

MANUFACTURING AND SERVICES INTERACTIONS IN INTERNATIONAL TRADE AND GLOBAL VALUE CHAINS

Abstract. *We explore patterns and trends in interactions involving manufacturing and services in international trade based on trade in value added data. The analysis results show a weak upward trend in the intensity of links between services and manufacturing from 2000 to 2014 in the EU. Foreign services gained in importance in the value added of manufacturing exports across all EU economies, and relatively more in new EU member states, including Slovenia. The analysis points to the dominant role played by services in international business processes, holding implications for public policies, firms' strategies and the directions of future research.*

Keywords: *services, trade in value added (TiVA), services exports, manufacturing exports, global value chains, WIOD database, input-output model*

Introduction

In the last 50 years, driven by several factors, international trade has recorded dynamic growth. These include the gradual liberalisation and lowering of regulatory barriers within multilateral trade negotiations that were crucial in the first part of the period, while later on rapid technological progress and lower transport costs seem to have become more important. While expanding international trade benefits most countries, it is very important for economies with smaller domestic markets as they become able to source various inputs more easily and cheaply. Further, the emergence of Global Value Chains (GVCs) and intensive integration of businesses and economies into international transactions has been a new lever for growth and development. These trends, especially technological disruptions, and structural changes towards services and intangibles, add to the complexity of international economic relations with interlinkages and interdependence building between actors at national and international levels.

A particularly noticeable direction in this respect entails the deepening

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and broadening of the links existing between two major economic sectors – manufacturing and services – and to the blurring of the boundaries between them. On one hand, service firms are increasingly using new equipment (for example, in transport or distribution) and information-communications hardware to create innovative services for final and intermediate consumers. In contrast, manufacturing firms are extensively integrating services and service activities into production and distribution processes. Due to new technologies, digitalisation and the dominant share held by services in value added, manufacturing's dependence on services and service functions is escalating. In 2011, services' value added constituted 40 percent of the value of final manufacturing goods in the EU. Moreover, in-house production of services by employees working in service occupations in manufacturing is significant, accounting for 42 percent of employees in EU manufacturing in 2015 (Nordwal, 2016).

Forced by global competition, manufacturing companies are seeking new sources for value creation to sustain and improve their competitive position. They complement their production of goods by also providing services (i.e. servitisation of manufacturing) that differentiates them from other suppliers of goods. The provision of services usually brings in higher revenue to manufacturing companies than goods alone and helps better address customer needs (Crozet and Milet, 2015). In addition, they establish long-term relationships, in particular when installation, technical and maintenance services can considerably influence the efficiency of equipment.

These patterns in the composition of value creation in manufacturing translate in the area of international trade as services' value added contributes an important share to manufacturing exports. The pattern exists in both developed and emerging market economies due to the availability of enabling technology and better responding to customer/market needs. The intensity of the links differs across countries depending on their size, degree of in-house provision of services, and other reasons. Another driver of the intensive interactions of manufacturing and services stems from the new production patterns seen within GVCs and the splitting up of manufacturing production into several tasks performed by specialist producers at different global locations. The functioning and efficient performance of GVCs is impossible without a variety of services ranging from transportation, information-communications services, design, distribution, and marketing (Stephenson, 2012). Service companies have also been establishing GVCs, yet the analysis shows these GVCs based on services are less fragmented than the goods value chains (Lanz and Mauer, 2015).

The article's main aim is to analyse patterns and trends in interactions between manufacturing and services in international trade, and to contribute new knowledge that may assist in shaping policy. We hypothesise

strong interlinkages exist between the two sectors, and explore the origin of the value added in services and manufacturing exports, as well as possible changes in the dynamics and direction of change in the EU's international trade between 2000 and 2014. Special emphasis is paid to the characteristics of these processes in Slovenia as an economy highly integrated into international trade due to the limitations of its local market. The biggest contribution is the new empirical evidence provided concerning the composition of value added in manufacturing and services exports based on a longer time series, where the focus is on the EU and on Slovenia. The key findings show the rising share of foreign services in the value added of manufacturing gross exports (and falling share of domestic services' value added) across EU countries, along with diminishing share of domestic manufacturing in the total value added of services gross exports. Slovenia is catching up with EU trends. These findings are particularly relevant for public policy and managerial strategies, especially in a setting of growing protectionism.

The structure of the article is as follows. After a short introduction, we present the theoretical background underpinning the rationale of the analysis, which involves both a discussion of a novel concept for measuring international trade and the evolving debate on the interactions between different sectors in international trade. Drivers of the latter phenomenon primarily relate to rapidly changing technologies, increased global competition and introduction of new business models. The methodological section explains the database and the process of calculating the main components of value added in services and manufacturing. The analysis departs from trade in value added data (WIOD, OECD, TiVA) concerned with EU members' international trade. The article's central part discusses insights arising from the analysis of the links between manufacturing and services. Two short cases of GVCs complement the analysis to help enable a deeper understanding of services-manufacturing interrelations. In the conclusion, we consider the analysed phenomena's implications for the shaping of public policy and firms' strategies, while proposing directions for future research.

