and firm competitiveness. Today, more than half of world manufactured imports are intermediate goods (primary goods, parts and components, and semi-finished products), and more than 70% of world services imports are intermediate services.

The emergence of GVCs during the last two decades has implications in many policy areas, starting with trade, investment and industrial development. Some of these implications have been explored in recent OECD work but the empirical evidence on GVCs remains limited. The last few years have witnessed a growing number of case studies on the globally integrated value chain at the product level, but of course these analyses only depict the situation for that specific product.

More aggregate evidence has also been developed in order to get a more comprehensive picture of GVCs. The OECD, in co-operation with the World Trade Organization (WTO), has developed estimates of trade flows in value-added terms. Inter-country input-output tables and a full matrix of bilateral trade flows are used to derive data on the value added by each country in the value chain, thus giving a better picture of trade flows related to activities of firms in GVCs.

The main objective of this paper is to provide for more and better evidence allowing us to examine the position of countries within international production networks. The paper develops a number of indicators that give a more accurate picture of the integration and position of countries in GVCs. It also provides a more detailed assessment of global value chains in six broad industries: agriculture and food products, chemicals, electrical and computing machinery, motor vehicles, business services and financial services.

The GVC participation index indicates the extent to which a country is involved in a vertically fragmented production process (in relative and absolute terms). It distinguishes the use of foreign inputs in exports (backward participation) and the use of domestic intermediates in third country exports (forward participation). The index of the number of production stages shows how long global value chains are and also highlights the domestic and international part of the value chain. Lastly, the distance to final demand points out the "upstreamness" of countries and their position in the value chain. The collection of these different indicators at the country and industry level reveals the following stylised facts:

- Also at the aggregate level, empirical data on trade and output confirm the fragmentation of production and the emergence of global value chains. Recent indicators introduced in the literature give a better understanding of the depth of the phenomenon. On average more

than half of the value of exports is made up of products traded in the context of global value chains.

- Global value chains are not limited to Asia; all OECD regions show a comparable level of participation in GVCs, differences being between large economies producing a significant share of their intermediates domestically and small open economies relying more on international sourcing. While most studies on GVCs have focused on Asia, Europe shows a comparable if not higher level of participation in GVCs.
- Successful emerging economies have become more specialised in intermediate inputs and generally increased their "upstreamness". This can be seen in particular in Asia (with China, Malaysia, the Philippines or Singapore), as well as in the Americas (with Chile).

An important implication of the new GVC paradigm is that one should look beyond industries to understand trade and production patterns. The GVC literature insists on business functions, which are the activities along the supply chain, such as R&D, procurement, operations, marketing, customer services, etc. Countries tend to specialise in specific business functions involving specific tasks rather than specific industries.

A better characterisation of the role of each economy in global production networks is necessary for several policy areas: trade policy, trade and employment, national competitiveness and growth, upgrading and development, global systemic risks, to name a few. These implications are discussed in the recent OECD publication *Interconnected Economies – Benefiting from Global Value Chains* (2013).

1. Introduction: the rise of global value chains

World trade and production are increasingly structured around "global value chains" (GVCs).[1] A value chain can be simply defined as the "full range of activities that firms and workers do to bring a product from its conception to its end use and beyond" (Gereffi and Fernandez-Stark, 2011). Typically, a value chain includes the following activities: design, production, marketing, distribution and support to the final consumer. These activities can be performed within the same firm or divided among different firms. The fact that they are increasingly spread over several countries explains why the value chain is regarded as "global".

The concept of GVC was introduced in the early 2000s and has been successful in capturing several characteristics of the world economy:

- The increasing fragmentation of production across countries. Global value chains link geographically dispersed activities in a single industry and help to understand shifting patterns of trade and production. For policymakers, global value chains are useful to apprehend the interconnectedness of economies. In particular, GVCs emphasise how export competitiveness relies on the sourcing of efficient inputs, as well as access to final producers and consumers abroad.
- The specialisation of countries in tasks and business functions rather than specific products. While most policies still assume that goods and services are produced domestically and compete with "foreign" products, the reality is that most goods and an increasing number of services are "made in the world" and that countries compete on economic roles within the value chain. The concept of GVCs is thus important to close the gap between policy and the reality of business.
- The role of networks, global buyers and global suppliers. Global value chain analysis gives insights on economic governance and helps to identify firms and actors that control and coordinate activities in production networks. Understanding governance structures is important for policymaking, in particular to assess how policies can have an impact on firms and the location of activities.

For all these reasons, there is a need to better understand how global value chains work and to provide new data and analysis to policymakers in the field of trade, industry and innovation. This report takes stock of the growing research on GVCs and develops a series of indicators and case studies, based on newly available data. Because policies are determined at the level of countries and for industries broadly defined, the report focuses on aggregate data and country indicators.

A brief history of "global value chains"

The concept of GVC can be traced back to the end of the 1970s with some work on the "commodity chain" (Bair, 2005). The basic idea was to trace all the sets of inputs and transformations that lead to an "ultimate consumable" and to describe a linked set of processes that culminate in this item (Hopkins and Wallerstein, 1977). The concept of "global commodity chain" was later introduced in the work of Gary Gereffi (1994), describing for example the apparel commodity chain, from the raw materials (such as cotton, wool or synthetic fibres) to the final products (garments).

1. See Gereffi and Fernandez-Stark (2011) for an overview of global value chain analysis.

In the 2000s, there was a shift in terminology from the "global commodity chain" to the "global value chain", the latter coming from the analysis of trade and industrial organisation as a value-added chain in the international business literature (Porter, 1985). The concept of value chain is not really different from the commodity chain but it is more ambitious in the sense that it tries to capture the determinants of the organisation of global industries (Bair, 2005). Gereffi *et al.* (2005) provide a theoretical framework for the value chain analysis and describe different types of global value chain governance.

An important difference emphasised in the literature is between "producer-driven" and "buyer-driven" chains. Producer-driven GVCs are found in high-tech sectors such as the semi-conductor or the pharmaceuticals industry. Because these industries rely on technology and R&D, lead firms are placed upstream and control the design of products as well as most of the assembly which is fragmented in different countries. In buyer-driven chains, retailers and branded marketers control the production, which can be totally outsourced, the focus being on the marketing and sales. GVCs with lower needs for capital and relying on fewer skilled workers are generally organised this way, as illustrated by the apparel commodity chain (Gereffi, 1994).

A third and more recent strand of research prefers to put the emphasis on the concept of "network" rather than "chain" (Coe and Hess, 2007). This change in the metaphor highlights the complexity of the interactions among global producers: "economic processes must be conceptualised in terms of a complex circuitry with a multiplicity of linkages and feedback loops rather than just "simple" circuits or, even worse, linear flows" (Hudson, 2004). In this report, we focus more on "global value chains" as we describe the position and participation of countries in global production and we do not rely on network analysis.

The main drivers of the phenomenon

The outsourcing of activities and the fragmentation of production are not new. The trade economist Bertil Ohlin already noted in 1933 that "As a matter of fact, production is in many cases divided not into two stages – raw materials and finished goods – but into many". There are examples of global value chains before the 1980s. But what is undoubtedly new is the scale of the phenomenon and how technological change has allowed in the last two decades a fragmentation of production that was not possible before.

The main reason why firms can fragment their production is that trade costs have significantly decreased. Trade costs include the whole range of costs that companies face between the factory or office where the good or service is produced and the final consumer. In the case of goods, trade costs include land transport and port costs, freight and insurance costs, tariffs and duties, costs associated with non-tariff measures, and can be extended to also include mark-ups from importers, wholesalers and retailers. In the case of services, transport costs are replaced with communication costs (although services can also be provided by natural persons that have to travel to the country where the consumer is located) and trade barriers are non-tariff measures. Other important costs related to global value chains are co-ordination costs as geographically dispersed activities have to be managed in a consistent way; ICT technological progress has increasingly allowed the co-ordination and monitoring of activities located at a large distance.

Transport and communication costs have first and foremost decreased due to technological advances such as the container or the Internet. Progress has been made all along the logistics chain, ensuring the smooth flow of goods and services in a co-ordinated and inexpensive way. But lower trade costs are not limited to technological change. An important driver was also trade and investment liberalisation, as well as regulatory reforms in key transport and

infrastructure sectors. Policies have played an important role in improving efficiency and explain as much the fragmentation of production as advances in transport and communication technologies.

Lastly, beyond technological change and regulatory reforms, it is also on the demand side that the world economy has radically changed in the last decades. The emergence of Asia and the high growth rates in new emerging economies have increased the size of world demand and boosted international trade. Asia is not just the factory of the world; there are also new consumers that can afford a broader range of products. As a consequence, trade in final goods and services has increased as much as trade in intermediates.

How far will the fragmentation of production go?

The level of fragmentation of production can be explained by the technical characteristics of products and the costs incurred when the production is split in different locations. Not all products can have their production sliced up in multiple stages. Services, for example, are less prone to vertical specialisation when the face-to-face contact between the provider and the consumer is required. Moreover, as described by Jones and Kierzkowski (2001), the level of fragmentation depends on a trade-off between lower production costs and higher transactions/co-ordination costs. By locating stages of production in countries where production costs are lower, firms decrease the marginal cost of production but they incur higher fixed and variable costs that correspond to all the services links needed to maintain the production in several locations. There is therefore an optimal level of fragmentation that depends on the level of trade and transaction costs.

This optimal level of fragmentation implies that we should not expect global value chains to continuously expand. Following the financial crisis, the consolidation of some value chains has been observed. Increasingly difficult access to trade finance and higher transactions costs due to uncertainties in the supply of some inputs have caused the disruption of some value chains. Likewise, following the disruptions of GVCs in the aftermath of the 2011 tsunami in Tokohoku (Japan), some companies, in particular in the automotive and electronics industries, have made their value chains significantly shorter and less complex.

Companies continuously redefine their strategies and their boundaries. A model of production which is successful at some point is not guaranteed to be successful in the future. Some GVCs also rely on differences in the cost of labour and capital between countries that are constantly changing. For example, as China grows more prosperous, wages rise and some production is already being offshored to other countries, while China develops new activities requiring workers with higher skills. Trade and production patterns will continue to change and policies should consequently be ready to adjust.

Industries, business functions or tasks?

An important implication of the new GVC paradigm is that one should look beyond industries to understand trade and production patterns. Industries are still relevant for economic analysis but trade tends to be more intra-industry and the reallocation of resources following trade and investment liberalisation is also an intra-industry reallocation (Melitz, 2003). If the division of labour no longer follows industries, the question is: what is the relevant unit?

The GVC literature insists on business functions, which are the activities along the supply chain, such as R&D, procurement, operations, marketing, customer services, etc. Countries tend to specialise in specific business functions rather than specific industries, such as the

assembly operations for China or business services for India. The idea behind GVCs is also that the product and firm strategies define the global value chain, involving several "industries". Some services industries, such as financial services or transport services will be part of almost all value chains. Extractive and raw material industries are also likely to be at the beginning of most manufacturing GVCs. The value chain follows specific commodities and services and encompasses several industries. This is also why specialisation is no longer in industries but in specific functions in the value chain.

The trade literature has also introduced a smaller unit of specialisation based on specific workers' activities: the tasks they perform. Tasks can be outsourced and their offshoring becomes "trade in tasks" (Grossman and Rossi-Hansberg, 2006). However, according to Lanz *et al.* (2011), there is no clear evidence that the fragmentation of production goes to the task level. Firms generally prefer "multi-tasked" workers and "Toyotism" rather than "Fordism" remains the dominant production model. This being said, bundles of tasks could explain the specialisation of countries in the value chain, bringing the "trade in tasks" paradigm close to the "business functions" described in the GVC literature. What is clear is that, as highlighted by Grossman and Rossi-Hansberg, this is "no longer wine for cloth" and policymakers have to think beyond industries when looking at trade and industrial policies.

Against this backdrop, the rest of the report is organised as follows. Section 2 provides a brief description of the data used in the project, as well as the methodology. Some stylised facts on the importance of GVCs are included, as well as aggregate results for OECD countries and selected non-OECD economies. Section 3 introduces six case studies, four in the manufacturing sector (agriculture and food products, chemicals, electrical and computing machinery, motor vehicles) and two in the services industry (financial and business services). Section 4 concludes. The policy implications of the work can be found in the OECD publication *Interconnected Economies – Benefiting from Global Value Chains* (2013). A specific chapter deals with the implications of GVCs for trade policy.

2. Data and methodology

Global value chains challenge the way statistics on trade and output are collected. There is a growing awareness that current statistics can give the wrong picture (Maurer and Degain, 2010). Trade statistics in particular are collected in gross terms and record several times the value of intermediate inputs traded along the value chain. As a consequence, the country of the final producer appears as capturing most of the value of goods and services traded, while the role of countries providing inputs upstream is overlooked. Bilateral trade statistics and output measures at the national level make it difficult to visualise the "chain" or the production network.

New data available to study GVCs: the OECD ICIO model

The OECD, in co-operation with WTO, has built a new database of trade flow in value-added terms based on a global model of international production and trade networks.[2] The Inter-Country Input-Output (ICIO) model links internationally input-output tables from 58 countries (one of these countries being the "rest of the world") and accounts for more than 95% of world output. Flows of intermediate inputs across countries and industries come from

2. See http://oe.cd/tiva for more information on the TiVA database.

the Bilateral Trade Database by Industry and End-Use Category (BTDIxE) also developed in the course of this project.[3]

The OECD ICIO model allows the analysis of GVCs from a truly global perspective detailing all transactions between industries and countries for 37 industries. In contrast, previous research often used input-output data for a limited or even single country, hence offering only a partial picture of the GVC reality. Five years are available: 1995, 2000, 2005, 2008 and 2009. As 2009 was the year of the financial crisis and 'trade collapse', indicators are quite different from previous years. This is why 2008 was added to the model (thus offering some insights on the impact of the crisis on GVCs).

There are several assumptions behind the construction of the OECD ICIO model and still gaps in the data. The Secretariat will work in the coming years on the improvement of the tool but one should be aware that such a model can only provide rough estimates of bilateral trade flows across industries and of the contribution of each economy to global production. At the level of aggregation where the results are presented, the margin of error remains low. But the more specific results are in terms of countries and industries, the more cautious should the reader be about the nature of the data reported.

Measuring the importance of GVCs: country and industry indicators

This section describes the indicators in a non-technical way; readers interested in the technical details can read Annex 1 that includes more information on the methodology. Results are presented on the importance, depth and length of global value chains, as well as the specific position of countries in these production networks.

Participation in GVCs: what is the share of exports involved in a vertically fragmented production process?

The first question that comes to mind when thinking about GVCs is to what extent countries are involved in a vertically fragmented production. One way to measure it – and historically the first indicator calculated in the literature – is to measure the vertical specialisation share, which can be understood as the import content of exports. The indicator measures the value of imported inputs in the overall exports of a country (the remainder being the domestic content of exports).[4] However, the VS share only looks at the importance of foreign suppliers backward in the value chain. As a country also participates in GVCs by being a supplier of inputs used in third countries for further exports, the literature has also introduced the 'VS1' share, which is the percentage of exported goods and services used as imported inputs to produce other countries' exports (Hummels *et al.*, 2001). Combining the VS and VS1 shares, one can have a comprehensive assessment of the participation of a country in GVCs, both as a user of foreign inputs (upstream links, i.e. backward participation) and supplier of intermediate goods and services used in other countries' exports (downstream links, i.e. forward participation). Such an indicator is proposed by Koopman *et al.* (2010).

