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# Services exported together with goods

Charles Cadestin,  
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## OECD TRADE POLICY PAPER

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## SERVICES EXPORTED TOGETHER WITH GOODS

Charles Cadestin and Sébastien Miroudot, OECD

How prevalent are services sold together with goods? Using aggregate and micro-data, this report assesses this prevalence so as to gain a better understanding of how firms combine goods and services in their exports. Leaving aside the specific case of distribution services, 'Other business services', 'Construction' and 'Research and development' are the most common services supplied by manufacturing firms. With respect to industries, 'paper and printing', as well as 'repair and installation' come first in terms of prevalence of bundles of goods and services. Since the trade regime is different for trade in goods and trade in services, manufacturing firms engaged in servitisation strategies may face higher trade barriers just by expanding their activities in sectors that are less open to trade. When negotiating trade agreements, policy makers need to take into account complementarities between goods and services, and look at the joint restrictiveness for goods and services.

**Key words** Services, trade in services, servicification, servitisation, trade policy

**JEL Codes** F13, F23, L16, L80

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## Key messages

### Services exported together with goods: What is the issue?

- The multilateral trade regime is built on separate rules for trade in goods and trade in services. When a good is exported, the General Agreement on Tariffs and Trade (GATT) applies. When a service is exported, the General Agreement on Trade in Services (GATS) defines the trade regime. Regional or bilateral trade agreements also introduce distinct rules for goods and services.
- But today manufacturing firms increasingly export services together with the goods they supply. This phenomenon, described as the ‘servitisation’ of manufacturing, is part of a shift to services where manufacturing firms try to add value and better serve customer needs, while creating a long-lasting relationship with consumers. Some manufacturing firms become full services providers when they no longer sell goods but provide solutions to consumers that no longer involve the transfer of ownership on the goods they manufacture.
- What happens when services are exported together with goods? Trade rules for both goods and services apply and interact. Barriers to trade in goods can become barriers to services exports and restrictiveness in services trade can affect exports of goods.

### What can be found in the report?

- As trade statistics are also collected separately for goods and for services, it is difficult to assess the prevalence of servitisation strategies and joint exports of goods and services. Using aggregate and firm-level data, this report confirms that a significant share of services are exported together with goods and that manufacturing and services activities are often intertwined.
- To help policy makers understand the servitisation of manufacturing and its implications for trade policy, the report provides a mapping of the most common joint exports of goods and services across sectors and industries. Referring to the WTO Services Classification List, it indicates the relevant GATS sectors where liberalisation commitments can facilitate exports of goods in specific industries.

### What can policy makers do?

- The report draws the attention of policy makers on the fact that trade in goods and trade in services should not be looked at in silos and that manufacturing firms need market access and national treatment commitments for the services they export.
- When negotiating trade agreements, policy makers should take into account complementarities between goods and services and look at the joint restrictiveness in sectors where bundles of goods and services are exported.
- For countries wishing to further open trade, there is an agenda for a joint liberalisation of goods and services, not only in terms of allowing manufacturing firms to access the services inputs they use in their production process but also to remove barriers that prevent exports of services complementary to exports of goods.

## Executive summary

With the shift towards services of manufacturing firms, the lines between exports of goods and services are blurring. Not only do manufacturing firms rely on services inputs to create value and to organise their activities in global value chains, they also produce and sell services together with goods, a phenomenon described as the servitisation of manufacturing. Companies tend to add value by providing services and aim at offering integrated solutions to their customers. This trend has important implications for trade policy-making as the trade regime for goods and services is not the same.

This report contributes to a better understanding of the way firms combine goods and services in their exports by assessing the prevalence of services sold together with goods, using aggregate and micro-data. This information is used to provide a mapping of the manufacturing industries that produce bundles of goods and services with the relevant GATS sectors. This tool can help policymakers assessing interactions between the trade regime for goods and services and can be used to identify where some joint market access is needed.

The report then looks at some of the policy implications and barriers faced by services bundled with goods. When exporting companies no longer provide a simple good but add services, there is both the export of a good and a service. The servitisation leads to situations where barriers to trade in goods affect exports of services and barriers to trade in services affect exports of goods.

The main findings are the following:

- Due to the strict separation between goods and services in trade statistics and national accounts, it is difficult to document and assess the prevalence of services exported together with goods.
- There is, however, a broad literature on the servitisation of manufacturing and empirical work based on firm-level data highlights the important role of manufacturing firms in exporting services. Additional OECD research using the ORBIS database confirms the significant number of firms involved in the production of both goods and services.
- This new empirical analysis cannot give reliable estimates on the share of services exported together with goods but provides insights on the relevant GATS sectors and manufacturing industries.
- Leaving aside the specific case of distribution services (that are provided by most manufacturing firms even in the absence of a servitisation strategy), ‘other business services’, ‘construction services’ and ‘research and development services’ are the most common services supplied by manufacturing firms.
- With respect to industries, ‘paper and printing’, as well as ‘repair and installation’, come first in terms of the prevalence of bundles of goods and services but these industries already include the provision of services in their definition (ISIC classification). Industries such as ‘wood’, ‘pharmaceuticals’ and ‘ICT & electronics’ are the ones where the servitisation is the most prevalent.
- Based on the sample analysed, firms engaged in servitisation strategies tend to have larger sales and value-added, a higher share of intangible assets and more employment per unit of value added. Servitisation is a strategy more observed in large firms and these firms tend to have characteristics closer to service firms (use of intangible assets, more employment in the production process).
- Although the trade regime is not the same for goods and for services (whether at the multilateral level, regional level or domestically), there are relatively clear rules when it

comes to applying regulations, determining customs valuation or implementing rules of origin for bundles of goods and services.

- But since trade restrictiveness is generally higher for services, the servitisation means that manufacturing firms face higher trade barriers just by expanding their activities in sectors that are less open to trade. Traditional barriers to trade in goods, such as tariffs, affect the provision of the service, while the service itself also faces trade barriers that are specific to services. It suggests a joint assessment of the impact of restrictive trade policies for goods and services. Firms engaged in servitisation strategies can only export if there is trade liberalisation both for the good and the service they sell together.
- With the exception of distribution services (that are not the ones representative of the servitisation), significant barriers to trade in services (and related goods) are observed for bundles of goods and services. Some countries also appear more restrictive for joint exports of goods and services (i.e. cumulate high barriers for trade in services and trade in goods).

Manufacturing firms shift to services to add value, to remain competitive, to address the challenges of the digital economy and to better serve their customers. By doing so, they face new barriers on their export markets related to the provision of services. The increasingly services-driven strategies of manufacturing firms can be facilitated by: (i) more co-ordination between trade rules for goods and services, (ii) a joint assessment of trade barriers for services and goods, and (iii) a joint agenda in terms of liberalising both the regime for goods and for the related services.



## 1. Introduction

This report complements previous work on services in global value chains (GVCs)<sup>1</sup> with an emphasis on the delivery of bundles of goods and services. Previous OECD analysis has looked at the role of services used as inputs in the production process, whether outsourced (i.e. bought from independent suppliers) or insourced (i.e. produced in-house). This report focuses on the third aspect of the ‘servicification’ of manufacturing, which is the fact that manufacturing firms increasingly sell services to final consumers together with goods (Box 1.1).

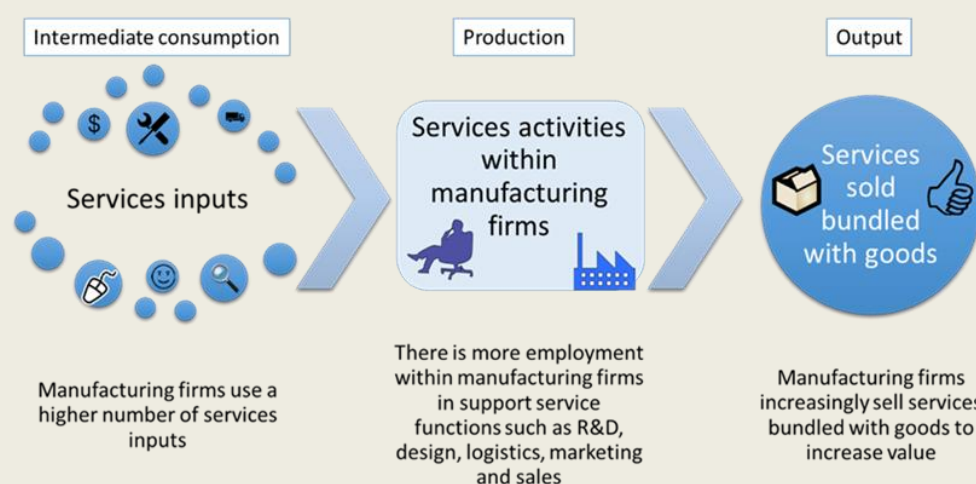
### Box 1.1. Servicification of manufacturing

The servicification of manufacturing means that the manufacturing sector is increasingly relying on services, whether as inputs, as activities within firms or as output sold bundled with goods (Figure 1.1). The phenomenon is intrinsically related to global value chains as it is through the deployment of services that GVCs operate. But it goes beyond as services are also redefining the way manufacturing companies produce value.

The expression ‘servicification’ was introduced in the work of the National Board of Trade (2012<sup>[1]</sup>) to describe:

- The increase in the use of service inputs as measured in input-output or supply-use tables in national accounts leading to a higher share of value-added originating in service industries;
- The shift towards service activities within manufacturing firms with less resources devoted to core manufacturing and assembly activities and more occupations related to support service functions such as R&D, design, distribution, logistics, marketing, sales, after-sale services, IT, back-office and management;
- The convergence between goods and services, sold bundled together by manufacturing firms that are increasingly selling services to add more value. The term ‘servitisation’ (Vandermerwe and Rada, 1988<sup>[2]</sup>) describes this third trend, i.e. the increase in sales of services by manufacturing firms.

Figure 1.1. Servicification of manufacturing: Using, producing and selling services



Source: Miroudot and Cadestin (2017<sup>[3]</sup>).

<sup>1</sup> “Services in global value chains: from inputs to value-creating activities” (TAD/TC/WP(2016)11/FINAL) and “Services in global value chains: trade patterns and gains from specialisation” (TAD/TC/WP(2017)6/FINAL).

This report is organised as follows. Section 2 explains the concepts used in the report and the blurring lines between exports of goods and services. Section 3 introduces a mapping of manufacturing industries and GATS sectors that include the main bundles of goods and services based on an empirical analysis of aggregate and micro-data. Section 4 investigates to what extent trade barriers affect the provision of bundles of goods and services. Section 5 concludes.

## 2. The blurring lines between exports of goods and services

National accounts and trade statistics distinguish goods from services. The world trading system then provides different rules and disciplines for trade in goods and trade in services. According to the 2008 *System of National Accounts* (SNA), goods are “physical, produced objects for which a demand exists, over which ownership rights can be established and whose ownership can be transferred from one institutional unit to another by engaging in transactions on markets.” Services are “the result of a production activity that changes the conditions of the consuming units, or facilitates the exchange of products or financial assets.”

While these definitions have been improved over time and include operational criteria to distinguish goods from services, there is already some ambiguity when thinking about products such as meals or photographs. Are they goods or services? The latest version of the Central Product Classification (CPC) –which is the international classification of reference- suggests that some products fail to meet the strict definitions of goods or services and should be regarded as bundles (UNSD, 2015<sup>[4]</sup>). Photographs and meals are the examples provided. The CPC now has three types of products: goods, services and ‘other products’ but this third category has no equivalent in national accounts.

Statistics and the trade regime are based on a distinction between goods and services. But firms are not divided between those producing goods and those producing services. Many firms produce both goods and services and increasingly sell them together as bundles. Firms are then identified as belonging to the manufacturing sector or the service sector based on their main activity. For companies having a significant production of both goods and services, this classification can become quite arbitrary.