Theoretical background

Discussions on the role and relations between the two major sectors - services and manufacturing in international trade, have for long been based on the traditional balance-of-payments approach to measuring international trade that follows from the concept of gross flows of goods and services. This has led to double counting of imported inputs used to produce a final product exported afterwards (Koopman et al., 2012). This approach does not allow for proper understanding of the roles played by services and manufacturing in international trade. The compilation of new international trade

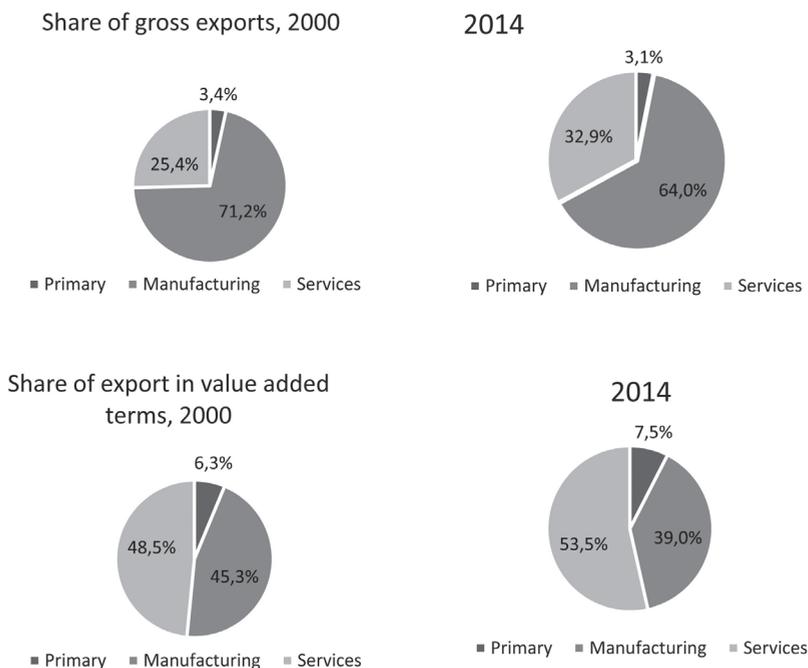
data that originate from the trade in value added (TiVA) concept enables the analysis of international trade to change focus from gross to net flows and to yield insights into trade in intermediates and the vertical integration of production. Net flows better capture the value added of individual stages of the business process at different locations while allowing them to be attributed to an individual country's exports/imports. At the same time, the trade in value added concept provides a broader understanding of the weight of individual sectors in world trade and of their interrelations. This altered perspective of measuring international trade highlights the fact that the service sector's role in internationalisation (and in GVCs) is significantly underestimated when the traditional measurement concept is applied (Low, 2013). Services account for the biggest share of value added in world exports, a fact generally difficult to understand prior to the TiVA database becoming available. A similar discrepancy is seen for data on EU international trade¹ (Figure 1). The share of services in the EU grew between 2000 and 2014 in both categories of exports. In value added terms, services demonstrate the majority share of exports in 2014, accounting for 53.5%.²

The interactions between services and manufacturing are developing alongside progress in economic development as reflected in the business processes of companies and relations between sectors. In the late 1970s, scholars noted that production processes engaged in by companies are interlinked through intermediates in the commodity chain of final products (Hopkins, Wallerstein, 1977) and this finding is considered the conceptual root of the value chain discussion. A value added chain is defined as a series of activities performed by individual companies at different stages of the production and distribution of products to final consumers (Porter, 1985). Parallel to the increasing evidence concerning the interlinkages between different activities of such companies, the rising importance of service inputs for manufacturing was being recognised (Riddle, 1986). Technological progress ignited scholarly discussion on the connectedness of the two sectors, culminating in the proposition that the radical changes occurring in manufacturing are leading to the dominance of services in goods production (Gershuny, 1987). In today's context, this observation no longer seems bold anymore and it is not unusual to observe that manufacturing firms are gradually becoming skill-intensive service firms (NBT – National Board of Trade Sweden, 2016), and transforming themselves from product-centric into service-centric firms (Nie, Shirahada and Kosaka, 2013)

¹ *Since the main aim of the article is to explore the relationships between manufacturing and services, we do not debate the role of primary products that also shows much larger share in value added terms of exports than in gross export (Figure 1).*

² *In 2014, the share of services export in value added terms accounted for 43% in Slovenia, while their share in gross exports was 23%.*

Figure 1: SECTORAL DISTRIBUTION OF EU EXPORTS IN GROSS TERMS (TOP ROW) AND VALUE ADDED TERMS (BOTTOM ROW), 2000 AND 2014 (IN %)



Note: Utilities are counted within the manufacturing sector
 Source: Own calculations based on the WIOD database.

or that part of the future of manufacturing firms lies in services (Crozet and Millet, 2015). Nevertheless, the relationship between manufacturing and services deserves further clarification.

