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The European Competitiveness and Sustainable Industrial Policy Consortium, ECSIP Consortium for short, is the name chosen by the team of partners, subcontractors and individual experts that have agreed to work as one team for the purpose of the Framework Contract on ‘Industrial Competitiveness and Market Performance’. The Consortium is composed of Ecorys Netherlands (lead partner), Cambridge Econometrics, Danish Technological Institute, Euromonitor, IDEA Consult,IFO Institute and wiiw, together with a group of highly skilled and specialised individuals.

# Abstract

The share of manufacturing in GDP is declining, whereas the share of services – and business-related services in particular – is rising in almost all advanced economies. However, as these industries are mutually dependent in various ways this study focuses on the manufacturing sector as a user of activities provided by the services industries and – in particular – the way the latter contributes to productivity and value creation in the former. To the extent that this is the case, manufacturing industries benefit from a vibrant business-services industry and themselves play an important 'carrier function' of services – issues which are addressed by considering manufacturing activities in a value chain approach. As a consequence, EU Member States facing a declining share of manufacturing might still be part of the manufacturing value chain via the provision of services whereas other countries benefit from services provided by other countries. The role of cross-border flows of services and the patterns of outsourcing and offshoring of such activities across Europe is therefore gaining importance. It is argued that a differentiated pattern of specialisation emerged within Europe with a set of countries keeping a stronghold in manufacturing industries and others are specialising in the provision of related services, whereas some countries have faced a decline in their manufacturing shares, but have not succeeded in increasing their specialisation in business services either.

The first four sections of the study present selected quantitative indicators concerning the "manufacturing value chains", discuss the relative importance of the manufacturing–services interaction and its cross-border dimensions, and point towards differences across countries, industries and services activities, and the respective changes over time. Further, impacts of these interactions on manufacturing performance are addressed econometrically. The following two sections highlight important dimensions of services use in manufacturing and issues related to services trade and potential barriers in that respect for selected industries and countries, incorporating both quantitative and qualitative insights.

Keywords: manufacturing-service interaction; EU wide specialisation; manufacturing value chains; industry studies

JEL classification: F10; L6; L8; O14; R15;

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# Executive summary

*Changing patterns of specialisation in manufacturing and business service activities across Europe*

Despite positive growth rates of industrial output in absolute terms, the share of manufacturing value added in overall GDP of the EU declined from 20% in 1995 to 16% in 2011 (following a long-term trend), whereas the share of business services increased from about 14% to 18% over the same period for the whole economy. However, despite this increase in business services, an overall 'deindustrialisation' trend is still to be observed for the EU as a whole, when only those services are included that are used in manufacturing activities for the provision of final manufactured goods. This 'value chain approach' shows a decline in the combined manufacturing and related services share of GDP from 25.7% in 1995 to 22% in 2011. A number of reasons have driven this trend, including overall shifts in demand, significant improvements in productivity, companies externalising business services to outside Europe, offshoring of core manufacturing activities (notably to Asian countries) and changes in relative prices in favour of services (Baumol's cost disease[1]).

These changing patterns of specialisation are, however, not uniform across the EU Member States: the geographical patterns of specialisation have become more pronounced. While some countries remain relatively specialised in manufacturing (e.g. Germany, Austria, Central and Eastern European countries), a second group is specialising more in business services (e.g. the UK, the Netherlands, Belgium and France). Consequently, specialisation and agglomeration trends are observed for both manufacturing and services activities.

A third group of countries, comprising the Baltic States, Greece, Malta, Spain and Portugal, have faced a decline in their manufacturing shares, but have not succeeded in increasing their specialisation in business services either. This may be because these countries have started from a lower level and, with respect to initial specialisation patterns, from a less favourable manufacturing base. These conditions, together with the creation of bubbles in their economies and the ensuing difficulties, resulted in a loss of manufacturing competitiveness and an unfavourable economic development following the economic and financial crisis.

*A mutually dependent and dynamic relationship between manufacturing and services*

The production of manufactured output involves many activities along the value chain, from predominantly pre-production-stage activities (such as R&D and design), through the production (or assembly) stage, to predominantly post-production activities (such as logistics, distribution, maintenance and marketing).[2] As physical inputs, services can either be provided in-house or sourced from service providers. In terms of direct cost shares in manufacturing, on average about 25% are service inputs; but

[1] Baumol's cost disease states that due to larger productivity growth in manufacturing activities, as compared to services, the relative price of manufactured products is declining, which consequently implies that the share of manufacturing is declining in nominal terms.

[2] Some services, such as marketing or logistics, play a role throughout the entire value chain.

there are large differences across countries, with shares ranging from more than 30% to less than 15%. In terms of direct cost shares, distribution services account for about 12%, transport and communication for about 5%, and business services for about 9% of total manufacturing costs. The service content of manufacturing production increased by about 3 percentage points on average across countries over the period 1995 and 2011.