The participation index at the country level is represented on Figure 1 for OECD countries. The index is expressed as a percentage of gross exports and indicates the share of foreign

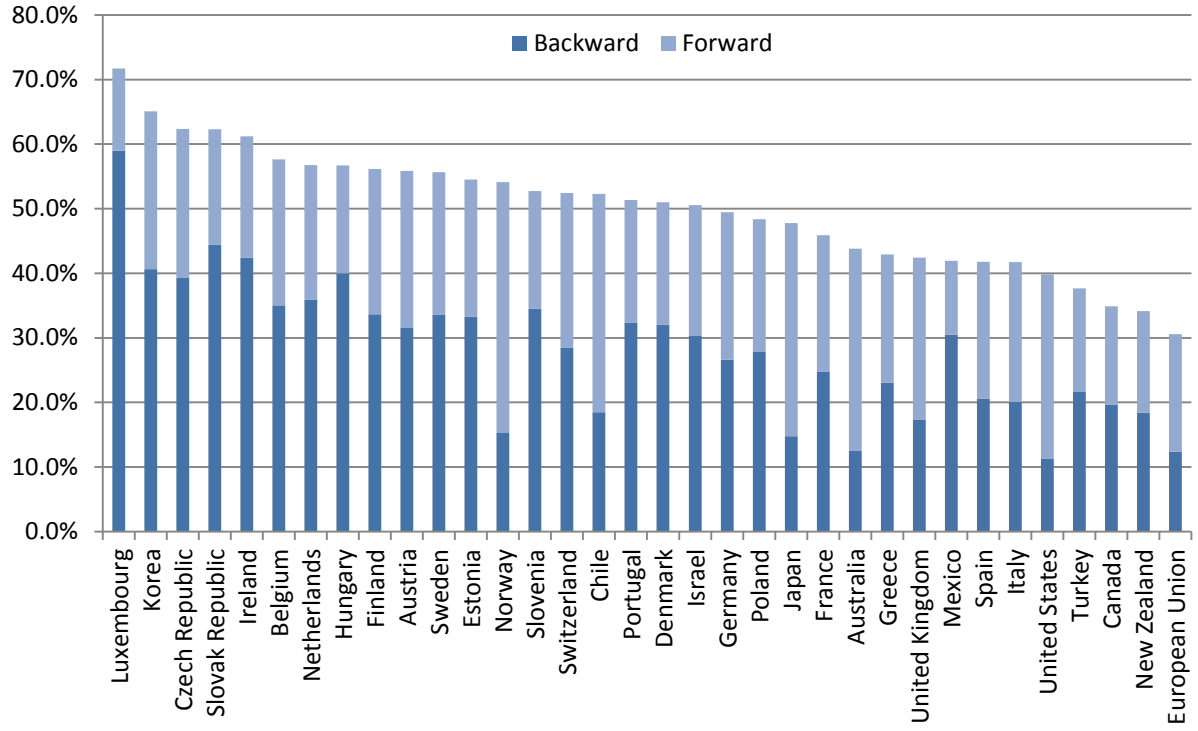
3. The BTDIxE database is described in Zhu *et al.* (2011) and covers trade in goods. Earlier work on trade in intermediate goods and services includes Miroudot *et al.* (2009).

4. The VS share was first introduced by Hummels *et al.* (2001) and can be calculated on the basis of national input-output tables. See De Backer and Yamano (2007) and Miroudot and Ragoussis (2009) for previous OECD reports where the vertical specialisation share is calculated.

inputs (backward participation) and domestically produced inputs used in third countries' exports (forward participation). As domestically produced inputs can incorporate some of the foreign inputs, there is an overlap and potentially some double counting (the indicator is not based on value-added trade).[5]

Figure 1. GVC participation index in OECD countries (2009)[6]

Foreign inputs (backward participation) and domestically-produced inputs used in third countries' exports (forward participation), as a share of gross exports (%)



Source: Authors' calculations using the OECD ICIO model, May 2013 release.

Small open economies such as Luxembourg, the Czech Republic and Slovak Republic source more inputs from abroad in GVCs than large countries, such as the United States or Japan (where due to the size of the economy, a larger share of the value chain is domestic, see below). The participation index, however, is less correlated with the size of countries than the import content of exports, since it also looks forward at the use of inputs in third countries. For example, the foreign content of US exports is about 15% while US participation in GVCs rises to 40% when taking into account the use of US intermediates in other countries' exports.

Comparing OECD and non-OECD economies (Figure 2), the participation in GVCs is of a similar magnitude in the two groups of countries. Large economies, such as Brazil or India, have a lower share of exports made of inputs taking part in vertical trade, as opposed to small

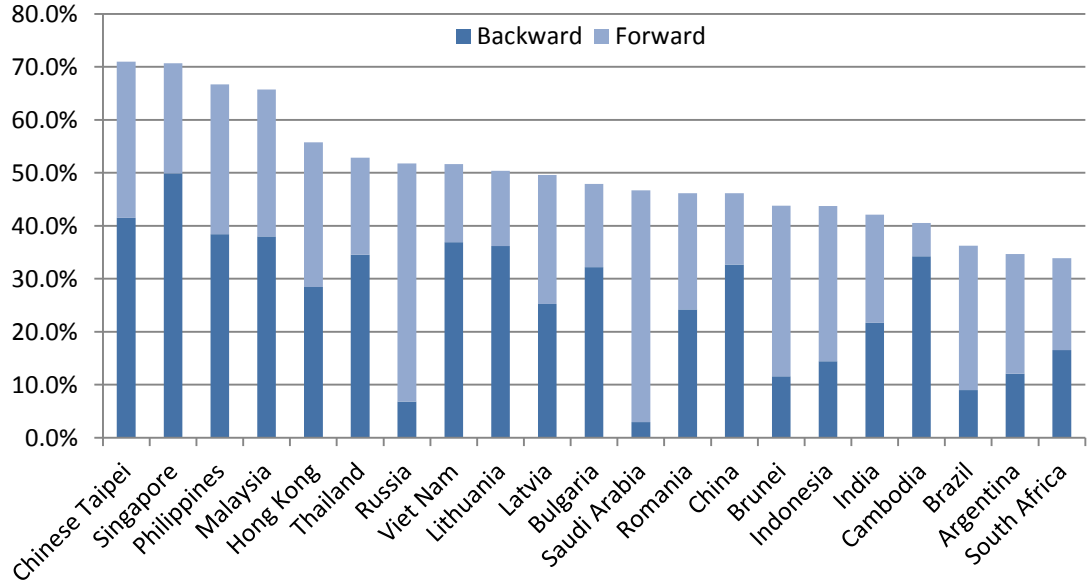
5. Likewise, some foreign inputs can incorporate domestic value added exported in an earlier stage of the value chain.

6. The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

economies, such as Singapore or Chinese Taipei. But Figure 2 only includes emerging economies; the participation in GVCs would be lower for least developed countries (LDCs) if data were available to include them in the global input-output model.

Figure 2. GVC participation index for selected non-OECD economies, 2009

Foreign inputs (backward participation) and domestically-produced inputs used in third countries' exports (forward participation), as a share of gross exports (%)



Source: Authors' calculations using the OECD ICIO model, May 2013 release.

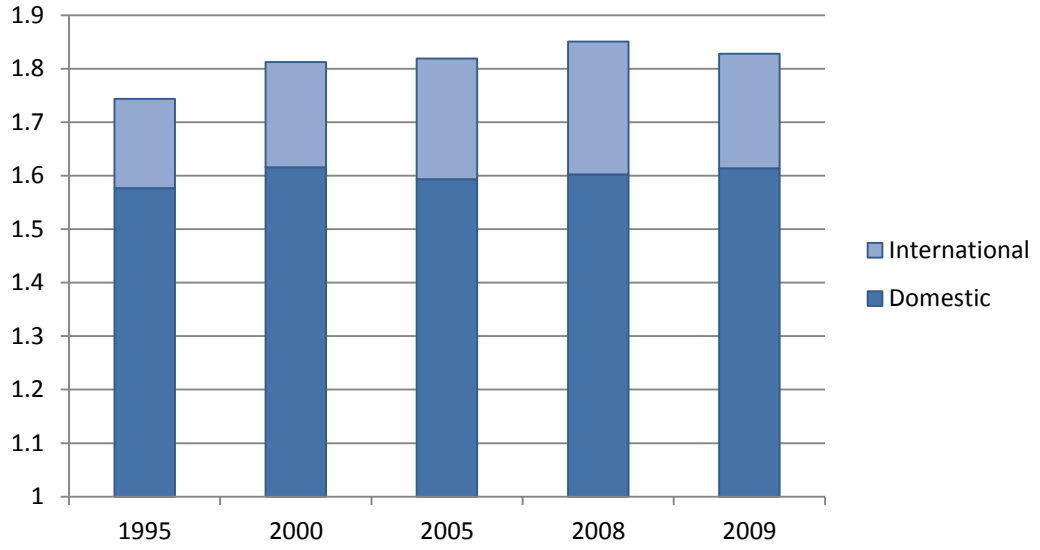
The length of GVCs: how many production stages in the GVC?

While the imported foreign inputs in countries' own exports and the domestically-produced intermediates used in third-countries' exports give an idea of the importance of vertical specialisation, they do not indicate how "long" value chains are, i.e. how many production stages are involved. For example, a high VS share could correspond to the use of expensive raw materials in a very simple value chain, while conversely a high VS1 share could be added in one go at the final stage of the production process. This is why an indication on the "length" of GVCs would be useful and complementary.

In the literature, the length of GVCs has been assessed through the "average propagation length" (APL), an indicator emerging from input-output analysis (Dietzenbacher and Romero, 2007). In this section we refer to a simpler index, introduced more recently in the trade literature (Fally, 2012; Antràs *et al.*, 2012). The index takes the value of 1 if there is a single production stage in the final industry and its value increases when inputs from the same industry or other industries are used, with a weighted average of the length of the production involved in these sectors (see Annex 1 for the calculation).

As we have information on foreign and domestic inputs, we can identify the domestic and international part of the value chain. Figure 3 below shows the average length for all industries. The value of the index could be interpreted as the actual number of production stages if it was calculated based on plant-level information. When calculated at the aggregate level, the value is only an index but still reflects the length of the value chain.

Figure 3. Average length of GVCs across all industries

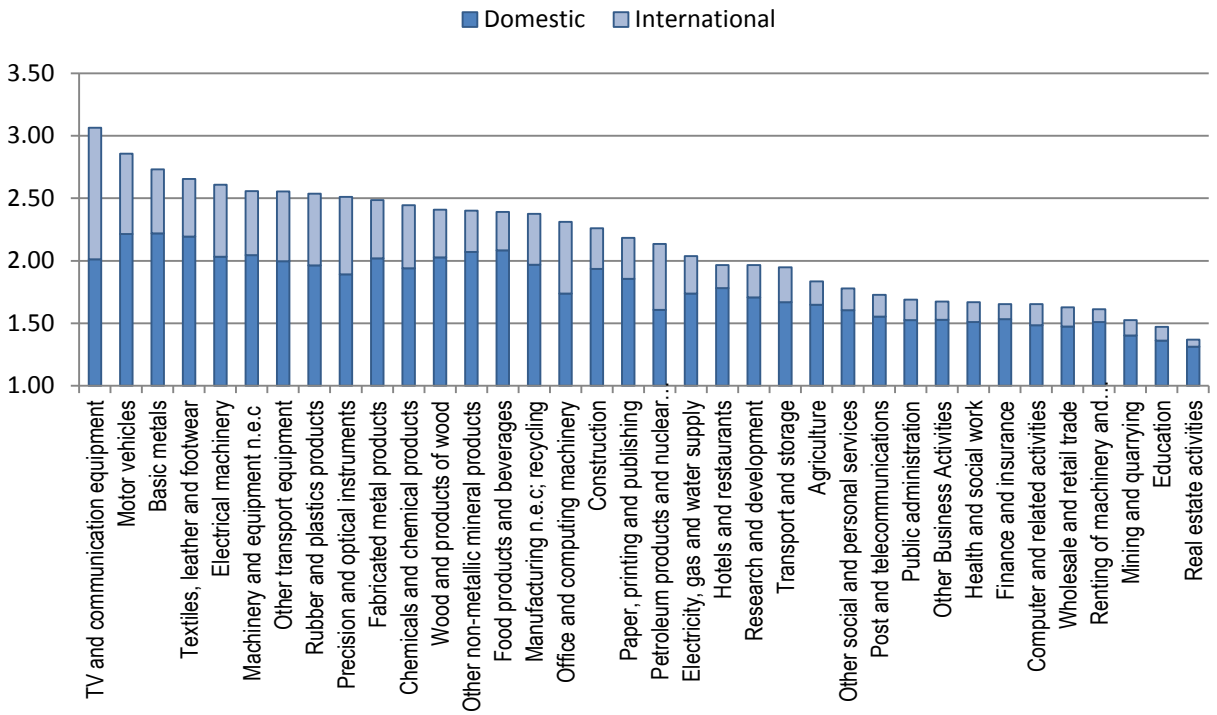


Source: Authors' calculations using the OECD ICIO model, May 2013 release. The minimum value of the index is 1 when no intermediate inputs are used to produce a final good or service.

Figure 3 highlights the increase in the average length of value chains between 1995 and 2008. The domestic length has remained almost unchanged; all the increase is explained by the international part of the value chain. With the financial crisis and trade collapse in 2009, there is a decrease in the length of GVCs. Again the international part is the driver of the observed change with even a slight increase in the domestic length in 2009 confirming that some companies have switched back to domestic suppliers in the context of the lack of availability of trade finance and risks associated with international suppliers. Figure 3 is consistent with the "optimal level of fragmentation" previously mentioned. It is possible that firms have explored outsourcing strategies with various degrees of success and some of them have abandoned such strategies. However, with 2008-2009 being the period of the financial crisis, it is early to conclude whether this consolidation of GVCs is cyclical or corresponds to a structural change. Further reductions in trade and transaction costs in the future could lead to higher levels of fragmentation.

More variation in the length of value chains is observed at the industry level (Figure 4). The five industries with the highest index of fragmentation are: "television and communication equipment", "motor vehicles", "basic metals", "textiles, leather and footwear" and "electrical machinery". Services industries have on average shorter value chains but some services industries such as "construction", "hotels and restaurants", "research and development" or "transport and storage" are also found with relatively long value chains. Only sectors such as "education" or "real estate activities" are services not involving any significant fragmentation of production.

Figure 4. Length of GVCs by industry, 2008



Source: Authors' calculations based on the OECD ICIO model, May 2013 release. The minimum value of the index is 1 when no intermediate inputs are used to produce a final good or service.

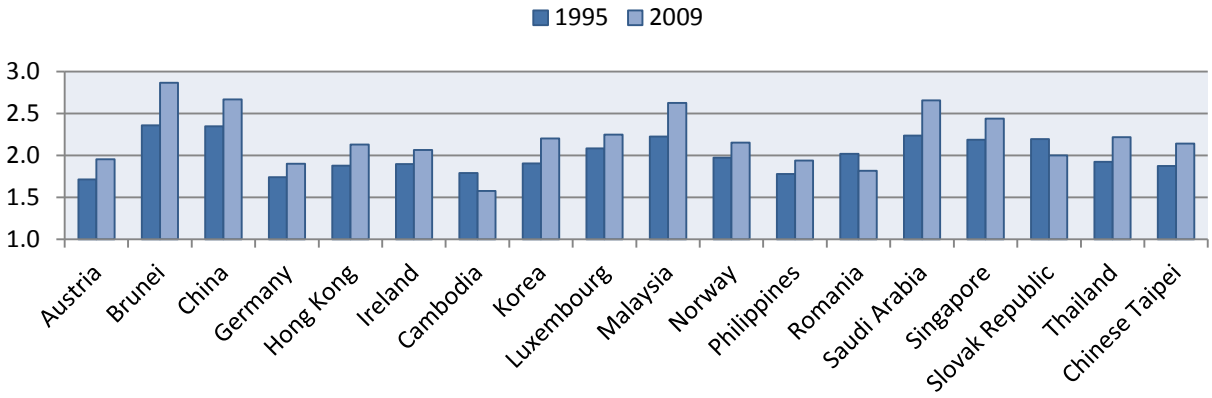
The distance to final demand: what is the position of a country in the value chain?

Once the depth and length of particular GVCs is assessed, the important question is where countries are located in the value chain. A country can be upstream or downstream, depending on its specialisation. Countries upstream produce the raw materials or intangibles involved at the beginning of the production process (e.g. research, design), while countries downstream do the assembly of processed products or specialise in customer services.

Fally (2012) and Antràs *et al.* (2012) have introduced a measure of "upstreamness" that we can refer to as the "distance to final demand". Starting from one industry in a given country, the index measures how many stages of production are left before the goods or services produced by this industry reach final consumers. This is again a calculation based on the inter-country input-output framework that we used to derive the previous GVC indicators. The average value by country (over all industries) is presented in Figure 5 for selected OECD countries and non-OECD economies. Looking at the change in the value of the index between 1995 and 2008, Figure 5 only includes economies where the value has increased by more than 8% to show the most significant changes. An increase in "upstreamness" means that these economies are now more specialised in the production of inputs at the beginning of the value chain. The increase in the index is high for economies such as China, Chinese Taipei, Hong Kong, Malaysia, the Philippines, Singapore or Thailand. But interestingly, EU countries such as Austria, Germany, Ireland or Luxembourg have also significantly increased their upstreamness.

There are only a few countries where the distance to final demand has decreased (Cambodia, Romania and the Slovak Republic, for example, on Figure 5). These countries tend to specialise in goods and services more downstream. The fact that, on average, most countries move upstream is consistent with the overall increase in the length of GVCs and the outsourcing phenomenon. When the production of some inputs is outsourced, their value-added is moved backward to the industries supplying intermediate inputs and the distance to final demand increases.