In fact, the computer and/or mobile phone that these days are among the most broadly used final manufactured goods in developed and emerging market economies are indispensable items used throughout the economy. They provide a fundamental platform for new services (e.g. computer-aided design or inventory record via QR code) to emerge. Manufactured goods that enter a services value chain show the other side of the dyadic relation characterised by complementarity, mutual dependence and synergy in co-creating value in several phases. Manufacturing often plays a carrier function for services by embodying the value added created by services in final goods that are exported (Stehrer et al., 2015). Yet, both sectors are undergoing deep changes that also impact the links and relations between them. While in the past manufacturing played the dominant role in this relation, technological progress and organisational changes are shifting the focus over to services and service functions.

The complementarity between manufacturing and services is driven by the advance of the information-communications technology (ICT) enabling deeper specialisation, increasing the weight of intelligent inputs and improving the competitiveness of actors in international trade (Miles and Wyatt, 1991). Manufacturing companies can more easily focus on their core business (e.g. areas of specialisation) and outsource³ the provision of services and other inputs. They thereby lower costs, improve flexibility and quality, in turn impacting the efficiency and competitive position held by manufacturing companies. These developments are seen in both home-market and international trade and have spurred the growth of trade in intermediate goods and services (De Backer et al., 2015).

The breaking up of the production process and specialisation into individual phases/tasks performed at various locations around the globe clearly point to the new focus of competition from industries (e.g. individual manufacturing and service industries) to phases/tasks of production (Timmer et al., 2013; Cataneo et al., 2013). In the context of discussions on between manufacturing-services interrelations in both international trade and global value chains (GVCs) this suggests that the effective provision of different tasks in the business process is very relevant to the efficiency of manufacturing or service GVCs.

Analysis of the value creation process within a GVC of a manufacturing company that produces computers inspired the conceptual model of a stylised “smile curve” that describes the relative value added of suppliers in individual phases of the production process (Shih, 2005). In line with this concept, various service tasks/activities in pre-manufacturing phases (e.g. development, innovation, design) and in post-manufacturing tasks (e.g. such logistics, marketing and after-sales services) are considered to create relatively more value added than the manufacturing process itself. Accordingly, service activities seem to be fundamental in value creation and for the competitiveness of the final product⁴. Since the role played by heterogeneous service activities in the value creation process differs, it was proposed to supplement the smile curve model and integrate standardised services into the central production phase (e.g. in manufacturing). The reasoning for this is that those services add less value than knowledge-based services that are found at the start and end of the business process (Mudambi, 2008). Further, the analysis compared the locations of the individual tasks within the country groups in which they are most frequently carried out. It turned out that

³ *The term offshoring is used when the provision of services and other inputs is carried out by a partner from a foreign country.*

⁴ *The analysis of 45 GVCs confirms that the share of value added in “tangible” phases of production is rather small compared to the share of “intangible” phases (e.g. various services and intellectual capital) (Ali-Yrkkö, Rouvinen, 2013).*

developed economies mainly perform intangible tasks/service activities at the start and end of the value chain. Conversely, emerging market economies concentrate on the manufacturing process that results in tangible products. It is concluded that companies and countries focusing on tasks in the middle of the smile curve are motivated to catch up via developing sources and competencies that lead to higher value added creation and enable the shift over to intangibles and knowledge-intensive services (Mudambi, 2008).

While acknowledging that companies' strategies play a critical role in building the capacity for greater value added content in international trade and for progressing up GVCs, this reasoning logically raises the discussion of how public policies can support companies in their efforts. This discussion needs to depart from assessing countries' export structures based on indicators of trade in value added and links between international trade sectors. In the next section, we present the methodological approach and database for an empirical analysis of the linkages between manufacturing and services in EU member states' international trade since 2000.

Methodological approach and data

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The interlinkages between services and manufacturing activities in international trade are evaluated using input-output methodology and a comparable data set. Traditionally, the analysis of international trade departed from evaluating gross trade flows, whereas applying the new conceptual approach to measuring international trade allows to assess actual value added flows between countries and sectors. By breaking down all costs entailed in a single good or service (for country and/or sector of origin), we can trace every single element of the 'value creation activity' for every good or service of final demand.