When taking account of both direct and indirect linkages, the average service content of manufactured goods produced in the EU comes close to 40% of the total value of final manufacturing goods produced. The bulk of these services are distribution services (15%), transport and communication (8%), and business services (which range from under 10% to 20% or more across the EU Member States). This last category includes services such as legal and accounting services, research and development (R&D), advertising and market research, engineering activities and information and communications (ICT) services. The remaining service activities, which represent a negligible share of the total, are non-market services. These numbers reflect a trend towards increased use of outsourcing of services by manufacturing firms.[3]

Additionally, there is a trend towards services being increasingly supplied together with physical products: a phenomenon sometimes described as 'servitisation of manufacturing'. The amount of services provided by manufacturers is not completely represented in officially available statistics and hence is not part of the cost shares presented above. The servitisation share of total manufacturing revenues varies greatly. Shares of between zero and 30% have been mentioned in interviews. Servitisation is to a large extent dependent on product programme and market environment with, generally speaking, final goods markets providing better opportunities to offer services over the whole product lifecycle. Servitisation contributes to EU manufacturers' international competitiveness through comparative advantages in the field of services driven by know-how, in particular engineering, and thus opens up growth opportunities for manufacturers who tap into new business areas, such as BOT,[4] lifecycle services, etc.

Finally, of course, services also use manufacturing inputs for the provision of services. However, these channels operate primarily via the supply of capital goods, rather than intermediate inputs. The direct cost shares of manufacturing in services are therefore rather low at only about 2% of the gross output of services, and do not give an accurate quantification of the relationship between services and manufacturing.

*Services–manufacturing interaction is growing across industries for different reasons*

Expert interviews in four industries (machinery, transport equipment, textiles and clothing, and food and beverages) and six countries (France, Germany, Denmark, Sweden, the Czech Republic and Poland) have shown that, for an in-depth understanding of the use of services in manufacturing, country and industry characteristics have to be taken into account. The industries considered differed greatly in terms of their structure, production technology, rate of innovation and their exposure to globalisation. For the

[3] Note that these data provide a conservative estimate concerning the service content of manufactured products, as they do not account for services produced 'in-house' as services.

[4] Build–Operate–Transfer: a form of project finance which traditionally has been applied to large investment projects where manufacturers are reimbursed by revenue earned through the operation of the establishments delivered. Finally, ownership is transferred to the client.

four industries, these four features largely explain the differences in the relationship between manufacturers and service providers, the critical fields of interaction and the economic impact of services on manufacturing companies' performance.

In the machinery and transport equipment industries – as examples of medium-high- and high-tech industries – the cost share of services for medium-high to high-tech industries has been growing and is expected to increase further, mostly through outsourcing of R&D and engineering services, in particular by the spin-off of R&D and engineering units and because of the need to set up more efficient and effective development processes. The most important drivers behind this trend are the growing complexity of products and the integration of different technologies. The findings indicate that the success of R&D and engineering projects depends on the interaction of the different players involved and on the objectives of the outsourcing strategies pursued. For example, outsourcing of R&D and engineering services can be motivated by cost saving, as well as by the need for access to specific expertise.

By contrast, in both so-called 'low- to medium-low-tech' industries considered – food and beverages and textiles and clothing – efforts to increase the efficiency and effectiveness of the value chain management is the most important driver of growing business service inputs. A second explanation for the growing cost share of business services is related to downstream strategies. Manufacturers try to be better placed in their sales markets, through services such as market research and advertising, and to offer their clients additional services, such as logistics and product placement. These activities comprise the provision of external and own services (i.e. servitisation, as discussed above). These 'low-tech' industries also show higher cost shares of industrial output caused by transport and distribution services, which is due to the fact that these two industries are, to a greater extent, producers of consumer products.

The ability to exploit services – in particular business services – has contributed a great deal to the success of manufacturers in these 'low-tech' industries. Above all, companies from the textiles and clothing industry have been investing heavily in value chain management and the related upstream and downstream services. As such, these companies have been able to meet the challenges of globalisation through the management of international supply chains. In terms of value added and jobs, this has partly been able to compensate for the reduction in domestic production capacities, thanks to the tapping of new business areas. The success of these industries has therefore driven the growing integration of services and manufacturing. Although the growth in related services might not be sufficient to fully compensate for the losses in manufacturing activities, these services do increase EU companies' competitiveness and reduce any negative impact resulting from the structural changes taking place in the low-tech industries as a result of globalisation.

The differences in the interaction of services and manufacturing between the industries under consideration suggest that sectoral specificities have to be taken into account when formulating public policies and schemes.

*Services–manufacturing interrelationships also determined by country specifics*

The interrelationship of services and manufacturing further shows quite different patterns between the Member States under consideration. The predominant strategies pursued by manufacturers in the

individual countries impact not only on the overall use of services, but also on the kind of services sourced from outside. This is particularly the case with regard to the use of R&D and engineering services in medium-high- to high-tech industries, which are well suited to contribute to manufacturers' economic performance and to their supply of technologically leading, high-performance products.

For example, there are remarkable differences in the amount of external services used by French and German companies. French companies have been more inclined to outsource, whereas German firms have relied to a greater extent on internal service provision. Outsourcing is driven not only by the sophistication of products and the integration of numerous different technologies, but also by the manufacturers' need to improve their economic performance through cost saving. French companies in this the transport equipment industry have been struggling more than their German competitors, and this may explain why they have outsourced more. There are indications that German companies are also moving towards a greater use of outsourcing.

For the smaller countries, the fieldwork revealed that the Danish manufacturing sector, for example, is struggling with a loss of competitiveness. The cost shares of services in manufacturing are well below those of the other EU Member States under consideration, so that Danish manufacturers are less able to exploit the possibilities of increasing their competitiveness through outsourcing than are manufacturing firms in other comparable countries.

