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SERVICES IN GLOBAL VALUE CHAINS AND GLOBAL VALUE CHAINS IN SERVICES

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ABSTRACT: This paper provides new evidence on the role of services in global value chains (GVCs). Using the WIOD database, it first analyses services value-added in exports over the period 2000-2014 and shows that if there is not an increase in the share of services value-added over time, there is an internationalisation of services value-added in exports. By looking at services activities within manufacturing firms through occupational data and a business function approach, the paper then highlights that when adding the in-house provision, services value-added in manufacturing exports becomes as high as 50%. It then provides additional evidence on the fact that goods and services are increasingly sold together as bundles. This evidence suggests revisiting the GVC framework for services and introducing new models of value creation that better fit services GVCs: the value networks and the value shops. The prevalence of these models is also assessed in terms of value-added in exports to characterise the 'servicification of GVCs'.

I. Introduction

The global value chain (GVC) framework has gained a lot of traction in the past decade to describe global production, analyse value creation along supply chains and answer policy questions related to trade, competitiveness and development (Gereffi, 2014). As it focuses on the sequences of value added within an industry, from conception to production and end use (Gereffi and Fernandez-Stark, 2016), the GVC framework fully acknowledges the fact that services and manufacturing activities are intertwined. The production of any good starts with R&D and design services while at the other end of the value chain, services allow the product to reach consumers –marketing, distribution and after-sale services.

The important role of services in GVCs has also been highlighted empirically by the development of new indicators derived from input-output analysis and tracing value-added internationally in Inter-Country Input-Output (ICIO) tables. In particular, this new work has revealed the true contribution of services to trade. While two-thirds of all economic activity is made up of services, trade in services seemed to account for a small share of world trade in balance of payments data, between one fifth and one quarter. With a value-added approach, services represent a larger share of world exports, almost 50% (OECD, 2013).

By taking into account services embodied in exports of goods, value-added statistics are useful to reveal the importance of services inputs in trade. But still they tell only part of the story about the role of services in GVCs. First, these statistics do not capture services activities provided in-house within manufacturing firms. Moreover, services are exported not only by services firms but also by manufacturing firms (Kelle, 2013). Manufacturing firms often export R&D services, particularly to their affiliates, together with other headquarter services. But they also increasingly export services that are bundled with material goods (e.g. installation, maintenance and repair services). Through this process, firms create more value and try to accompany the existing product all along its life cycle (Vandermerwe and Rada, 1988). As the lines between goods and services become blurred, it is difficult for statistics at the industry level to fully disentangle the two types of activities.

But services are not just inputs or products bundled with goods, they are also the output of value chains. First, the fragmentation of production is not limited to manufacturing. While supply chains are generally shorter for services (De Backer and Miroudot, 2013), there is also a fragmentation and internationalisation of production for services. Some service industries such as transport, telecoms and financial services now have sophisticated global value chains. Even haircuts -the textbook example of a non-tradable service- are nowadays the product of an international industry with some large companies managing hair salons in multiple countries, and organising the training of hairdressers and the supply of equipment and consumables at a global level.

More recently, services have also been described as value-creating activities as their role is to create value all along the GVC. There is now a "service science" (Demirkan *et al.*, 2011), an

interdisciplinary approach aimed at understanding the complex interactions between people, technology and organisations when services are provided. The starting point is that services involve the deployment of knowledge, skills and competences that one person or organisation has in order to create value for another, often done as a single customised job involving substantial input from the customer. Services lead to higher value creation and are part of a shift towards more productive and more customer-centric production models where value can be seen as co-created with consumers (Cinquini *et al.*, 2013).

Against this backdrop, the paper provides some evidence on the role of services in GVCs using the World Input-Output Database (WIOD) updated in 2016 (Timmer *et al.*, 2016). The analysis builds on earlier work at the OECD using the ICIO of the TiVA database (Miroudot and Cadestin, 2017).

The paper is organised as follows. Section II introduces the methodology and describes how the different indicators are calculated, as well as the sources used in addition to WIOD. Section III presents some stylised facts on services in global value chains, looking at the services value-added in exports but also the in-house provision of services in manufacturing firms and bundles of goods and services. In Section IV, the focus is on global value chains in services and how the GVC framework needs to be revisited to accommodate the fragmentation of production for services. Section V concludes and provides some policy implications.

II. Methodology

In order to analyse the role of services in global value chains, this paper relies on the inter-country input-output data from the WIOD dataset (Timmer et al., 2015; Timmer et al., 2016), complemented with occupational data at the industry level that allow us to look at the in-house provision of services, as well as firm-level data on bundles of goods and services developed in the context of an OECD project.

1. Measuring the contribution of services to gross exports and final demand

The starting point for the analysis of the role of services in GVCs is the decomposition of value-added in exports according to the industry of origin. Building on the work of Hummels *et al.* (2001), Koopman *et al.* (2014) were the first to propose a decomposition of gross exports based on an inter-country input-output table. They do not look specifically at the industry of origin of value-added but their matrix algebra allows such decomposition. Foster-McGregor and Stehrer (2013), as well as Los *et al.* (2016), have provided alternative formulas in what is now a growing literature on trade in value-added.

The first indicator we use in this paper is the total value added of the services sector embodied in gross exports (by industry), as a percentage of total exports. It is calculated as:

$$SERV_VAGR_{c,i} = \sum_p \sum_{j \in S} V_{p,j}(B_{p,c})_{ji}\, EXGR_{c,p,i} \,/\, \sum_p EXGR_{c,p,i} \quad (1)$$

where $V_{p,j}$is a vector of the value added share of service industry j in partner country p (which can be foreign or domestic), B is the global Leontief inverse of the inter-country input-output

matrix ($B = (I - A)^{-1}$ with $(B_{p,c})_{ji}$ the ji-th element of $B_{p,c}$) and $EXGR_{c,p,i}$ is a vector of gross exports from country *c* to country *p* for any given industry *i* (where $c \neq p$). $\sum_p EXGR_{c,p,i}$ are total exports for country *c* and industry *i*.

The services content of gross exports can then be decomposed into a domestic and foreign part, and the domestic part further decomposed into the direct domestic service industry value added content of gross exports (i.e. services VA from the exporting industry), the indirect domestic services content of gross exports (i.e. services VA from other domestic industries) and the re-imported domestic services value added content of gross exports (i.e. domestic services VA found in imported intermediate inputs). As opposed to Koopman *et al.* (2014), we do not try to identify double counting terms and accept that the domestic content still involves some double counted value-added which makes it different from the domestic value-added in exports consistent with GDP.

The direct services content of gross exports can be simply calculated by multiplying gross exports by the vector of value-added shares of output. Expressed as a ratio of gross exports, it becomes simply:

$$SERV_DIR_VAGR_{c,i} = \frac{V_{c,j} \sum_p EXGR_{c,p,i}}{\sum_p EXGR_{c,p,i}} = V_{c,j} \quad (2)$$

where $V_{c,j}$ is a vector of the value-added share of service industry *j* in country *c*. The same share of value-added applies to gross exports and gross output in the absence of a different production function for exporting firms. There is a direct services content only for exports of services industries; it is equal to zero in the case of manufacturing industries.

The indirect services content (resulting from the use of services inputs) can be retrieved by subtracting the direct services content (2) from the total services content (1). But in order to identify a foreign services content (which is by definition indirect), we calculate:

$$SERV_\text{FOR}_VAGR_{c,i} = \sum_{p \neq c} \sum_{j \in S} V_{p,j} (B_{p,c})_{ji} \, EXGR_{c,p,i} \, / \sum_p EXGR_{c,p,i} \quad (3)$$

The formula is similar to (1) but limited to country *p* being different from country *c*. The domestic indirect content can be then obtained either as a residual or by calculating (3) for *p=c*. It includes a small share of 'returned value-added', i.e. services inputs that have been exported (and are counted in gross exports) and that are coming back embodied in other inputs. We do not calculate this specific component as it is even more negligible than for goods in the case of services.

All the above equations provide results by country and industry (the exporting industry *i*). The value-added is aggregated across industries *j*, *j* being the industry of origin with $j \in S$ (the group of all services industries). Services industries in WIOD start with ISIC Rev. 4 'F' (construction) and include all industries up to 'R_S' (other service activities).

The WIOD database is useful to reveal the true importance of services inputs in trade but cannot fully capture all services activities and particularly the ones provided in-house within

manufacturing firms. This is why additional data are then used to identify services activities within manufacturing output.

2. In-house provision of services: an approach relying on business functions identified with occupational data

The business function is a new statistical unit of analysis proposed in the GVC literature to better characterise the activities of workers within firms and industries (Sturgeon et al., 2013). It builds on the value chain as described by Michael Porter (1985) and the distinction between the primary or core activity of the firm (its operations) and a number of intangible support functions such as R&D, sales, marketing or IT services. These functions are services inputs when outsourced by firms.

Statistics on business functions have started to be collected at the firm-level in the context of national surveys such as the 2010 National Organizations Survey in the US (Brown et al., 2014) or EUROSTAT ad-hoc survey on the international sourcing of business functions by enterprises (Nielsen, 2008).