Figure 5. Distance to final demand, selected economies, 1995 and 2009



Source: Authors' calculations using the OECD ICIO model, May 2013 release. The countries represented are those where the distance to final demand increased or decreased by more than 8% between 1995 and 2009.

The indicators presented above are further used in the analysis of specific GVCs in the next section. They illustrate the use of aggregate country and industry indicators to inform the policy debate. From the data presented so far, we can emphasise the following stylised facts:

- Even at the aggregate level, empirical data on trade and output confirm the fragmentation of production and the emergence of global value chains. Recent indicators introduced in the literature gives a better understanding of the depth of the phenomenon. On average more than half of the value of exports is made up of products traded in the context of global value chains.
- Global value chains are not limited to Asia, all OECD economies show a comparable level of participation in GVCs but with differences between large economies that rely less on international trade and production and small open economies more inserted in global production networks. While most studies on GVCs have focused on Asia, Europe shows a comparable if not higher level of participation in GVCs.
- Successful emerging economies have become more specialised in intermediate inputs and generally increased their "upstreamness". This can be seen in particular in Asia (with China, Malaysia, the Philippines, Singapore or Thailand).

3. Analysis of specific GVCs

Case study 1: agriculture and food products

Global value chain analysis is not limited to manufacturing industries; it also applies to services (see below) or agriculture. In this latter case, the GVC perspective links agriculture to

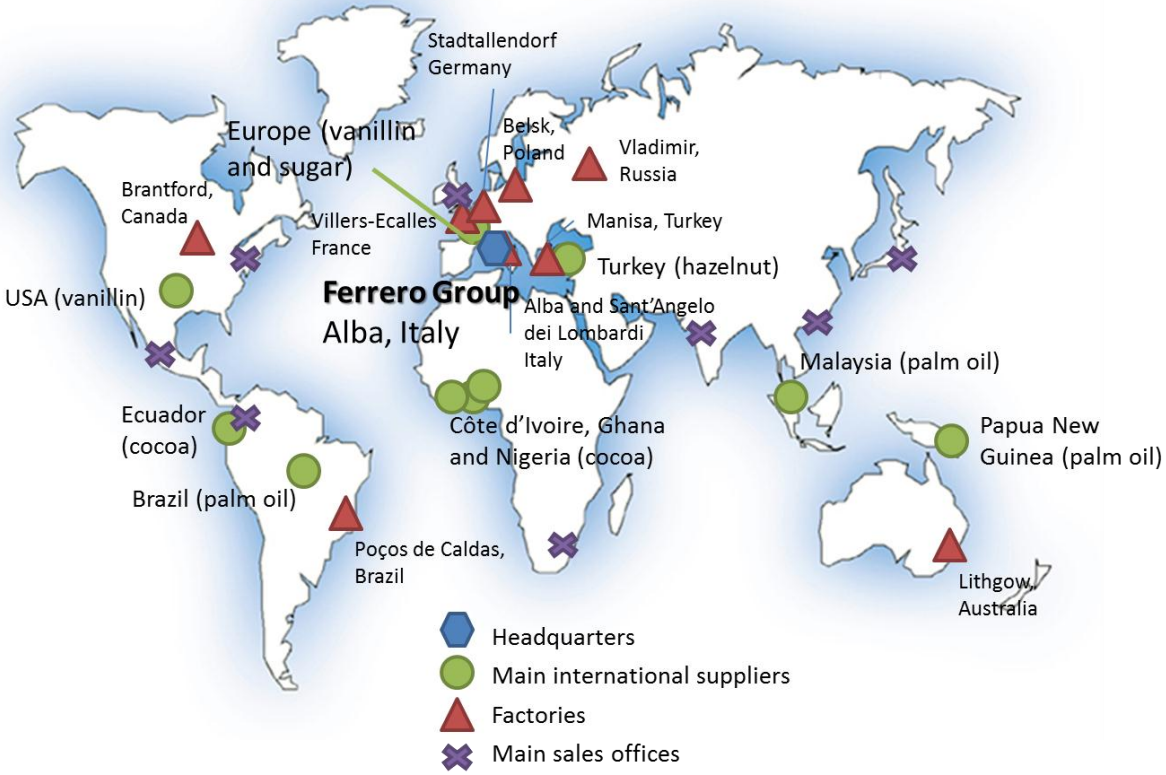
downstream activities in what can be called the "agri-food business". This is why the following analysis covers both agriculture and the food and beverage industry.

The agri-food industry is increasingly structured around global value chains led by food processors and retailers. Supermarkets, for example, work both with importers and exporters and want to control how products are grown and harvested. They want to ensure that quality and food safety standards are met all along the chain and this requires vertical co-ordination. In all countries, consumers have changed their consumption patterns and ask for food quality and safety (Reardon and Timmer, 2007). At the same time, FDI and trade liberalisation have given new opportunities for firms to reorganise their value chain. A relatively small number of companies now organise the global supply of food and link small producers in developed or developing countries to consumers all over the world (Gereffi and Lee, 2009).

At the product level, Figure 6 represents the "Nutella®" global value chain. Nutella® is a famous hazelnut and cocoa spread sold in more than 100 countries.[7] About 350 000 tons of Nutella® are produced each year. Nutella® is representative of agri-food value chains. The food processing company Ferrero International SA is headquartered in Luxembourg and currently has ten factories producing Nutella®: five are located in the European Union, one in Russia, one in Turkey, one in North America, one in South America and one in Australia. Some inputs are mainly locally supplied, for example the packaging or some of the ingredients like skimmed milk. There are however ingredients that are globally supplied: hazelnuts come mainly from Turkey, palm oil from Malaysia, Papua New Guinea and Brazil, cocoa mainly from Ivory Coast, Ghana, Nigeria and Ecuador, sugar mainly from Europe and the vanilla flavour from the United States and Europe. Nutella® is then sold around the world through sales offices (that are more numerous than the few represented in Figure 6).

7. Nutella® is a registered trademark used for Spread Containing Cocoa and Other Ingredients and owned by Ferrero S.p.A. (Piazzale Pietro Ferrero).

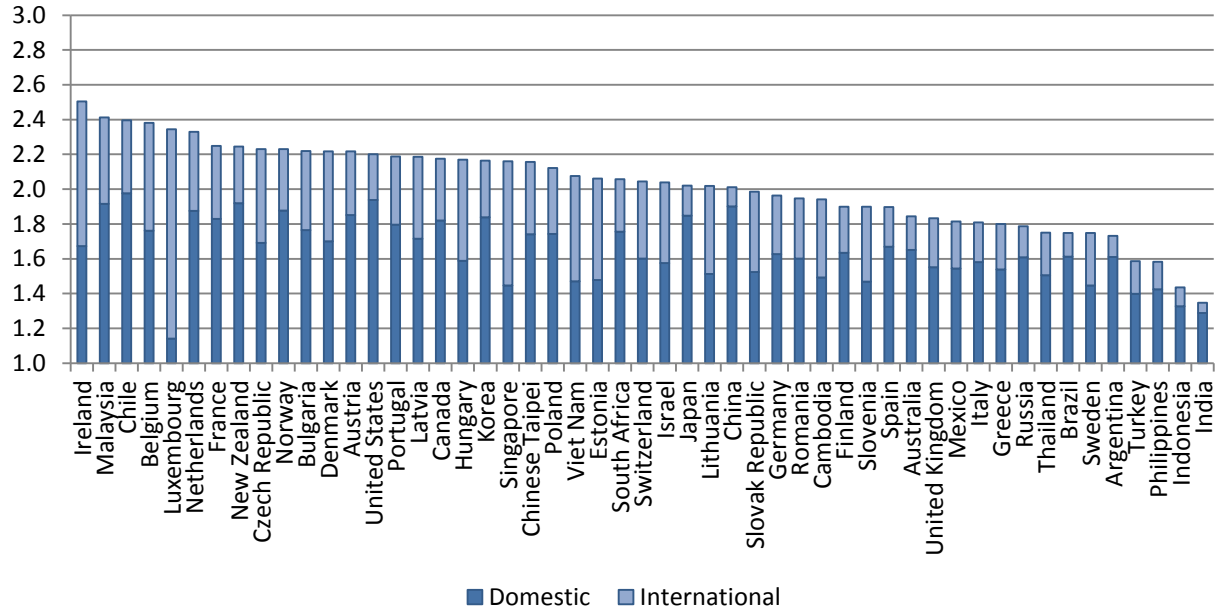
Figure 6. The Nutella® global value chain



Source: Ferrero.

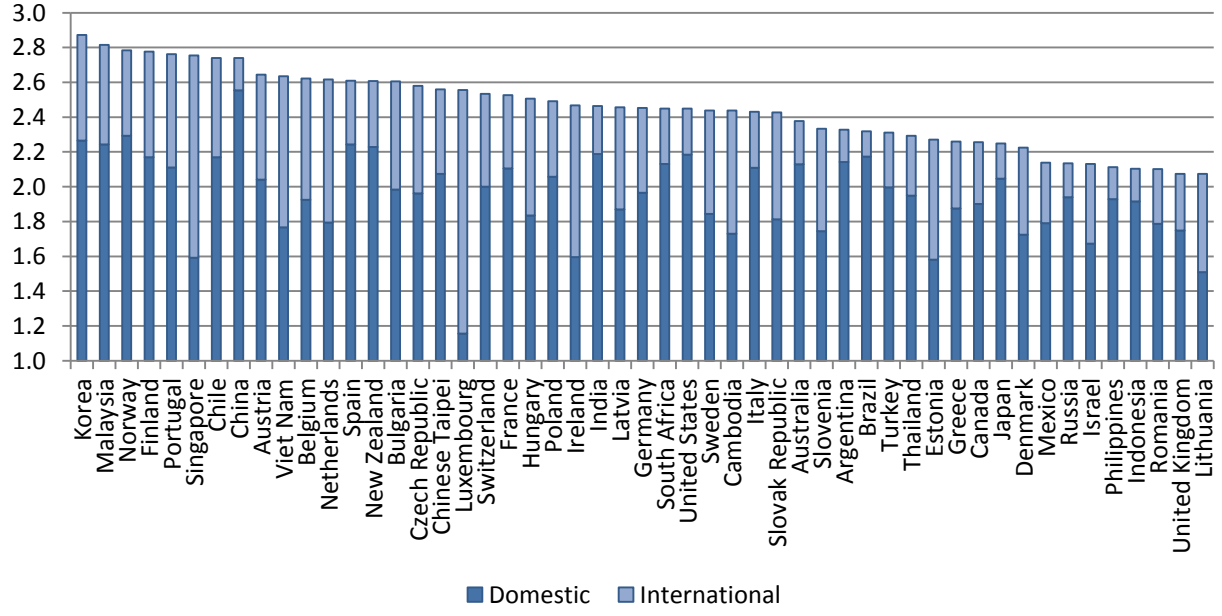
The location of production is close to final markets where Nutella® is in high demand (Europe, North America, South America and Oceania). There is no factory in central and east Asia so far because the product is less popular (another Ferrero delicacy, the Ferrero Rocher® is however more popular in Asia). In agri-food business value chains, there are more developing and emerging economies involved, as can be seen with countries in Latin America and Africa in the case of Nutella®.

Figure 7. Length index – Agriculture – By country (2009)



Source: Authors' calculations using the OECD ICIO model, May 2013 release.

Figure 8. Length index – Food products – By country (2009)



Source: Authors' calculations using the OECD ICIO model, May 2013 release.

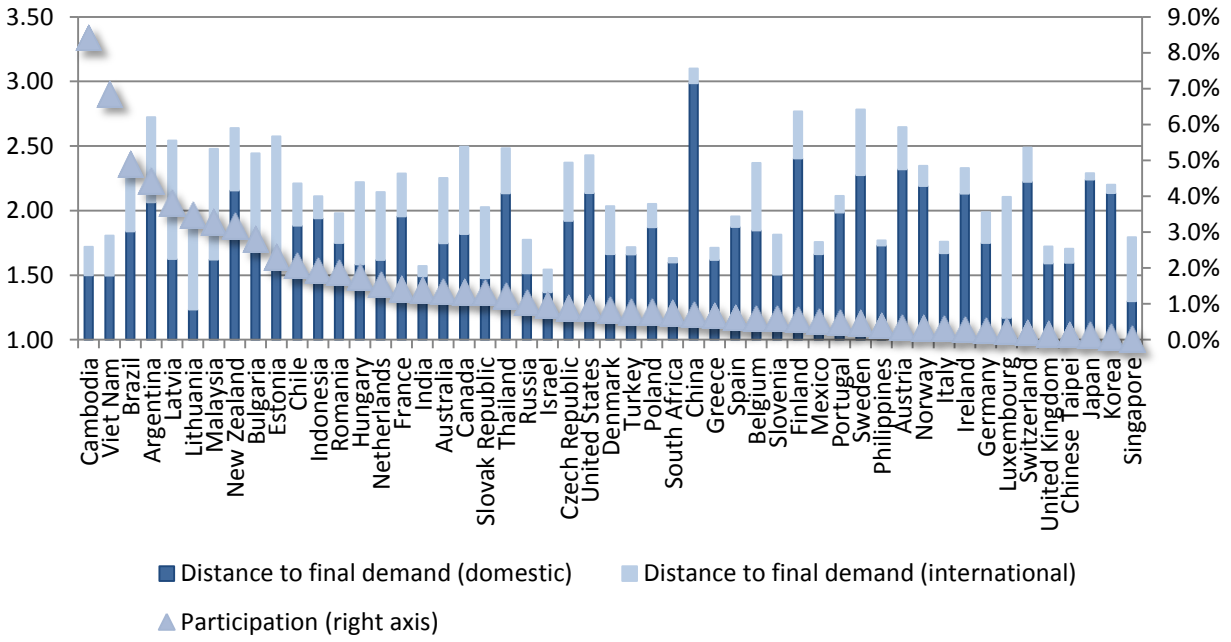
Figures 7 and 8 highlight that agriculture and food products value chains are relatively long. When they involve breeding animals for instance, there are many agricultural inputs upstream to produce all the food consumed and then further processing downstream and longer retailing chains when products go for example to hotels or restaurants. Fally (2012)

finds that in the US economy, meat packing plants and sausages and other prepared meat products have the longest value chains.

Both agriculture and food products have value chains that are quite international, in particular in the case of small economies such as Luxembourg or Singapore. East Asian economies such as Viet Nam or Cambodia also have highly international value chains. China has a different profile for agriculture and food products than in other GVCs. Most of the intermediate inputs used by the country in the different production stages are domestic.

In terms of participation, Cambodia, Viet Nam and Brazil are the three economies where the agriculture global value chain represents the highest percentage of exports (Figure 9). Brazil is positioned more upstream in the value chain as compared to Viet Nam and Cambodia. China is the country with the highest index of upstreamness, while India has one of the lowest. Agriculture represents a similar share of exports for the two economies, but their role in the agriculture value chain is very different. India produces mainly products going to final consumers after few production stages while China is involved in much longer agriculture GVCs, producing mainly inputs used in the agricultural activities of other countries.

Figure 9. Participation and distance to final demand – Agriculture – By country (2009)

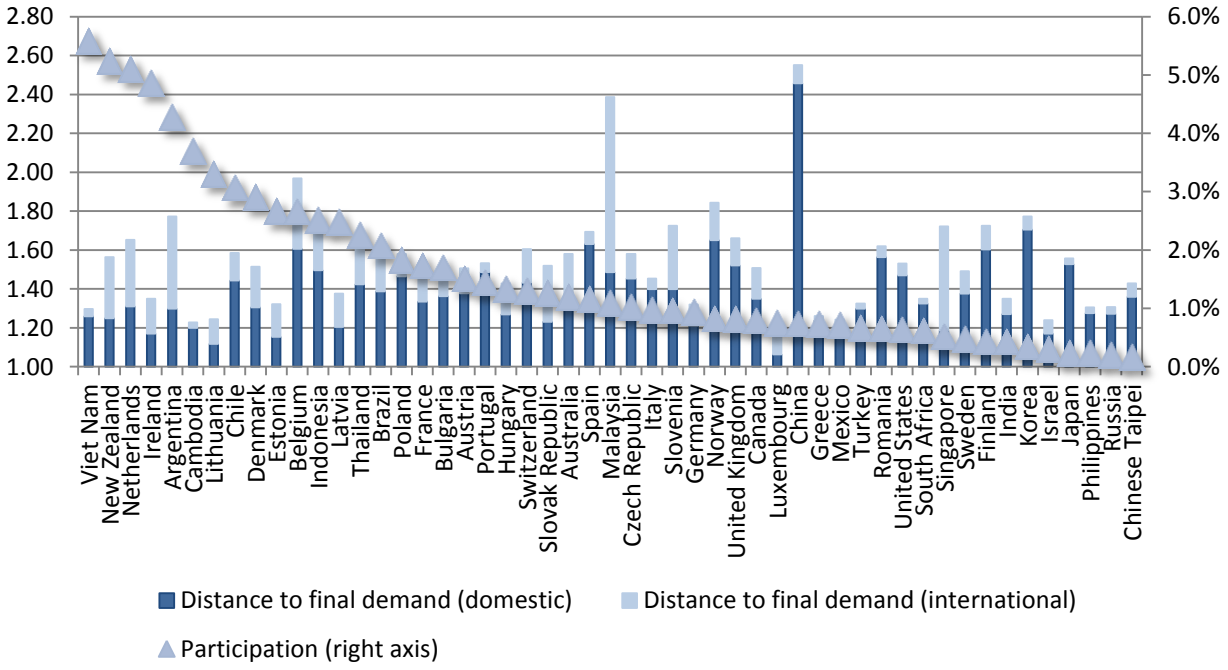


Source: Authors' calculations using the OECD ICIO model, May 2013 release.