The Swedish manufacturing industry provides a good example of maintaining a viable sector through comprehensive exploitation of services. Traditionally, Swedish firms have successfully commanded global value chains, and only little capacity is left in the country; however, these have remained competitive thanks to the use of services. Most impressive is the Swedish textiles and clothing industry: although only marginal manufacturing capacities are left in Sweden, the textiles and clothing industry is viable, provides attractive workplaces, is strong in R&D and design, and manages to keep its position in the global production network through value chain management.

Since the fall of the Iron Curtain, Poland and the Czech Republic have become market-oriented economies. During the transition phase companies were privatised, with foreign direct investment (FDI) playing an important role in this process and affecting the structure of the respective manufacturing industries. Typical of both countries are foreign-owned and domestically owned production sites that are integrated upstream in international supply chains. Independent, domestically owned companies which successfully command their own international distribution and sales networks exist as well, but are less frequent. Due to this characteristic the exploitation of services does not yet play the same role for Polish and Czech manufacturers as it does for most companies from EU Member States of longer standing. As many companies are struggling to meet the challenges emerging from production sites located in non-EU low-wage countries, in the longer run their survival will probably depend on process and product innovations and the upgrading of product programmes, for which services are pivotal. However, the Central and Eastern European manufacturing sector is expected to undergo structural changes similar to those in the long-standing Member States. The loss of production capacities, in particular of labour-intensive activities, will however only be partly alleviated through the use of services by manufacturers, increasingly driven by know-how.

To summarise, these results indicate that improved access to services and increases in the quality of services have the potential to strengthen the competitiveness of the EU manufacturing sector. However,

even improved services and an improved integration of services and manufacturing will not prevent changes in the international division of labour and the relocation of manufacturing capacities.

*Manufacturing firms in smaller countries source a higher proportion of business services from abroad than do manufacturing firms in larger countries*

The proportion of business services sourced from abroad tends to be small in all countries: in most, the share of imported business services in manufacturing gross output is less than 1% (compared to about 5–10% in terms of direct cost shares of total business services used in manufacturing), with only a few countries showing higher shares. However, it should be borne in mind that this does not include services provided domestically via the commercial presence of foreign-owned affiliates (Mode 3[5]) or through the long-term presence of foreign-national persons (Mode 4). For the cross-border provision of services (Mode 1) measured here, there is a distinct pattern whereby manufacturers in smaller countries source a relatively large share of their business services from foreign, mostly intra-EU, suppliers. This is, in particular, the case for Central and Eastern European countries.

The differences in the intensity of use of imported business services suggest that manufacturers in larger countries have access to a more substantial base of domestically supplied services, whereas manufacturers in smaller countries have to rely more on foreign-sourced business services in order to gain access to the services they need. These different patterns also become apparent when considering the relationship between manufacturing performance and business services: for the set of large EU countries, econometric evidence reveals a positive impact of domestic (and – to a smaller and less robust extent – foreign) business service inputs on manufacturing performance, measured in terms of productivity or value added growth; for smaller countries, the econometric results suggest that in particular foreign business services linkages are important for improved manufacturing performance. However, this does not mean that large EU Member States would not profit from more open services markets. In particular, the service providers in larger countries would also benefit from enlarged markets, and the manufacturing sector in larger countries would, in turn, gain advantage from increased competition and the specialisation of business service providers.

Given the increasingly pronounced patterns of specialisation across Europe, and the relative importance of foreign-sourced business services – particularly for smaller countries – potential barriers to cross-border trade in services and to international manufacturing–services linkages are an important policy issue. However, the issue is not straightforward and goes beyond the issue of regulatory barriers. An analysis of the correlation between the patterns of use of imported services by manufacturing industries and the number of regulatory barriers to services trade present in a country did not reveal a significant relationship between the two. Furthermore, interviews with EU service providers and an analysis of regulatory barriers to services trade using data from the OECD Services Trade Restrictiveness Index (STRI) and Product Market Regulation (PMR) indices suggest that legislation at the EU level is not significantly hampering cross-border trade in services. Nevertheless, from the interviews it is also clear that in practice significant regulatory barriers still exist at lower levels. These barriers relate, for example, to differences in Member States' internal legislation or the concrete implementation of EU regulations in individual countries.

[5] The four modes of supply (as defined by the General Agreement on Trade in Services (GATS)) are: Cross-border trade (Mode 1); Consumption abroad (Mode 2); Commercial presence/establishment (Mode 3); Presence of natural persons (Mode 4).

Moreover, given the lower tradability of services (compared to goods), entry modes other than the cross-border provision of services are often more important. For example, for most performance-enhancing services, tradability of services is rather low and a local presence is required for a large part of the service offering, because factors such as 'trust', the performance of domestic services markets, language, and knowledge of local regulations and culture all play an important role. Consequently, for many types of services the policy issue for stimulating the use of foreign-sourced services in EU manufacturing industries relates more to the entry and the right of establishment of firms, as well as to the recognition of professional qualifications across borders. It should, however, be noted that the increasing digitalisation of performance-enhancing services is likely to increase their tradability in future. This in turn will affect the policy intervention needed to support them.