Previous OECD work has already highlighted the important role of services in the production of manufacturing and the blurring lines between goods and services (Pilat et al., 2008<sup>[5]</sup>; Nordås and Kim, 2013<sup>[6]</sup>; De Backer, Desnoyers-James and Moussiégt, 2015<sup>[7]</sup>; Miroudot and Cadestin, 2017<sup>[3]</sup>). Services are used not only for the production of goods in global value chains (GVCs), they are also part of the solutions that firms deliver to their customers in combination with goods. This orientation of manufacturing industries towards services is not new and has been studied in management literature for a long time (Baines et al., 2009<sup>[8]</sup>) by referring to the *servitisation* of manufacturing (Vandermerwe and Rada, 1988<sup>[2]</sup>) or more recently by studying *service-driven manufacturing* (Gebauer et al., 2012<sup>[9]</sup>).

### 2.1. Servitisation: When manufacturers become service providers

The servitisation of manufacturing 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<sup>[8]</sup>). As emphasised by Vandermerwe and Rada (1988<sup>[2]</sup>), manufacturing firms are “increasingly offering fuller market packages or ‘bundles’ of customer-focussed combinations of goods, services, support, self-service, and knowledge”. And this trend is now amplified with the digitalisation of economies (Coreynen, Matthyssens and Van Bockhaven, 2017<sup>[10]</sup>).

One important aspect in this servitisation is that firms sell services together with the good they produce in what is described as a ‘package’ or ‘bundle’. As will be later discussed, this combination is what is difficult to capture in statistics. It is possible to identify firms that produce both goods and services but these two activities could be independent such as in the case of a conglomerate operating in separate industries. Moreover, the service can be outsourced to an independent firm while still be sold as a bundle (Box 2.1)

The bundle generally consists in the physical good plus additional services that add value for the customer, such as repair, maintenance, installation or insurance services. But the servitisation also covers cases where the good and related services are more integrated in what is described as a ‘solution’ or a ‘product-service system’ (PSS). When talking about solutions or PSS, what is sold to the customer is no longer a product with additional services but the result of what the customer would like to achieve. For example, instead of selling printers, a manufacturer can sell ‘document solutions’. The manufacturer then decides how to best meet the needs of the consumer by providing impression services, supplying and maintaining different types of printers in the office of the customer and giving advice to rationalise printing costs. The consumer is charged a fixed price per copy covering all the services provided and does not have to buy printers.

#### **Box 2.1. Developing capabilities in services: Inside or outside the firm?**

While manufacturing companies offering ‘bundles’ or ‘solutions’ are by definition selling together a good and a service, the provision of the service can be outsourced to a partner firm. Paiola et al. (2013<sup>[11]</sup>) discuss the ‘make or buy’ decision of firms with respect to capabilities in services. When moving from products to solutions, manufacturing firms can add service components internally, externally or in a mixed way. The advantage of internal development is that firms remain in control of all the services needed for the solution. It might be strategic when a large share of income is derived from the services supplied and no longer the product. But developing the required skills and competencies is costly. An external development can be more efficient as the manufacturing firm will no longer have to pay for the high fixed costs involved. It is also less risky if the servitisation strategy is not successful and does not increase the income of the manufacturing firm. Depending on the service component concerned, firms can take different decisions and decide to insource or outsource on a case-by-case basis. There are also additional determinants such as regulations that can require an external firm to perform the service. It is often the case for financial services (e.g. leasing, insurance) where regulations generally involve a license or the implementation of prudential rules that do not allow the manufacturer to directly provide the service. The provision can however still remain ‘internal’ through a fully-owned affiliate.

The ‘make or buy’ decision has an impact on the way we analyse the servitisation. Most studies look at firms that produce both goods and services and thus do not capture the services provided by external firms. When it comes to exports, some services may be bundled with goods but will appear in trade statistics as pure exports of services. Therefore, the servitisation is likely to be empirically underestimated, particularly for some categories of services such as financial services.

As such, PSS can be seen as a special case of servitisation and have different trade policy implications when the good is part of the solution but no longer sold to the customer. Some companies pursuing servitisation strategies can become full service providers and in this case what is sold is a service and no longer a ‘bundle’. Examples of such shift include the case of IBM (from computer manufacturer to computer service provider) or Xerox (Box 2.2) But in-between there are many cases where companies are both selling goods and services.

### Box 2.2. Servitisation in the photocopier industry

The photocopier industry is often used as an example when discussing the servitisation because it was one of the first to rely on business models involving services. In the late 1950s, the Haloid Company (later known as Xerox) introduced the first plain paper photocopier, the Xerox 914. While using plain paper was cheaper and easier than photographic film, the machine was expensive and had many mechanical parts requiring maintenance to function properly. Most companies in the sector had a 'razor and razor blade' business model with a low margin on the photocopier itself (to ensure a low price) and higher mark-ups on the supplies (ink and paper). Since the novelty in Xerox's product was the possibility to use plain paper, it was difficult to follow the same model. In addition, the Xerox photocopier was about six times more expensive than products sold by competitors. This is why the company started to lease photocopiers for a fixed price per month covering the maintenance services. The success of the servitisation strategy was so important that an antitrust suit was brought against Xerox in 1975 due to its dominant market position and the company had to allow competitors such as Kodak and IBM to provide services for its products.

Tougher competition came for Xerox in the 1980s with the growth of Japanese manufacturers (Canon, Ricoh, Sharp, Minolta, Panasonic, Toshiba and Konica). Instead of challenging Xerox in the high-end market, these companies focused on cheaper and 'service-free' products. Their main innovation was to include in a single component the most strategic parts of the photocopier (the drum, charger, toner and cleaner) that could then be easily replaced by the customer (and not a technician). This strategy coupled with the lean manufacturing and just-in-time production that characterised Japanese firms made photocopiers more affordable and Canon became the world's leading company in 1985, pushing Xerox in the high-end market where customers would still pay for services.

But it is still through services that Xerox found an answer to declining market shares. In the 1990s, new innovations led to the digitisation of the photocopier industry with the development of charged coupled device (CCD) sensors. Digital products brought new competitors such as HP, Samsung and Lexmark, already strong in the printer market and who started to offer multifunction devices with a photocopier function in addition to scanning, printing, faxing and mailing. This combination of functions inspired Xerox to extend the range of services offered. The company was one of the first to introduce a full 'office document solution' and as of 1994 introduced itself as 'The Document Company'. Instead of selling multifunction devices with a maintenance contract, Xerox and its competitors now offer 'managed print services', i.e. integrated solutions for enterprises to manage and optimise all the document output environment. Through a single contract with generally a pay-per-page fee, these companies provide the hardware, the software, the consumables and all the services required with a commitment to reduce printing costs, optimise all document processes, increase safety and environmental sustainability. All aspects of document management and printing are outsourced and the customer can focus on its core business.

Source: Visintin (2014<sup>[12]</sup>).

## 2.2. Why offering services together with goods?

Product bundling is a very common strategy implemented in many industries. The objective is to combine products so that the consumer derives more value than if the products were bought individually. A typical example is a meal or menu in a restaurant. The price is cheaper for the consumer when compared with a separate order for a starter, main dish and dessert. It is also more convenient and saves time. By providing additional features or complementary functions, the benefits of the bundle often go beyond price. Product bundling can also be used to introduce to the consumer new products that she may have not initially thought about buying. E-commerce websites, for example, often suggest products that are bought together with the one picked by the customer to encourage further sales.

The rationale is the same for services bundled with goods. But since services are about 'changing the conditions of the consuming units', services bundled with goods are generally more related to the additional or complementary features that can be added to the good and provide extra benefits

to the consumer. Through services, the idea is also to establish a long-lasting relationship with the customer rather than a one-off sale of multiple products. Accompanying the customer through the product life cycle can create loyalty. It also provides information to the manufacturer that can be used to improve products. Last but not least, services are generally a more stable source of revenues and more resilient to fluctuations during the economic cycle.

Cusumano et al. (2015<sup>[13]</sup>) classify services offered by manufacturing firms into three different categories. First, they distinguish the services that are complementary to goods against those that are substitutes. Then, the complementary services are further decomposed into smoothing and adapting services. Smoothing services are those that do not alter the product's functionality (such as financing, insurance, maintenance and repair). They involve some exchange of information between the manufacturer and the customer but they could be supplied by independent firms. For example, a car manufacturer can offer some loan to buy the car it produces but a similar financing could be offered by a bank. In the case of adapting services, the manufacturer extends the product functionality or helps the customer to develop new uses. Such service is generally supplied only by the firm that has manufactured the product as it requires access to the manufacturing process or some knowledge about the product that only the manufacturer has. An example is the modification of a standard product to be used in extreme weather conditions or a training to show a new use to the customer. The solutions previously mentioned also belong to this category when the manufacturer takes care of all the processes involving the product within the customer's organisation. As compared to smoothing services, adapting services require even more exchanges of information between the manufacturer and the customer and are associated with further customisation of the delivered product.

As for substituting services, they simply replace the purchase of the good. An example often used is Rolls Royce's 'Power by the Hour'. In 1962, the manufacturer of aircraft engines introduced a new business model where the engine and maintenance services are paid on a fixed cost per flying hour basis. As with the example of Xerox (Box 2.2), there are two reasons for switching to such a model. First, from the point of view of the consumer, when the good is expensive, complex and difficult to maintain and not used on a full time basis, it is more cost efficient to rent it and to shift the burden of its maintenance on the producer. Second, from the point of view of the manufacturer, a long term contract with the provision of services creates higher margins, more predictability and a closer relationship with the customer. This is particularly welcomed in industries with declining profitability and stiff competition.

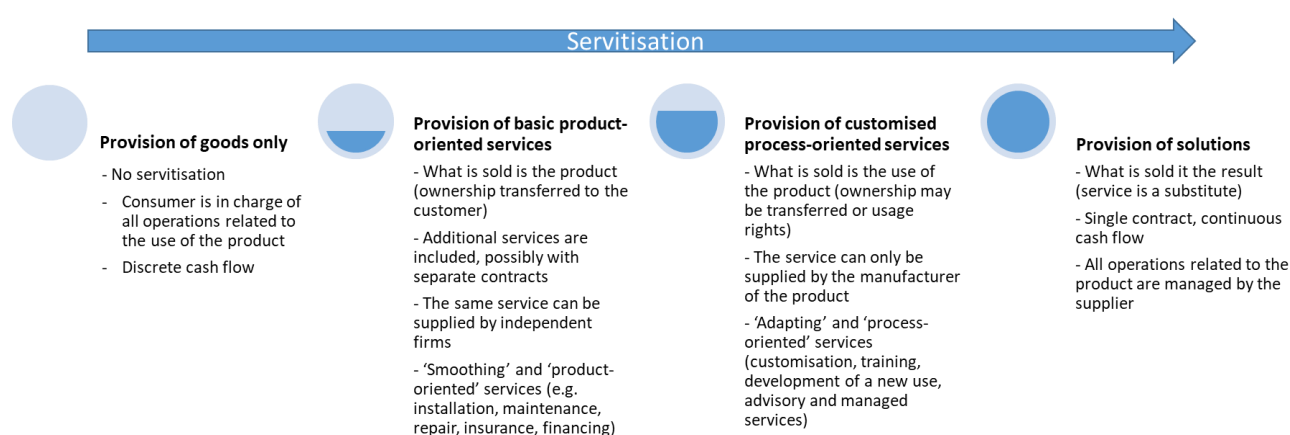
The servitisation of manufacturing is very diverse and depends on products and firms' strategies. Capital goods and durable goods are more subject to servitisation because they are not immediately consumed and require services to be maintained over time. Goods that are more complex or have a high technological content are also more prone to servitisation due to the knowledge that has to be shared with consumers using them. Then, firms operate in specific environments with different degrees of contract enforceability and specific GVC patterns that also lead to differences across countries in the way businesses operate.