To perform such calculations, large databases are required along with a coordinated approach by several international organisations (e.g. OECD, WTO, EC). Their efforts have led to the merging of national input-output data within a single world input-output table based on aggregate flows between each sector and each country. Our calculations are based on the 2016 edition of the World Input-Output Database (WIOD) that considers 43 countries (and the residue Rest of the World) and 56 sectors. Use of the WIOD database instead of the TiVA database that covers 63 countries and 34 sectors is due to the larger timespan of the WIOD data (2000-2014) that also enables inclusion of the post-crisis period, while the TiVA database analysis currently ends with data for 2011.⁵

The basic input-output approach was formalised by Wassily Leontief

⁵ *The use of latest available WIOD instead of TiVA data set is also the reason for differences between*

(1936) who formulated an equation determining total output as a function of final demand: $X=(I-A)^{-1}F$.⁶ This model and methodology are used also today when analysing international trade flows between countries. In doing so, we significantly expand the dimensions of datasets (by a factor equal to the number of countries observed in the WIOD database) since one must trace an individual trade flow between each sector of each country. Using this approach enables all international trade relations to be observed in value added terms between countries and sectors. Even if this methodology has some inherent limits⁷, its application allows broad, long-term trends and processes across countries to be identified that may be considered as a relevant approximation of the actual dynamics and structural changes of international trade.

Results and discussion of the main findings

Applying the described method, we examined the links between services and manufacturing in terms of value added in the total exports of EU economies. More precisely, we explored the role of services in manufacturing by accounting for the share of services in the value added of manufacturing gross exports, which was further broken down into:

- a. The share of domestic services in the value added of manufacturing gross exports
- b. The share of foreign services in the value added of manufacturing gross exports

Similarly, we examined the role of manufacturing in services by accounting for the share of manufacturing in the value added of services gross exports, where we distinguish:

- a. The share of foreign manufacturing in the value added of services gross exports

GVC country profiles available at WTO and our calculations. Differences between 2018 and 2016 TiVA indicators arise from the use of SNA 2008 and ISIC 4 classification.

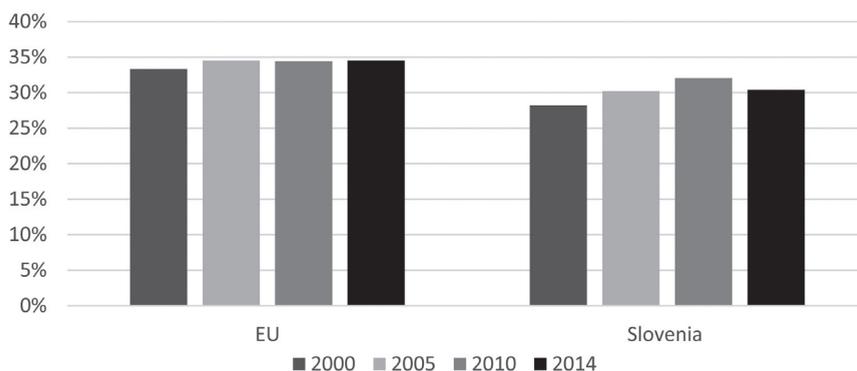
⁶ While total output (X) and total final consumption (F) are simple vectors, the intermediate consumption can be formulated as a matrix, of which each element represents intermediate consumption of a good or service produced by one sector by the other sector. Intermediate demand is thus a function of total output (AX), where A represents input-output technical coefficients.

⁷ The trade flows between sectors (and countries) are constructed as yearly sectoral averages, cannot differentiate between different companies and model them as averagely productive. Secondly, trade flows are assumed to be average costs in national accounting data between companies and all the relevant decomposition of work inside one company is lost, (simple example would be service job inside a manufacturing company), because all the value creation is accounted as value creation in the sector of company classification. Data thus gives different results for countries with companies more prone to outsource various production activities than for countries with companies more prone to accommodate activities inside one legal account. Accordingly, the results of the empirical analysis need to be interpreted with caution.

b. The share of domestic manufacturing in the value added of services gross exports

To decompose the two sectors' value added in gross exports, we observed the changes since 2000 and in selected 5-year difference intervals, except for 2014 which was when the latest data were available (namely: 2000, 2005, 2010, 2014). In this way, we were able to explore the dynamics of the inter-linkages between manufacturing and services over a period of 15 years and detect changes between the pre- and post-crisis periods. Figure 2 presents the share of services in the total value added of manufacturing gross exports for the EU (EU-28) and gives comparative information for Slovenia as the country in focus in our analysis (Figure 2). Table 1 in Appendix presents the data for the 'old' (EU-15) and 'new' (EU-13) member states.