In the food products and beverages value chain, Viet Nam, New Zealand and the Netherlands are the three countries the most involved (Figure 10). Malaysia and China have a clear specialisation in inputs very upstream while Cambodia, Mexico and Lithuania are the countries the most downstream, processing imported food and agriculture products. Figures 9 and 10 illustrate that there are marked differences across countries in patterns of specialisation. Moreover, there is no correlation between the participation index and the distance to final demand. Important exporters of agriculture and food products are found both upstream and downstream the value chain.

Aggregate data on the length, participation and distance to final demand confirm what could be highlighted with the Nutella® case study. Food products are globally produced in value chains where both developing and developed countries are involved. The data do not indicate that developing or developed economies are confined to specific roles. For example, both Sweden and China can be found very upstream in agriculture value chains and conversely, both Viet Nam and Germany are quite downstream in the food products value chain. As exemplified with the Nutella® supply chain, being close to final consumers and to specific inputs suppliers matters for the agri-food industry and the same activities can be located in developed and emerging markets.

Figure 10. Participation and distance to final demand – Food products – By country (2009)



Source: Authors' calculations using the OECD ICIO model, May 2013 release.

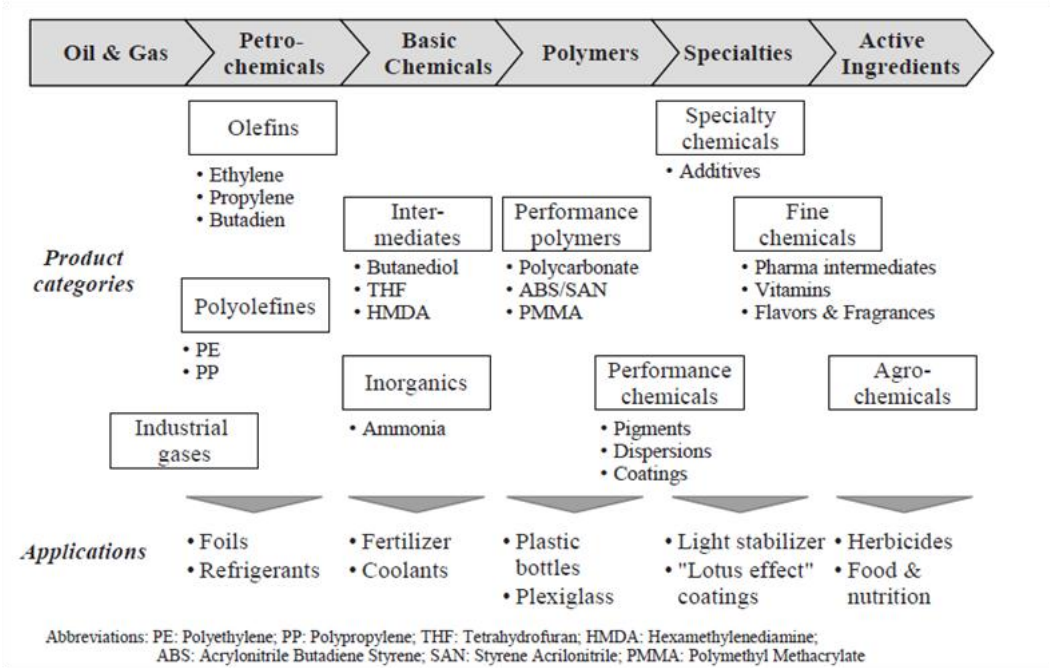
Case study 2: chemical products

Reflecting the large number of products (final and intermediates) and production processes, the chemicals industry is probably more than other industries characterised by the presence of a multitude of different GVCs. Figure 11 depicts the structure and value chain of the complete chemical industry starting with oil and gas which is transformed in the following steps in petrochemicals, basis chemicals, polymers, specialties and active ingredients. The chemical industry provides raw materials and inputs for many other industries since its products are used in multiple applications cross-industries.

Products in the early stages of the chemical GVC include more commodity type products, i.e. products which are produced in high volumes and sold at low unit value to mass markets. Specialty products are typically produced in the later stages of the chemical GVC and incorporate larger degrees of complexity often linked to higher R&D/marketing investments (e.g. in pharmaceuticals): different product variants, branding, adapted packaging, small volumes, etc.

Market evolutions differ across the various stages in the value chain: for example within the segment petrochemical commodities especially propylene polymers are suffering from the high and volatile prices of oil; while the new discovery of giant supplies of natural gas in shale rock around the world but especially in the United States provides a growing supply of raw materials for ethylene based products. These different evolutions are also changing the geography of the industry which was since a couple of years bound to be moving to the Middle East. In the specialty stages, a clear trend towards commoditisation is observed as new competitors try to gain market share in this high profitable market.

Figure 11. The chemicals value chain



Source: Kannegieser (2008)

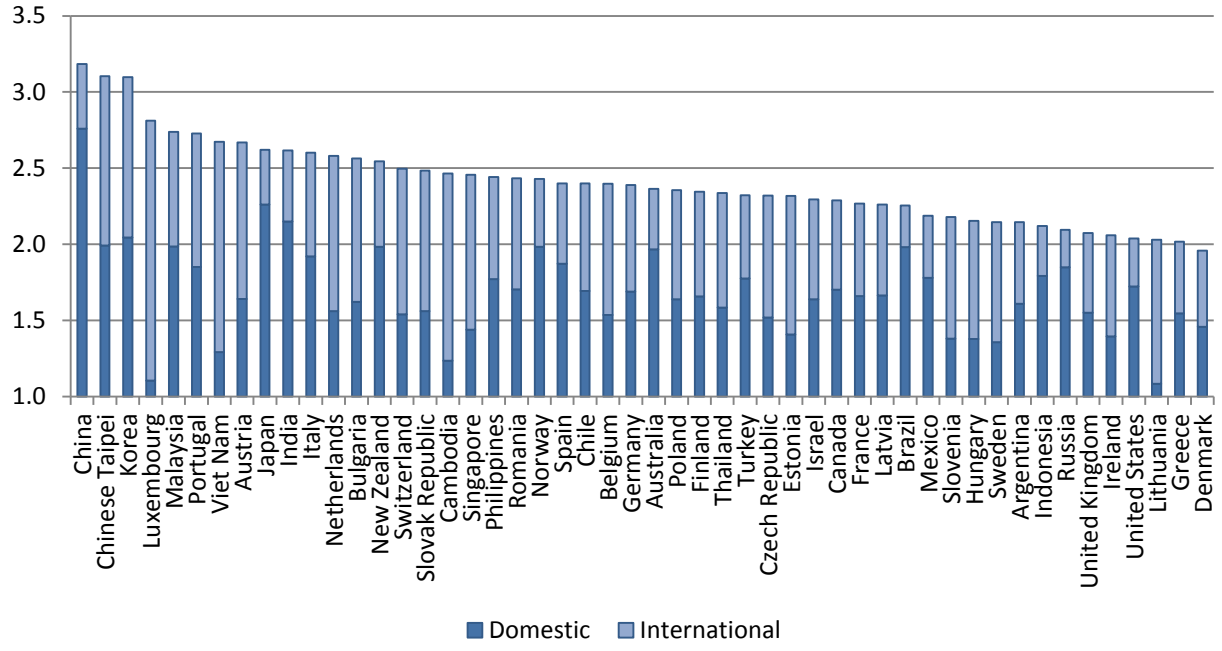
The chemicals industry sources to a large extent inputs internally (between chemical sub-industries) as well as from other industries. A large part of these inputs are sourced domestically, reflected in the relatively high average domestic length of the chemical GVC across countries (Figure 12). Not surprisingly, smaller countries show relatively more international stages; in contrast the chemical industry in China sources more than 90% of its inputs domestically, suggesting that the Chinese chemical industry is strongly clustered geographically with other supplying industries.

The index of the distance to final demand gives an idea where countries are positioned and specialised in the complete chemical GVC as presented in Figure 11 above. In general, one observes a large variation across countries indicating that some countries like Korea, China, Malaysia and Chinese Taipei are more specialized in basic chemicals in the earlier stages of chemicals GVC while other countries are more active in specialty (intermediates and final) products in the later stages; for example Ireland and Switzerland in pharmaceuticals who produce especially for final demand abroad (Figure 13).

A number of smaller countries show especially high participation indexes in the chemicals industry driven mostly by the imports of intermediates. In Ireland this is related to the

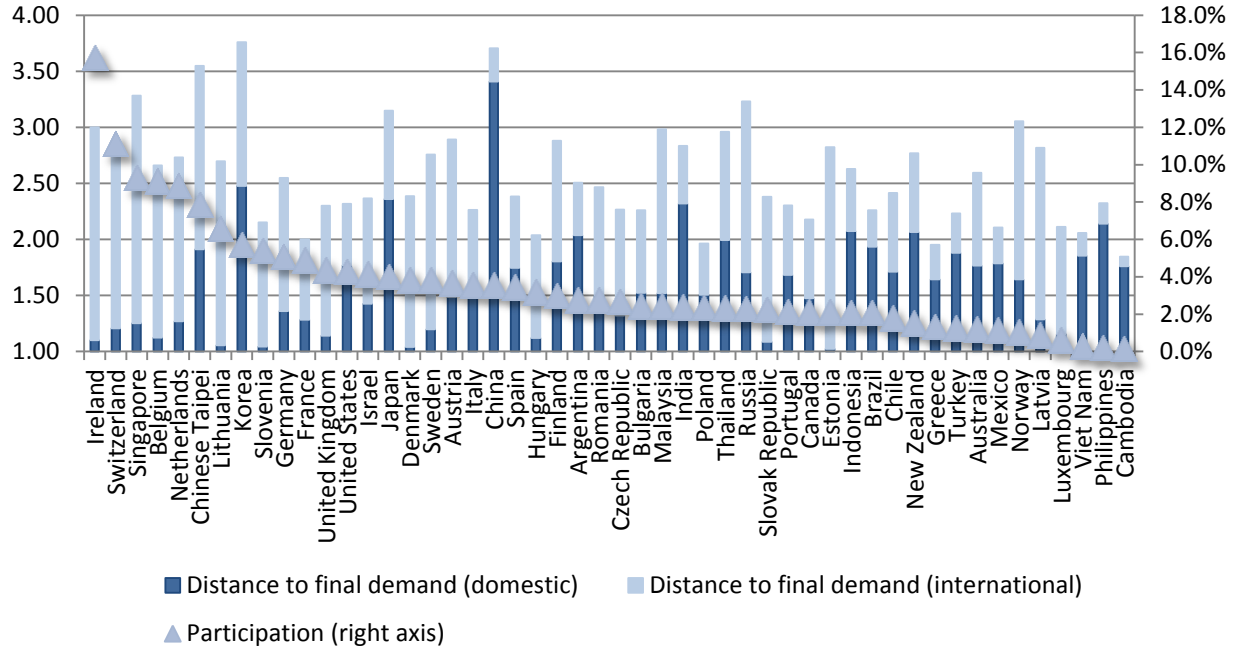
investments of large pharmaceutical companies especially from the United States, while Singapore, Belgium and the Netherlands are important ports that serve as important gateways for (basic) chemicals. For other countries like Switzerland, Germany, France, the United Kingdom and the United States the participation is more closely linked to the use of their intermediates in other countries' chemical industries.

Figure 12. Length index – Chemicals – By country (2009)



Source: Authors' calculations using the OECD ICIO model, May 2013 release.

Figure 13. Participation and distance to final demand – Chemicals – By country (2009)



Source: Authors' calculations using the OECD ICIO model, May 2013 release.

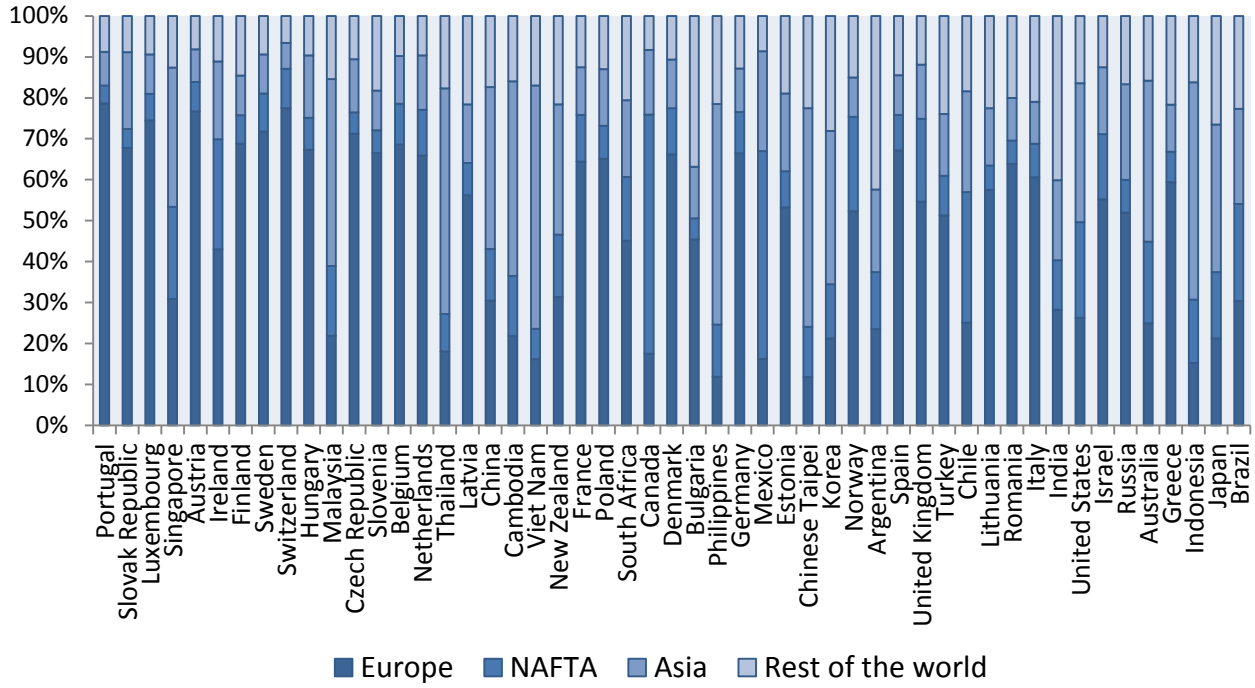
Case study 3: motor vehicles

The industry "motor vehicles" is an industry where the unbundling of production has already been taken place for decades; outsourcing/offshoring by companies have pushed the international fragmentation of production quite far in this industry. The value chain of motor vehicles is largely organized through a hierarchical structure, with the large automotive manufacturers positioned on top of the pyramid as lead firms responsible for design, branding, and final assembly. One level down, first-tier suppliers produce complete subsystems by cooperating with a large network of lower tier suppliers and subcontractors. Close relationships have developed especially between car assemblers and first tier suppliers as these last ones have taken up a larger role in the whole production process, including design. These suppliers have increasingly developed into global suppliers since lead firms increasingly demand that their largest suppliers have a global presence and system design capabilities as a precondition to being considered as a source for a complex part or subsystem (Sturgeon and Florida, 2004).