Finally, it should be highlighted that not all servitisation strategies succeed. Some firms are not able to develop a profitable business when moving to services (Gebauer, Fleisch and Friedli, 2005<sup>[14]</sup>). It is the case when firms do not initially have the knowledge and skills needed for the services they intend to supply and have to heavily invest to develop a capacity. The returns on the services provided are then too low to cover the costs. Moreover, there are also firms that grow through a 'deservitisation' strategy. It does not mean that they abandon the provision of services but instead of focusing on customised services and integrated solutions for a limited number of key customers, these firms develop a simpler offer of products and limited services to reach a broader customer base, achieving profitability through standardisation and scale economies rather than through customisation (Kowalkowski et al., 2015<sup>[15]</sup>).

## 2.3. From goods and services to solutions

As previously emphasised, the servitisation covers cases where goods and services are combined to different degrees. The literature suggests that there is a product-service continuum going from the pure provision of goods to the provision of solutions where the good is fully replaced by a service (Figure 2.1). The level of servitisation increases along this continuum with first the provision of basic product-oriented services that are simply added to the purchase of the good such as installation, maintenance, repair, insurance or financing services. These services are the ones described as ‘smoothing’ complementary services by Cusumano et al. (2015<sup>[13]</sup>). They could be supplied by independent firms but are offered as a bundle by the manufacturer of the product. They do not require a high level of interactions between the customer and the producer, just some exchange of information. The good is still sold to the consumer (i.e. ownership is transferred) as a bundle with services.

Figure 2.1. The product-service continuum



Source: Authors’ elaboration based on Baines et al. (2007<sup>[16]</sup>), Kowalkowski et al. (2015<sup>[15]</sup>) and Oliva and Kallenberg (2003<sup>[17]</sup>).

Firms pursuing a servitisation strategy then move to the provision of customised process-oriented services. Such services are generally not provided by independent firms as they consist in altering the product to better fulfil the needs of the customer. The producer becomes involved in the processes and operations of the customer, requiring more interactions and exchange of knowledge. The focus is on the use of the product which can be rented or leased instead of being sold. There is still a bundle but it is more difficult to disentangle the service from the good and the bundle is closer to a service.

The last stage in the continuum is when a solution is sold to the consumer, through a single contract which is a pure service with no longer a good sold. There is a continuous cash flow for the whole service. In this case, the focus is on the functional result and all operations and processes are outsourced to the supplier. The bundle is now fully a service.

If one thinks about a car manufacturer, the first stage in the servitisation would be to add insurance and maintenance to the sale of the car (product-oriented services), the second stage would be the rental or lease of cars for a given amount of kilometres or the adaptation of cars for a specific use (e.g. desert driving) while the third stage would be to become a provider of transportation services (taxi, private drivers or network of autonomous cars). The three stages involve a good (the car) and services but bundled in different ways.

It should be stressed that the continuum does not mean that all manufacturing firms aim at becoming providers of solutions and advancing towards higher levels of servitisation. While there are gains



in the servitisation, each firm may find one specific position in the continuum to be the most profitable and nothing prevents firms from offering different types of bundles along the continuum to different types of customers. For example, some manufacturing firms develop customised solutions for key large customers while offering only basic product-oriented services to the rest.

## 2.4. Implications for trade and trade policy

While there is a large literature on the servitisation and services produced by manufacturing firms, very few papers address issues related to trade. One exception is Aquilante and Vendrell-Herrero (2019<sup>[18]</sup>). Using information collected for a panel of German SMEs, the authors find a positive relationship between the bundling of goods and services and exporting. Firms that bundle goods and services are also more productive. In this study, firms are actually identified as exporting bundles (through a survey) and are not just firms that produce both goods and services.

Empirical studies looking at the share of manufacturing firms in exports of services generally find significant shares. For example, Kelle (2013<sup>[19]</sup>) indicates that manufacturers account for 25% of German services exports. Services particularly exported by manufacturing firms are R&D services, engineering services and construction services and such services are likely to be complementary to exports of goods. In Italy, according to Federico and Tosti (2012<sup>[20]</sup>), half of manufacturing firms export services and they account for 30% of exports of services.

Also, the servitisation seems to have a positive impact on export performance. In one of the few empirical studies available, Lodefalk (2014<sup>[21]</sup>) finds that Swedish firms with a higher share of services produced in-house have a higher export intensity. However, the variable does not indicate whether services produced in-house are exported together with goods or just used as inputs in the production process.

This evidence indicates that many firms have to export both goods and services and have to deal with two separate trade regimes. Whether exports are under multilateral rules or through a preferential trade agreement (PTA), the regime for goods and services is not the same. The way it affects exporters depends on the level of servitisation and here it is useful to refer to the continuum that was described on Figure 2.1.

When a good is exported and the ownership is transferred from a resident to a non-resident, the relevant trade regime is the one for goods. The provision of additional complementary services is regarded as a separate service export (subject to the trade regime for services). Whether there is a single contract or not does not affect the way rules are applied since rules are defined on the basis of the product. If a payment is for a complementary service, it cannot enter into the value of the good exported during the customs valuation process.

Moving further along the continuum, when dealing with services that alter the product or are embedded in the product (such as a software in a device), one question is whether one can separate the service from the good. Different rules will still apply. For example, a regulation on imports of software applies to the software included in a computer or a printer. But for valuation purposes, in relation to customs duties or the implementation of rules of origin, the whole good is considered (including services as long as they are part of the good).<sup>2</sup>

But when the good is no longer exported, such as in the case of renting or leasing services or more generally the solutions at the end of the continuum, the trade regime is unambiguously the one for

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<sup>2</sup> See WTO (2018<sup>[30]</sup>) for a discussion of valuation rules in relation to the servitisation. There is also a discussion on whether services inputs should be considered for the valuation of goods, see Cernat and Kutlina-Dimitrova (2014<sup>[29]</sup>). But services inputs are not part of the servitisation since they are consumed in the production process.

trade in services. The good in this case is no longer exported (the ownership is not transferred to a non-resident).<sup>3</sup>

As trade regimes for services are generally more restrictive, one concern with the servitisation is that firms move to business models that face higher trade barriers. It is not only a concern at the end of the continuum where exports become fully services, but also at the beginning where complementary services are subject to rules on trade in services. Some of these services may be ‘indispensable’ to the export of the good (National Board of Trade, 2014<sup>[22]</sup>). Furthermore, the fact that both barriers to trade in goods and trade in services apply suggests to look at some joint trade restrictiveness.

The objective in this report is to get a better understanding of the services exported together with goods, with a mapping across manufacturing and GATS sectors, in order to assess the prevalence of bundles of goods and services and the trade barriers they face.

### 3. Assessing the prevalence of bundles of goods and services

Since official statistics are built on the distinction between goods and services, there is no easy way to assess the prevalence of bundles of goods and services in exports. This Section explores four different methods using national accounts on the one hand and micro-data (the ORBIS database) on the other hand. These methods have limits and can only produce rough estimates of services sold together with goods. With the exception of data on foreign affiliates, trade is generally not covered and one has to assume that exports follow the same patterns as overall sales. Moreover, it is difficult to distinguish the services that are actually bundled from services sold separately to customers as a secondary activity of the firm. Lastly, cases where the service exported with the good is supplied by a different firm can generally not be covered (in particular when this firm is in the service sector).

Nevertheless, the convergence in the results obtained through these different methods suggests that what is captured is rather robust. It might not be possible to provide accurate estimates of the share of sales or exports corresponding to bundles of goods and services but at least one can identify the type of activities involved. The objective in this Section is therefore to link GATS sectors (the ones trade negotiators are generally familiar with) to exports of specific goods that require complementary services. This mapping is proposed as a tool for trade negotiators to identify interdependencies between trade rules for goods and for services.

A link between exports of goods and relevant GATS sectors for complementary services was previously established for environmental goods by the National Board of Trade (2014<sup>[22]</sup>). The list was derived from interviews with companies operating in the relevant industries. We follow a similar approach but instead of interviews, we use the information from national accounts and from the ORBIS database to identify bundles of goods and services for a broader set of sectors.

#### 3.1. Sales of services by manufacturing firms: A national accounts perspective

Supply-use tables in national accounts can provide some information on the sales of services by manufacturing firms. The supply table includes data on the output of different industries broken down by product. One can therefore identify the value of services produced within specific manufacturing sectors. However, not all countries provide a full matrix by product and industry and for some countries there is only a diagonal where all the output of an industry is allocated to a single product. Even when countries provide data for more products, services are not always fully covered.

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<sup>3</sup> The good might still have to cross the border and go through customs clearance, but it will not be part of the transaction with the final consumer. It will be part of the internal operations of the service provider.



This is why one cannot infer the value of services produced by manufacturing firms through national accounts data.

Using the OECD SNA database, Table 3.1 provides an overview of what available data suggest in terms of the prevalence of different types of bundles of goods and services. The table is based on the information for selected countries that report at least some sales of services in manufacturing industries. Each row in the table corresponds to a sector or sub-sector in the WTO Services Classification List (MTN.GNS/W/120), which is the classification used by most countries to schedule their GATS commitments. We work with the first and second levels of the W/120 classification.

Columns then indicate the manufacturing industry. The data are aggregated for 16 industries in ISIC Rev. 4. We use a simple rating scale based on the percentage of sales corresponding to services (above 1%, above 5% or above 10%). These percentages are generally low as national accounts are not able to track well the services sold by manufacturing firms. But there is already some evidence on their prevalence across different types of industries.

**Table 3.1. Services sold by manufacturing firms based on national accounts, 2014**

Share of output by manufacturing industry and type of service (+ above 1%, ++ above 5%, +++ above 10%)

	Food products	Textiles & apparel	Wood	Paper & printing	Coke, petroleum	Chemicals	Pharmaceuticals	Rubber & plastics	Non-metal minerals	Metals	ICT & electronics	Electrical equipment	Machinery	Transport equipment	Other manufacturing	Repair & installation
1. Business services				+		+	+++		+	+	+++	+	+	+	+	+
1.A. Professional services											+					
1.B. Computer and related services											++					
1.C. Research and development services							++				++		+	+		
1.D. Real estate services																
1.E. Rental/leasing services without operators							++		+		+					
1.F. Other professional services				+												
2. Communication services																
3. Construction and related engineering services																
4. Distribution services	+	+++	+		+	+	++	++	+	+		+	++		+	+
5. Educational services																
7. Financial services																
8. Health related and other social services																
9. Hotels and restaurants (incl. catering)																
10. Recreational, cultural and sporting services																
11. Transport services																

Note: The countries covered are Australia, Chile, Colombia, Costa Rica, Czech Republic, Luxembourg, Norway, Portugal, Slovenia, South Africa, Sweden, the United Kingdom, and the United States.

Source: OECD SNA database.

According to Table 3.1, the most common services supplied by manufacturing firms are ‘distribution services’ and ‘business services’. Such services are part of the manufacturing value chain and found prevalent in almost all industries. There are however differences, with distribution corresponding to a higher share of output in industries such as ‘textiles & apparel’ or ‘pharmaceuticals’. After distribution services, the two main categories of bundles of goods and services involve ‘research and development services’ and ‘rental/leasing services without operators’. These activities are clearly part of the servitisation described in Section 1. Under ‘research and development services’ in the GATS are some of the adapting services where manufacturing firms help their customers to use their products and optimise processes. Rental and

leasing services are then the ones that correspond to solutions where the good is not sold but user rights are transferred to the customer.