Figure 2: SHARE OF SERVICES IN THE TOTAL VALUE ADDED OF MANUFACTURING GROSS EXPORTS IN THE EU AND IN SLOVENIA, SELECTED YEARS (IN %)



Source: Own calculations based on the WIOD database.

In the first period (2000–2005), the share of services (foreign and domestic) in the value added of manufacturing gross exports in the EU saw a small rise while afterwards remaining fairly stable at 34.5% in 2014. Slovenia lags behind the EU in the share of services in value added of manufacturing gross exports for the whole period under observation, but the gap has narrowed. The differences between the two EU country groups (Table 1 in Appendix) are not large, neither in absolute terms nor in the dynamics of change. The share of services in the value added of manufacturing is slightly higher in the EU-15 than in the EU-13. Slovenia shows a relatively smaller share of services in the value added of manufacturing exports but a bigger change over the entire period; from 28.2% in 2000, this share rose

to 32% in 2010 but then declined to the pre-crisis level (30.4%) in 2014.

Exploration of the origin of services' value-added inputs reveals new findings and differences. The data show a consistently growing share of foreign services in the total value added of EU manufacturing gross exports (Figure 3). International trade in services is increasingly relevant for European manufacturing exports as its competitiveness is strongly related to services (Nordwal, 2016). While in 2000 domestically-sourced services still represented the majority of service inputs used in EU manufacturing exports, the situation changed in 2010 when foreign services started to account for a bigger share of value added than domestic ones. Between 2000 and 2014, the EU increased the share of foreign services' value added from 15.1% to 19.1%, while the share of domestic services in the value added of manufacturing exports shrank from 18.2% to 15.4%. The substitution of domestic for foreign services input seems more intensive in the old EU members, although both country groups reveal the same pattern (Appendix). Exports of Slovenian manufacturing seem to rely on foreign services' value added to an even larger extent as they account for the rising share of value added of manufacturing exports. The share of domestic services in the value added of manufacturing exports from Slovenia fluctuated over the period under study, but dropped by 1.5 percentage points since 2000.

Figure 3: SHARE OF FOREIGN AND DOMESTIC SERVICES IN THE VALUE ADDED OF MANUFACTURING EXPORTS (IN %)

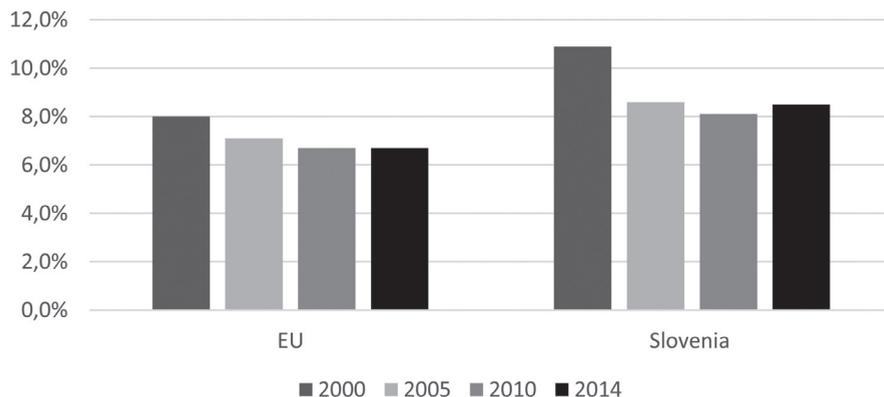


Source: Own calculations based on the WIOD database.

As discussed in the theoretical overview, the stronger contribution of foreign services may have different origins: a consequence of changes in technological intensity, the greater internationalisation of European manufacturing firms via GVCs and procurement of services from subsidiaries abroad, or from more competitive service providers via arms'-length

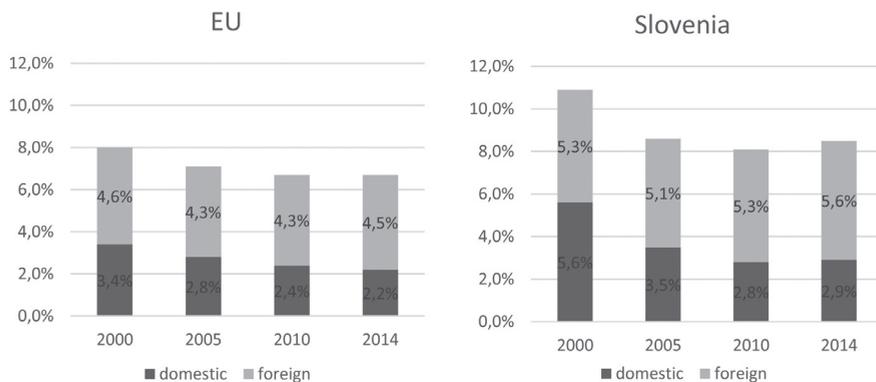
transactions. The latter may in particular apply to Slovenia and other new member states (EU-13) for whom the development of services has followed a different development pattern than in the EU-15.