Notwithstanding the global activities of lead firms and first tier suppliers, regional production is still very important in the motor vehicles industry. High transportation costs make intercontinental shipping very costly especially in downstream activities, e.g. complete cars or subsystems. In addition, political pressure may also motivate lead firms to locate production close to end markets; the high cost and visibility of automotive products can create the risk of a political backlash if imported vehicles become too large a share of total vehicles sold. This in turn creates pressure for supplier co-location within regional production systems for operational reasons, such as just-in-time production, design collaboration and the support of globally produced vehicle platforms (Van Biesebroeck and Sturgeon, 2010). As a result, the supplier network in the motor vehicles' industry consists of a large number of suppliers, some

of them pure local suppliers (typically lower tier suppliers), others global suppliers with a local presence (top tier suppliers).

Figure 14. Import content of exports by country of origin, motor vehicles industry (2009)

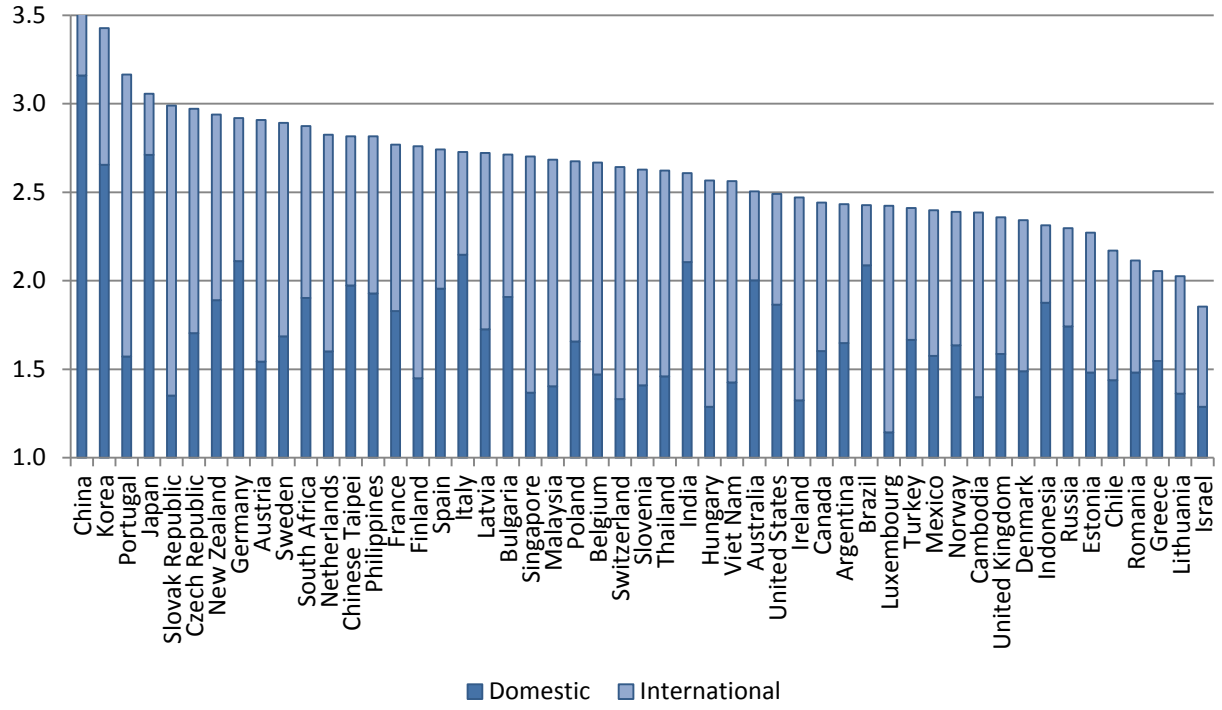


Source: Authors' calculations using the OECD ICIO model, May 2013 release.

The regional organisation of the production process is clearly demonstrated when distinguishing the source country of imported intermediates (Figure 14). It becomes clear that intra-regional sourcing within the 3 main regional blocks is important in the motor vehicles industry. European Union member states source the majority of their intermediates from other European countries, while NAFTA partners largely source from within NAFTA. Also in Asia a clear regional integration has developed through the sourcing of intermediates largely from within the region.

GVCs are very prominent in the motor vehicles industry, which is reflected in the index of the length of GVCs across all industries (Figure 4 in previous section). Except for a couple of countries, the index of the 'number of production stages' is above 2.5 (recall that the index for a final industry without production stages equals 1) illustrating the importance of vertical linkages between the motor vehicles industry and other industries. A significant part of these stages are located abroad, underlining the international (although regional instead of truly global) character of these motor vehicles chains. Smaller countries display on average more international production stages, illustrating the fact that these countries depend more on (directly and indirectly) imported intermediates (Figure 15). Countries like Korea, China and Japan display larger production stages at home reflecting very well the domestic organisation structure of the motor vehicle industry in these countries.

Figure 15. Length index – Motor vehicles industry – By country (2009)



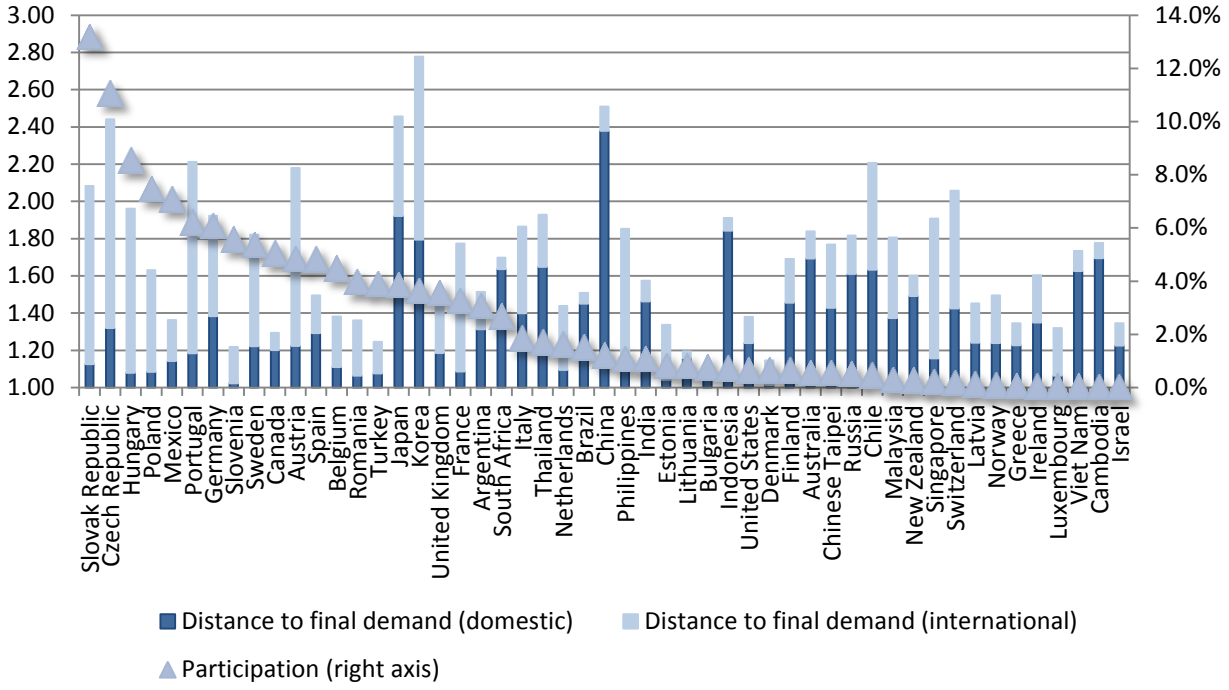
Source: Authors' calculations based on OECD ICIO model, May 2013 release

The participation of countries in motor vehicles' GVCs seems to be strongly driven by the importance of imported intermediates (see Figure 14 above on the import content of exports). Figure 16 shows large participation indexes especially for smaller (Eastern European) economies with important car assembly activities: the Slovak Republic, Hungary, the Czech Republic and Poland. Also countries like Mexico (maquiladores) undertake important car manufacturing activities based on intermediate products imported from abroad.

Also Germany shows a relatively high participation in the car industry, reflecting its large car assembly activities as well its production of intermediates which are then exported to other countries. The same observation also applies for Japan and the United States; both countries have important assembly activities but also produce large number of intermediates which are then exported for assembly in other countries.

Countries with a high "distance to final demand" index, such as the Slovak Republic, Hungary or the Czech Republic in Europe, have companies that are on average located at the higher levels in the supplier networks of automotive industry, meaning that the intermediates that they produce are exported to other countries and included there in more downstream production activities (high international distance to final demand). At the other end, closer to end markets, a country like Mexico is rather specialised in the assembly of cars for the local market but also exported to other Latin American countries and to NAFTA; hence, a high participation rate and low distance to final demand index.

Figure 16. Participation and distance to final demand – Motor vehicles industry – By country (2009)



Source: Authors' calculations based on the OECD ICIO model, December 2012 release.

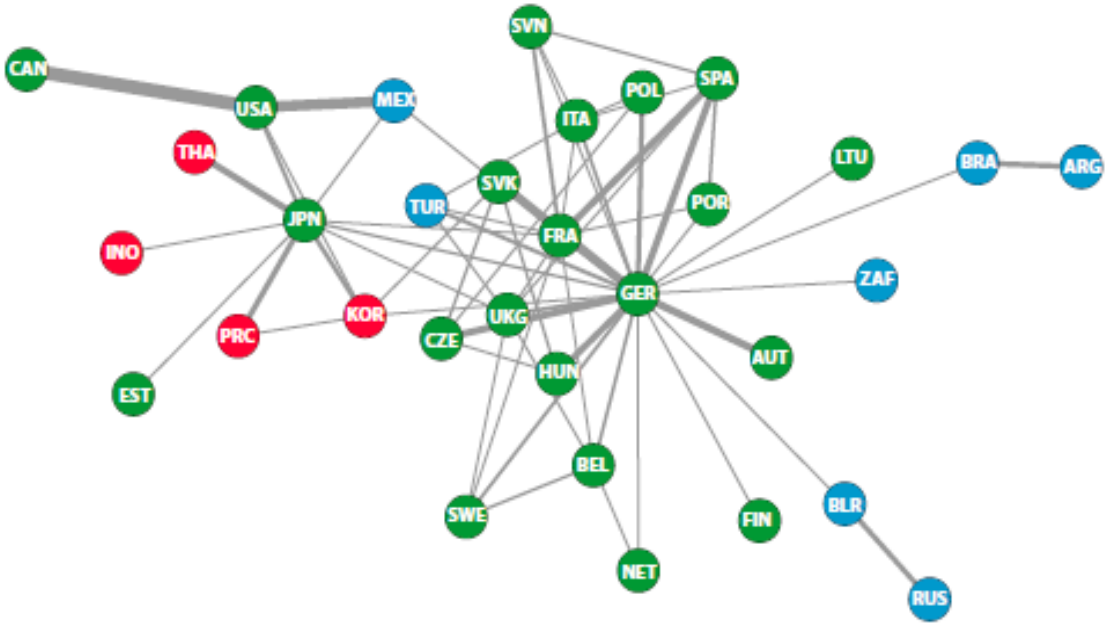
Some additional insights about the main players in the motor vehicles GVCs are provided by the results of a network analysis of vertical trade relationships between countries (Ferrarini, 2010).[8] The regional concentration of the automotive industry is clearly reflected in the three (traditional) hubs of global production: Asia, NAFTA and Europe. But the links between these different hubs are much more limited compared for example to the electronics industry (see below). As already explained, high transportation costs and lower value-weight ratios are an important explanation for this regional structure.

Within the regional hubs one observes the central position of Japan in the Asia hub; within NAFTA one observes a strong integration between the United States, Canada and Mexico. The European hub is centred around Germany where, in particular, the links with Eastern

8. Countries' mutual dependency in vertical trade (i.e. as suppliers or assemblers of parts and components) is calculated through the Network Trade Intensity (NTI) on the basis of bilateral trade data for 75 countries. The NTI is defined as a supplier's country share in parts and components by an industry in the hosting country, weighted by that industry's share of total final goods exports. This NTI-index is computed at the level of industries for each country pair (in both directions: e.g. from Japan to China and from China to Japan); the results are then averaged and normalised to allow comparisons across countries and industries. To visualise a world map of vertical trade relationships, the set of dyadic network relations is subjected to a force-directed algorithm. Each country in the network is presented by a circle; the circles' position within the network and their proximity to each other is proportional to the force of attraction countries exert on each other directly through vertical trade relationships and indirectly via third countries or country-clusters. The strength of bilateral network relations determines the width of the arcs connecting the countries. In order to improve the visibility of the network maps, only the main network connections (NTI > .05) are included.

European countries like the Czech Republic, the Slovak Republic and Hungary are noticeable. France has closer ties with Spain.

Figure 17. Vertical trade in the motor vehicles industry (2008-09)



Source: Ferrarini (2010)

Case study 4: electronics (office, accounting and computing machinery)

Electronics is probably the industry where GVC are the most pervasive as illustrated by the large number of case studies for individual electronic products (Apple's iPod®, iPhone®, iPad®; Nokia's phones, etc.).[9] An important reason for the high value chain character of the electronics industry is the high modularity of its products. Standardisation, codification and computerisation allow for a large interoperability of parts and components which in turn allows for the fragmentation of the production process across different stages. Product design, logistics and different parts of the production process are often executed by different firms in the value chain.

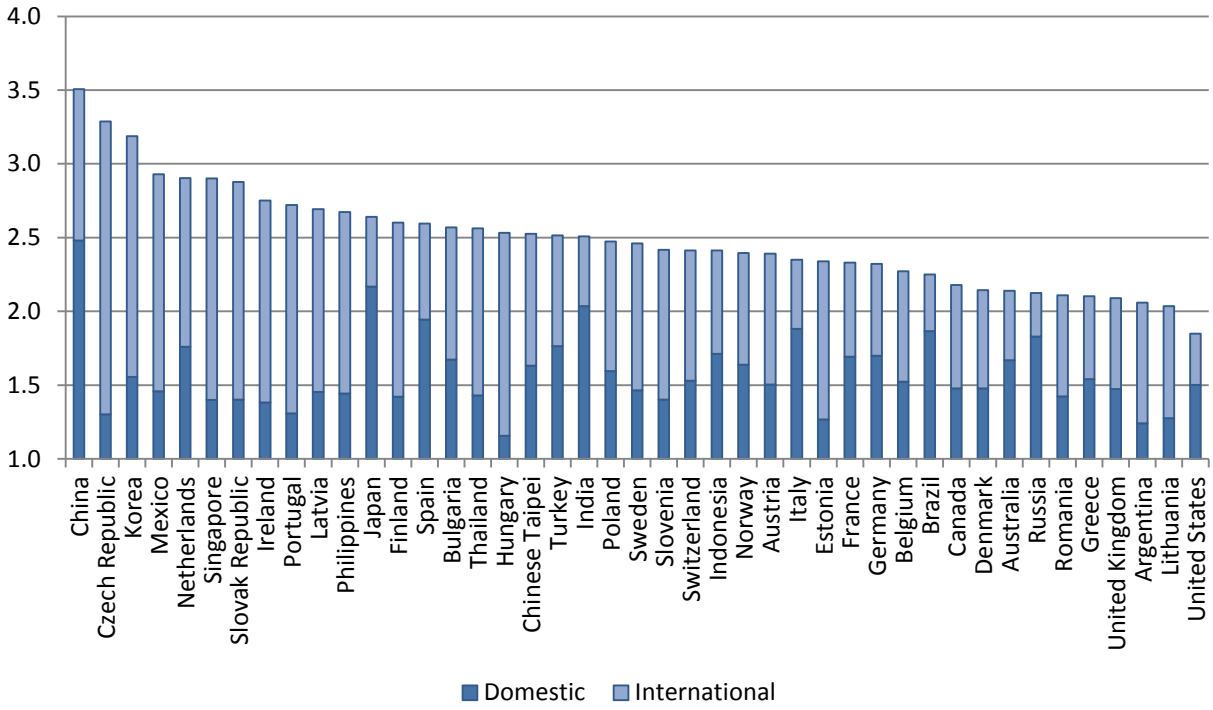
Value chains in the electronics industry are increasingly global since high modularity enables activities to be undertaken across large distances if transportation costs are small. Most electronic products are characterized by high value-weights ratio's resulting in the rapid (often via air transport) and rather inexpensive delivery of intermediate and final electronic products across the globe. The coordination between the different production stages across different countries is largely done via the Internet allowing for a smooth sharing and monitoring of information.