The results then suggest that the three industries the most involved in bundles of goods and services are ‘paper and printing’, ‘pharmaceuticals’ and ‘ICT & electronics’. Printing being related to publishing, it is not surprising to see this category coming first. Firms in this industry bundle their products with ‘other business services’ such as advertising, publishing, recording, maintenance and packaging. The pharmaceuticals sector is known for having servitisation strategies involving health solutions and not just the production of medicines. Pharmaceutical products are bundled with ‘research and development services’ but also ‘rental/leasing services without operators’ maybe in relation to the use of medical devices. Lastly, ‘ICT & electronics’ are also related to ‘computer and related services’ that make use of the devices produced in this industry, as well as ‘research and development services’.

### 3.2. Using micro-data to identify the service activities of manufacturing firms

Since aggregate data cannot capture well the servitisation of manufacturing firms, most empirical work relies on firm-level evidence. In the rest of the Section, we use the ORBIS dataset to look at manufacturing firms that produce and possibly export services. The first information that can be used in this dataset is the list of activities of firms. For each firm, ORBIS reports the main activity (‘core’) but also secondary activities using the NACE classification. Manufacturing firms that produce services can be identified as the ones that have a core activity in the manufacturing sector and for which secondary activities include NACE codes corresponding to services.

Of course, the fact that a firm is involved both in the production of goods and services does not always mean that they are sold as bundles. But firms involved in two complementary activities are likely to encourage customers to buy them as a package and should not lose the opportunity of exploiting the synergies between their goods and services. But we have no empirical way of confirming this. Still, these firms will be impacted by barriers to trade in goods and trade in services. The exercise of matching the relevant manufacturing industries with GATS sectors remains of interest for such firms, independently of whether they export goods and services as a bundle or not.

Using such a methodology on 16.5 million firms for the year 2018, Table 3.2 summarises the main results of the analysis.<sup>4</sup> The format is similar to Table 3.1 with rows corresponding to GATS sectors and columns to ISIC industries. This time the frequency is based on the share of firms in ORBIS that offer such a combination of goods and services.

Results confirm the role of ‘distribution services’ as the main type of service offered by manufacturing firms. But as compared to national accounts, more detail is available for business services. In addition to ‘research and development services’ previously identified, there are services such ‘computer and related services’ or ‘professional services’ that are also supplied by manufacturing firms. Not surprisingly, ‘computer and related services’ are associated with the ‘ICT & electronics’ industry. But it is interesting to see that professional services play a role in the ‘pharmaceuticals’ industry or in ‘machinery’, possibly in relation to engineering services.

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<sup>4</sup> The high number of firms covered provides some confidence on the robustness of the results. However, these firms are pulled across countries and sectors for which the information on firm activities is not uniformly available and comparable. There might still be some bias in the analysis.

The category ‘other business services’ then aggregates many types of additional services supplied by manufacturing firms. A more detailed analysis is found in Table 3.3. This level of disaggregation highlights the important role of ‘maintenance and repair of equipment’ services as well ‘services incidental to manufacturing’ which are the main product-oriented services supplied by manufacturing firms. ‘Management consulting services’ would be expected to account for a significant share of bundles of goods and services but are only identified as prevalent in the ‘ICT & electronics’ industry.

Another interesting industry is ‘wood’. It was associated with ‘construction and related engineering services’ in Table 3.2 and has bundled activities with ‘services incidental to agriculture, hunting and forestry’, ‘services incidental to mining’ and ‘services incidental to manufacturing’ in Table 3.3, as well as ‘maintenance and repair of equipment’. Wood products have different industrial uses and are part of construction materials and all related services are identified in the analysis of ORBIS data.

**Table 3.2. Services sold by manufacturing firms based on industry codes in the ORBIS database, 2018**

Share of firms in each industry (+ above 1%, ++ above 5%, +++ above 10%)

	Food products	Textiles & apparel	Wood	Paper & printing	Coke, petroleum	Chemicals	Pharmaceuticals	Rubber & plastics	Non-metal minerals	Metals	ICT & electronics	Electrical equipment	Machinery	Transport equipment	Furniture	Manufacturing NEC	Repair
1. Business services	+	+	++	+++	+++	++	++	+++	++	++	++	++	+++	++	+++	++	+++
1.A. Professional services			+				+				+	+	+				+
1.B. Computer and related services				++							+						
1.C. Research and development services							+				+						
1.D. Real estate services			+														
1.E. Rental/leasing services without operators																	+
1.F. Other business services	+	+	++	+++	+++	+	+	+++	+	++	++	++	++	+	++	++	+++
2. Communication services				+													
3. Construction and related engineering services			++	+	+	+		+	++	++	+	+	+	+	++	+	++
4. Distribution services	+++	+++	+++	++	+++	+++	+++	+++	+++	+++	+++	+++	+++	++	+++	+++	+++
5. Educational services																	
6. Environmental services																	
7. Financial services																	
8. Health related and other social services																	
9. Tourism and travel related services	++		+													+	
10. Recreational, cultural and sporting services																	
11. Transport services	+	+	+	+	+	+	+	+	+	+			+	+	+	+	++
Total (thousands)	1,989	2,294	818	1,139	93	649	146	694	923	2,223	752	571	1,264	529	669	976	924

Note: A firm producing services belonging to several GATS categories is counted several times.

Source: Authors own calculations based on ORBIS database.

Table 3.3. More detailed results for business services based on industry codes in ORBIS

	Food products	Textiles & apparel	Wood	Paper & printing	Coke, petroleum	Chemicals	Pharmaceuticals	Rubber & plastics	Non-metal Minerals	Metals	ICT & electronics	Electrical equipment	Machinery	Transport equipment	Furniture	Manufacturing NEC	Repair
1.A. Professional services			+				+				+	+	+				+
1.A.a. Legal services																	
1.A.b. Accounting, auditing and bookkeeping services																	
1.A.g. Urban planning and landscape architectural services																	
1.A.h. Medical and dental services																	
1.A.i. Veterinary services																	
1.B. Computer and related services				++							+						
1.B.b. Software implementation services																	
1.B.d. Data base services				++													
1.C. Research and development services							+				+						
1.C.a. R&D services on natural sciences							+										
1.C.b. R&D services on social sciences and humanities																	
1.D. Real estate services			+														
1.D.a. Involving own or leased property			+														
1.D.b. On a fee or contract basis																	
1.E. Rental/leasing services without operators																	+
1.E.c. Relating to other transport equipment																	+
1.E.d. Relating to other machinery and equipment																	
1.E.e. Other																	
1.F. Other business services	+	+	++	+++	+++	+	+	+++	+	++	++	++	++	+	++	++	+++
1.F.a. Advertising services				+													
1.F.b. Market research and public opinion polling services																	
1.F.c. Management consulting service											+						
1.F.e. Technical testing and analysis serv.																	
1.F.f. Services incidental to agriculture, hunting and forestry			+														
1.F.h. Services incidental to mining			+		++				+	+							+
1.F.i. Services incidental to manufacturing			+	+		+		++	+	+	+	+	++	+	+	+	++
1.F.j. Services incidental to energy distribution					+												
1.F.k. Placement and supply services of Personnel																	
1.F.l. Investigation and security																	
1.F.n. Maintenance and repair of equipment		+	+	+						+	+	+	+	+	+	+	+++
1.F.o. Building-cleaning services																	
1.F.p. Photographic services				+													
1.F.r. Printing, publishing				+++												+	
1.F.s. Convention services				+		+	+								+	+	+
Total (thousands)	1,989	2,294	818	1,139	93	649	146	694	923	2,223	752	571	1,264	529	669	976	924

Note: A firm producing services belonging to several GATS categories is counted several times.

Source: Authors own calculations based on ORBIS database.

### 3.3. Identifying bundles of goods and services through text analysis of the description of firms

In addition to industry codes, what we can find in the ORBIS database is a description of activities of firms in plain text. The description is not always available but as compared to industry codes, it can tell more precisely whether firms are selling goods and services together in some kind of bundle or solution. This is why in the management literature, text analysis tools have been used to look at product-service systems in firm-level datasets (Neely, 2009<sup>[23]</sup>; Visnjic, Wiengarten and Neely, 2016<sup>[24]</sup>). Some studies also rely on the web-scraping of manufacturing firm websites to find keywords that could indicate that they are ‘servitised’ (Technopolis Group, Dialogic and Cambridge Service Alliance, 2018<sup>[25]</sup>).

Using a similar approach, we work with a sample of 3.3 million manufacturing firms (current information in 2018) for which a description of activities is provided in English in ORBIS and we use text analysis tools to infer from this description the provision of services. The keywords used to identify services come from the Central Product Classification (CPC) 2.1. This official classification covers all goods and services and is the classification of reference to distinguish goods from services. It includes very detailed and up-to-date sectors (Zhang, 2015<sup>[26]</sup>). In addition, the

W/120 Services Classification List was designed with corresponding CPC categories.<sup>5</sup> We can thus obtain a direct correspondence between services activities of manufacturing firms in ORBIS and GATS sectors. A more concrete illustration of how text analysis works can be found in Box 3.1 with the example of the pharmaceutical company Merck & Co and more technical details are available in Annex A.

A limitation with such a methodology is that results depend on the available information in ORBIS where not all firms have a detailed description going into a list of activities. For example, there are many observations for which we find the text “Firm engaged in the production of [...]” with only the name of a product. Also, some companies are described not on the basis of what they do or produce, but through their structure (e.g. joint-venture) or the certifications they have received. This information is not sufficient to identify the production of services.

### Box 3.1. An example using text analysis: Merck & Co Inc.

#### Description of the company

Merck & Co., Inc. is a global healthcare company. The Company offers health solutions through its prescription medicines, vaccines, biologic therapies and animal health products. It operates through four segments: Pharmaceutical, Animal Health, Healthcare Services and Alliances. The Company's Pharmaceutical segment includes human health pharmaceutical and vaccine products marketed either directly by the Company or through joint ventures. Human health pharmaceutical products consist of therapeutic and preventive agents, generally sold by prescription, for the treatment of human disorders. The Company sells its human health pharmaceutical products primarily to drug wholesalers and retailers, hospitals, government agencies and managed healthcare providers, such as health maintenance organizations, pharmacy benefit managers and other institutions. Vaccine products consist of preventive pediatric, adolescent and adult vaccines, primarily administered at physician offices.

Positive match for W/120 '1.A.i Veterinary services'.

Positive match for W/120 '8. Health Related and Social Services'. Could also match with '1.A.h Medical and dental services' but not taken into account based on health services being associated only with '8. Health Related and Social Services'.

Positive match for W/120 '4. Distribution services'. However, a careful reading of the description suggests that Merck & Co is not involved directly in the distribution of pharmaceuticals. This illustrates a potential false match.

Table 3.4 is based on the frequency of firms for which there was a match with the specific service activity. These percentages cannot be interpreted as the percentage of firms involved in bundles of goods and services since there are firms for which the description does not allow to determine whether there is the provision of services or not. They are then lower than in Table 3.2 but we use the same rating scale for comparability.

The results confirm the prevalence of servitisation strategies in ‘paper and printing’, ‘pharmaceuticals’ and ‘ICT & electronics’. But, in addition, higher shares of firms selling goods and services are found in the ‘chemicals’ and ‘electrical equipment’ industries. For ‘machinery’ and

<sup>5</sup> In 1991, only the provisional CPC classification was available. Using correspondence tables at the 5-digit level from UNSD, we have updated the correspondence between GATS and CPC sectors to match version 2.1 of CPC.