To identify business functions at the country and industry level, occupational data from labour force surveys are used. The methodology relies on a simple correspondence between each occupation at the 3-digit level and one of the seven business functions listed in Table 1. Correspondence tables were developed based on the description of the occupation in each national classification, building on Timmer *et al.* (2015). The database covers all the WIOD countries except China, Chinese Taipei and Russia (as well as the 'rest of the world'). The sources are Eurostat Labour Force Survey (EU countries, Norway, Switzerland and Turkey), Australia's Labour Force Survey, the 'Pesquisa Nacional por Amostra de Domicílios' (PNAD in Brazil), Canada's Labour Force Survey, the Population Census of Japan, the National Sample Survey in India, Indonesia's Labour Force Survey, the 'Encuesta Nacional de Ocupación y Emple' (ENOE in Mexico) and the Occupational Employment Statistics (OES) survey in the United States.

Except for the core activity of the firm (operations in Table 1), all other business functions are services support functions and are used to identify the in-house provision of services in the output of manufacturing firms. In the case of a firm operating in the service industry, 'operations' also correspond to services activities and all in-house activities are by definition services.

Based on labour force surveys, data on business functions are expressed in the number of workers employed in each industry. By combining this information with wage data (often available together with employment data in the labour force survey), a share of labour compensation for each business function is obtained. This share is then used in the input-output framework to decompose value-added by business function. In this exercise, we assume that the remuneration of capital and other factors of production is proportional to the distribution of labour compensation across business functions. We apply the shares calculated on the basis of labour compensation to the whole value-added of the industry.

Table 1. Typology of business functions

No.	Business function	Definition	Examples of occupations (ISCO 2008)
1	Operations/Core business functions	The core/primary business function of the firm. Generally the production of goods or services intended for the market or third-parties.	Food processing and related trades workers; Wood processing and papermaking plant operators; Assemblers; Garment and related trades workers.
2	Transport, logistics and distribution support functions	A support function that includes activities related to procurement, transportation, warehousing and the delivery of goods and services to customers.	Material-recording and transport clerks; Heavy truck and bus drivers; Transport and storage labourers.
3	Marketing, sales, after sales service support function	A support function focusing on market analysis, advertising, selling, retail management, as well as customer services (including help desks and call centres).	Sales, marketing and development managers; Sales, marketing and public relations professionals; Cashiers and ticket clerks; Client information workers.
4	IT services and software support functions	Activities related to data processing, software development and the provision of ICT services.	Software and applications developers and analysts; Database and network professionals; Information and communications technology technicians.
5	Management, administration, and back-office support functions	Activities associated with the administration of the firm, including legal, finance, accounting and human resources management.	Managing directors and chief executives; General office clerks; Administrative and specialised secretaries.
6	R&D, engineering and related technical services and R&D support functions	This support function includes activities related to experimental development, research, design, engineering and related technical consultancy, technical testing, analysis and certification.	Mathematicians, actuaries and statisticians; Architects, planners, surveyors and designers; Engineering professionals; Life science technicians and related associate professionals; Ship and aircraft controllers and technicians.
7	Other business functions	Activities related to maintenance and repair, security, as well as other activities not belonging to specific firm-level business functions. Also includes education and training.	Domestic, hotel and office cleaners and helpers; Protective services workers; Machinery mechanics and repairers; Armed forces officers; legislators and senior officials; religious professionals; Secondary education teachers.

Source: Based on Nielsen and Sturgeon (2014).

3. Firm-level data for the analysis of bundles of goods and services

Finally, in order to identify bundles of goods and services, firm-level data from the ORBIS database are used. ORBIS is a commercial dataset provided to the OECD by Bureau van Dijk. It includes information on millions of companies over the world. The coverage is relatively good for EU countries, the US, Japan and Korea, as well as key emerging economies such as Brazil, China and Russia. The analysis is conducted for 2013 which is the year with the highest coverage for most countries.

For each company, the dataset includes a list of NACE Rev. 2 codes corresponding to its core, primary and secondary activities. The identification of bundles of goods and services relies on this information. For each industry with a core activity in the manufacturing sector, the primary and secondary activity codes are extracted and analysed. When codes belonging to the service sector are found, it implies that the company is selling both goods and services. There is no guarantee that these two activities are "bundled" in the sense that they are sold together by the firm as some kind of package. But at least we know that the firm is involved both in manufacturing and service activities, which is what the servicification means.

Other limitations in this analysis are the following. First, ORBIS is a dataset at the firm-level. Some companies may sell goods and services through separate affiliates and in this case the bundle would not be identified. It is also possible that the firm is a conglomerate with totally separated manufacturing and service activities that are not related. We could not see it either in the data. The bundle of goods and services in our analysis is defined on the basis of the dual activities of the firm.

Second, there are no data in ORBIS on the sales of goods and services by each firm. We have just information on total sales. The secondary service activity could be very marginal. But we assume there is a threshold for this activity to be reported in the ORBIS dataset and therefore it should still be an activity generating a significant amount of income for the firm.

Lastly, there are differences across countries in the information collected on activities in the ORBIS database. For some countries, only one code is provided (core activity) and the analysis cannot be conducted. Then, for some other countries, no information is provided on secondary activities, but more codes are reported as primary activities. This is why we merge the primary and secondary activities in the analysis and regard as bundles the combination of a core manufacturing activity with either a primary service activity or secondary service activity.

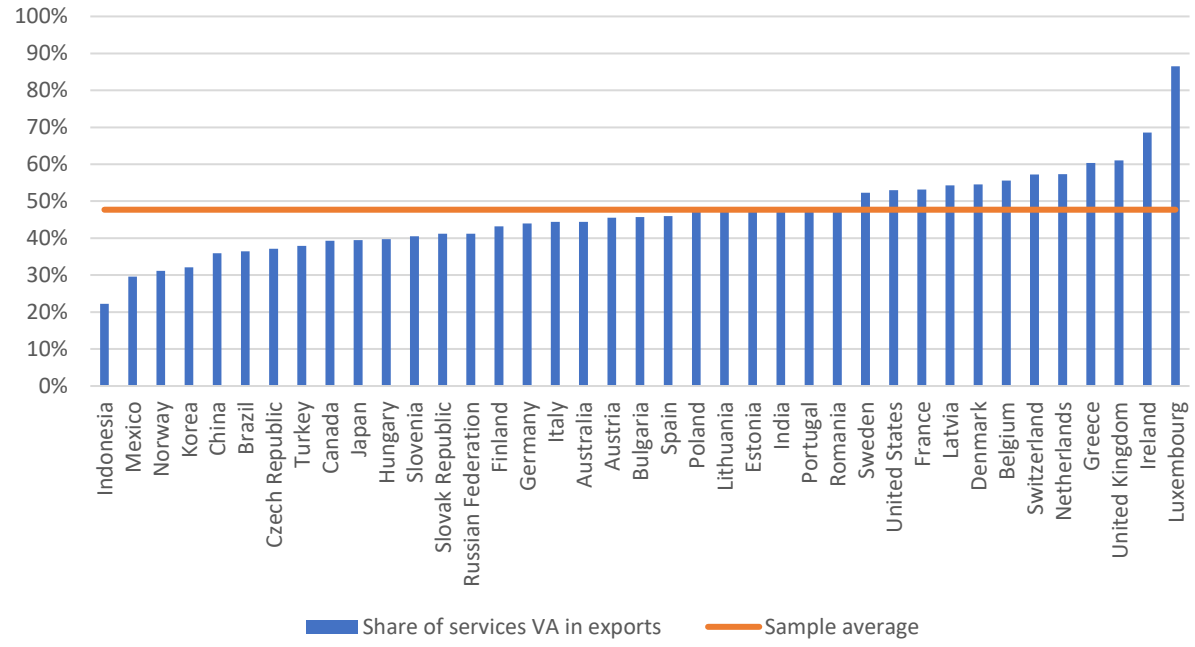
III. Services in global value chains: stylised facts

This section presents the main results from the analysis of the indicators described in the previous section. It is organised around a series of stylised facts related to the role of services in GVCs and derived from the three types of data previously presented: the services content of gross exports, the services activities within manufacturing firms and data on firms selling both goods and services.