Figure 4: SHARE OF MANUFACTURING IN THE TOTAL VALUE ADDED OF SERVICES GROSS EXPORTS (IN %)



Source: Own calculations based on the WIOD database.

Figure 5: SHARE OF FOREIGN AND DOMESTIC MANUFACTURING IN THE VALUE ADDED OF SERVICES EXPORTS (IN %)



Source: Own calculations based on the WIOD database.

Overall, the stagnation of services' share in the total value added of EU manufacturing exports since 2010 may be the outcome of a variety of factors. The global recession could be one reason since companies may change business decisions when growth is sluggish and instability rising in

international markets. It may be expected that in such an environment manufacturing companies increasingly source services from foreign affiliates and that these transactions are not necessarily captured by foreign trade data (intra-firm transactions). The observed trends in services' share in the value added of EU manufacturing exports also needs to be considered from the aspect of changes in manufacturing's employment structure where service jobs are increasing dynamically. In the period 2005–2015, the share of employees performing service jobs in EU manufacturing grew from 39% to 45% (Mirodout and Cadestin, 2017). These figures show yet another dimension of services' integration into manufacturing that may reflect the substitution of the use of external services with the use of in-house services.

To explore the reverse situation of the interlinkage between manufacturing and services, we moved past the perspective of considering the intensity of manufacturing inputs in services exports (Figure 4). At first glance, it is evident that services' contribution to value added in manufacturing exports is much higher than vice versa. The share of manufacturing in the value added of services' gross exports in the EU was slowly declining from 8% in 2000 to 6.7% in 2014, owing mainly to the shrinking domestic value added. In Slovenia, the share of manufacturing in the value added of service exports is higher than in the EU and this share fell more rapidly than in the EU. In the period 2000–2014, the share of foreign manufacturing in the value added of services exports from Slovenia remained stable while the share of domestic manufacturing declined steeply (most likely because the new equipment is chiefly sourced from abroad).

The observed downward trend in manufacturing's share in the total value added of services exports in both the EU and in Slovenia is driven by the decline of domestic manufacturing. This is perhaps explained by the fact that the competition in goods markets is greater than in services markets due to the intrinsic features of services (e.g. intangibility, need for close contact between supplier and customer). This may have led to the decline in the relative prices of ICT equipment most frequently used by service industries compared to the trend of the growing relative prices of services.

The distinction between the share of foreign and domestic manufacturing in the value added of exported services (Figure 5) reveals the share of foreign manufacturing in the value added of services exports in the EU was relatively stable between 2000 and 2014 (at approximately 4.5%), while the share of domestic manufacturing in the value added of services exports was continuously falling. The latter characteristic was more pronounced in the new EU member states. In Slovenia, this share almost halved during the period under study while the share of foreign manufacturing in the value added of service exports remained quite stable.

As noted in the literature, the links between services and manufacturing

activities in international trade are even more complex within the GVCs in which companies engage. To illustrate how services and goods relate to and depend on each other in the process of value creation at different locations, we present two firm-level cases of a manufacturing company GVC (Box 1) and a service company GVC (Box 2).

Box 1: Value creation within a manufacturing company's GVC increasingly depends on services

The case study of a manufacturer of caravans and motorhomes (from a mature industry) reveals how fragmentation of the production process and the interaction of different activities entailed in the co-creation of value led to greater revenues by essentially increasing the role of services. To enable a timely response to consumer needs, product development requires ever more intensive and constant interaction and cooperation between conception, design, development, production, marketing and sales. The case firm performs these stages that are spread geographically across different markets, but interlinked and integrated through ICT and organisational approaches that stimulate regular interaction and communication. Product development depends on a higher number of services from both within and outside the company. The conception, development and design stages cannot do without marketing, sales and after-sales services. All of these functions recently faced the rapid breaking up of service activities (developed in-house, outsourced and/or offshored), especially in after-sales services, altogether they are the key drivers of the company's growth and regional expansion of its GVC. Market research and after-sales services take care of consumer engagement, facilitated by close cooperation between marketing and sales (across 25 key European and other markets). This has helped them identify several fresh needs and the potential to add value to existing products. One example is the possibility of BBQ equipment in caravans and motorhomes. The swift cooperation of R&D, design, development and production has led to new/upgraded products and substantial differentiation from competitors. Further interactions among services from the initial and end stages of production (sales and R&D and supportive IT services) resulted in the development of a mobile (and within-motorhome) application that monitors and reports facilities, occupancy, capacities and the potential company of other (familiar travellers) in surrounding locations. Services inputs helped the innovation process to be sped up and to increase export revenues from products that were introduced less than 3 years before.