‘transport equipment’ (including motor vehicles), results are maybe not as high as expected. Other studies suggest that these industries are among the most involved in servitisation strategies (Technopolis Group, Dialogic and Cambridge Service Alliance, 2018<sup>[25]</sup>).

The ‘repair and installation’ industry is a special case as it is classified as manufacturing but provides services. It is nonetheless interesting to see that these services are also combined with other services such as ‘construction and related engineering services’ or ‘other business services’, providing evidence on the package of services commonly found in the provision of solutions.

Although often offered jointly with an important number of durable consumption goods, insurance and finance services are not associated with many manufacturing firms. It was already the case in Table 3.2 and the methodology based on the description of firms does not correct for this. As mentioned in Box 2.1, the issue could be that due to regulations, separate entities have to provide the service and therefore the methodology does not allow to properly identify the bundles. But in Annex A, where additional results are included, we note that financial services are important for the ‘pharmaceuticals’, ‘electrical machinery’ and ‘ICT & electronics’ industries, as well as ‘coke, petroleum’ and ‘transport equipment’.

**Table 3.4. Services sold by manufacturing firms based on the description of activities in ORBIS, 2018**

Share of firms in each industry (+ above 1%, ++ above 5%, +++ above 10%)

	Food products	Textiles & apparel	Wood	Paper & printing	Coke, petroleum	Chemicals	Pharmaceuticals	Rubber & plastics	Non-metal minerals	Metals	ICT & electronics	Electrical equipment	Machinery	Transport equipment	Furniture	Manufacturing NEC	Repair
1. Business services	+	+	+	+++	+	++	++	++	+	+	++	++	++	++	+	++	+++
1.A. Professional services												+					+
1.B. Computer and related services											+						
1.C. Research and development services						+	+				+	+					
1.D. Real estate services			+														+
1.E. Rental/leasing services without operators																	
1.F. Other business services	+	+	+	+++	+	++	+	++	+	+	+	+	+	+	+	++	+++
2. Communication services																	
3. Construction and related engineering services			+++	+					+	+	+	+	+		+		++
4. Distribution services	++	+	+	+	++	++	+++	+	+	+	++	++	+	+	+	+	+
5. Educational services																	
6. Environmental services																	
7. Financial services																	
8. Health related and other social services																	
9. Tourism and travel related services																	
10. Recreational, cultural and sporting services																	
11. Transport services					+			+						++			++
Total (thousands)	703	397	156	207	15	146	31	152	122	459	188	123	256	121	99	197	147

Note: A firm producing services belonging to several GATS categories is counted several times.

Source: Authors own calculations based on ORBIS database.

### 3.4. A closer look at groups: Exports of services by foreign affiliates of manufacturing multinationals

Lastly, some other information we can use in ORBIS is the ownership structure of firms. We can select multinational firms from the manufacturing sector (identified through the parent company having its core activity in manufacturing) and look at their affiliates in service industries. What is interesting with this method is that first it gives some insights on the intra-firm provision of services and that second it really points at services exported (Mode 3 exports). This methodology is also useful to address the issue of complex corporate groups that are involved in different activities through their affiliates and not within the same firm.

Table 3.5 provides a mapping similar to the previous ones in terms of GATS sectors and manufacturing industries. Instead of the share of firms supplying the service, the variable used is the share of the service affiliate in the turnover of the whole group. A very interesting finding is that the ‘motor vehicles’ industry is now associated with the provision of financial services, confirming the interpretation that such services are supplied by a different entity (which can nonetheless be an affiliate).

Results are generally consistent with what was observed across all firms. But one difference for the foreign affiliates seems to be that ‘research and development services’ are less prevalent. Such services may be offered by the parent company rather than by affiliates in the country of the customer, as opposed to ‘distribution services’ or ‘other business services’ that include specific product-oriented services (such as repair and maintenance).

**Table 3.5. Services sold by foreign affiliates of manufacturing firms, 2018**

Share of turnover of the consolidated accounts of the group (+ above 1%, ++ above 5%, +++ above 10%)

	Food products	Textiles & apparel	Wood	Paper & printing	Coke, petroleum	Chemicals	Pharmaceuticals	Rubber & plastics	Non-metal minerals	Metals	ICT & electronics	Electrical equipment	Machinery	Motor vehicles	Other transport	Furniture	Manufacturing NEC	Repair
1. Business services				+		+	+	+			+	+	+		+	+		
1.A. Professional services																		
1.B. Computer and related services																		
1.C. Research and development services																		
1.D. Real estate services																		
1.E. Rental/leasing services without operators																		
1.F. Other business services				+				+				+			+	+		
2. Communication services																		
3. Construction and related engineering services																		
4. Distribution services	+	++		+	+	+	++	+	+	+	+	++	+	++	++	+	++	
5. Educational services																		
6. Environmental services																		
7. Financial services														+				
8. Health related and other social services																		
9. Tourism and travel related services																		
10. Recreational, cultural and sporting services																		
11. Transport services																		

Source: Authors own calculations based on ORBIS database.

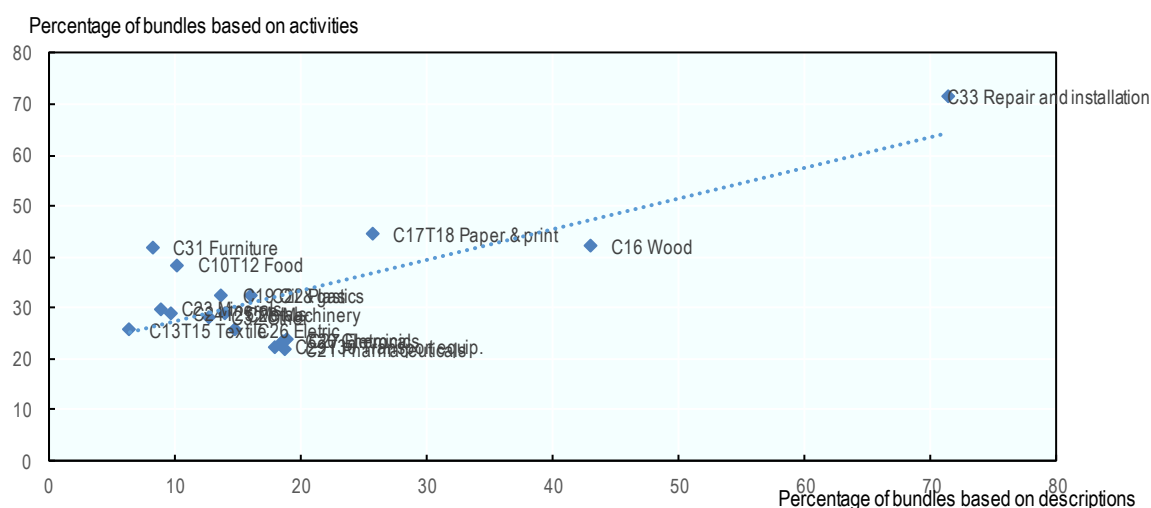
### 3.5. Comparison of results and preferred methodology

When comparing the different methodologies used to assess the prevalence of bundles of goods and services, we find that the approach based on the description of activities (text analysis) tends to underestimate the number of firms engaged in servitisation. For instance, in the distribution sector, the share of firms providing bundles is 13% based on activity codes while it is only 8% when looking at the firm’s description. We also find lower shares for ‘other business services’ or ‘construction and related engineering services’.

However, looking at the distribution of shares rather than their absolute level, the two methods have convergent results. For example, with both methods, there are relatively higher shares of services sold by the ‘repair and installation’, ‘wood’ and ‘paper and printing’ industries. These three industries also have similar patterns when it comes to the GATS sectors that are the most prevalent in bundles: ‘maintenance and repair of equipment’, ‘construction and related engineering services’,

‘printing and publishing’. Figure 3.1 shows more systematically the correlation observed in results by industry.

**Figure 3.1. Percentage of bundles identified based on activity codes and description of activities, by industry**



Source: Authors own calculations based on ORBIS database.

Since there is a fair degree of convergence in results and the largest sample of companies is the one based on activity codes, the rest of the analysis is based on results obtained with the activity codes.

### 3.6. Characteristics of firms providing bundles of goods and services

In order to assess the main characteristics of firms identified as selling both goods and services, we run probit regressions on a dummy variable that indicates whether a manufacturing firm is also selling services. We look at different variables that can have an impact on the probability of being such a firm, such as the size (turnover, value-added, employment), the capital intensity or the use of intangible assets. Results are reported in Table 3.6.

The analysis suggests that firms engaged in servitisation strategies tend to have a larger turnover and value-added but not a larger number of employees. While most examples of the servitisation involve large firms, it should be noted that the strategy can also be implemented by small firms. For example, Bonfanti et al. (2018<sup>[27]</sup>) describe the servitisation of craft workshops in industrial districts in Italy. By embracing new digital technologies and providing more services in relation to their products, some of these small firms manage to remain competitive. The fact that without having more employees, the companies selling both goods and services tend to have a higher turnover or value-added points at the benefits of servitisation strategies.

A positive and significant coefficient is observed for the share of intangibles in fixed assets (and accordingly a positive coefficient for the level of intangible fixed assets and a negative one for the level of tangible fixed assets). It confirms an insight from case studies on the servitisation which is that the journey to services is about investing in intangibles. The positive and significant coefficient for the ratio of employment to value-added also points at the specialisation in service activities that are more labour-intensive.



**Table 3.6. Probit regressions on firms selling bundles of goods and services**

Each coefficient can be read as the increase in probability attributed by a 1% increase in each variable

	(1)	(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)
<b>VARIABLES</b>									
Fixed assets (log)	-0.00105								
	(0.00172)								
Intangible fixed assets (log)		0.00447***							
		(0.00132)							
Tangible fixed assets (log)			-0.009***						
			(0.00162)						
Turnover (log)				0.0123***					
				(0.00202)					
Value added (log)					0.00456**				
					(0.00210)				
Employment (log)						-0.00019			
						(0.00252)			
Capital intensity (log)							-9.34e-07		
							(3.05e-05)		
Share of intangible in fixed assets								0.127***	
								(0.0191)	
Employment / Value added									0.000495***
									(0.000104)
Constant	0.263***	0.229***	0.332***	0.124***	0.219***	0.248***	0.259***	0.244***	0.211***
	(0.0296)	(0.0254)	(0.0289)	(0.0322)	(0.0315)	(0.0277)	(0.0252)	(0.0246)	(0.0264)
Observations	454,775	454,773	454,775	454,773	454,773	454,759	454,775	454,773	454,773

Note: Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Fixed effects: country, industry.

Source: Authors own calculations based on ORBIS database.

## 4. Barriers to trade affecting services exported together with goods

As explained in Section 1, since the trade regime is different for goods and services, bundles of goods and services will generally be seen as the joint export of a good and a service with different rules and regulations applying to the good and the service. It is only in the case of fully integrated solutions (where the service is a substitute for the good) that the relevant trade regime is the one for services. In all other cases, servitised firms have to deal both with barriers to goods and to services when they export.

After having identified the most common bundles of goods and services in Section 2, this section looks more closely at the ‘joint restrictiveness’ and at the way exports of goods may be affected by service barriers. It draws some implications for trade policy and the design of trade agreements.