1. Services account for about half of value-added in exports with differences across countries

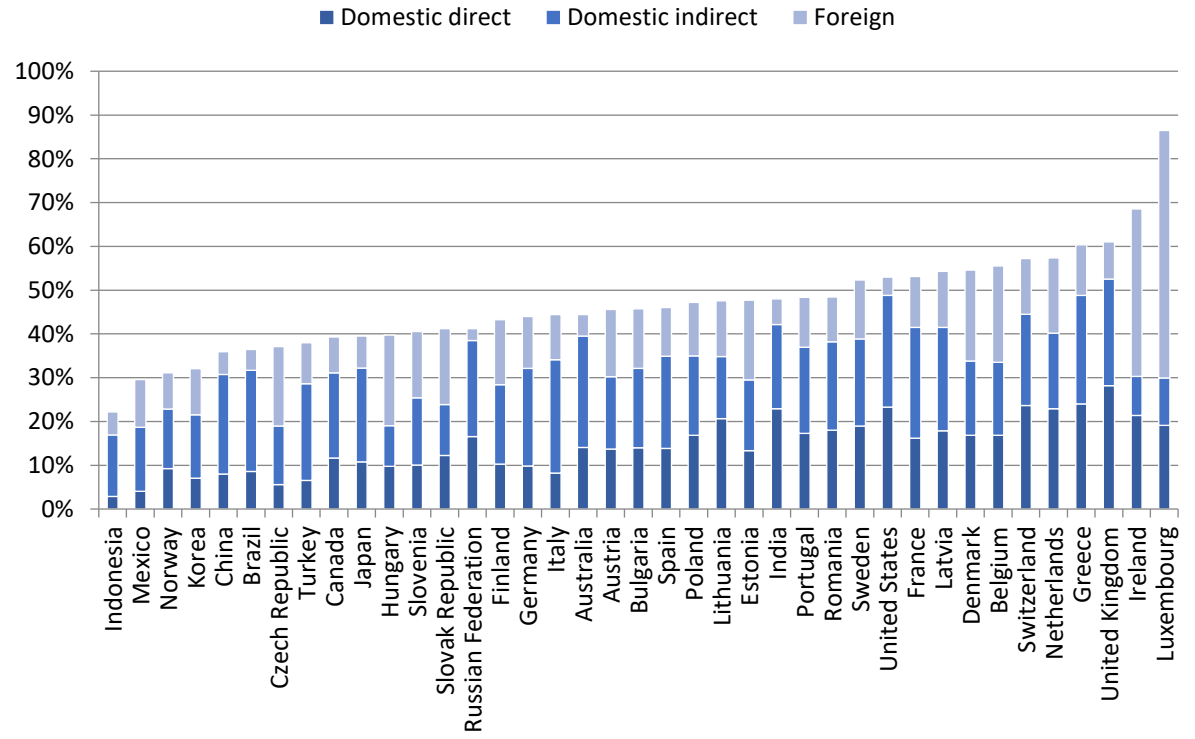
An important result from the trade in value-added literature is that services account for a much bigger share of exports when looking at flows in value-added terms. As can be seen in Figure 1, moving from a share calculated in gross terms to a value-added (VA) share significantly increases the contribution of services to trade. In 2014, 48% of the value added in world gross exports originates in the service sector, highlighting that services are traded embodied in goods.

Figure 1. Share of services VA in gross exports, 2014



Source: WIOD, 2016 release.

Figure 2. Share of direct, indirect and foreign services VA in gross exports, 2014



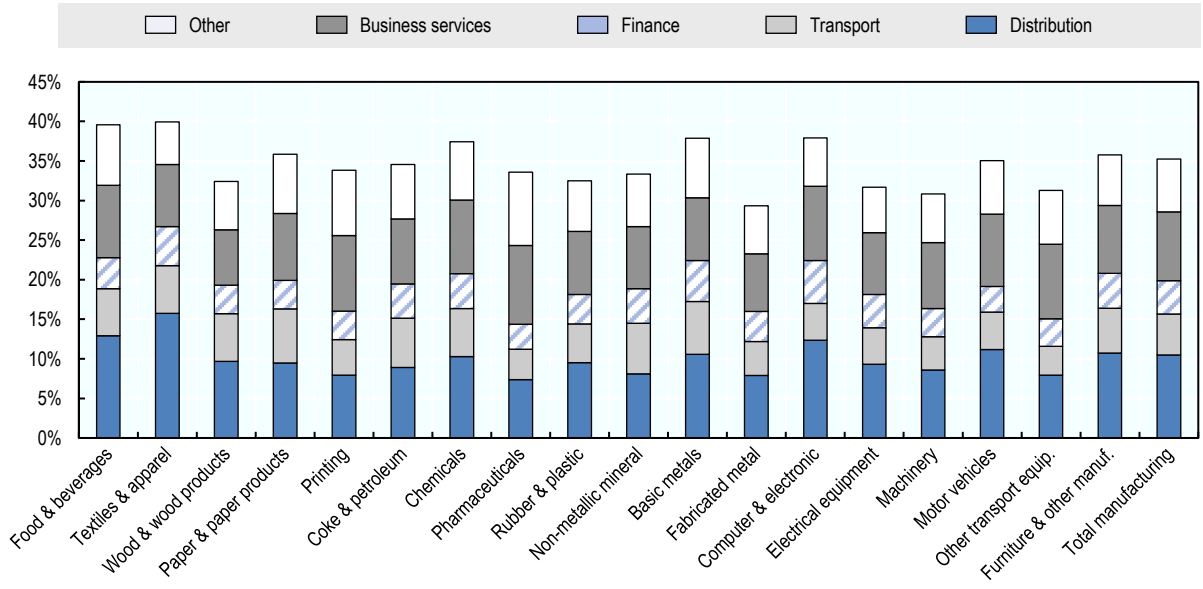
Source: WIOD, 2016 release.

There are however differences across countries based on their specialisation. The UK, Ireland or Luxembourg are economies specialised in services and exporting directly services, while countries on the left side are rather specialised in exports of commodities (Indonesia or Norway) or manufacturing goods (Mexico or Korea). Their services content in exports is more related to indirect value-added coming from inputs embodied in the goods they export It can be seen on Figure 2 further distinguishing services directly exported (i.e. exports of service companies) from those embodied as inputs. This latter category includes both domestic services inputs (indirect domestic services value-added in exports) and foreign services inputs (foreign services value-added in exports).

Figure 2 highlights differences in the direct services VA in exports when comparing countries rather specialised in goods or services, but it should be noted that even the countries mostly exporting services (such as Luxembourg) have a high share of indirect services VA (foreign or domestic). It is explained by the fact that services are produced with other services and also in global value chains. For example, financial services are produced in hubs connected to other financial centres that provide services inputs (Venzin, 2009).

What can be seen on Figure 2 is also that the mix of domestic and foreign services inputs varies across countries. Small open economies like Ireland or Luxembourg, but also Denmark or Belgium, have a much higher foreign services content as compared to the UK, France or the United States, three countries that also export a large share of services VA but with a lower foreign content.

Figure 3. Services inputs embodied in manufacturing exports, by industry, 2014



Source: WIOD, 2016 release.

Turning now to the type of services embodied in exports of goods, Figure 3 provides a decomposition by industry of origin. In manufacturing industries (excluding agriculture and mining), the share of services VA goes as high as 40% for ‘textiles & apparel’ and ‘food &

beverages'. It is lower for 'fabricated metal' (29%) but above 30% in all other industries. On average, a bit more than one third of manufacturing exports consists in value-added originating in services industries.

All manufacturing industries tend to rely on the same mix of services inputs. Distribution represents about one third of the services VA in manufacturing exports at the same level as business services (that include telecoms, computer & information services, professional services, R&D, consulting, advertising and marketing and technical testing). The last third is split between transport, finance and other services (a category covering construction, accommodation & food services, government services, health and education, publishing and audio-visual services).

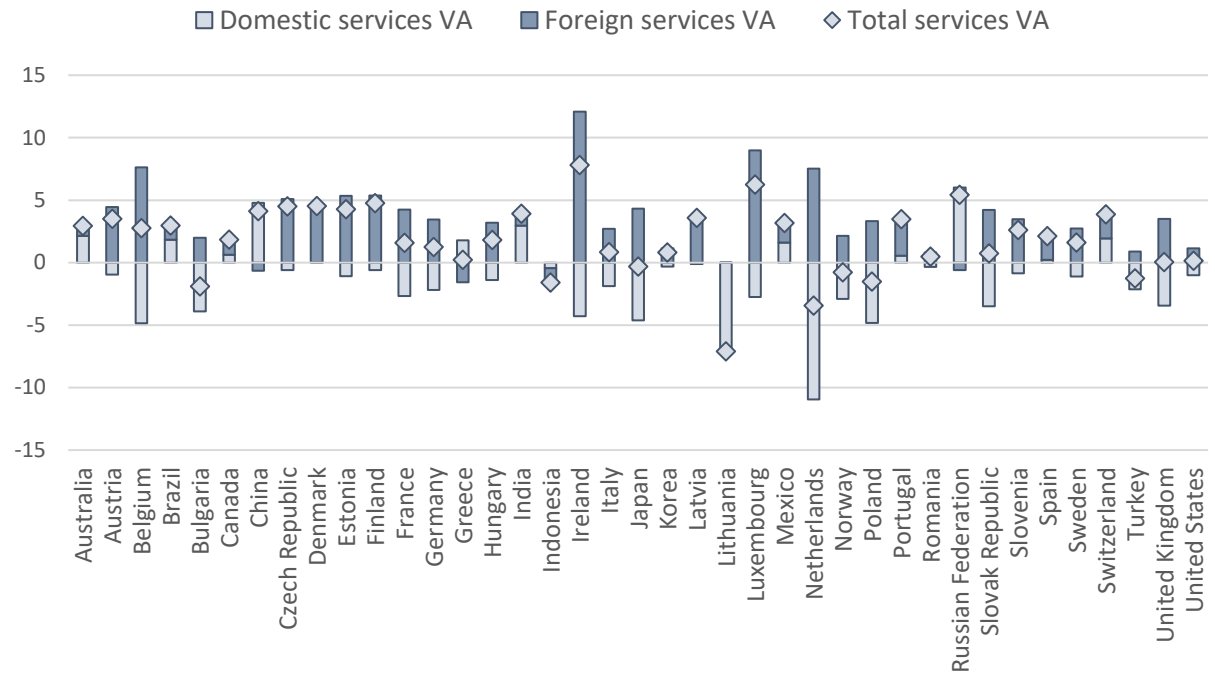
2. Over time, there is an increase in the share of foreign services value-added rather than more services value-added in manufacturing value chains

While some authors find that there is a 'servicification' of manufacturing in some EU countries (Lodefalk, 2013; National Board of Trade, 2016), corresponding to an increase in the use of services inputs by manufacturing firms over time, it is not clear that this trend is confirmed for all countries when looking at the value-added in exports. No such 'servicification' for example is found for the United Kingdom or the United States. There are also countries, like the Netherlands, where there is less services value-added in exports in 2014 as compared to 2000. On this Figure, the structure of exports has been kept unchanged between 2000 and 2014 (with the 2014 structure) to capture only changes within industries and not a change in the composition of exports. There are however changes related to relative prices that cannot be accounted for as the WIOD tables are in current prices.