The international character of electronics GVCs is reflected in the significant international number of stages involved in the manufacturing of electronic products. On average, around two thirds of the total length index of office, computing and accounting industry concerns

9. Apple's iPod®, iPhone® and iPad® are trademarks of Apple Inc., registered in the United States and other countries. Nokia is a registered trademark of Nokia Corporation.

international sourcing of intermediates domestically as well as internationally (Figure 18); results for other electronic industries are similar. Electronic manufacturers source a large number of inputs from suppliers abroad.

Figure 18. Length index - Electronics - By country (2009)

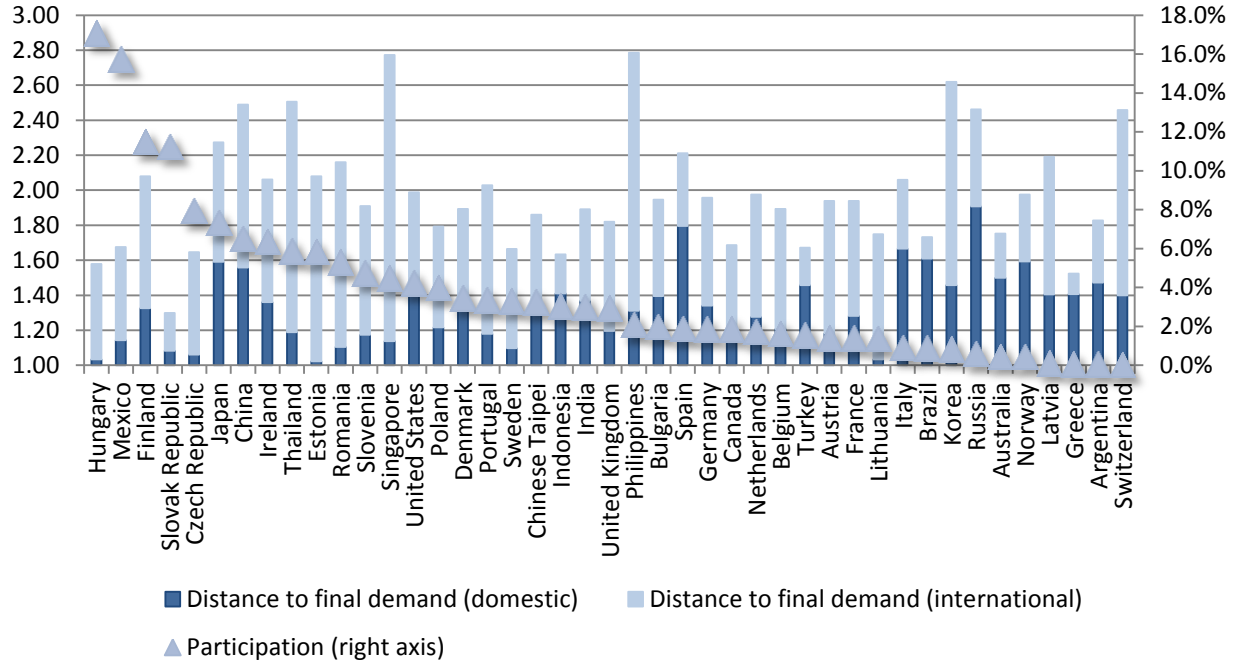


Source: Authors' calculations using the OECD ICIO model, May 2013 release.

The electronics GVC consist of a very large number of firms across different countries, from large MNEs to small SMEs. Sturgeon and Kawakami (2010) distinguish between lead firms and contract manufacturers in discussing the most important actors within the electronics GVC. Lead firms are the firms that carry brands and sell branded products to final customers; these firms have typically a lot of market power over suppliers more upstream in the electronic GVC because of technological leaderships and large investments in brand development. In some segments of the electronics industry like PCs, mobile phones, etc. these lead firms have grown to platform leaders, as their technology is incorporated in the products of other companies (examples are Intel and Apple).

Contract manufacturers assemble products for lead firms, have limited market power notwithstanding they are typically large and have often operations in different countries (comparable to the first tier suppliers in the automotive industry). The actual activities undertaken by contract manufacturers differ across companies; Original Equipment Manufacturers (OEMs) provide only production services while Original Design Manufacturers (ODMs) undertake production as well design activities. Contract manufacturers are working with smaller suppliers although the supplying pyramid in electronics is less developed than in automotive.

Figure 19. Participation and distance to final demand – Electronics – By country (2009)



Source: Authors' calculations using the OECD ICIO model, May 2013 release.

Most lead firms in the electronics industry are located in developed economies, especially Europe, Japan and the United States; Korea has joined this group recently (Sturgeon and Kawakami, 2010). Emerging countries are more represented in the category of contract manufacturers; some companies like Acer and Huawei have successfully moved up the value chain from OEM over ODM to true Original Brand Manufacturers (OBM), while others like computer manufacturers from Chinese Taipei have failed.

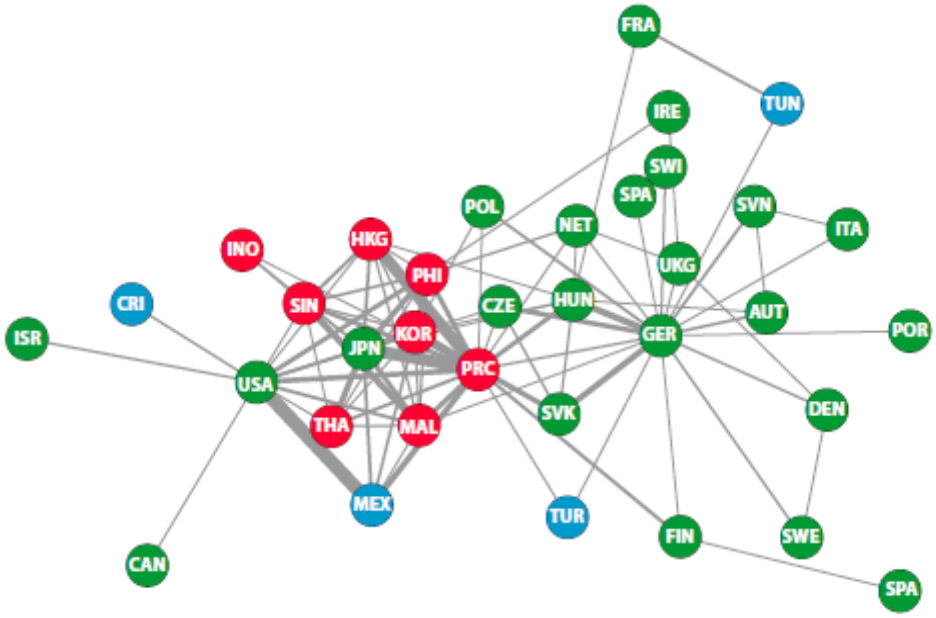
Looking at the participation in the office, accounting and computing GVCs, the high participation of smaller countries is observed: Hungary, the Czech Republic, the Slovak Republic, Ireland, etc. import large numbers of inputs from abroad for assembly in (final) products (Figure 19). Also larger countries like Mexico, China and Thailand act as contract manufacturers using processing imports and exports. The higher participation of countries like Finland and Japan is more driven by their exports of high value intermediates, often to the contract manufacturing countries.

A network analysis of the total electronics industry based on vertical trade[10] (Figure 20) shows the existence of three hubs in the global production of electronics; Asia, NAFTA and Europe centred around Germany (Ferrarini, 2011). The Asian hub is dominant in a global perspective and is largely built around Japan as lead manufacturer/producer of parts and components and China as contract manufacturer. Most other Asian countries are connected with Japan and China, with especially important positions of countries like the Philippines, Thailand, Malaysia, etc.

10. See the case study on motor vehicles for the definition of vertical trade and the methodology used in this network analysis.

The dominance of the Asian hub is not only due to the strong inter-Asia linkages but also to the strong relationships between Asia and the NAFTA hub (especially the United States and in second order Mexico) but also Europe (Germany, the Czech Republic, the Slovak Republic and Hungary) but the Asian-Europe links seem less strong.

Figure 20. Vertical trade in the electronics industry (2008-09)



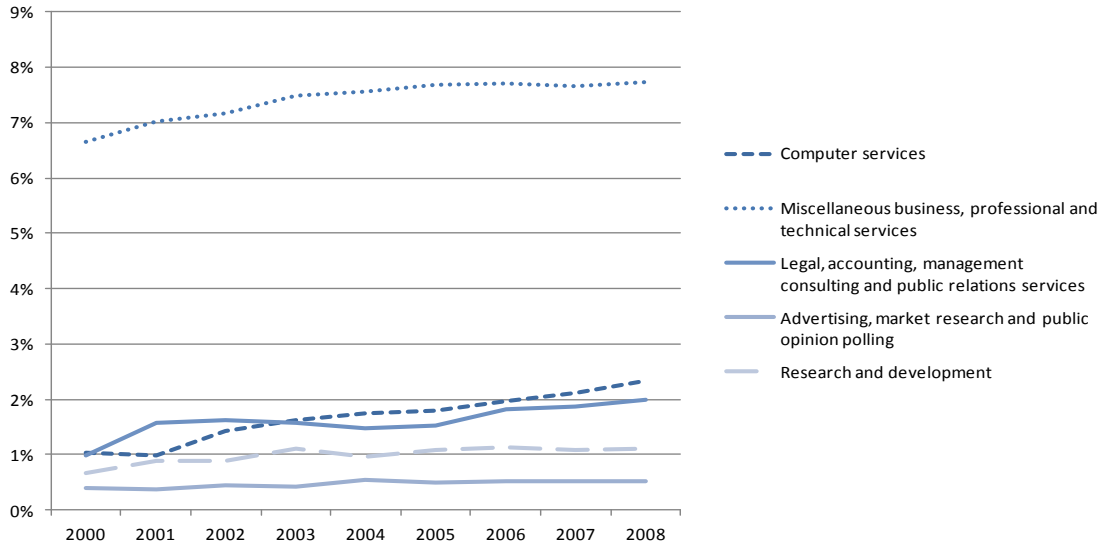
Source: Ferrarini (2011)

Case study 5: business services

In Section 2, there was some evidence that services are generally less produced through GVCs. A large part of the services sector is made up of small domestic companies that provide services directly to domestic consumers with very limited (foreign) inputs. But it would be wrong to assume that this is the case for all services industries. The fragmentation of production takes place in the services sector as well and a good example is the business services sector.

As firms have redefined their boundaries and focused on their core competencies, an increasing number of business services previously supplied within companies have been outsourced and offshored. The share of business services in international trade has steadily increased over the last 15 years (Figure 21). Computer services, legal, accounting, management consulting and public relations services, as well as miscellaneous business, professional and technical services represent a higher share of total trade in services today as opposed to 10 years ago. Business services are an integral part of the global value chain and to some extent what ties it together.

Figure 21. Trade in business services, as a share of total trade in services (2000-08)

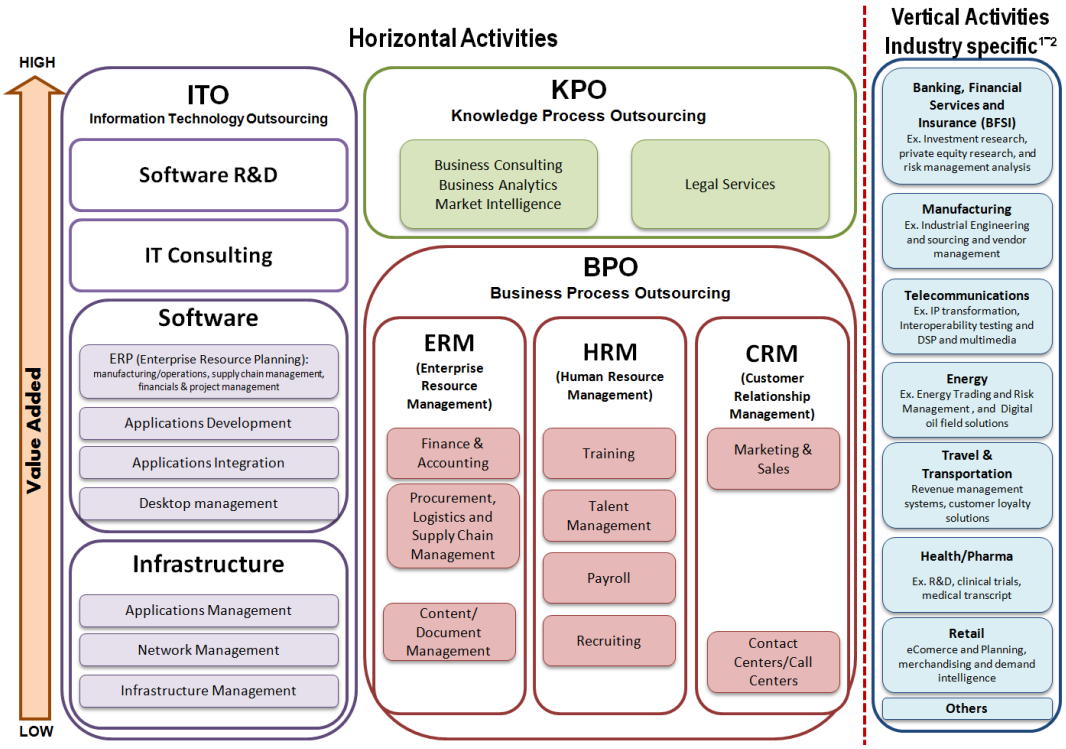


Source: Authors' calculations using OECD, Eurostat and UN trade in services data based on balance of payment statistics.

As described by Gereffi and Fernandez-Stark (2010), business services can be horizontal, i.e. provided across all industries, or industry-specific (Figure 22). Horizontal activities include services that are needed by any type of company: information technology services (e.g. software research and development, IT consulting), knowledge process outsourcing (KPO) services (e.g. market intelligence, legal services), business process outsourcing (BPO) services (e.g. accounting services, human resource management, supply chain management). Vertical activities correspond to services that are part of a specific value chain in the manufacturing sector (e.g. clinical trials in the pharmaceuticals value chain) or in another services industry (e.g. private equity research or risk management analysis in the banking and insurance industries). Figure 22 groups these activities according to their value-added (vertical axis). Human capital (the education of the people providing the services) explains much of the differences in the value of business services. High value-added activities, such as KPO services, are provided by highly educated people while routine BPO activities (such as recruitment or data management) are carried out by employees with lower degrees.

The market for business services is concentrated in high-income countries where most firms operate and in particular have their headquarter activities. But the industry has become global with the offshoring of some of these services to developing economies where the skills and talents can be found at a lower cost. The model of lead firms in the industry is the "global delivery model" (Sako, 2009). Firms create a network of support offices in the countries where their customers are located. Specialised delivery centres are then located in lower cost countries, such as India or the Philippines. All activities are coordinated from the headquarters. This "spider-type" of network ensures the close contact with clients while achieving scale economies.

Figure 22. The business services value chain (Gereffi and Fernandez-Stark, 2010)

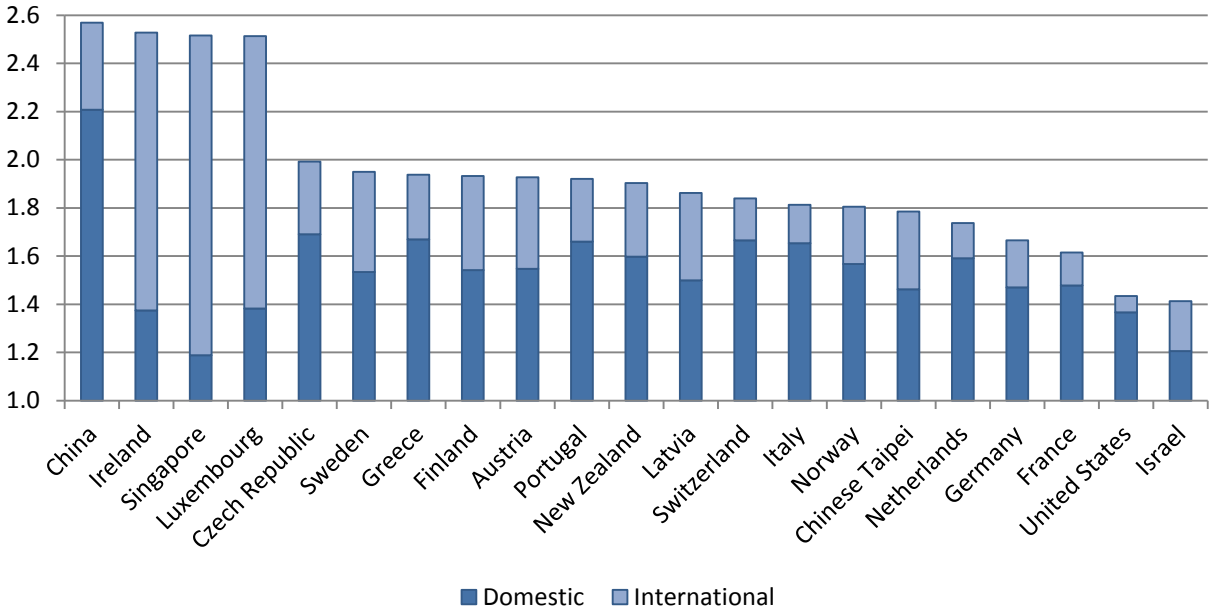


Source: Gereffi and Fernandez-Stark (2010)

Services trade statistics are unfortunately not detailed enough to capture bilateral flows of specific business services. Ideally, statistics should be collected at the level of detail of Figure 22, but this is far from being the case. Based on available data and on the indicators previously presented, we can characterise the role of specific countries in the business services value chain for two segments: "computer and related activities" and "other business services". The first category covers most of the information technology outsourcing (ITO), software and infrastructure services described on Figure 22, while the second corresponds to all the rest of the horizontal activities (KPO, BPO) and includes some of the industry-specific services (but not all of them; for example, banking, financial services and insurance are in part of financial services in our classification).