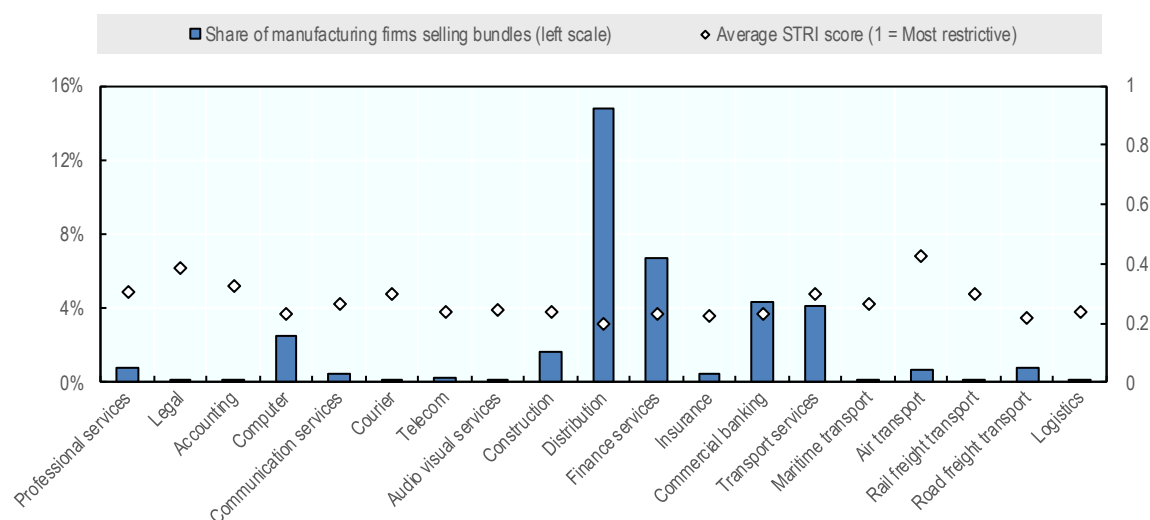
#### 4.1. Service barriers affecting manufacturing firms engaged in servitisation strategies

The Services Trade Restrictiveness (STRI) database and indices bring together comprehensive and comparable information on barriers to trade in services in 44 countries and 22 sectors (OECD, 2017<sub>[28]</sub>). The STRI reflects the actual trade regime and is based on laws and regulations implemented in each country. Figure 4.1 compares the average level of STRI indices across countries with the prevalence of manufacturing firms selling such services together with goods.

Distribution services have the lowest STRI and were found as the most prevalent type of services sold with goods. However, all goods go through a distribution stage. Efficient regulations and trade openness for distribution services can have a positive impact on all exports of goods but this policy implication is not specific to servitisation strategies.

In the case of business services identified as the most important for manufacturing firms, there are three findings when looking at Figure 4.1. Some of them, and in particular ‘computer and related services’, have a relatively low STRI. Since the information for ‘computer and related services’ in the STRI database is based on horizontal measures and not on sector-specific regulations (as this sector is generally not regulated by countries), the score should be similar for a set of other business services that are not covered in the STRI but that would fall under a similar regime with no sector-specific regulation. It is different for professional services, that were also identified as key for the servitisation in some industries, and that are among the most restrictive on average in the STRI database. There might also be business services not covered in the STRI database that are also quite regulated such as advertising or technical testing. It would also be interesting to know the trade regime for ‘repair and maintenance services’ and other installation services that could be categorised as indispensable for manufacturing firms. Such services are however not covered in the STRI.

**Figure 4.1. Indices and prevalence of services in bundles of goods and services, 2016**



Note: Simple average of STRI scores by country; the share of manufacturing firms selling bundles is weighted by turnover in ORBIS.

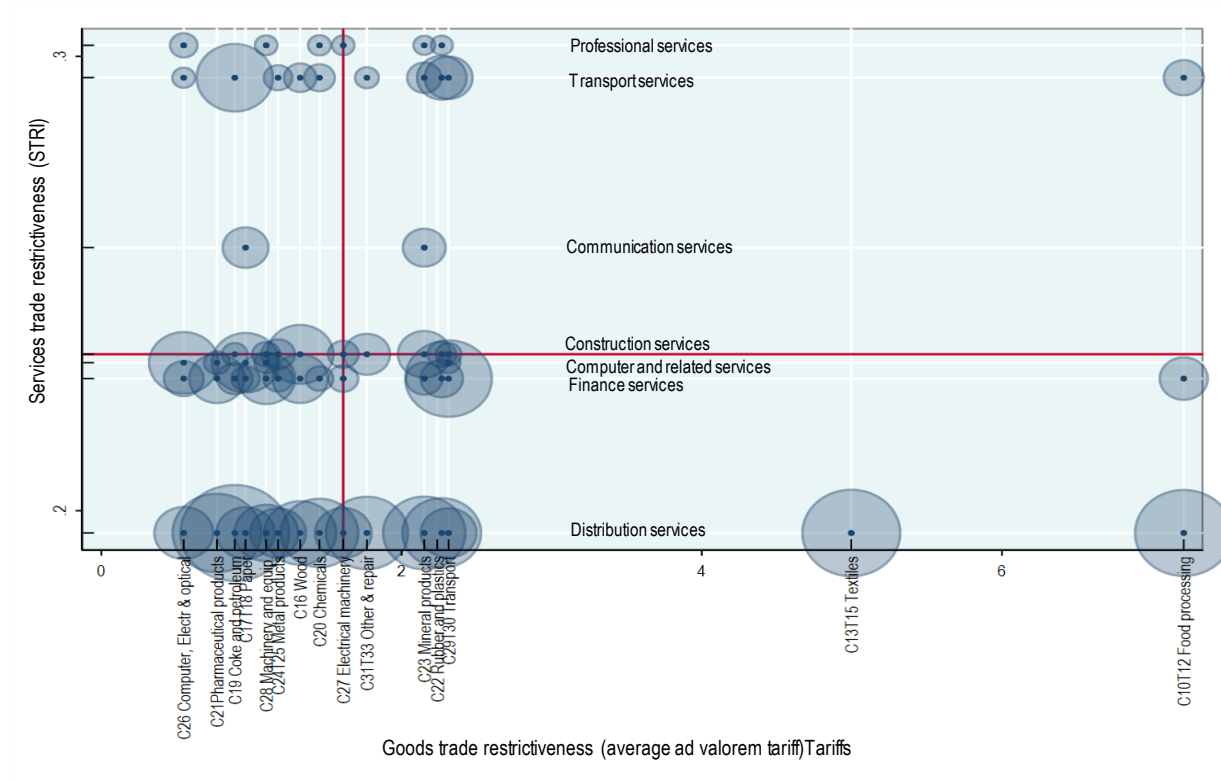
Source: OECD STRI database and own calculations based on ORBIS.

Lastly, there are services such as transport services that are also mentioned in the literature on the servitisation (for example in relation to the manufacturing of transport equipment) and these services are both in highly trade-restrictive sectors and not found as prevalent in our empirical work. The explanation could be that regulations prevent the implementation of servitisation strategies or – as illustrated with financial services – that the servitisation has to rely on independent firms (and therefore is not correctly measured).

## 4.2. Assessing the ‘joint restrictiveness’ for goods and services

In addition to barriers to services, bundles of goods and services are also likely to face barriers to trade in goods, starting with tariffs. Using average tariffs by industry from the UN TRAINS database and STRI indices, Figure 4.2 highlights what are the combinations of goods and services the most affected by trade restrictions. On the vertical axis is found the STRI value for the service included in the bundle and on the horizontal axis the ad valorem tariff for the good (industry average). Values are averaged across countries. The size of the bubble for each bundle is proportional to its prevalence (i.e. the share in all bundles observed weighted by firms’ turnover).

Figure 4.2. Joint trade restrictiveness, by type of bundle, 2016



Note: Each bubble corresponds to the share of the bundle in all bundles, weighted by turnover. Only bundles with a share above 1% are plotted. Tariffs and STRI indices are averaged across countries. Grey lines correspond to medians (calculated for the whole sample).

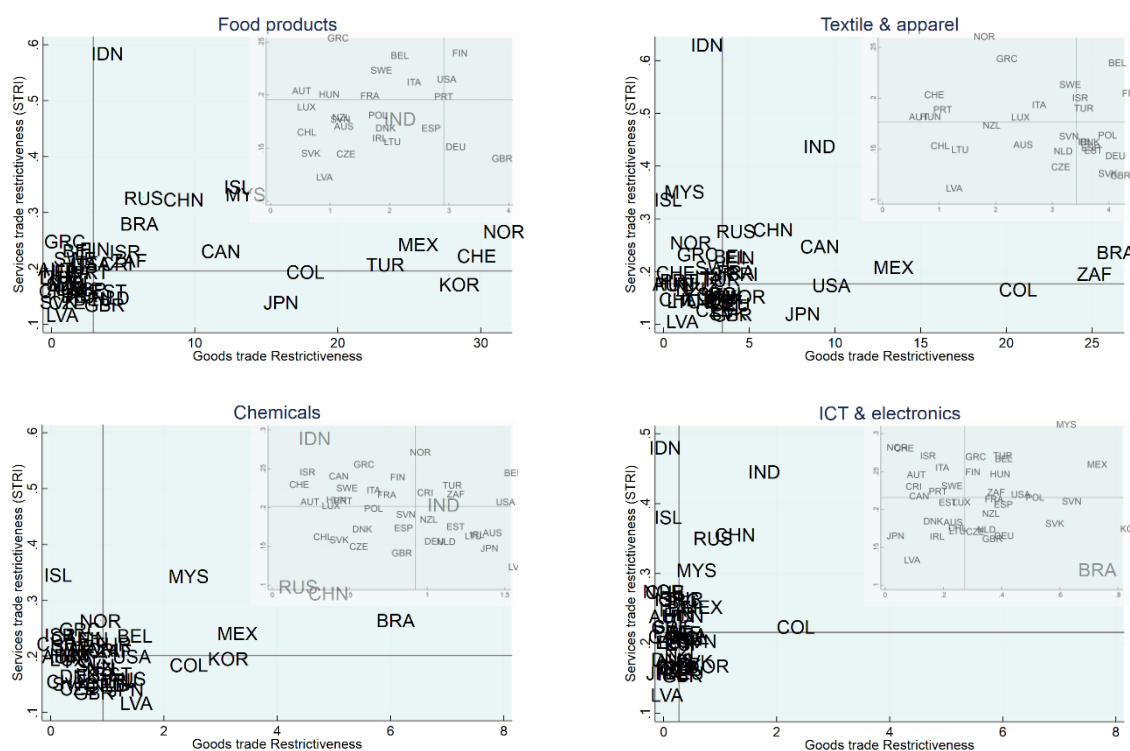
Source: STRI, TRAINS and own calculations based on ORBIS database.