For countries where the total services VA has increased between 2000 and 2014, the increase is generally quite small, below 5 percentage points. It is more significant for countries such as Ireland or Luxembourg that are clearly shifting towards services within their manufacturing exports. But Figure 4 suggests that the main trend over time is not the 'servificifcation' of manufacturing but the internationalisation of services in value chains as a common pattern in most countries is a shift from domestic services inputs to foreign services inputs in manufacturing exports. An important exception is China where for services too, there is in the recent period a shift towards domestic suppliers of inputs.

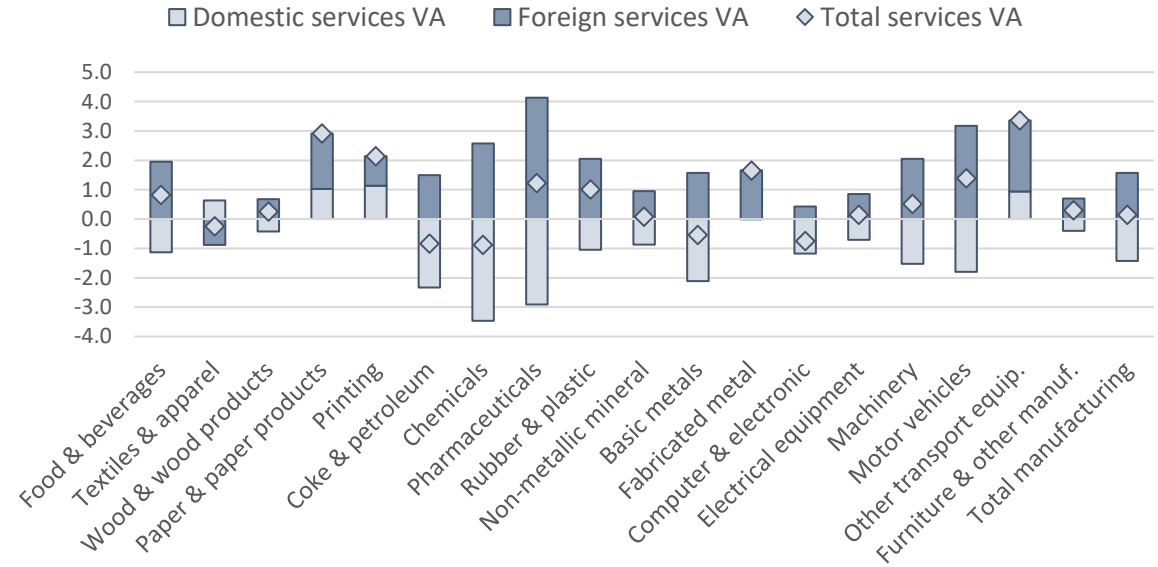
It is further confirmed when looking at results by manufacturing industry (Figure 5). For the total of manufacturing exports, there is almost no change in the services VA between 2000 and 2014. Some industries are relying more on services inputs over time, such as the 'paper & paper products' industry or 'other transport equipment'. But it is in the total compensated by industries where the services VA has decreased, in particular for 'coke & petroleum' and for the 'chemicals' industry. However, in all industries except 'textiles & apparel', there is a clear trend towards the use of foreign services VA rather than domestic services VA in gross exports. For the textile industry, the opposite change could be the consequence of some reshoring and a production closer to consumers' markets, implying more domestic services inputs.

Figure 4. Change in the domestic and foreign services VA in manufacturing exports, by country, percentage points, 2000-2014 (exports by industry kept constant)



Source: WIOD, 2016 release.

Figure 5. Change in the domestic and foreign services VA in world gross manufacturing exports, by industry, percentage points, 2000-2014



Source: WIOD, 2016 release.

3. Adding their in-house provision, services account for half of manufacturing value-added in exports

Another important dimension of the 'servicification' is the role played by in-house services within manufacturing firms. These activities can be identified as services in the sense that if they were outsourced they would belong to services industries. Firms often develop in-house their R&D activities or their IT capacity, as well as a variety of support services that can help them to become more efficient and to export. This servicification inside manufacturing firms is more difficult to assess and to measure. Using Swedish firm-level data, Lodefalk (2014) shows that raising the proportion of services in in-house production yields higher export intensity on average.

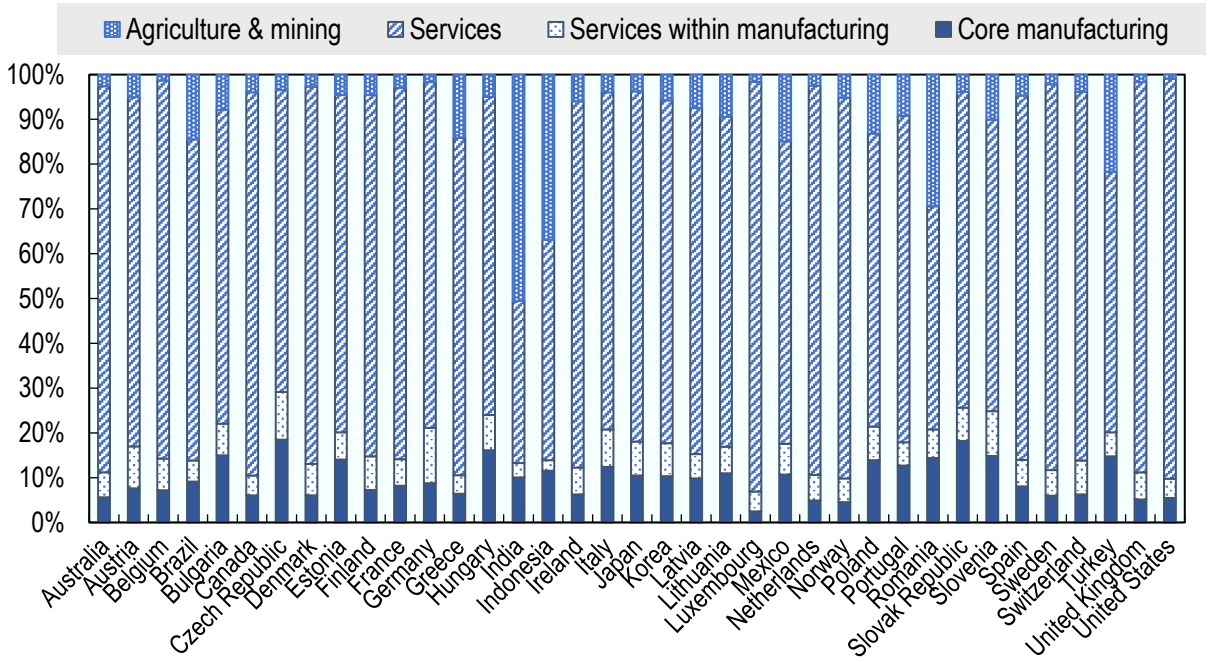
It is therefore important to consider services supplied in-house to have a full assessment of the impact of services on trade and value creation, especially having in mind the fact that the comparability of services outsourcing across countries might be affected by statistical conventions in the construction of input-output tables. For example, countries for which data are collected at the enterprise level and countries for which data are at the establishment level will not report similar levels of outsourcing. There is more in-house provision of services when the unit is the enterprise and when different establishments are involved in the manufacturing and service activities. Data are the enterprise group level are then further including within the perimeter of the same firm additional services provided by affiliates.

Depending on the size and cost structure of the firm, the same service can be less costly when outsourced or when performed in-house. Some heterogeneity is expected across firms and there is no reason to regard one strategy as better than the other is. In addition to costs, companies assess to what extent they need the service on a continuous basis and with a certain degree of control over it supply. Often the trade-off is between training and keeping qualified employees in-house as opposed to finding a reliable high-quality outside supplier, thus explaining different choices. Companies also maintain in-house services that have core strategic functions in the firm such as sales and operations planning, strategic procurement and R&D.