Box 2: Manufacturing inputs for a service company's GVC as a prerequisite for starting a business

The extent of material goods used in the operations of a services company's GVCs varies due to the variety of services and possibility to provide services online (e.g. a GVC in tourism versus mobile applications). Thus, the extent of manufacturing inputs for service GVCs may vary substantially.

We illustrate the case of GVCs of a service company that sells mobile applications over the Internet. The essential material input of the head company and its subsidiaries that are located around the world refers to ICT hardware. The latter range from computers, mobile phones and own servers to telecommunications equipment that is mostly foreign in origin. These goods are essential for starting the development of a mobile application and for designing, testing, advertising, marketing and delivering the application via the Internet and, finally, an ICT platform is used to manage customer relationships. Without the material inputs and technology underpinning them, such innovative mobile applications could not be developed and released to the market. Nevertheless, the value-added contribution of the material inputs to the final mobile application's value is much lower than the value added that comes from the service functions, most notably the development, design and marketing. On one hand, the case illustrates how cooperation between services and manufacturing is indispensable for the final product – mobile applications – while also revealing the dominant weight of services in the interlinks between the two sectors.

The managers of manufacturing and services companies face several changes in coordination tasks within the enterprise and global business environments that are forced to respond to a number of uncertainties and rising tensions in international relations. Recognising and managing all service activities and their contribution to total value added – especially when combined with in-house services – is a new challenge. The insights from the two cases of the companies' GVCs serve to complement the findings of the empirical analysis and emphasise the vital importance of manufacturing-services interlinkages for the co-creation of both the value and competitiveness of companies and GVCs.

Conclusion

The analysis explores the key aspect of the stronger sectoral interlinkages seen in the economy and international trade – the relationship between services and manufacturing in the value creation process, which holds many

implications for public policy and management strategies. The results show a weak upward trend in interlinkages between services and manufacturing functions in the period 2000–2014 in the EU. The share of manufacturing in the value added of services exports in the EU amounted on average to 7% while the share of services in the value added of manufacturing exports is much higher and on average accounts for 34% in the observed period. Profound changes in their relationship may require that policies which aim to support manufacturing industries will need to focus more on services (Mirodout, 2018). Foreign services' value added was gaining in importance throughout the period, indicating that trade in services is becoming a key driver of value creation in manufacturing. In this context, international trade in services represents a vital contribution to goods exports. The share of domestic services in the value added of manufacturing exports in the EU has declined, but this does not mean that locally produced services have lost their importance in export competitiveness. High demand for foreign services and/or a lack of competitive domestic services may on the other hand stimulate the in-house development of services that are provided by employees yet not recorded in world input-output tables.

The results for Slovenia are in line with general trends, but slightly deviate from the EU average and the average for new EU members (EU-13) in both manufacturing and services exports. The intensity of the links of services in the value added of Slovenian manufacturing exports is less than the EU average and even below the EU-13, however the gap was narrowing from 2000 to 2014. The total share of services in the value added of Slovenian manufacturing exports rose from 28.2% to 30.4% in the period 2000–2014, and the contribution of foreign services' value added increased by 3.7 percentage points. This increase must be put in the context of the structure of manufacturing exports that is characterised by the dominance of medium-tech exports in Slovenian exports (Institute for Macroeconomic Analysis and development – IMAD, 2018). Services influence the competitive advantages of high-tech, medium-tech and low-tech manufacturing in different ways. Low-tech manufacturing particularly depends on being able to buy service inputs while high-tech manufacturing on selling services as a complement to innovation (Nordwal, 2016). The share of manufacturing in the value added of Slovenian services exports exceeds the European average and mainly originates from the high share of foreign manufacturing, showing a certain dependence on imported goods.

The analysis of value added in the manufacturing–services interlinkages based on the WIOD database does not however reveal any additional channels for their intricacy. Two highly important dimensions of sectoral interlinkages lie beyond the focus of our analysis. The first refers to trade flows that originate from foreign direct investment (FDI) and the establishment of

subsidiaries that provide goods and services (international intra-firm trade, offshoring). The evolution of FDI by sectors shows a clear trend towards the prevailing weight of services, which accounted for 65% of the total FDI stock in 2015⁸. This trend is likely to continue as executives' expectations for global FDI activity for 2017 to 2019 reveal a large majority of survey participants anticipate further growth of FDI in services (United Nations Conference on Trade and Development – UNCTAD, 2017). Second, neither the WIOD nor TIVA data on domestic and foreign value added in manufacturing capture the use and contribution of in-house service functions within manufacturing exports⁹. The outcome is that the value added provided by the labour force performing these jobs (e.g. marketing, information services, R&D, etc.) is not taken into account, in turn affecting the size of both the domestic and foreign value added of services. Thus, the role played by services in value creation is in fact even bigger than our analysis was able to reveal and calls for a deepening of the research.