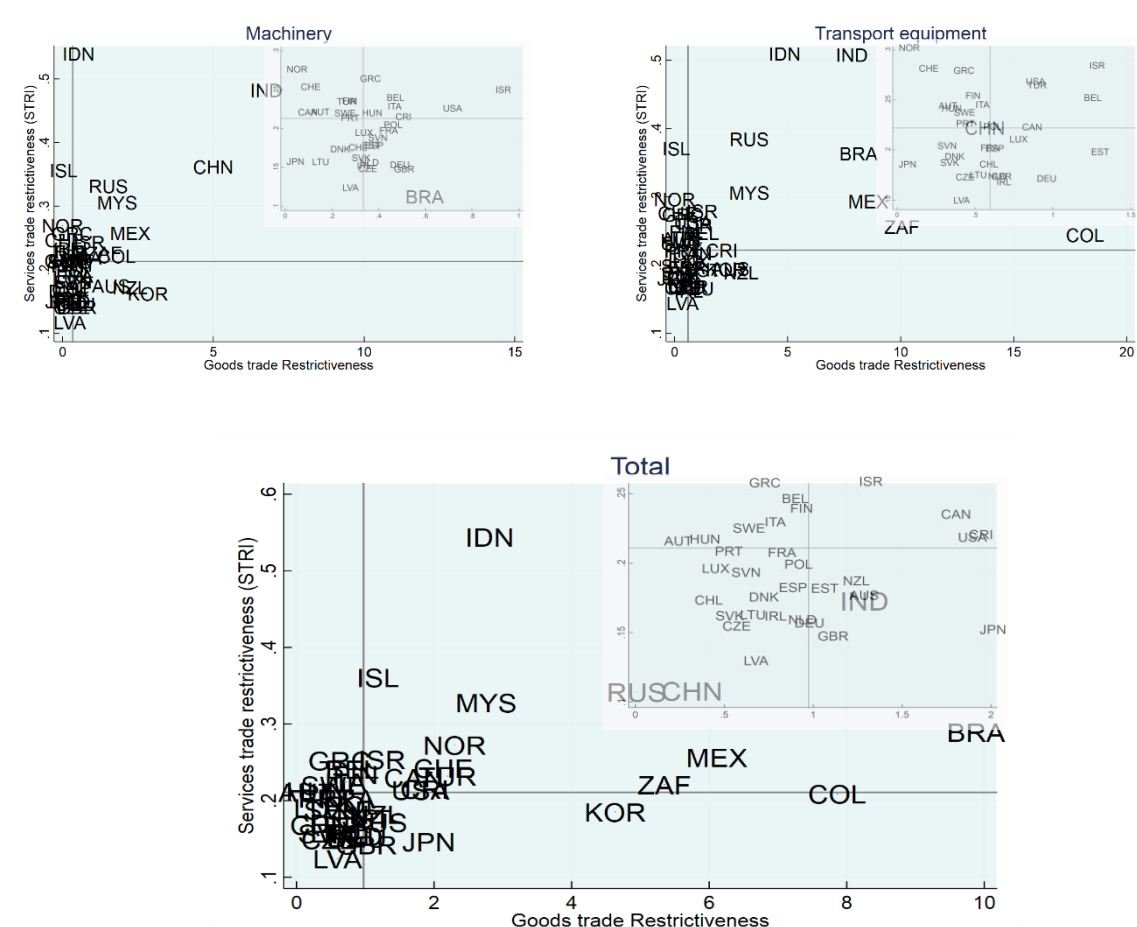
The upper right quadrant points at combinations of goods and services that are affected both by relatively high barriers for the good and for the service. The combination facing the most restrictive trade regime is ‘food processing’ and ‘transport services’. On the contrary, in the bottom left quadrant, ‘distribution services’ for ‘ICT & electronics’ is the bundle for which the trade regime is the most liberal. ‘Professional services’ supplied with ‘ICT & electronics’ would face the most restrictive services trade regime but most liberal goods trade regime. ‘Distribution services’ for ‘food processing’ illustrate the opposite case: a liberal services trade regime but high tariffs on the goods exported.

The analysis can also be done by country (importing economy) with an average STRI and average tariff across the different types of bundles (Figure 4.3). However, it should be stressed that we have no country information on imports of bundles of goods and services. For this Figure, it is assumed that each country is importing in the same proportion the different types of bundles of goods and services that were identified as prevalent in the previous section. Figure 4.3 is only based on differences in the STRI and average *ad valorem* tariff for each country and industry as an illustration of the way joint restrictiveness can be assessed.

There are countries, such as Indonesia, which have a high STRI (i.e. a rather restrictive services trade regime) but low average tariffs for goods (in most industries). For others, such as Brazil, it is the opposite: a relatively low STRI but higher average tariffs (again with differences across industries). At the end, when assessing the ‘joint restrictiveness’, the most trade restrictive economies are countries such as India (for food processing or chemicals) or China (for transport equipment) that do not have the highest STRI or the highest average tariff but that combine relatively high restrictions both on services and on goods. Chile, the Slovak Republic, the Czech Republic and Latvia are the countries with the lowest trade barriers on both the goods and services that tend to be exported as bundles (on average across all industries).

Figure 4.3. Joint trade restrictiveness, by country, selected industries, 2016





Note: Values differ only based on differences in tariffs and STRI indices. Bundles of goods and services are assumed to be imported in the same proportion in each country. Trade restrictiveness corresponds to average *ad valorem* tariff.

Source: STRI database, TRAINS database and own calculations based on ORBIS database.

#### 4.3. Contract enforcement, business environment and barriers to data flows

In addition to barriers affecting the service or the good exported (and that would be the same if they were exported separately), one can also assume that the combination of the good and the service leads to specific issues on the exporter's side. It is difficult to assess whether there are barriers targeting specifically the joint export, as the analysis of trade restrictiveness is also typically done separately for goods and services. But what the literature suggests is that contract enforcement is an important determinant of the success of servitisation strategies. As it was highlighted before, the servitisation often consists in replacing the sale of the good by a contract covering the provision of the good and related services. Manufacturing firms should be able to set up such contracts, deal with all regulations needed for the provision of their service and the contract should be enforced (both on the supplier and customer side).

Since servitisation strategies rely on the exchange of information with the customer, the capacity for the manufacturing firm to organise processes and manage activities where the customer is located, the ease of doing business is also likely to have a positive impact. Trade facilitation, investment facilitation and other policies aimed at improving the business environment can facilitate the shift of manufacturing firms to services. Such policies benefit all firms and not just those involved in servitisation strategies. But when firms have to combine activities for which there

is a different regulatory regime, costs are likely to be multiplied rather than added. Manufacturing firms shifting to services can therefore benefit more from the streamlining of administrative procedures and trade and investment facilitation.

Finally, in an increasingly digitalised economy, policies related to cross-border data flows and privacy can also be seen as part of the conducive environment that can allow manufacturing firms to sell and export solutions. To provide process-oriented services, interactions with customers are central and involve collecting data, monitoring performance, tracking devices and integrating information systems between the provider and the customer (Coreynen, Matthyssens and Van Bockhaven, 2017<sup>[10]</sup>). The international provision of such services involves cross-border data flows. A related policy that can also have a very positive impact is the effective protection and enforcement of intellectual property. Bundles of goods and services were found prevalent in manufacturing industries such as pharmaceuticals (in relation to health solutions) for which intellectual property matters.

## 5. Concluding remarks

This report has provided new evidence on the interactions between trade in goods and trade in services and further explored the policy implications of strategies of firms that sell together goods and services (i.e. servitisation of manufacturing).

The main findings are the following:

- Due to the strict separation between goods and services in trade statistics and national accounts, it is difficult to document and assess the prevalence of services exported together with goods.
- There is however a broad literature on the servitisation of manufacturing and empirical work based on firm-level data highlights the important role of manufacturing firms in exporting services. Additional OECD research using the ORBIS database confirms the significant number of firms involved in the production of both goods and services.
- This new empirical analysis cannot give reliable estimates on the share of services exported together with goods but provides insights on the relevant GATS sectors and manufacturing industries.
- Leaving aside the specific case of distribution services (that are provided by most manufacturing firms even in the absence of a servitisation strategy), ‘other business services’, ‘construction services’ and ‘research and development services’ are the most common services supplied by manufacturing firms.
- With respect to industries, ‘paper and printing’, as well as ‘repair and installation’, come first in terms of the prevalence of bundles of goods and services but these industries already include the provision of services in their definition (ISIC classification). Industries such as ‘wood’, ‘pharmaceuticals’ and ‘ICT & electronics’ are the ones where the servitisation is the most prevalent.
- Based on the sample analysed, firms engaged in servitisation strategies tend to have larger sales and value-added, a higher share of intangible assets and more employment per unit of value added. Servitisation is a strategy more observed in large firms and these firms tend to have characteristics closer to service firms (use of intangible assets, more employment in the production process).
- Although the trade regime is not the same for goods and for services (whether at the multilateral level, regional level or domestically), there are relatively clear rules when it

comes to applying regulations, determining customs valuation or implementing rules of origin for bundles of goods and services.

- But since trade restrictiveness is generally higher for services, the servitisation means that manufacturing firms face higher trade barriers. Traditional barriers to trade in goods, such as tariffs, affect the provision of the service, while the service itself also faces trade barriers that are specific to services. It suggests a joint assessment of the impact of restrictive trade policies for goods and services. Firms engaged in servitisation strategies can only export if there is trade liberalisation both for the good and the service they sell together.
- With the exception of distribution services (that are not the ones representative of the servitisation), significant barriers to trade in services (and related goods) are observed for bundles of goods and services. Some countries also appear more restrictive for joint exports of goods and services (i.e. cumulate high barriers for trade in services and trade in goods).

To conclude, manufacturing firms shift to services to add value, to remain competitive, to address the challenges of the digital economy and to better serve their customers. By doing so, they face new barriers on their export markets related to the provision of services. The increasingly services-driven strategies of manufacturing firms can be facilitated by: (i) more co-ordination between trade rules for goods and services, (ii) a joint assessment of trade barriers for services and goods, and (iii) a joint agenda in terms of liberalising both the regime for goods and for the related services.

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## **Annex A. Further explanations on the methodology and additional results**

The objective of the empirical work is to identify firms that are potentially selling bundles of goods and services. Data on firms producing both goods and services are scarce. In national accounts, the supply matrix provides information on the provision of different products by each industry. However, not all countries report this information and the product coverage is limited. For instance, BEA's supply table for the United States fully covers the sectors "Computer systems design and related services" and "miscellaneous professional, scientific, and technical services" but has limited information on other services. The French supply table only provides diagonal elements which do not permit to identify bundles. The output of each industry is fully accounted for in the products corresponding to the industry.

To overcome these limitations, we use firm-level data from the ORBIS database. We have different ways of identifying manufacturing firms that produce services in this dataset. The first source of information is the industry of registration of the firm and NACE codes for its core and secondary activities. The second source is the description of the firm that can include information on the products it sells. Lastly, we can also use the ownership information to identify the services affiliates of manufacturing multinationals.

In order to classify firms in different manufacturing industries according to the services they might sell with their product, we work with a sub-sample of firms with a core activity in manufacturing. We convert NACE codes into their equivalent in the International Standard Industrial Classification (ISIC). Then, we look at the services these firms can provide on the basis of the WTO W/120 classification of services.

### **Identifying bundles of goods and services through industry and activity codes**

After having sampled the manufacturing firms, their secondary (service) activity is converted into the Central Product Classification revision 2.1, then into the W/120 classification. A single firm can report several secondary activities. In this case, the firm is involved in different combinations of goods and services.

### **Matching GATS categories with the firm's description**

Second, firms offering bundles of goods and services are identified based on their description. We use the bag of keywords in the firm's description, as well as combinations of keywords (from two words to four words). For each ISIC sector at the two-digit level, a sample of 1000 randomly chosen firms was analysed to identify the keywords or combination of keywords that point to the services sold together with goods.

**Table A.1. Example of word matching with the GATS category '1.B. Computer and related services'**

GATS sector	Words	Combination of two words	Combination of three words	Combination of four words
1.B. Computer and related services	saas	programming services, computer services, software development, software consultancy, software service, software publishing, application software, performance software, management software, software developer, accounting software, software house, data processing, develop softwares, software solutions, software package, data protection, software services, computer software, data processing, software development, online software, hardware consultancy	development of software, database management, data collection, computer aided manufacturing, computer technology development, data processing services, computer systems design, data base activities, graphic design services, electronic chips programming, computer related services, data capture services, computer systems consultancies, computer related services	data and analytical solutions, digital and creative solutions, development of computer software, servicing of consumer electronic, manage large unstructured data, computer systems housing services, computer network information system

### Matching GATS categories with sales of foreign affiliates

Lastly, we estimate exports of services by manufacturing firms through commercial presence (Mode 3 in GATS). To do so, we work with a sample of multinational enterprises in the manufacturing sector for which we have consolidated accounts. We merge these data with the unconsolidated accounts from their services affiliates that are located in a foreign country and we calculate the share of turnover of the affiliate in the consolidated turnover of the parent company. Results are presented in Table 3.5.