Since the database we use to identify services activities within manufacturing firms (and not as inputs) is based on occupational data, we can first look at the distribution of total employment in the countries covered. Figure 6 indicates the share of employment in the primary sector (agriculture & mining), in manufacturing and in services. Within manufacturing, employment in the core manufacturing activities of the firm is distinguished from employment in services activities, using the business functions data.

With the exception of India and Indonesia that are still emerging economies with a large primary sector, employment is predominantly in services activities in all countries. While the employment in the manufacturing sector already accounts for a small share of total employment, below 20% in most economies, this share becomes even smaller when removing the in-house provision of services.

Figure 6. Employment by type of activity, by country, 2014



Source: OECD business functions dataset.

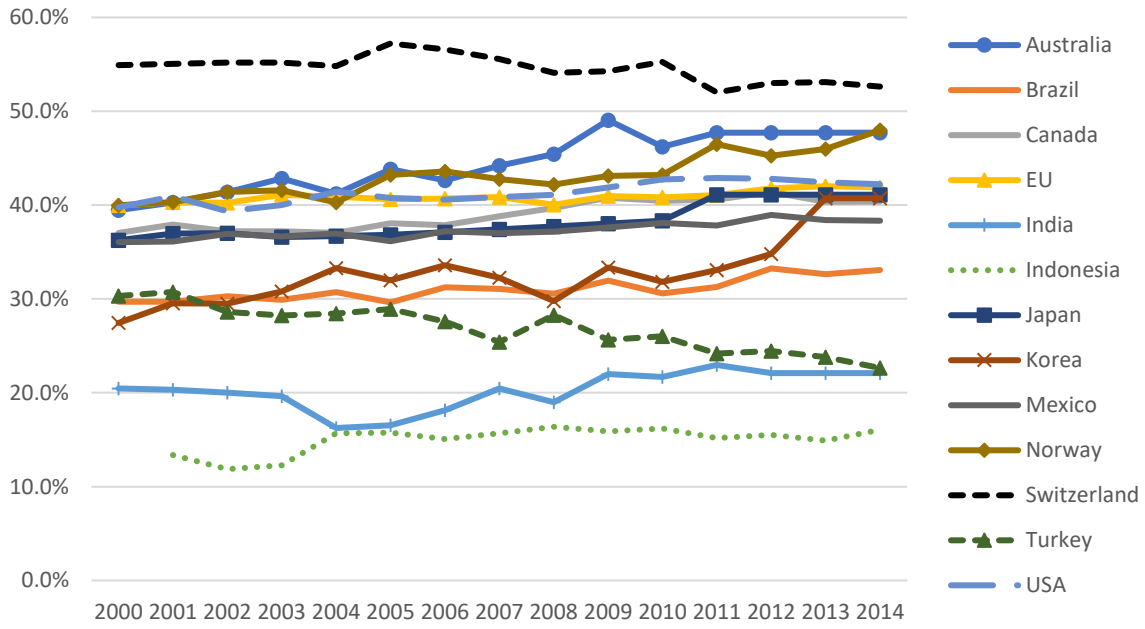
On the one hand, Figure 6 can be interpreted as the result of the "de-industrialisation" which is just another way of looking at the "servicification" from the opposite side. But even in countries such as Brazil, Mexico, Korea or Turkey, that are specialised in manufacturing exports, the share of employment in manufacturing is quite low. Figure 6 should therefore be interpreted more from a GVC angle, acknowledging that employment in services includes jobs related to all the services support functions needed in manufacturing value chains and that have been outsourced. In addition, Figure 6 emphasises that within the manufacturing firms, many jobs (about 40% on average) are also related to services support functions. Figure 6 illustrates what Theodore Levitt (regarded as the "father" of the servificifation) had noticed in 1972: "There are no such things as service industries. There are only industries whose service components are greater or less than those of other industries. Everybody is in services".

Figure 7 provides more evidence of the increase over time of the in-house provision of services inside manufacturing firms. It is generally a slight increase but more pronounced for Australia, Korea and Norway. Only Switzerland and Turkey have a lower share of employment in services activities within manufacturing firms in 2014 as compared to 2000. But Switzerland is the country with the highest share, reflecting headquarter activities. On average, the share of employment in in-house services tends to be lower in emerging economies (Brazil, India, Indonesia and Turkey) indicating that more services are outsourced, maybe to developed economies that have a comparative advantage in these activities.

The two previous Figures were just based on employment data. The next step is about evaluating a share of value-added corresponding to the in-house provision of services. It is

done with the wage information from the labour force surveys, assuming that we can split the whole value-added on the basis of labour compensation (i.e. that the remuneration of capital is proportionally allocated across the business functions). Figure 8 shows the insourced (in-house provision), outsourced and offshored services value-added in manufacturing exports. The outsourced value-added is the domestic indirect services VA and the offshored value-added the foreign (indirect) services VA, as on Figure 2 (but Figure 2 was for all exports and not just manufacturing exports). Figure 8 adds the share of services VA corresponding to the in-house provision. It includes a smaller number of countries as not all labour force surveys have wage information.

Figure 7. Share of employment in services activities within manufacturing firms, by country, 2000-2014

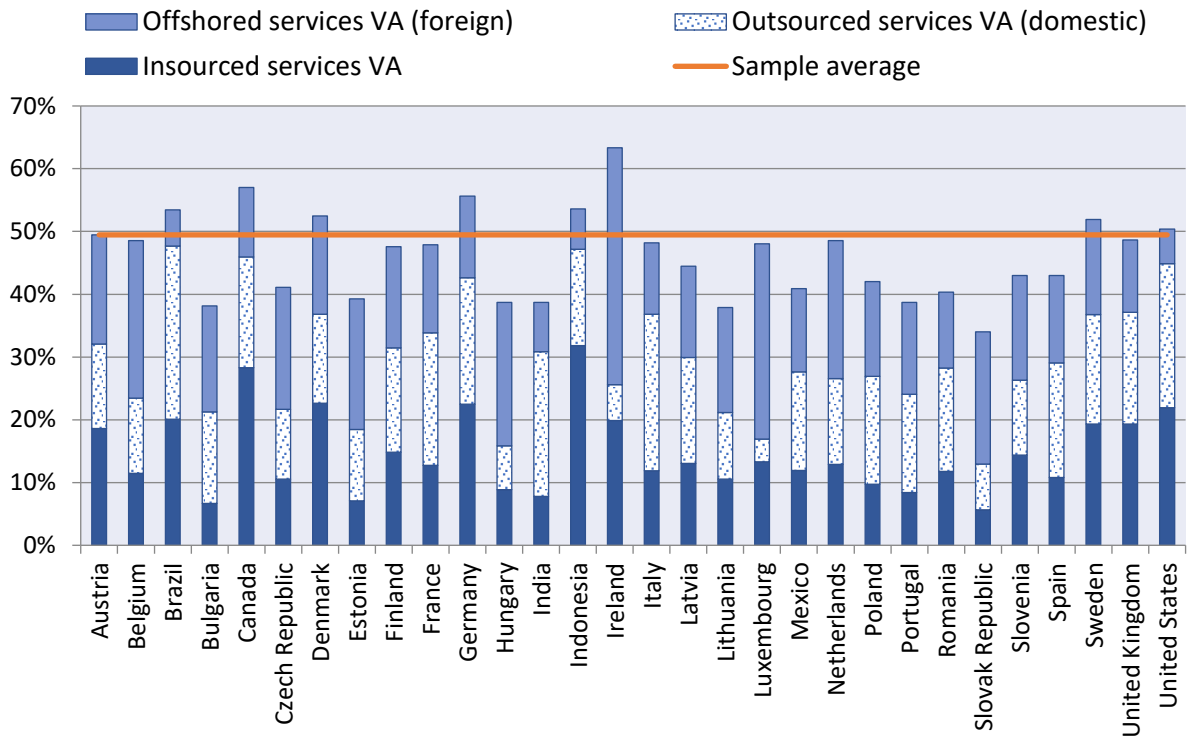


Source: OECD business functions dataset.

The value-added figures tend to give even more importance to insourced services as services support functions generally involve high-skilled jobs that receive higher wages. It is particularly the case for Indonesia when comparing Figure 6 and Figure 8. On average 18% of the value-added in exports comes from the in-house provision of services. As a result, instead of one third of the manufacturing value-added originating in services (as on Figure 3), we now have on average half of the manufacturing value-added corresponding to services activities, either outsourced or insourced.