*Main policy messages*

In summary, there is evidence of a positive relationship between the performance of business services and the performance of manufacturing: notably, manufacturing sectors that buy in a relatively high proportion of business services have better productivity performance than do sectors with a relatively low buy-in of business services. This indicates that the performance of manufacturing could be improved through policies that support the development of business services activities and their quality. Furthermore, access to foreign suppliers of business services seems particularly important for smaller countries, since they usually do not have a full range of high-quality domestically supplied business services. However, given the ongoing trend towards further specialisation and agglomeration of both business services and manufacturing across Europe, even for larger countries there is increasing potential from improved competition and increased trade in business services. The 'manufacturing core' countries would benefit, for example, from improved access to foreign services suppliers from countries that are becoming more specialised in business services. In turn, the 'business services' specialist countries will also profit from the increased cross-border demand for business services.

Since goods and services markets are becoming more closely linked, and since business services impact positively on the performance of manufacturing (and vice versa), further steps towards integration should be undertaken, in particular in areas where barriers still exist. For example, a more ambitious implementation of the EU Services Directive would be a significant step forward in this direction, accompanied by the removal of remaining regulatory barriers to goods markets as well, in particular at the national level. Consequently, with the trends towards further specialisation and agglomeration in business services and manufacturing, reinforcing the internal market for both services and goods is likely to become even more important for EU competitiveness in the future.

Openness to trade will support further specialisation across countries and will allow the EU as a whole to reap the rewards of specialisation. This study shows that a group of countries, perhaps in particular those on the periphery, have managed neither to keep a strong manufacturing base nor to develop strong business services industries. This indicates that there is a risk that some Member States may have difficulty in participating in EU (and globalised) manufacturing and business services value chains. These problems are to a degree caused by the loss of competitiveness due to the build-up of economic bubbles in these countries in the run-up to the economic and financial crisis. While they have to some extent managed to develop sectors other than business services and manufacturing, it would seem advisable for these countries to improve their overall competitiveness, in order to benefit more from the opportunities resulting from the globalisation of manufacturing and business services value chains.

# 1. Introduction

## 1.1. MANUFACTURING, SERVICES AND THEIR INTERRELATEDNESS

The services sector plays an important role in advanced economies, not only because of its high and growing share in total GDP (more than 70% in most advanced economies) or its role in employment creation, but also because it is an essential source of inputs in manufacturing. Of the service sectors, business services play a particularly important role as inputs in production, e.g. in terms of consultancy activities, design activities, marketing, cleaning, etc. As can be seen, business services are heterogeneous and have different degrees of importance in the manufacturing process in upstream and downstream activities along the manufacturing value chain.

By contrast, most developed economies have witnessed a declining share of the manufacturing sector over an extended period of time. However, the experience is mixed, and while some countries experience an acceleration of this trend, others successfully maintain their strong manufacturing bases (Stöllinger et al., 2013). Therefore, on the one hand policy makers focus on reorienting their economies towards services in order to outweigh the loss of manufacturing jobs; but on the other hand, they also strive to maintain a strong manufacturing base. This is referred to as 're-industrialisation', which is widely debated not only in the EU and among its Member States, but also in other major advanced economies, particularly the United States. However, given the strong linkages between manufacturing and services, the question is not just about promoting manufacturing *per se*, but about promoting manufacturing and service sectors/activities in which the EU can be globally competitive.

There is an increasing awareness that manufacturing and services are closely intertwined. First, manufacturing firms not only use various services as important inputs in their production process in a broad sense, but also bundle their products and provide services along with their products. Second, a number of service activities are also carried out within manufacturing firms, which may be partly outsourced or offshored (e.g. business function offshoring). Conversely, service industries also use the output of manufacturing industries, which allows them to provide their activities more efficiently, for example, (i) goods are sold by service providers (for instance for maintenance and repair), (ii) via information and communications technology (ICT) systems development and integration and (iii) capital goods used in service activities. Hence, given strong inter-sectoral linkages and interrelationships, changes or improvements in the service sectors and the conditions impacting on the interaction of services and industry (both within and across countries) are expected to have important effects on the performance of the manufacturing sector.

In the European Industrial Policy Communication of 2012, the Commission emphasised the need to reverse the declining role of manufacturing in Europe from the current 16% or so of GDP to as much as 20% by 2020, in order to address and counter the prevailing and persistent economic ailments, to guarantee sustainable growth and the creation of high-value jobs, and to solve pressing societal challenges. This is even more relevant as the growth of manufacturing has been negatively affected by crisis-related low consumption, low investment levels and general policy uncertainty. On the positive side, the good export performance of European industry and its global competitiveness in high value-

added goods point to important growth potentials for European manufacturing. This can, however, only become sustainable if European firms succeed in maintaining their competitive edge in global markets by further improving productivity, increasing the value-added content of their products and innovating. In all of this the service sectors provide important inputs.

The emphasis on the interrelatedness of the two sectors implies a shift in perspective. Baumol (1967) warned of the danger posed to the global economy by increasing services intensity. He claimed that, due to the low productivity of the 'stagnant' services sector, an increase in the share of services in GDP causes overall productivity growth to stagnate – the so-called 'Baumol disease'. However, the major critique of Baumol's theory lies in the fact that he considered services to be used for final consumption only, and not as intermediate inputs which can affect economy-wide productivity indirectly.[6] In particular, some services facilitate transactions through space (transport and telecommunications) and time (financial services). Also, many producer-related services are often found to be important vehicles for the transmission of knowledge spillovers and to initiate changes in the production processes of client firms, which, in turn, improve overall productivity not captured by direct measurement. Empirically there is mounting evidence to refute Baumol's concerns about the negative productivity effects emanating from the continuously expanding service sector. Instead, a positive productivity effect is found to prevail. For example, Maroto-Sanchez and Cuadrado-Roura (2009 show that between 1980 and 2005 the relationship between the growth of services (in terms of percentage of total employment) and overall productivity growth was positive and statistically significant in 37 OECD countries.