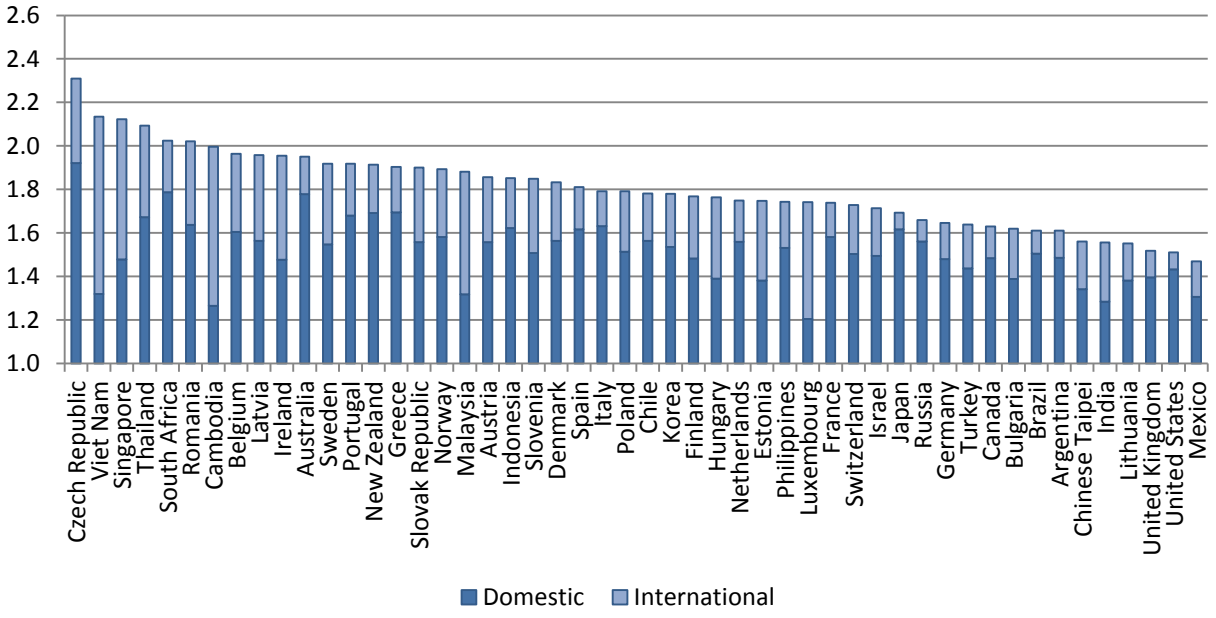
Computer services incorporate more foreign inputs than other business services, but overall there is also a fragmentation of production in the case of these services activities, especially in small open economies. Value chains can be quite long in the industry (Figures 23 and 24) with indexes above 2 similar to what can be observed in manufacturing value chains. The value chain in business services involves upstream knowledge and information management (e.g. training and research). Consultative and advice activities are in the middle of the chain and the client relationship management at the end (Sako, 2009). There are also horizontal supporting activities, such as human resource management, accounting and IT. For economies on the left of Figure 24, some of these activities are outsourced and offshored, while for economies on the right offshoring is more limited. But the fragmentation can be domestic through domestic outsourcing.

Figure 23. Length index – Computer services – By country (2009)



Source: Authors' calculations using the OECD ICIO model, May 2013 release. Data for computer services are only available for selected economies.

Figure 24. Length index – Other business services – By country (2009)

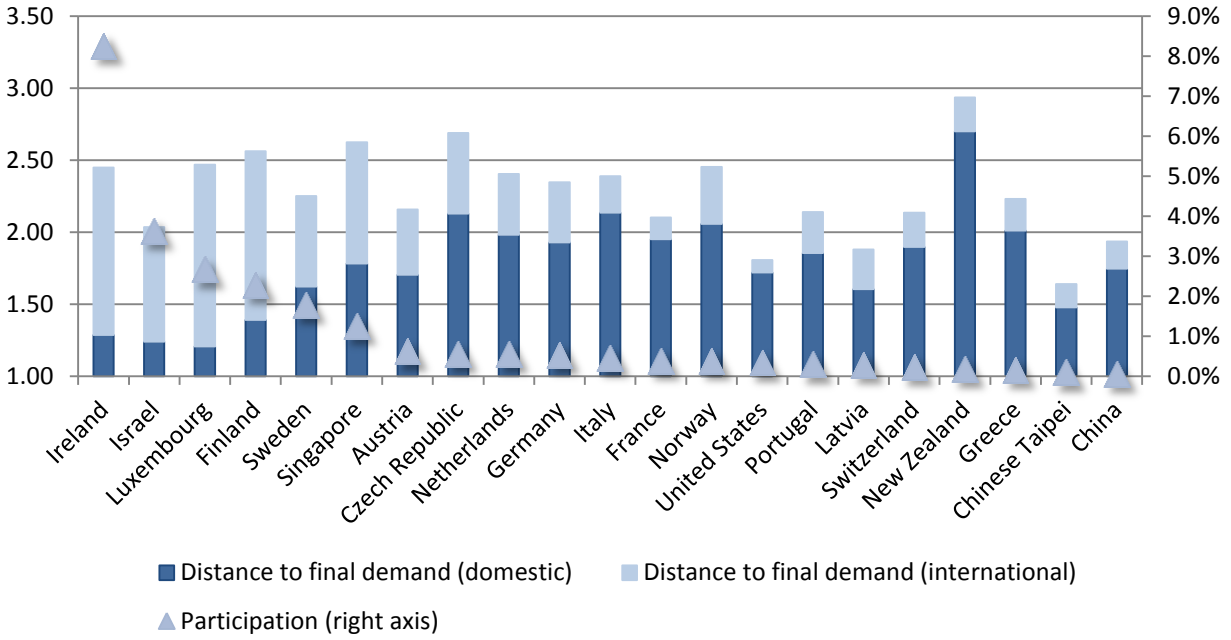


Source: Authors' calculations using the OECD ICIO model, May 2013 release.

Figures 25 and 26 provide more information on the participation and position of economies in the value chain. Computer services represent a high share of GVC exports in

Ireland, Israel, Luxembourg, Finland and Sweden (Figure 25). There are differences across these economies in terms of position in the value chain. Israel, one of the main exporters for this type of services, is positioned more downstream. Israeli companies tend to serve relatively more the final producers at the end of the value chain. Singapore is another important exporter and positioned upstream. Upstream activities in the value chain are IT services that companies need when they research and design new products or find solutions for their customers. The value of these IT services then "trickles down" all along manufacturing and other services value chains, explaining the higher distance to final demand.

Figure 25. Participation and distance to final demand – Computer services – By country (2009)

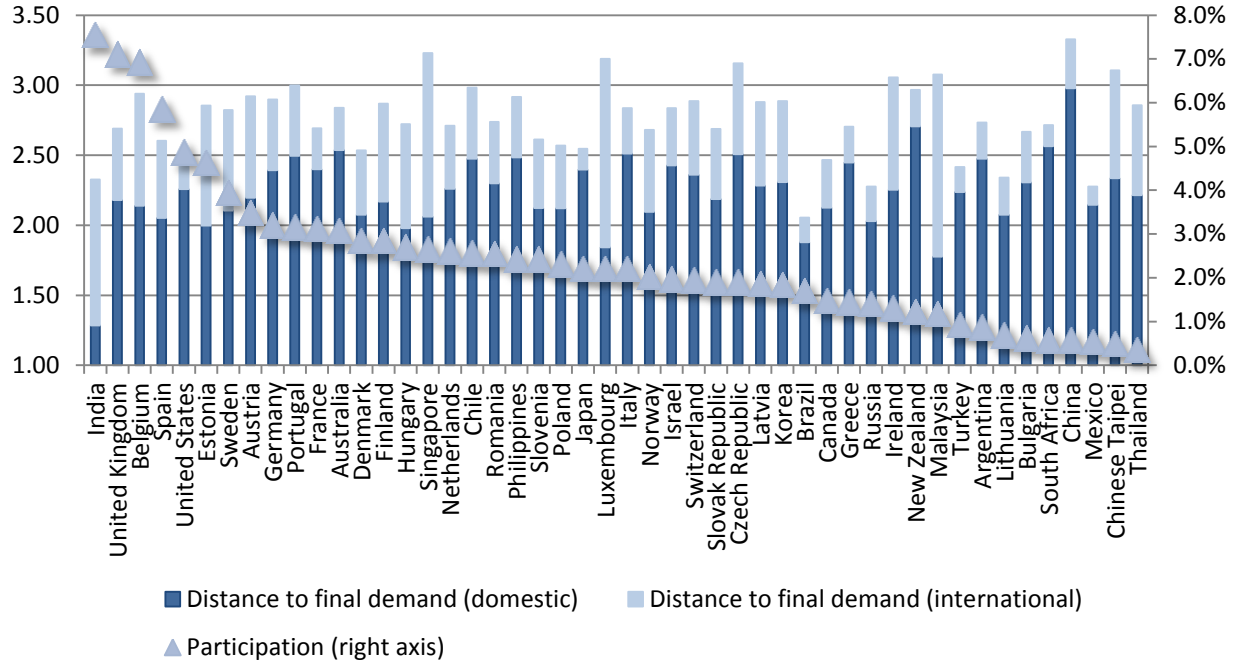


Source: Authors' calculations based on the OECD ICIO model, May 2013 release. Data for computer services are only available for selected economies.

Turning now to "other business services" (Figure 26), there are differences across economies but overall, the distance to final demand tends to be high, which is not surprising since most business services are provided at the beginning of the value chain: research and development activities, consulting, market intelligence, etc. The participation in GVCs is high for India, the United Kingdom and Belgium. The UK and Belgium tend to be specialised on average in services rather upstream, while India is on the contrary more downstream, indicating a specialisation more oriented towards customers business services.

As was observed with the agriculture and food products value chain, both developing and developed countries can be found among countries with a high participation in business services GVCs. There is also no clear pattern that developed and developing countries are confined to specific segments of the value chain. The specialisation in horizontal activities or more industry-specific business services, as suggested by Gereffi and Fernandez-Stark (2010) is more likely to explain differences across GVC indicators.

Figure 26. Participation and distance to final demand – Other business services – By country (2009)



Source: Authors' calculations based on the OECD ICIO model, May 2013 release.

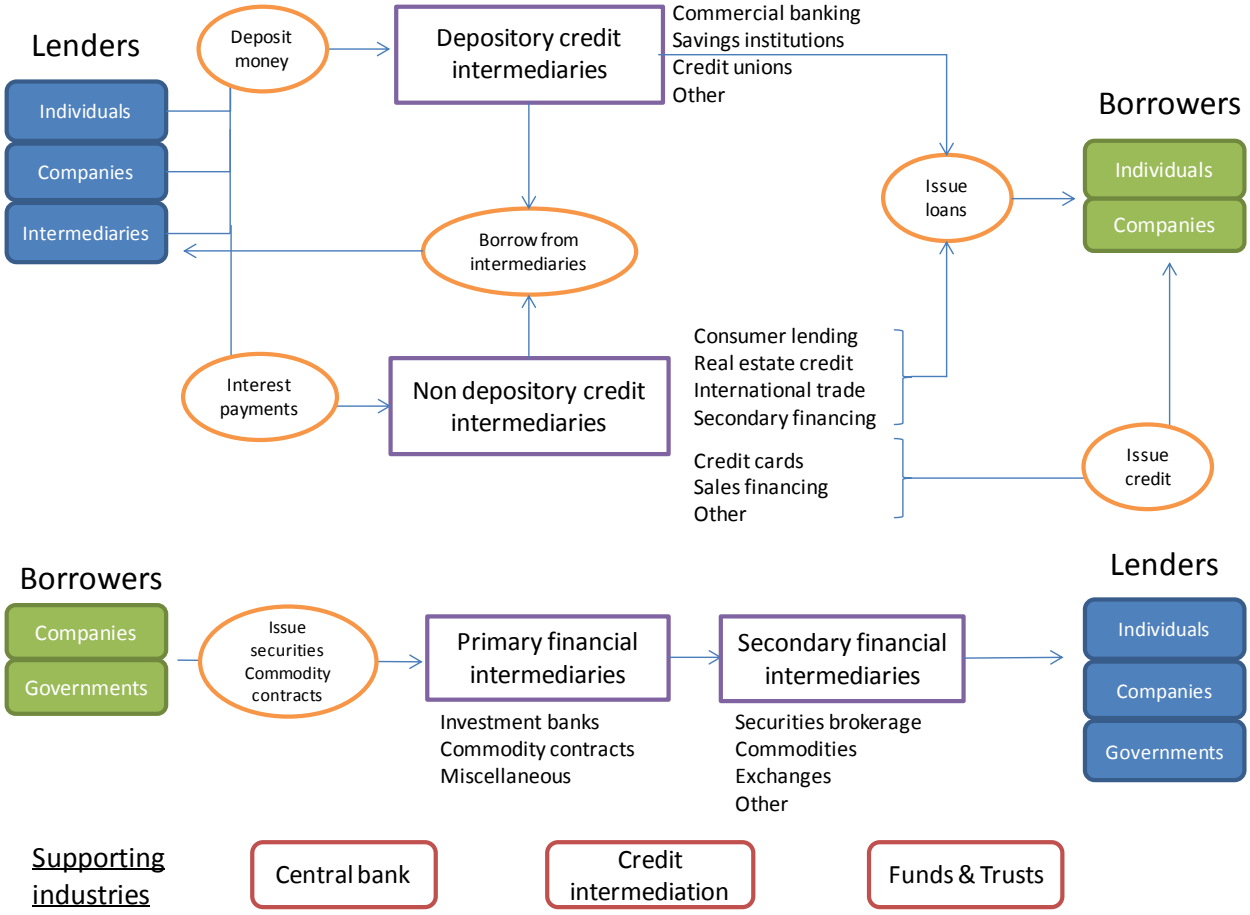
Case study 6: financial services

Another interesting example of services provided in global value chains is the financial sector. It covers financial intermediation, insurance and pension funding, as well as auxiliary financial activities. In the wake of globalisation and deregulation, the sector has rapidly changed in the two last decades and with the 2008-09 financial crisis business models had to be further readjusted.

Some financial services firms have a high international exposure, such as HSBC, Citigroup, AIG or UBS (Venzin, 2009). Emerging economies play a growing role in the sector, as exemplified by the Industrial and Commercial Bank of China (ICBC) which has become the largest bank in the world in terms of market capitalisation. While the internationalisation of the banking industry is not new, what has changed is that financial services firms are not only seeking new customers and new markets abroad but are increasingly locating some of their value-adding activities in offshored centres where they can find specific factor endowments that reduce their costs (Mudambi and Venzin, 2010).

In the financial services value chain, "inputs" are money and information. The banking and finance value chain is represented on Figure 27 (Center on Globalization, Governance & Competitiveness, 2011). The firms involved include commercial banks, investment banks, securities brokers, asset management firms, securities exchanges and trusts. Firms raise funds by taking deposits or issuing securities and make loans or trade securities. The value chain goes from lenders to borrowers and the products can be divided into credit intermediaries and financial intermediaries. There are also firms providing supporting services and advice to facilitate these transactions. Pooling risk corresponds to another segment of financial services (insurance).