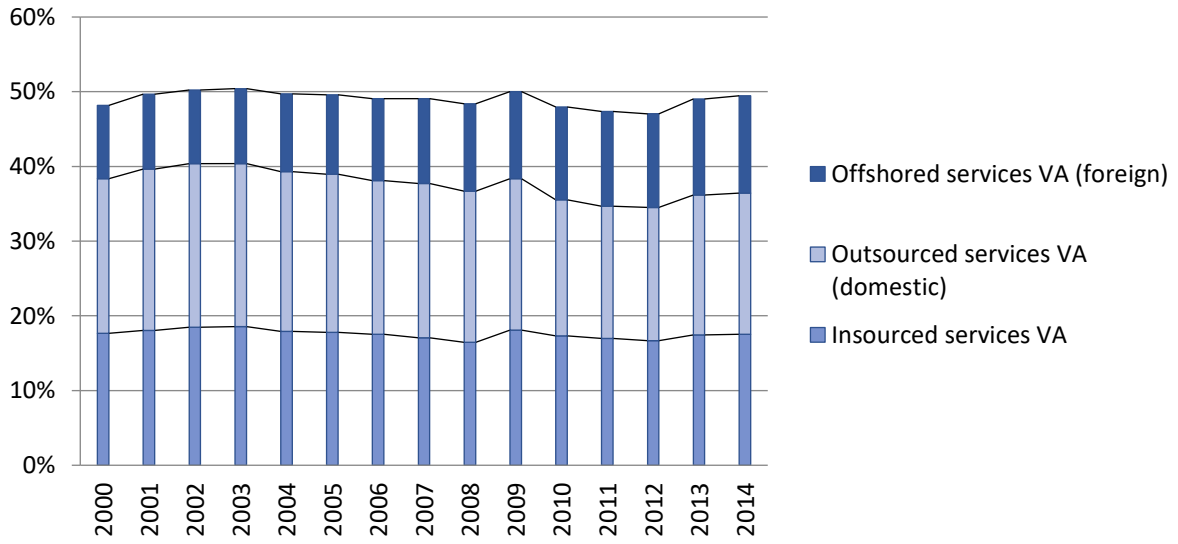
With the exception of Indonesia, there is more services value-added outsourced than insourced (i.e. insourced VA is smaller than domestic outsourcing plus offshoring). It makes sense when thinking about the 40 to 50 different types of services that manufacturing companies need to uphold their international activities according to some case studies (National Board of Trade, 2010 and 2013).

Figure 8. Share of insourced, outsourced and offshored services VA in manufacturing exports, by country, 2014



Source: WIOD, 2016 release and OECD business functions dataset.

Figure 9. Share of insourced, outsourced and offshored services VA in manufacturing exports, sample total, 2000-2014



Source: WIOD, 2016 release and OECD business functions dataset. The sample includes all countries from Figure 8.

Over time, Figure 9 confirms that there is no clear-cut trend suggesting additional servicification in the 2000-2014 period (for the same sample of countries as on Figure 8). One can see however the impact of the financial crisis in 2008-2009 which has impacted relatively more the outsourced services and generally decreased the share of services VA. In value-added terms, services were not so resilient to the crisis (Nagengast and Stehrer, 2016).

While there is no overall increase of the share of services value-added in manufacturing exports, the previous trend of an "internationalisation" of services VA is confirmed as offshored services VA accounts for less than 10% of the value of exports in 2000 and 13% in 2014. This increase matches a similar decrease for the domestic outsourced services VA, while the share of insourced services VA remained stable. Figures 8 and 9 are only describing manufacturing exports. If we go back to Figure 2 and add the insourced services, it is no longer half but two-thirds of the value-added in exports that is services.

4. Services are often sold bundled with goods

A third aspect of the 'servicification' is that services are increasingly sold bundled with goods. When statistics distinguish goods and services and identify firms producing goods or producing services, it is to a large extent artificial as manufacturing firms are responsible for a significant share of services sales and exports. It is highlighted in the firm-level literature. For example, Kelle (2013) finds that manufacturing firms account for about 25% of exports in Germany. In Italy, Federico and Tosti (2010) indicate that 30% of services exports are by manufacturing firms. In France, Crozet and Milet (2015) find that 76% of French manufacturing firms are selling services.

This phenomenon is not new and was first described as 'servitisation' in the work of Vandermerwe and Rada (1988). It can be defined as the "innovation of an organisation's capabilities and processes to shift from selling products to selling integrated products and services that deliver value in use" (Baines et al., 2009). It is also related to the introduction of 'service engineering' (Tomiyama, 2001) in manufacturing firms as a way to increase value by combining services and products.

Services bundled with goods are generally needed for the customer to make use of the product. As described by Cusumano *et al.* (2015), some services are bundled with goods to "smooth" the sale or usage of the product without significantly altering its functionality (smoothing) while others aim at expanding the functionality of the product or help the customer to develop new uses (adapting). The second type involves more interactions with customers. But not all services offered by product firms are complementary to the product they sell. The authors also point out that some services are sold to replace the good formerly traded, such as in the case of software bought as a service and not as a product. Some companies also switch to a business model where they rent the product instead of selling it (the example of Rolls Royce "Power by the Hour" service replacing sales of aircraft engines). Some companies may also decide to focus on services rather than manufacturing because one activity becomes more profitable than the other over time. A famous example is IBM, a company that has rapidly shifted from

manufacturing to services and totally reinvented its business model to maintain its leadership in the high-tech sector (Ahamed et al., 2013).

By construction, the input-output framework and national accounts cannot say much about these bundles of goods and services as typically the data will separate as products the good and the service. When providing data by industry, either the activities will also be separated (if the unit surveyed allows it) or will be merged together in a manufacturing or service industry. The input-output framework cannot generally be used to study the last stages in the value chain that involve distribution services but also installation, repair and other customer services that can have been bundled with the goods produced.

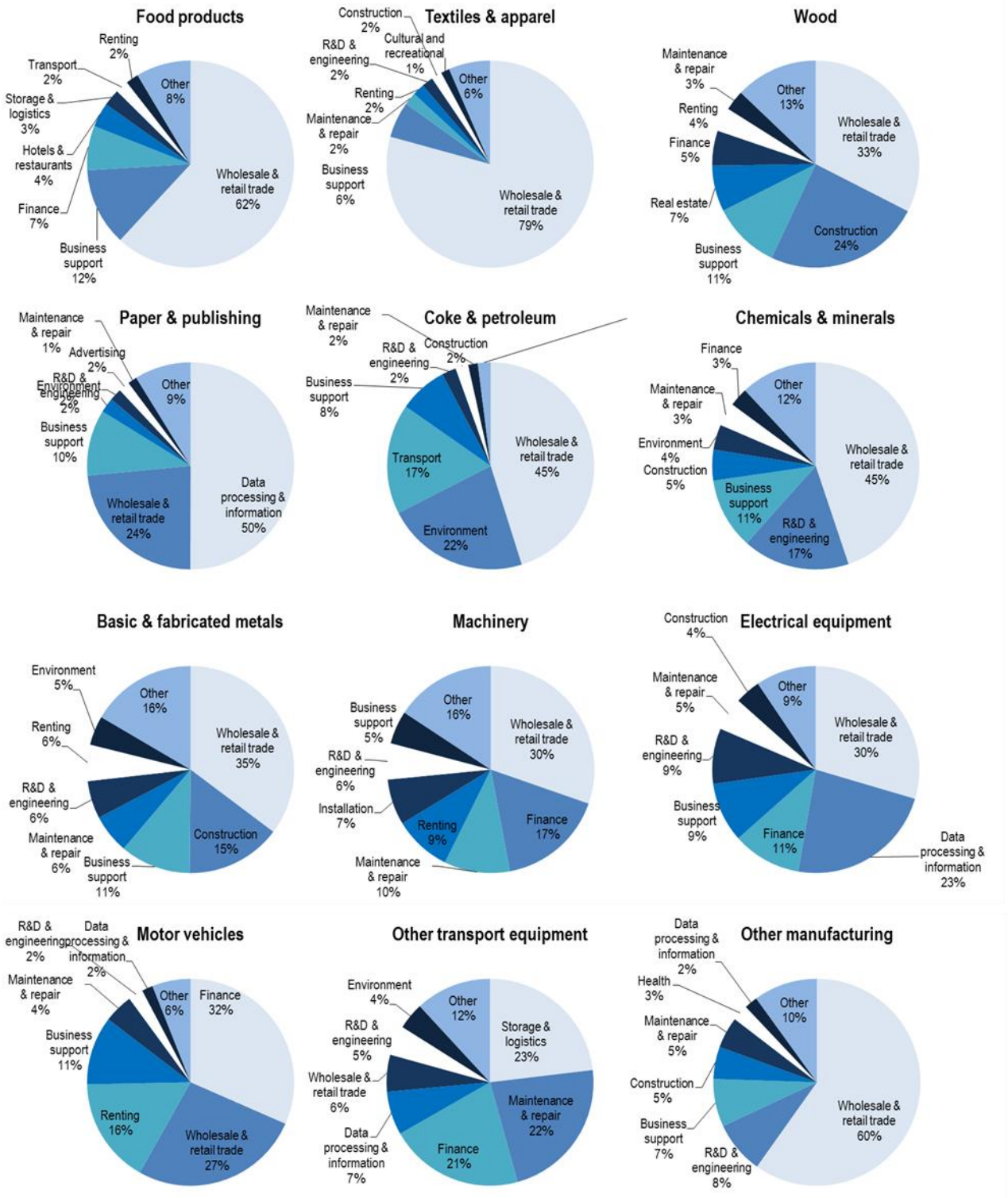
To provide some information on bundles of goods and services with a GVC perspective, Figure 10 reports for selected manufacturing industries the services typically sold by firms that have their primary activity in this industry. It is based on an aggregation of firm-level data from the ORBIS database, weighted by the sales of each firm and based on the primary and secondary activities reported in the database (in the NACE Rev. 2 classification).