The relevance of this critique may best be seen from the role of knowledge-intensive business services (defined as NACE Rev. 1 70 to 74), the so called knowledge-intensive business services (KIBS).[7] The share of business services and of KIBS is generally increasing in the EU Member States, as is their share used as intermediate inputs in manufacturing, as will be documented below.

These trends can imply two effects: on the one hand, manufacturing outsources or offshores low value-added activities to external suppliers, which raises measured productivity in manufacturing. On the other hand, manufacturing makes increased use of specialist service inputs (e.g. KIBS), which gives rise to a positive (spillover) effect on productivity.

For a number of reasons, therefore, services have become increasingly intertwined with manufacturing activities. Consequently, developments in the services sector are not isolated, but instead affect manufacturing, too, so that productivity improvements or increases in growth in the service sector give rise to important productivity or output growth effects in the manufacturing sector, and vice versa. The service sector is found to be an important engine of innovative activities and spillovers for other sectors. For example, Kox (2004) shows that the Dutch business services industry, which has grown much faster

[6] Besides, misleading findings on productivity in services may arise from incorrect measurement (Maroto and Rubalcaba (2008). Wölfl (2003) identifies the following sources of measurement biases: difficulties in measuring output of certain service sectors (such as financial services); choice of deflators and disentangling the effects of price changes from the effects of quality changes; aggregation bias when calculating aggregate productivity based on its components. There is substantial evidence that low or negative productivity rates in services are partly linked to inadequate measurement of service productivity growth (in particular the way constant prices are computed). Potential underestimation of service productivity growth leads to an underestimation of aggregate productivity growth.

[7] In the literature, various definitions of the knowledge-intensive business services (KIBS) industries are used: these depend rather on data availability and the respective classifications to be used. These figures are therefore only indicative of the relative importance of the KIBS sector.

than the market services sector as a whole, but displayed stagnating productivity growth, plays a crucial role in the national innovation system and creates knowledge spillovers to other sectors. Similarly, Foster-McGregor et al. (2012) use the World Input-Output Database (WIOD) to analyse the prevalence of technology spillovers between services and industry. They demonstrate that through R&D the service sector generates non-negligible productivity effects for manufacturing industries.

Thus, given the importance of industry–service linkages, it is important to understand the potential barriers – and also the enablers – of these links. Previous studies have shown that framework conditions can be an important determinant of the productivity performance of the service sector, which, in turn, affects the performance of other sectors. For example, PWC (2007) conducted a literature review and found that inappropriate labour or product market regulation can dampen innovation and inhibit the uptake of ICT. Moreover, in the retailing sector, restrictions on planning permission, flexible working, opening hours and other operational factors can place important limitations on retail sector efficiency. Also the role of the internal market was found to be an important determinant of service sector productivity. Ecorys (2011) showed that differences in regulatory regimes are significant determinants of relative performance in services between EU Member States. This study has also found that, for example, administrative burdens, barriers to trade and investment, price controls and the costs of starting up a company have an important negative impact on the performance of services.

Next to these different perspectives, the impact of regulations on services–industry relations can be expected to differ depending on the type of relation between the two (see discussion below). For example, if services play an important role in manufacturing innovation – as is the case with technical engineering and its relation to technical products (an instance of co-production) – innovation policy may affect not only the technical engineering sector, but also the producer of technical products. By contrast, if a service is supplied as a support service and not as an input (e.g. security services), innovation policy may affect the performance of the security service sector, but is unlikely to contribute significantly to any increase in productivity of the industry that uses those security services. It has to be stressed, however, that the effect of framework conditions may be positive or negative: they can act as a barrier, hindering productivity improvements, or they can help to promote productivity improvements in interrelated services and industries. Although previous studies have started to analyse some of these framework conditions, the analysis has been at a relatively general level. A deeper understanding of how framework conditions affect the service sector and its relationship with industry is needed in order to develop appropriate policies.

To summarise, the strong and growing inter-sectoral linkages and the critical role of the service sector for the development and performance of industry all point to the importance of a policy framework that helps to revitalise industry and keep it internationally competitive by also fully exploiting the potential of services. Moreover, industrial policy also needs to ensure that the service sector can fully profit from – and exploit the opportunities emanating from – industry to optimise economic growth and employment generation. Concerning the EU, an important aspect is the role of the internal market and trade in services among EU Member States which might contribute to a thriving manufacturing industry in the EU economy.