Figure 27. The banking and finance value chain



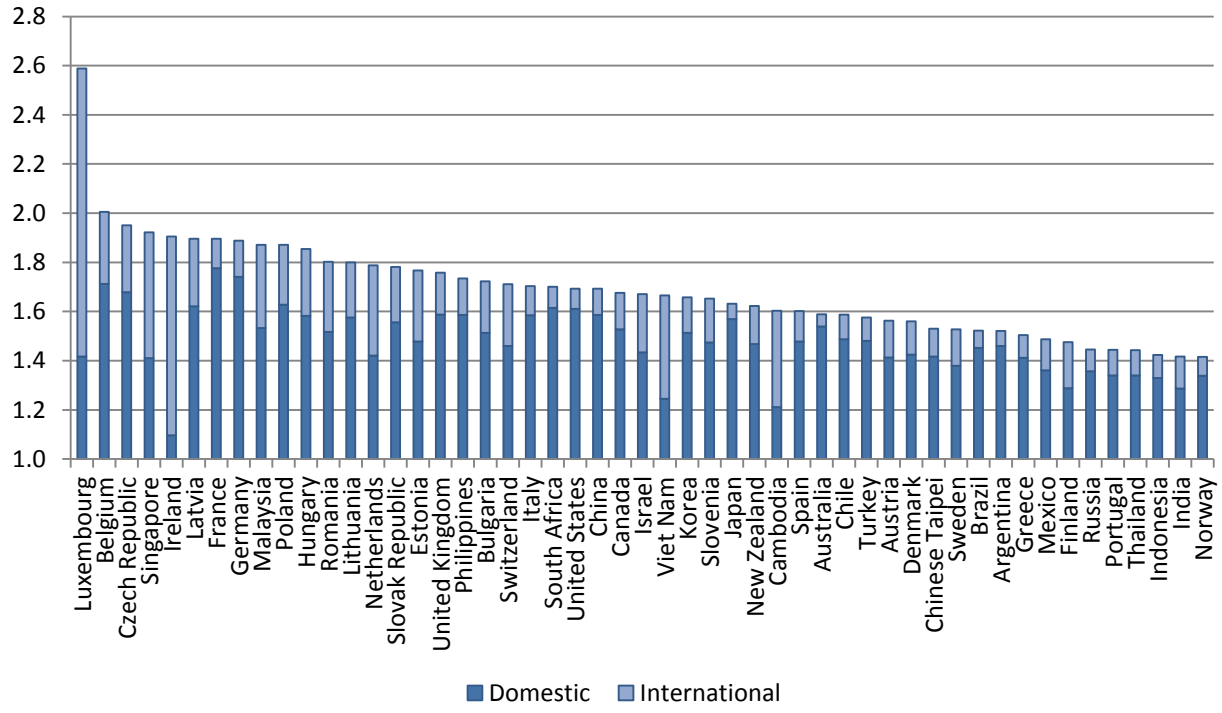
Source: Center on Globalization, Governance & Competitiveness, Duke University (2009-2011)

Most of banking and insurance activities are easy to disaggregate and to be supplied cross-border due to their high degree of digitalisation. Tangibles (IT backbone, branch offices) are only needed at the end of the chain, involving contacts with the customer. Other services can be decomposed and operated in remote places due to their digital component and the fact that they do not require physical resources (Venzin, 2009). The difference with manufacturing value chains is that banking activities cannot be represented in the form of a linear sequential value chain across countries. The activities represented on Figure 27 are undertaken in different financial services hubs (such as London or New York) and in offshored locations with skilled human resources and processing capabilities.

The Unicredit Group, an Italian financial services company, is a good example of how vertical fragmentation can occur in the banking sector. The firm has created competence centres that can be seen as "global factories" located in diverse places to provide group-wide services by leveraging local skills, market conditions and scale effects. Core banking competences are located in Italy, asset management in Ireland, investment banking in Germany, loans and mortgages in Austria, credit cards in Turkey and payments in the Czech Republic (Mudambi and Venzin, 2010).

Looking at the length of financial services GVCs (Figure 28), there are important differences across countries. A characteristic of services in global production networks is that for some countries they are industries as fragmented and as internationalised as manufacturing sectors, while for others they remain mainly domestic. The longest value chains are found in Luxembourg, Belgium and the Czech Republic. These countries are typically the type of "competence centres" where financial firms from other countries offshore some activities.

Figure 28. Length index – Financial services – By country (2009)



Source: Authors' calculations based on the OECD ICIO model, May 2013 release.

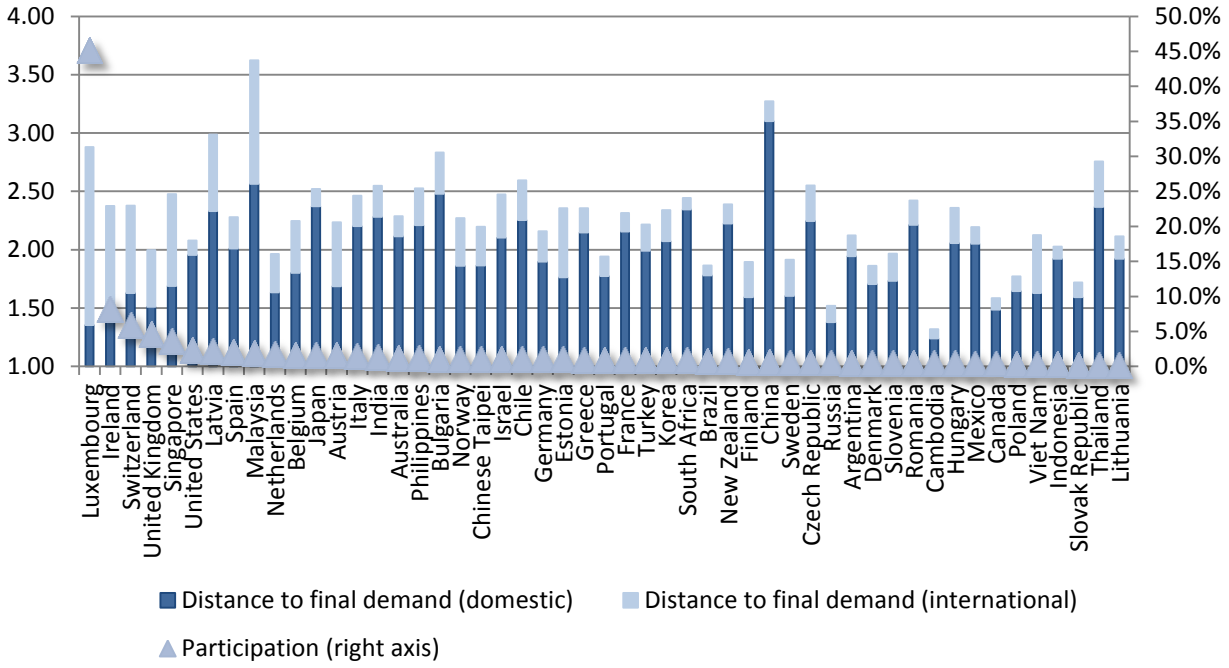
Otherwise, most banking or insurance activities are likely to remain local and this explains why in Norway or in Portugal we can observe very short financial value chains that are mostly domestic. This does not mean that banking and insurance are less developed in these markets, but rather that there is limited vertical fragmentation in these activities.

In terms of participation, one country – Luxembourg – has clearly a higher index than all other countries with almost half of its gross exports corresponding to trade within financial services GVCs (Figure 29). Ireland, Switzerland and the United Kingdom are next in terms of participation but with smaller percentages. These countries are typically financial hubs but Figure 29 gives some indication on their role in the value chain. Luxembourg is the country the most upstream while the United Kingdom is involved in more downstream activities. Financial services in Luxembourg are more oriented towards companies, in particular corporate finance and the management of funds.

Unlike business services, there are fewer developing economies involved in financial services GVCs. For example, with the exception of Singapore, ASEAN economies tend to have shorter value chains (Figure 28) and smaller participation rates (Figure 29). China, despite the internationalisation of ICBC, does not appear as a country with a high participation

or internationalisation in financial services GVCs. The country is, however, clearly specialised in upstream activities (Figure 29) reflecting the importance in particular of investment banking and financial services to firms rather than consumers.

Figure 29. Participation and distance to final demand – Financial services – By country (2009)



Source: Authors' calculations based on the OECD ICIO model, May 2013 release.

4. Concluding remarks: closing the gap between policies and the reality of business

The increasing importance of GVCs during the past two decades has significantly reshaped the global economy. Hence GVCs can be expected to generate substantial impacts on national economies. The size and direction of these effects are, however, not yet fully understood, since the empirical evidence on GVCs remains limited and largely falls short of capturing their impact on national economies. The last years have witnessed a growing number of case studies on the globally integrated value chain at the product level, but of course these analyses only depict the situation for a specific product.

More aggregate evidence has also been developed in order to get a more comprehensive picture of GVCs. The OECD has, in co-operation with the WTO, developed a large project on the measurement of trade in value-added terms. Inter-country input-output tables and a full matrix of bilateral trade flows are used to determine the trade in value added data. Since these data capture the domestic value that countries are adding to goods and services, the results will give a better picture of the integration and position of countries in GVCs.

Policy makers everywhere are looking for more and better policy evidence to examine the position of countries within international production networks. This paper has developed a number of indicators that help policy makers assess the role of their country in these GVCs. A better characterisation of the role of each economy in global production networks is necessary for several policy areas, such as trade policy, trade and employment, national competitiveness and growth, innovation and development. There are also global systemic risks associated with

global value chains. The interconnectedness between economies highlights that macro-economic shocks can be transmitted along the value chains.

This report has introduced new data that can be used in the above areas. The policy implications of global value chains are explored with more details in OECD (2013) and a series of reports recently released.[11] Once the position and participation of countries in the GVC have been identified, the next step is to understand what determines this position and participation and what the policies are that have a positive or negative impact on the gains expected from GVCs. Through GVC analysis, one can expect to close the gap between policies and the reality of business, in order to provide policymakers with more efficient tools to design and implement policies that support inclusive growth.

11. See United States International Trade Commission (2011), Foreign Affairs and International Trade Canada (2011) and National Board of Trade (2012) for recent government reports dealing with the policy implications of GVCs.

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Annex 1: Indicators on global value chains

The indicators on global value chains presented in the report are calculated with the May 2013 release of the OECD Inter-Country Input-Output model. The model consists of five global input-output matrices estimated for the years 1995, 2000, 2005, 2008 and 2009. Based on national input-output tables harmonised by the OECD, the model covers 58 economies (34 OECD and 23 non-OECD economies plus the "rest of the world") and 37 industries.

The national input-output tables on which the model is built are those developed by the OECD in the STAN I/O database. They are linked internationally with trade flows decomposed by end-use. The Bilateral Trade Database by Industry and End Use (BTDIxE) covers goods and relies on the Broad Economic Categories (BEC) classification to identify consumption, intermediate and capital goods.[12] Data on services are based on official statistics but are complemented with estimates (using gravity modelling and optimisation techniques) to fill the gaps and decompose trade flows by end-use.

The inter-country input-output matrix is organised as shown on the diagram below:

	Interindustry transactions			**Total intermediate**	**Components of final demand**
	Country 1 Industry 1 Country 1 Industry 2 Country 1 …	Country 2 Industry 1 Country 2 Industry 2 Country 2 …	…		Country1 Country 2 …
Country 1 Industry 1 Country 1 Industry 2 Country 1 …	Use of domestic inputs	Use of foreign inputs	…		
Country 2 Industry 1 Country 2 Industry 2 Country 2 …	Use of foreign inputs	Use of domestic inputs	…		
… … … … … …	. . .	. . .			
Value-added Gross output					

The model covers the following 58 economies:

- All OECD countries: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.
- Selected non-OECD economies: Argentina; Brazil; Brunei; Bulgaria; China; Chinese Taipei; Hong Kong, China; India; Indonesia; Latvia; Lithuania; Malaysia; Malta; Philippines; Romania; Russian Federation; Saudi Arabia; Singapore; South Africa; Thailand and Viet Nam.
- "Rest of the world" (to account for all other economies not included, representing less than 5% of world output).

12. An extended version of the BEC classification has been developed to deal with specific goods that are not clearly for consumption, intermediate or capital use. See Zhu *et al.* (2011).

The 37 sectors included are defined on the basis of the ISIC Rev. 3 classification and harmonised across countries. See www.oecd.org/sti/inputoutput/ for more details on the aggregation and specific country notes.

no	37sectors	ISIC Rev.3
1	Agriculture, hunting, forestry and fishing	1+2+5
2	Mining and quarrying	10--14
3	Food products, beverages and tobacco	15+16
4	Textiles, textile products, leather and footwear	17+18+19
5	Wood and products of wood and cork	20
6	Pulp, paper, paper products, printing and publishing	21+22
7	Coke, refined petroleum products and nuclear fuel	23
8	Chemicals	24
9	Rubber & plastics products	25
10	Other non-metallic mineral products	26
11	Basic metals	27
12	Fabricated metal products, except machinery & equipment	28
13	Machinery & equipment, nec	29
14	Office, accounting & computing machinery	30
15	Electrical machinery & apparatus, nec	31
16	Radio, television & communication equipment	32
17	Medical, precision & optical instruments	33
18	Motor vehicles, trailers & semi-trailers	34
19	Other transport equipment	35
20	Manufacturing nec; recycling (include Furniture)	36-37
21	Utility	40-41
22	Construction	45
23	Wholesale & retail trade; repairs	50-52
24	Hotels & restaurants	55
25	Transport and storage	60-63
26	Post & telecommunications	64
27	Finance & insurance	65-67
28	Real estate activities	70
29	Renting of machinery & equipment	71
30	Computer & related activities	72
31	Research & development	73
32	Other Business Activities	74
33	Public admin. & defence; compulsory social security	75
34	Education	80
35	Health & social work	85
36	Other community, social & personal services	90-93
37	Private households with employed persons	95-99

Length of GVCs

The index of the number of production stages is proposed by Fally (2012) and calculated for the US economy with a single country input-output matrix. Using our inter-country inter-industry framework, we calculate our index of the length of GVCs as:

$$N = u.(I - A)^{-1}$$

where N is a column vector with the indexes for all countries i and industries k, u is a column unit vector, I is an identity matrix and A is the matrix of technical coefficients in the ICIO. $(I - A)^{-1}$ is the Leontief inverse and the index is similar to the calculation of backward linkages in the input-output literature. In the ICIO matrix, we have the values of all inputs used by one industry in a given country. In addition, we can distinguish between domestic inputs and foreign inputs, by calculating the index in the country and industry dimension. This is how we decompose the index according to domestic production stages and foreign production stages.

Distance to final demand

The distance to final demand is the second indicator suggested by Fally (2012) and calculated in a similar way:

$$D = u.(I - G)^{-1}$$

where D is a column vector with the indexes for all countries *i* and industries *k*, u is a column unit vector, I is the identity matrix and G a matrix of output coefficients, with $(I - G)^{-1}$ being known as the *output inverse* or *Ghosh inverse* in the input-output literature. The index is similar to the calculation of forward linkages in the context of an ICIO.

See also Antràs *et al.* (2012) for a similar index of a country's "upstreamness" in the value chain.

Participation in GVCs

This index is based on Koopman *et al.* (2010). The starting point is the decomposition of gross exports into value added shares by source country. The following matrix is calculated:

$$VBE = V.(I - A)^{-1}.E$$

where V is the diagonal of a vector with value added shares in each country and industry, $B = (I - A)^{-1}$ is the Leontief inverse and E is the diagonal of a vector of gross exports.

When adding values in the columns of the VBE matrix (without the contribution of domestic industries), one obtains the contribution of foreign industries to exports (the import content of exports), which divided by gross exports in each country gives a vector of VS shares, as defined by Hummels *et al.* (2001). Summing over rows (and omitting domestic industries), we have the contribution of domestically produced intermediates to exports in third countries. Divided by gross exports for each country, this calculation provides the VS1 shares defined by Hummels *et al.* (2001).

The GVC participation index simply adds the VS and VS1 shares for country *i* and industry *k* and can be expressed as:

$$P_{ik} = \frac{VS_{ik}}{E_i} + \frac{VS1_{ik}}{E_i}$$

where $VS_{ik}$is an element of the vector obtained by summing the columns of the VBE matrix (without domestic industries), corresponding to the import content of exports in country *i* and industry *k*, and $VS1_{ik}$ is an element of the vector obtained when summing the rows of the VBE matrix (without domestic industries) and corresponding to exports of domestically-produced intermediates used in third countries' exports. VS and VS1 are values that are divided by gross exports in country *i*, E_i, in order to express the participation index as a share of gross exports.

The higher the foreign value-added embodied in gross exports and the higher the value of inputs exported to third countries and used in their exports, the higher the participation of a given country in the value chain.