The disruptive effects of increased digitalisation, diffusion of servitisation business models across manufacturing, broader implementation of the Internet of Things, additive (3D) manufacturing, Big Data and other innovative technologies are bound to accelerate the pace of changes and depth of what links services and manufacturing. With industry 4.0, manufacturing is becoming increasingly dependent on services in implementing new technologies. Modern industrial policies are horizontal, cross-industry, directed at the industrial system (manufacturing, complementary services and industrial infrastructure) and the ability to access competitive resources abroad (Singh, 2016; Andreoni, 2016; European Commission, 2010; UNCTAD, 2018). FDI and the operations of multinational companies are an integral part of contemporary industrial policies in many countries. Improving GVCs' participation implies a need for active policies to encourage learning with a view to facilitate upgrading towards activities with greater value added and diversifying into higher value added chains.

When looking at the situation in Slovenia, it seems that public policy is quite slow in recognising and responding to the reality of inter-sectoral dependency and the trends leading to further intensification of the related phenomena where new technology development and services play a pivotal role. Development of the modern industrial ecosystem stimulates the interlinkages between services and manufacturing and requires the building of technical capabilities, permanent innovation in all business processes,

⁸ It is observed that a large part of FDI in services relates to affiliates of primary sector and manufacturing MNEs that however perform service functions such as back-office functions, financial holdings, procurement or logistics hubs, distribution services, and research and development (WIR, 2017).

⁹ If these service activities were outsourced they would belong to service sector and would be recorded as inputs to manufacturing (Mirodout and Cadestin, 2017).

fast learning capabilities, knowledge and technology development institutions, access to and acquisition of foreign technology and entrepreneurship development. The overhaul of public policy is vitally important in various domains, most notably in industrial policy and areas closely related to it – education and training, research and innovation, competitiveness and trade.

The challenges for public policies and company strategies in a globalised world abound and relate not simply to disruptive technologies. The growing fragmentation of production across borders highlights the need for an open, predictable and transparent trade and investment regime. Tariffs, non-tariff barriers and other restrictive measures not only have an impact on foreign suppliers, but also on local producers. Considering the trends illustrated by our empirical analysis and those discussed above, it is all the more important to raise awareness of the interrelations between manufacturing and services and to integrate the latest knowledge into public policy shaping and in companies' strategic management. Parallel to this, an ambitious complementary policy agenda needs to leverage the engagement in GVCs towards more inclusive development. A globalisation backlash due to the rising protectionism and frictions in international relations could seriously aggravate trade in intermediary goods and services, which represent the majority of global trade, along with the links between services and manufacturing. Trade wars and the growing uncertainties may have an influence on major determinants of trade in intermediate products from price and quality through to the proximity and stable delivery of inputs. What would it mean if foreign value added were to decline? The rise of protectionism may seriously reshape the development of GVCs and global trade in general, bringing a range of effects across countries depending on their development level and extent of GVC integration. Limited access to foreign value added could slow growth down and strengthen the regional nature of GVCs. OECD scenarios for the future development of GVCs (OECD, 2017) highlight access to foreign value added, particularly to foreign services, as a key determinant of the growth, sustainability and complexity of value chains.

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Appendix

Table 1: SHARE OF VALUE ADDED OF SERVICES IN MANUFACTURING GROSS EXPORTS (IN %)

	2000	2005	2010	2014
Share of domestic value added of services in manufacturing gross exports				
EU	18.2	18.2	16.1	15.4
Old EU	19.9	20.7	17.7	16.7
New EU member states	16.7	16.0	14.8	14.4
Slovenia	14.2	13.9	14.5	12.7
Share of foreign value added of services in manufacturing gross exports				
EU	15.1	16.3	18.3	19.1
Old EU	14.7	15.6	18.7	19.7
New EU member states	15.5	16.9	18.0	18.6
Slovenia	14.0	16.3	17.5	17.7

Source: Own calculations.

Table 2: SHARE OF VALUE ADDED OF MANUFACTURING IN SERVICES GROSS EXPORTS (IN %)

	2000	2005	2010	2014
Share of domestic value added of manufacturing in services gross exports				
EU	3.4	2.8	2.4	2.2
Old EU	2.9	2.4	2.2	2.0
New EU member states	3.9	3.1	2.6	2.4
Slovenia	5.6	3.5	2.8	2.9
Share of foreign value added of manufacturing in services gross exports				
EU	4.6	4.3	4.3	4.5
Old EU	3.7	3.3	3.6	3.7
New EU member states	5.4	5.2	5.0	5.3
Slovenia	5.3	5.1	5.3	5.6

Source: Own calculations.