## 1.2. GENERAL FRAMEWORK FOR EXPLORING MANUFACTURING–SERVICES INTERACTIONS

### 1.2.1. BUSINESS SERVICES CATEGORISATION

There is a wide range of service activities which are directly and indirectly linked to the provision of a manufactured good. Kox and Rubalcaba (2007) provide a general taxonomy of producer services[8] (Figure 1.1) that distinguishes between those services that may be categorised as network-type services (e.g. distribution, transport and logistics, financial services, telecommunications, and energy) and business services, which they define as '*a set of service activities that – through their use as intermediary inputs – affect the quality and efficiency of the production activities by complementing or substituting the in-house service functions*'. Within the category of business services, they further distinguish between operational services that supply relatively standardised business services, and knowledge-intensive business services (KIBS) that generally produce client-specific services with high knowledge content. In relative terms, operational services are mainly concerned with the provision of manual skills, while KIBS are based on knowledge and information in the production and delivery of services. Viitamo (2007) considers that the taxonomy of Kox and Rubalcaba can be seen in terms of the generality of the service functions, with the highest generality (i.e. lack of client-specific characteristics) associated with network-type services, while operational business services – although also relatively standardised – are more specialised in terms of supporting specific functions. Finally, knowledge-intensive business services have the highest degree of customer specificity.

**Figure 1.1 / Overview of the categorisation of producer services**

<table>
<tr><td rowspan="15">Producer services</td><td rowspan="14">Business-related services</td><td rowspan="11">Business services</td><td rowspan="7">Knowledge-intensive business services (KIBS)</td><td>Software and computer services</td></tr>
<tr><td>Strategy and management consulting</td></tr>
<tr><td>Accounting, tax and legal advice</td></tr>
<tr><td>Marketing services, opinion polling</td></tr>
<tr><td>Technical services, engineering</td></tr>
<tr><td>Research and development</td></tr>
<tr><td>Personnel training, headhunting</td></tr>
<tr><td rowspan="5">Operational business services</td><td>Security services</td></tr>
<tr><td>Facility management, cleaning</td></tr>
<tr><td>Administration, bookkeeping</td></tr>
<tr><td>Temporary labour recruitment</td></tr>
<tr><td>Other operational services (e.g. catering, photography, translation, call centres)</td></tr>
<tr><td rowspan="2">Leasing and renting</td></tr>
<tr><td>Real estate</td></tr>
<tr><td rowspan="5">Network-type services</td><td colspan="2">Distribution and trade services</td></tr>
<tr><td colspan="2">Transport and logistics</td></tr>
<tr><td colspan="2">Banking, insurance, stock exchange</td></tr>
<tr><td colspan="2">Telecommunication, courier</td></tr>
<tr><td colspan="2">Energy services</td></tr>
<tr><td colspan="4">Consumer services partly used by enterprises (business travel, company health service, social insurance services)</td></tr>
</table>

Source: Adapted from Kox and Rubalacaba (2007).

[8] Based on the main client base (customer segment) for the service provided, a distinction may be drawn between consumer services – i.e. services that are primarily consumed by private individuals – and producer services that are primarily used as intermediate inputs into the production processes of businesses.

From the above, it is evident that there is a large and diverse range of business-related services that interface with industry in different ways; for example, by providing various technological, operational, distributive and financial capabilities. Moreover, these services vary in terms of the degree to which they are tailored to the specific requirements of industry. They also vary in terms of the intensity of their interaction with industry, with some services providing specific capabilities that require a high degree of understanding and continuous interaction with industrial (manufacturing) production activities to deliver effectively. Other services, by contrast, require a much lower degree of specific knowledge of industrial (manufacturing) processes.

As noted in Ecorys (2008), typically the combination of the general nature (i.e. lack of client specificity) of network-type services and the associated economies of scale in their provision means that in-house production is usually neither a viable nor a cost-effective option. Moreover, the fact that such services are relatively standard means that a significant level of in-house complementary knowledge (to make effective use of the service) is not normally required. By contrast, though increasingly subject to outsourcing, knowledge-intensive business services typically require the retention of a complementary in-house knowledge base. Meanwhile, operational business services are situated in between these two situations. In this context, the focus of this study is on knowledge-intensive business services, which are characterised by a close relationship to manufacturing production activities, the necessity for a complementary in-house knowledge base, and the possibility for firms to decide whether to rely on in-house provision or whether these service inputs are outsourced or offshored.

### 1.2.2. BROAD CATEGORISATION OF SERVICE–INDUSTRY INTERACTIONS AND PRODUCTIVITY IMPACTS

In general terms, the growth and productivity potential of interactions between service activities and manufacturing production activities – specifically in terms of the contribution of services, in particular KIBS, to the performance of manufacturing – can be considered to be influenced by conditions at three levels:

› **Within manufacturing sectors:** In general, empirical evidence – comparing both countries and sectors – points to a positive impact on productivity performance in manufacturing industries of the increased use of (external) service inputs. Equally, services – whether externally or internally supplied – are regarded as a means for industry (manufacturing) to extract higher levels of value added within the value chain. On the one hand, services may contribute to raising the efficiency of industrial (manufacturing) activities; on the other hand, specific attention has focused on the role of services – in particular knowledge-intensive services – as vehicles to increase value added in industrial (manufacturing) activities through the generation of non-physical or intangible capital. Many services used in industries act as a vector for the diffusion of technology and as a catalyst for innovation activities that contribute to productivity improvements in industrial (manufacturing) activities.

› **Within service sectors:** Factors that enhance access to service inputs, reduce their cost or raise their quality are likely to have an incremental effect on value creation within a value chain. In this respect, productivity gains within service sectors can be expected to create benefits for industrial (manufacturing) users of service inputs. This indicates the potential importance of the openness and overall functioning of service markets (e.g. in terms of their regulatory environment, competition

conditions, the extent of integration in international markets, and the level of innovation) as factors influencing the growth and productivity potential of manufacturing production activities.