The fact that we find mostly activities related to distribution in the services bundled with goods reflects the way global value chains are organised and that unlike what statistical classifications suggest it is often the same firms involved in the manufacturing and the distribution activity. Bernard *et al.* (2015) have highlighted that the most competitive companies are generally direct exporters and do not rely on intermediaries. It is also related to the servicification and the ambition to create a direct relationship with customers, a model popularised by Apple with its Apple Stores.

Related to distribution services, many manufacturing firms are also involved in transport services, particularly when the goods to be transported require specific types of technologies and skills that generally come from the same sector (e.g. transport via pipeline in the case of the coke and petroleum industry). The same logic applies to storage and warehousing as well as services related to recycling and material recovery (environment).

While wholesale and retail trade, transport and logistics services are essential to the operations of global value chains, the other categories of services bundled with goods on Figure 10 illustrate the "indispensable services" (National Board of Trade, 2014), that are required to export goods. For example, construction services are ranked second in the wood products industry because many sales of wood would not happen if not part of a construction contract involving these materials. In the case of chemicals and minerals, engineering and R&D services have a similar role as the firms providing these products also offer their technical expertise and help their customers to find the best solutions to their engineering issues. In the case of the machinery industry, maintenance and repair, as well as installation, are the indispensable activities without which companies could not sell the sophisticated machines they manufacture. The list goes on by looking at each specific industry on Figure 10 and the services ranked after wholesale and retail trade activities.

Figure 10. Main bundles of goods and services observed in the ORBIS dataset, by industry, 2013



Source: ORBIS database 2016. Based on the main secondary service activities of manufacturing firms, weighted by their operating revenue. The title of each chart indicates the manufacturing sector and the different shares the services provided by the product firms.

Interestingly, the maintenance and repair services come second after storage and logistics in the case of other transport equipment, as contracts involving for example airplanes are as much about maintenance than the sale of aircrafts. The third category is finance as firms often need specific financial solutions to acquire costly transport equipment. It should be noted that the data that are used to build Figure 10 cannot tell anything about the type of contract behind the provision of the good and the service and whether it is leasing or subcontracting as opposed to sales. However, the fact that wholesale and retail trade is a smaller secondary activity in the case of other transport equipment as opposed to finance indicates that different types of contracts are found in this industry. Similarly, finance and renting are among the main services picked up in the bundles data in the case of the motor vehicles industry.

IV. Global value chains in services: towards a new framework and new evidence

Until now the analysis has focused on services used by manufacturing firms or produced within manufacturing industries. To complement the previous analysis, we need also to look at how services industries are organised and have evolved with the servicification.

While the servicification is often referring to the transformation of manufacturing industries, the way services industries operate has also changed in the recent period. In the financial, transport, telecoms, distribution or other business services sectors, companies have broadened the range of services they provide and created new types of relationships with customers. For example, banks offer a variety of services through 'packages' that combine insurance services, payment services, legal services, access to advice or investment tools, etc. Telecom operators provide 'triple play' or 'quad play' services that combine fixed telephony, mobile services, access to Internet, television and additional digital content -in some cases through third-parties- while also renting the required hardware. Services companies themselves provide more services and solutions closer to consumers' needs. As a consequence, what we call "trade in services" today is not only more important from a quantitative point of view, in terms of value-added traded, but also it is qualitatively different.

The GVC literature has to some extent already acknowledged that there are differences in value chains when the final product is a service and not a good. For example, Baldwin and Venables (2010) stress that services are produced through a network of activities in what looks more like a "spider" than a "snake". Going beyond the "snakes" and the "spiders", there are indeed important differences in the way value is created in manufacturing and services industries. It was already noticed by Stabell and Fjelstad (1998) in a paper proposing to refine the seminal work of Michael Porter (1985) at the origin of the analysis of "value chains".

1. Value chains, value networks and value shops

According to Stabell and Fjelstad, the value chain is well suited to describe industries where raw materials are transformed and value is added to more processed products in a sequential way culminating in the final product. The primary activities described by Porter, such as "inbound logistics", "operations", "outbound logistics", "marketing and sales" and "service",

apply to this model where value is created by transforming inputs into products. Some service industries, such as construction and food services can fit into this model. But this is not the case of most services, for which two additional types of value creation are suggested.

The first one is the "value network" where value is created by linking customers. In the case of insurance services, for example, the value comes from the fact that there is a large group of insured people who share a risk and pay for the losses of a few. Banking services are also based on a network linking borrowers and lenders. There are then many network services based on a physical network, such as telecommunications and transport, where the value comes from the link offered by the infrastructure. In a value network, the core business functions are different and look more like "network promotion and contract management", "service provisioning" and "infrastructure operation".

The value network is also behind many of the new services provided through the Internet or through mobile applications. Uber for example can be seen as a transport service company but the value in its business model comes from the platform it offers to connect users and cab drivers and to organise the transport service and its payment in the easiest way for the customer. With Internet, the "network infrastructure operation", one of the core business functions in value networks is almost costless and small companies can focus on network promotion, contract management and service provisioning.

The second model of value creation more adapted to describe value creation in certain services industries is the "value shop". Value is created by solving customer problems. The value shops involve experts and professionals and the primary activities are: "problem-finding and acquisition", "problem-solving", "choice", "execution" and "control and evaluation". While standard processes are required for value chains, tailored solutions are the objective in value shops. Professional services, consultancy services, engineering services, R&D services are all examples of value shops. Value shops can be regarded as smaller companies, but it is not always the case. There are also scale economies in problem-solving and there are very large consulting firms for example that serve global clients. What is true is that location matters more in the case of value shops, not only to be close to customers but also to access the knowledge and skills that are likely to be in specific locations.

It is important to understand that what we regard as global value chains is a mix of these different business models. Manufacturing value chains already incorporate elements of value shops and value networks in some specific stages. For example, in the motor vehicles industry, there are activities that have the characteristics of value shops, such as R&D, design and all the business services needed by car manufacturers. There are also elements of value networks when it comes to the distribution of cars, as well as the financing of car sales. But it just reflects the fact that GVCs are not isolated from one another and that the manufacturing value chains rely on services that have themselves their own value chain, better described through the concepts of value networks and value shops.

2. Some empirical evidence on the three types of value creation models

The paper by Stabell and Fjeldstad (1998) already includes criteria that can be used to identify value chains, value networks and value shops among industries. Table 2 below suggests a simple correspondence between WIOD industries and the three types of value creation. Using the business function analysis, this correspondence is applied to the core activity of the firm (business function 1 in Table 1), the management support function (5) and the category "other business function" (7). Transport, logistics and distribution (2) is assumed to belong to "networks" in all industries. The other support services (marketing, sales, after-sale, R&D, engineering and related technical services) are assumed to follow the value shop model. The reasoning is that if these activities were outsourced, their provision would be through "shops" (e.g. consultancy firms providing inputs). Part of sales should rather go to network industries (together with distribution) but marketing and after-sale services are clearly part of value shops.

Table 2. Chains, networks and shops applied to WIOD industries, by business function

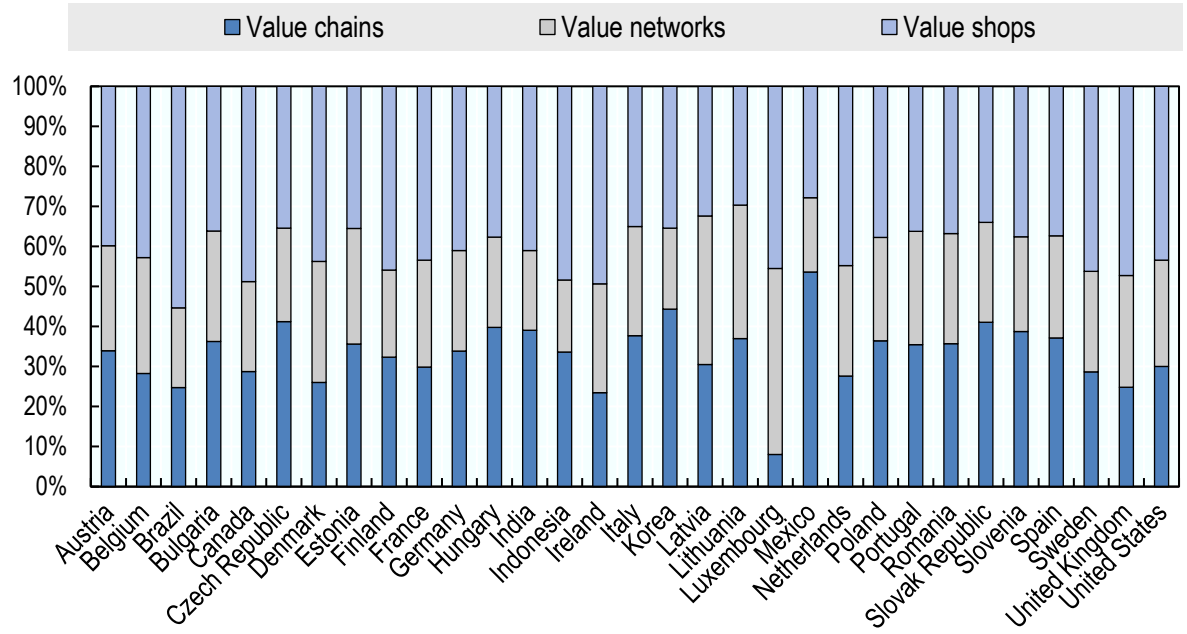
WIOD industries (ISIC Rev. 4)	Core activity, management and other business functions	Transport, logistics and distribution	Marketing, after-sale, R&D, engineering
Agriculture; Forestry; Fishing; Mining; Food & beverages; Textiles & apparel; Wood & wood products; Paper & paper products; printing; Coke & petroleum; Chemicals; Pharmaceuticals; Rubber & plastic; Non-metallic mineral; Basic metals; Fabricated metal; Computer & electronics; Electrical equipment; Machinery; Motor vehicles; Other transport equip.; Furniture & other manuf.; Construction; Accomodation & food	Chain	Network	Shop
Electricity & gas; Water collection & treatment; Sewerage & waste; Wholesale & retail, motor vehicles; Wholesale trade; Retail trade; Land transport; Water transport; Air transport; Warehousing; Postal & courier; Telecommunications; Financial services, excl. insurance; Insurance services; Activities aux. to financial services; Real estate activities	Network	Network	Shop
Repair & installation; Publishing activities; Audiovisual services; IT and information services; Legal and accounting activities; Engineering and technical testing; Scientific R&D; Advertising & market research; Other prof. & technical activities; Education; Health & social work	Shop	Network	Shop