**Table A.2. Mapping of services embedded in goods, by GATS sector and industry based on firms' descriptions, 2018**

	Food products		Textiles & apparel		Wood	Paper & printing	Coke, petroleum	Chemicals	Pharmaceuticals	Rubber & plastics	Non-metal minerals	Metals	ICT & electronics	Electrical equipment	Machinery	Transport equipment	Furniture	Manufacturing NEC	Repair
	3	2	3	20	3	10	7	8	2	4	7	6	6	5	3	8	54		
1. Business services	0	0	0	1	0	0	1	0	0	1	1	1	1	1	0	0	0	2	
1.A. Professional services	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.A.a. Legal Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.A.b. Accounting, auditing and bookkeeping services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.A.c. Taxation Services	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	
1.A.d. Architectural services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.A.ef. Engineering services; Integrated engineering services	0	0	0	1	0	0	0	0	0	1	1	1	1	1	0	0	0	2	
1.A.g. Urban planning and landscape architectural services	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	
1.A.h. Medical and dental services; 1.A.j. Services provided by midwives, nurses, physiotherapists and para-medical personnel	0	0	0	0	-	0	0	0	-	0	0	0	0	0	0	0	0	0	
1.A.i. Veterinary services	0	0	0	-	-	0	1	0	-	0	0	0	0	0	-	-	0	-	
1.B. Computer and related services	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	
1.C. Research and development services	0	0	0	0	1	1	4	0	0	0	2	1	1	1	1	0	0	0	
1.D. Real estate services	1	0	1	1	0	0	0	0	1	1	0	0	0	0	0	1	1	1	
1.E. Rental/leasing services without operators	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.F. Other business services	2	2	1	19	3	8	2	7	1	2	4	3	5	4	3	7	52		
1.F.a. Advertising services	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	
1.F.b. Market research and public opinion polling services; 1.F.c. Management consulting service; 1.F.d. Services related to man. Consulting	0	1	0	1	1	1	1	0	0	1	1	1	1	1	1	0	0	0	
1.F.e. Technical testing and analysis serv.	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	
1.F.f. Services incidental to agriculture, hunting and forestry; Services incidental to fishing; Services incidental to mining; Services incidental to manufacturing; Services incidental to energy distribution	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	2	0	1	
1.F.k. Placement and supply services of personnel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.F.l. Investigation and security	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.F.m. Related scientific and technical consulting services	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	
1.F.n. Maintenance and repair of equipment	0	0	0	1	0	0	0	1	0	1	1	1	1	2	0	0	50		
1.F.o. Building-cleaning services	0	0	0	1	0	7	0	0	0	0	0	0	1	0	0	0	1		
1.F.p. Photographic services	-	0	0	0	-	0	-	0	0	0	0	-	-	-	-	1	0		
1.F.q. Packaging services	1	0	0	3	0	1	1	5	0	0	0	0	1	0	0	0	0	0	
1.F.r. Printing, publishing	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.F.s. Convention services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2. Communication services	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
2.A. Postal services; 2.B. Courier services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0		
2.C. Telecommunication services	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
2.D. Audiovisual services	0	0	0	0	-	0	-	0	-	0	0	0	0	0	0	0	0	0	
3. Construction and related engineering services	0	0	37	2	1	0	0	1	1	2	1	3	2	1	1	1	9		
4. Distribution services	6	4	2	2	7	7	11	4	5	3	5	10	5	5	3	4	3		
5. Educational services	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6. Environmental services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7. Financial services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8. Health related and other social services	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	
9. Tourism and travel related services	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10. Recreational, cultural and sporting services	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
11. Transport services	0	0	0	0	2	0	0	3	0	1	0	0	1	7	0	0	5		
11.A. Maritime transport services; 11.B. Internal waterways transport	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
11.C. Air transport services	0	0	-	0	-	0	-	0	0	0	0	0	0	0	-	0	0		
11.D. Space transport; 11.G. Pipeline transport; 11.H. Services auxiliary to all modes of transport; 11.I. Other transport services	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2		
11.E. Rail transport services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total (thousands)	703	397	156	207	15	146	31	152	122	459	188	123	256	121	99	197	147		

Source: Authors own calculations based on ORBIS database.

**Table A.3. Mapping of services embedded in goods, by GATS sector and industry based on firms' descriptions, 2018**

	Food products	Textiles & apparel	Wood	Paper & printing	Coke, petroleum	Chemicals	Pharmaceuticals	Rubber & plastics	Non-metal minerals	Metals	ICT & electronics	Electrical equipment	Machinery	Transport equipment	Furniture	Manufacturing NEC	Repair
1. Business services	4	5	10	28	13	6	7	13	6	10	10	8	11	5	10	9	39
1.A. Professional services	0	0	1	1	1	1	2	1	1	1	2	1	2	1	1	1	2
1.A.a. Legal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.A.b. Accounting, auditing and bookkeeping services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.A.g. Urban planning and landscape architectural services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.A.h. Medical and dental services	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1.A.i. Veterinary services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.B. Computer and related services	0	0	0	9	0	0	0	0	0	0	2	0	1	0	0	1	1
1.B.b. Software implementation services	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
1.B.d. Data base services	0	0	0	8	0	0	0	0	0	0	1	0	0	0	0	0	0
1.C. Research and development services	0	0	0	0	0	1	2	0	0	0	1	0	1	0	0	0	0
1.C.a. R&D services on natural sciences	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0
1.C.b. R&D services on social sciences and humanities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.D. Real estate services	1	0	2	1	0	0	1	1	1	1	0	1	1	0	1	0	1
1.D.a. Involving own or leased property	1	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0
1.D.b. On a fee or contract basis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.E. Rental/leasing services without operators	0	0	1	1	0	0	0	0	1	1	0	0	1	1	0	1	2
1.E.c. Relating to other transport equipment	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1
1.E.d. Relating to other machinery and equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.E.e. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.F. Other business services	3	4	8	25	12	5	4	12	5	8	7	7	9	4	9	7	37
1.F.a. Advertising services	0	0	1	3	0	0	1	0	0	0	0	0	0	0	0	1	0
1.F.b. Market research and public opinion polling services	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0
1.F.c. Management consulting service	0	0	1	1	0	0	1	0	0	0	2	1	1	0	0	0	1
1.F.e. Technical testing and analysis serv.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1.F.f. Services incidental to agriculture, hunting and forestry	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1.F.h. Services incidental to mining	0	0	1	0	9	0	0	0	1	1	0	0	1	0	0	0	1
1.F.i. Services incidental to manufacturing	0	0	2	2	1	2	0	9	1	4	3	3	5	1	4	2	5
1.F.j. Services incidental to energy distribution	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
1.F.k. Placement and supply services of personnel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.F.l. Investigation and security	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.F.n. Maintenance and repair of equipment	0	2	2	1	0	0	0	1	1	2	2	3	2	1	4	2	31
1.F.o. Building-cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.F.p. Photographic services	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1.F.r. Printing, publishing	0	1	0	19	0	0	0	1	0	0	0	0	0	0	0	1	0
1.F.s. Convention services	1	1	1	3	0	1	1	1	1	1	1	0	1	1	1	2	1
2. Communication services	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1
2.A. Postal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.B. Courier services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.C. Telecommunication services	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2.D. Audiovisual services	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2.D.a. Motion picture and video tape production & distribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Construction and related engineering services	1	1	9	1	2	1	1	3	6	6	1	3	3	1	7	1	8
3.A. General construction work for buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.B. General construction work for civil engineering	0	0	2	0	1	0	0	1	2	1	0	1	1	0	1	0	1
3.D. Building completion and finishing work	0	0	7	1	1	1	0	2	3	3	0	1	1	0	6	1	2
3.E. Other	0	0	4	1	1	1	0	2	4	4	1	2	2	1	2	1	7
4. Distribution services	23	17	16	10	12	14	11	13	13	10	11	11	11	10	20	15	14
4.A. Commission agents' services	0	0	1	0	0	0	0	2	0	0	0	0	0	3	0	0	1
4.B. Wholesale trade services	11	8	11	6	9	11	9	8	8	7	8	9	9	4	11	8	7
4.C. Retailing services	16	12	10	7	6	6	5	6	8	6	5	4	4	5	15	10	8
4.D. Franchising	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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	Food products	Textiles & apparel	Wood	Paper & printing	Coke, petroleum	Chemicals	Pharmaceuticals	Rubber & plastics	Non-metal minerals	Metals	ICT & electronics	Electrical equipment	Machinery	Transport equipment	Furniture	Manufacturing NEC	Repair
5. Educational services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.A. Primary education services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.B. Secondary education services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.C. Higher education services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.E. Other education services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6. Environmental services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7. Financial services	1	0	1	1	1	1	1	1	0	0	1	0	1	0	0	0	0
7.A. All insurance and insurance-related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.B. Banking and other financial services (excl. insurance)	1	0	1	1	1	1	1	1	0	0	1	0	1	0	0	0	0
8. Health related and other social services	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
9. Tourism and travel related services	7	1	1	1	0	0	1	0	1	0	0	0	1	1	1	1	0
9.A. Hotels and restaurants (incl. catering)	7	0	1	0	0	0	1	0	0	0	0	0	0	1	1	1	0
9.B. Travel agencies and tour operators services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10. Recreational, cultural and sporting services	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
11. Transport services	2	1	4	1	4	2	1	3	3	2	1	1	2	5	3	1	9
11.A. Maritime transport services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.B. Internal waterways transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.C. Supporting services for air transport	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
11.E. Rail transport services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.G. Pipeline transport	1	0	1	1	3	1	1	1	1	1	0	0	1	1	1	1	1
11.H. Services auxiliary to all modes of transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.I. Other transport services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (thousands)	1,989	2,294	818	1,139	93	649	146	694	923	2,223	752	571	1,264	529	669	976	924

Source: Authors own calculations based on ORBIS database.

**Table A.4. Mapping of services embedded in goods, by GATS sector and industry based on multinational enterprises, 2016**

Industries	Orbis		TIVA
	Count	Operating revenue Turnover	Gross output
C10T12 Food processing	11	11	15
C13T15 Textiles	8	2	6
C16 Wood	7	1	2
C17T18 Paper	8	3	3
C19 Coke and petroleum	0	10	7
C20T21 Chemical products	3	11	11
C22 Rubber and plastic products	5	3	4
C23 Mineral products	5	2	4
C24T25 Metal products	16	10	13
C26 Computer, electrical & optical products	4	13	8
C27 Electrical machinery	3	3	4
C28 Machinery and equipment	8	7	7
C29T30 Transport equipment	3	18	12
C31T33 Manufacturing nec; repair	19	4	4
Total percentage point differences	65	31	/

Source: Authors own calculations based on ORBIS database ORBIS database.

Table A.5. Distribution of industries

Industries	Count	ORBIS	TiVA
		Operating revenue turnover	Gross output
C10T12 Food processing	11	11	15
C13T15 Textiles	8	2	6
C16 Wood	7	1	2
C17T18 Paper	8	3	3
C19 Coke and petroleum	0	10	7
C20T21 Chemical products	3	11	11
C22 Rubber and plastic products	5	3	4
C23 Mineral products	5	2	4
C24T25 Metal products	16	10	13
C26 Computer, Electrical & optical products	4	13	8
C27 Electrical machinery	3	3	4
C28 Machinery and equipment	8	7	7
C29T30 Transport equipment	3	18	12
C31T33 Manufacturing nec; repair	19	4	4
Total percentage point differences	65	31	/

Source: Own calculations based on ORBIS database, OECD TiVA database.