› **Interface between services and industry:** Beyond conditions at the level of service and industry sectors *per se*, the growth and productivity potential of interrelationships between service activities and manufacturing production activities depend on the combined ability of service providers and service users within value chains to generate effective service outcomes. In this respect, significant attention in the literature on services covers discussion of issues such as information asymmetries between service providers and users, or the role of users in the co-production of service outcomes. For example, the former may reflect the difficulty that users have in evaluating service quality (both pre-acquisition and during and after service delivery) or that providers have in clearly establishing the service requirements of their clients. The latter reflects the fact that effective delivery of many services requires interaction ('co-production') between service providers and clients; the level of interaction is likely to be more pronounced when services are more customised to the specific requirements of clients and where a high degree of mutual understanding is required. These attributes of the service–industry interface indicate the potential importance of factors that increase market transparency (i.e. facilitation of search and matching processes) and enhance the respective capabilities of service providers and users to engage effectively in co-production processes (e.g. 'learning processes' through which mutual understanding can be developed, with regard both to the nature of the services to be provided and to the requirements of client organisations).

### 1.2.3. MANUFACTURING–SERVICE INTERACTION ALONG THE VALUE CHAIN

Industry–services interactions occur throughout industrial value chains, from 'upstream' functions (such as R&D and design) through to downstream functions (such as 'marketing' and 'after-sales' services). The increasing importance of more upstream ('pre-production intangibles') and downstream ('post-production intangibles') functions is associated with the fact that the production phase occupies a less pivotal position in the value chain of manufactured goods than is the case with more service-oriented components (see e.g. Veugelers, 2013, for a recent discussion). The diminution of value creation in the core production phase (e.g. fabrication and assembly activities) reflects a combination of factors, including productivity gains and technology developments that have lowered costs and displaced employment in production activities, and growing (international) competition that has further contributed to driving down prices and reducing margins for physical production outputs. In particular, the pressure on value creation in core production activities has gone hand in hand with the trend that has seen them outsourced and offshored to low-cost suppliers/locations.

At the same time, as a consequence of the pressure on core production processes, many firms have sought to increase value creation and profit margins by focusing on the development of intangible service-related assets in 'upstream' and 'downstream' value chain activities. In general terms, services can be categorised relative to their position in the value chain:

› **Upstream (development) services in the value chain:** product conception and innovation activities (e.g. R&D, design and branding), together with the technical development of high value-adding production processes, are increasingly important as a source of competitive advantage. The focus on upstream functions links in with trends towards raising the technological level of products (e.g. high-tech products), increased specialisation of production processes and higher-end market positioning. In

this context, services play a key role in providing the specific scientific, technical and design capabilities necessary to support upstream functions that contribute to raising the value added 'embedded' in manufactured products through better product conception and specialised production processing. These include services dedicated to product innovations, such as R&D and engineering and design. For example, Europe is a global leader in independent engineering services providers (ESPs), which strengthen the comparative advantages of related industries. Particularly, the services provided by ESPs and their technological expertise are pivotal for the success of the EU automotive industry in global markets.

› **Core (production) services in the value chain:** these concern services which are associated most closely and directly to production activities, such as supply management, production and process engineering, and other technical services. They include:

  - **Services that contribute to improved linkages along the supply chain,** for example through the better functioning of input markets via greater transparency, shortened response times and reduction in transaction costs. These services increase manufacturing companies' opportunities to exploit comparative advantage even in remote areas, which might lead to a relocation of manufacturing activities from EU to non-EU locations. One striking example is the production of clothing, one of the most globalised industries. Some of the more successful EU companies have become international supply (and value) chain managers, retaining only a remnant of their own production (if at all). Their competitiveness depends greatly on the set-up of efficient, globally coordinated processes, supported by the application of adequate IT tools and agreements on common standards, at least proprietary ones.

  - **Services for process innovation within companies:** generally services in this area contribute to the competitiveness of European production locations. Disadvantages (such as high input costs) can to some extent be compensated for by increased efficiency, resource saving, and faster or more flexible processes. As an example, the setting-up of highly integrated and sophisticated business operations supported by IT systems requires a qualified staff and experienced consultants. The EU offers a more favourable environment for the establishment of efficient, IT-supported processes than do emerging economies. Service providers can therefore improve manufacturing companies' opportunities to exploit comparative advantage for EU production locations. However, the relocation of non-core, low value-added manufacturing processes to non-EU locations remains on the agenda.

› **Downstream (market) services in the value chain:** firms are increasingly using downstream services (e.g. distribution, marketing, pre- and after-sales services) as a means of generating value added by differentiating their products more clearly, enabling greater customisation and more broadly deepening their relationships with customers. The focus on downstream functions is part of the manifestation of the 'servitisation' of manufacturing, by which firms increasingly tend to supply hybrid goods and service combinations or service solutions, rather than just providing goods. Often manufacturing firms derive an increasing proportion of their revenue not from the sale of goods *per se*, but from the service activities that accompany the goods and that may generate longer-lasting revenue streams, with higher margins, than the goods themselves. In this context, the range of different service functions that are related to bringing products to market (e.g. logistics, distribution, marketing and pre-sales services) and that 'support' and 'accompany' goods in the market (e.g.

customer support, maintenance) and even after use (e.g. recovery and recycling) plays an increasingly important role in value generation within manufacturing value chains.