This correspondence is then used in Figure 11 to assess the value-added content of exports and its origin in value chains, shops and networks (not distinguishing the domestic and foreign value-added). The calculation is based on the industry of origin of value-added in the decomposition of gross exports.

The main takeaway from Figure 11 is that in all countries, one should not underestimate the importance of value shops and networks and that at the end exports are largely impacted by policies affecting value creation in these models. There are nonetheless differences across

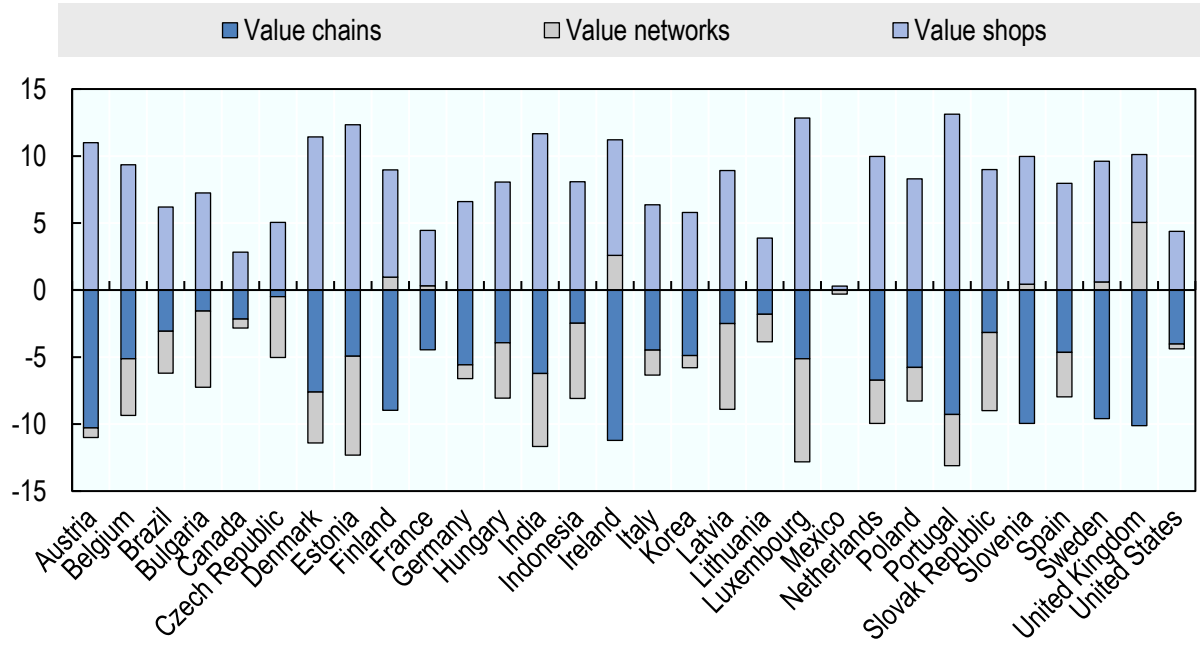
countries that can be further explored in Figure 12 by looking at the change over time (2014 versus 2000) in the value-added in exports attached to chains, shops and networks.

Figure 11. Value-added in gross exports by type of value creation model and by country, 2014



Source: WIOD, 2016 release and OECD business functions dataset.

Figure 12. Change in VA in gross exports by type of value creation model, % points, by country, 2000/2014



Source: WIOD, 2016 release and OECD business functions dataset.

All countries follow the same trend which is an increase in the value created as part of shops. Even if the country coverage is limited, Brazil and India have a profile similar to other countries, pointing out that this shift is universal and not the result of the specialisation of specific economies in service activities. The only significant difference among the countries of Figure 12 is the size of the increase in value shops. There are also differences with respect to value networks with two countries (the UK and Ireland) where there is an increase in the share of value-added originating in this type of business model (and related to financial services). Even for countries that are specialised in exports of manufacturing goods such as Korea, Mexico, or the Czech Republic in the EU, it is in value shops that value-added has progressed the most. Mexico is the only country with a positive percentage change in the share of value chains (but so small that it can hardly be seen on Figure 12). On Figure 11, Mexico was the country with the highest level of value added in value chains.

Figure 12 is maybe the most representative of the 'servicification' of GVCs. It shows an unambiguous move towards business models that aim at solving the problems of customers and creating value through tailored solutions. It was difficult in Section III to find evidence of an overall increase of services value-added in exports but from Figure 12 there is a clear shift of this value-added towards services value creation.

V. Concluding remarks and policy implications

This paper has provided new evidence on the role of services in global value chains. From the TiVA statistics, it was already emphasised that in value-added terms, services account for half of world trade. A new stylised fact is that when adding the in-house provision of services in manufacturing firms, the share of services in manufacturing exports increases from one third to 50% and the share of services value-added in world trade reaches two-thirds.

But since 2000, these shares have been relatively stable. Two trends are however observed that can be described as a 'servicification of GVCs'. On the one hand, there is a higher use of foreign services as inputs in exports, replacing domestic services inputs. Services value chains are becoming more and more international. On the other hand, there is a more qualitative shift with services redefining the way manufacturing companies produce value.

Some evidence on this shift can be found when looking at bundles of goods and services suggesting that firms increasingly provide 'solutions' to customers that combine goods and services. In addition, an analysis of value creation through the three models proposed by Stabell and Fjeldstad (1998) also highlights the raise of 'value shops' in the value-added in exports, confirming this trend towards activities that consist in solving problems and in co-creating value and productivity with the customers.

In the digital era, services are not only the enablers of GVCs, i.e. the activities that are deployed for international production networks to operate but also the drivers of value creation. Services are part of a 'business ecosystem' (Moore, 2013) where collaboration with customers, partners and contractors is the key to innovation and productivity.

The policy implications of GVCs have been well identified in the case of value chains where what matters the most is to remove tariffs and non-tariff measures affecting imports of intermediate goods, streamline customs procedures and administrative requirements and carry out domestic service reforms that can improve the provision of efficient services inputs (OECD, 2013).

These traditional trade barriers are still relevant in a world of services GVCs, particularly when taking into account the fact that many services are traded embodied in goods and therefore impacted by trade rules on goods (Miroudot et al., 2013, Cernat and Kutlina-Dimitrova, 2014). Through a cascading effect in the value chain, trade policy instruments such as tariffs but also non-tariff measures have an impact on the embodied services. The prevalence of bundles of goods and services also suggests reinforcing the consistency of trade rules on goods and on services.

But the shift towards value networks and value shops also points to additional reforms that could facilitate the expansion of services GVCs. In the case of value networks, the main trade barriers are generally sector specific regulations and the lack of enforcement of competition. Rules related to data localisation or commercial presence requirements can also prevent companies from creating a network of users across borders. In the case of value shops, the main barriers are related to movement of people. Beyond trade, skills and innovation policies play an important role in the development of value shops.

The prevalence of services activities within firms also suggests looking at whether services outsourcing or offshoring should be facilitated and is not blocked by restrictive policies. There is an economic rationale in keeping some services activities in-house, particularly when they are complementary with the core activities of the firm. For example, the literature has recently put the emphasis on the benefits of co-location for R&D and manufacturing activities. What regulators and policymakers should ensure is that the choice between outsourcing and insourcing is based on economic reasons and not distorted by policies.

Finally, future research should focus on the relationship between the 'servicification' of GVCs and productivity to be more specific about their role in value creation. It is quite challenging to measure productivity in services (Grassano and Savona, 2014) but still more empirical evidence is needed on the productivity gains and the way services are not just accounting for a large share of value-added but also providing more value with fewer inputs, thus increasing welfare and income.

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