Thus, 'servitisation' has the potential to contribute to comparative advantage for the EU-based production of complex, sophisticated products for specific applications and customised solutions. Demand for such comprehensive service packages – related, for example, to the supply of machinery and equipment – is growing strongly worldwide, with new business areas such as contracting and BOT[9] gaining in importance. The EU machinery industry is a paradigm for an industry with a notable and growing share of services in output, with its competitiveness driven by a combination of physical goods and services. This supply meets growing client demand for a comprehensive supply of machinery and equipment, together with product lifecycle services.

› **Transversal (management & coordination) services:** e.g. management and strategy consulting, management-related ICT. In this context, services – ICT-related services, in particular – can play an important role in enabling firms to maintain their competitive position in core production activities by supporting improved production efficiency, lowering production costs and facilitating coordination within complex supply chains and across multiple production locations.

The general point is that industry–service interactions occur throughout the value chain, and at each stage potential choices exist in terms of both (i) whether to provide services 'in-house' or to 'buy in' services from an external service provider, and (ii) and whether to source services locally or from a 'foreign' supplier. Decisions on the choice of service provision may be influenced by overall framework conditions at all levels, which furthermore should not be seen as independent of one another (see next sub-section).

### 1.2.4. INDUSTRY–SERVICE INTERACTIONS AND FRAMEWORK CONDITIONS

Despite increasing recognition of the importance of industry–service interactions for the (productivity and growth) performance of manufacturing industry, there has to date been very little analysis of the factors (e.g. framework conditions) that influence the efficiency and effectiveness of the interactions between manufacturing and services. To some extent this reflects the difficulty of providing an overarching framework capable of encompassing very heterogeneous service functions that interact with industry in many diverse ways.

Even if the analysis is limited to the KIBS which are deemed to be performance enhancing, there is an absence of studies that focus specifically on their interaction with manufacturing. On the whole, understanding of the role played by KIBS in terms of their contribution to their clients' innovation behaviour has developed significantly. Initially seen as adopters of technology developed in manufacturing, the role of KIBS as catalysts for innovation among their clients has now been recognised. This has been followed by increasing acknowledgement that KIBS are important as innovators in their own right, both for themselves and on behalf of their clients (Muller and Doloreux, 2007).

[9] Build-Operate-Transfer: A form of project finance which traditionally has been applied to large investment projects where manufacturers are reimbursed by revenues earned through the operation of the delivered establishments. Finally ownership is transferred to the client.

More problematic is the spatial dimension of KIBS. To date, relatively little analysis exists concerning the factors determining the location of KIBS; most of the existing analysis has focused on the tendency for KIBS suppliers to be concentrated in major metropolitan areas. In particular, it appears that service providers in major urban areas take advantage of the access that such locations offer to national and (increasingly) international networks and information exchanges. It appears, moreover, that service providers in major urban areas tend to be both more internationalised – indicating *a priori* a stronger market position – and more innovative. As a consequence, there is a self-reinforcing tendency for KIBS to become more spatially concentrated.

At first glance, the tendency for KIBS to become more spatially concentrated is somewhat counter-intuitive. In particular, the development of information and communication technology that supports the codification of knowledge and its delivery at a distance would *a priori* be expected to weaken the incentives for KIBS to group together in specific locations. However, there appears to remain an important component of tacit knowledge that is required to use and interface with flows of knowledge supported through ICT technologies. In this respect, the effective delivery of KIBS may nonetheless require proximity between service provider and (manufacturing) user, in order to develop the necessary mutual understanding (i.e. common tacit knowledge). Accordingly, it is understandable for KIBS to cluster in locations that provide access to a high concentration of (actual and potential) clients.

Recently, a number of authors have attempted to analyse the relationship between foreign direct investment (FDI) in services and in manufacturing, either in terms of the presence and size of manufacturing activities as a factor influencing service location decisions, or in terms of the complementarity between services FDI and manufacturing FDI. For example, Nefussi and Schwellnus (2010) find complementarity between the location of business services and the manufacturing activities of French affiliates abroad, and Meliciani and Savona (2011) find that intermediate demand from the manufacturing sector positively affects domestic specialisation in business services at a regional level. Similarly, Castellani et al. (2012) find that the localisation of FDI investment in business services is positively related to the presence of manufacturing activities, particularly for manufacturing sectors that are intensive users of business services, as is the case for high- and medium-high technology industries. That would suggest that business services that provide services to manufacturing industries tend to locate close to major manufacturing production locations. This finding might have implications in the context of the 'offshoring' of manufacturing production and the location of business services that can either relocate accordingly or remain in the respective countries and specialise in the service-intensive parts of the value chain. For example, the textiles industry is a highly internationalised industry which uses services heavily, whereas most of its production occurs outside Europe (see Section 5 for a detailed assessment of the organisation of production in selected industries and countries).

Unfortunately, there is relatively little analysis that has examined the spatial dimension of specific categories of knowledge-intensive services and in relation to the location of manufacturing activities (although there is somewhat more analysis of the locations patterns for R&D functions). In general, it appears that the main factors influencing the location of business services are typical location determinants, such as general demand, cost advantages, human capital and agglomeration economies. What is missing in this respect is any assessment of whether other framework conditions – specifically regulatory and other restrictions – may impact on FDI (and trade) in business services.

## 1.3. OVERVIEW OF STUDY

The purpose of the study is to shed light on prevailing services–industry inter-linkages, with the EU as focal area. It will take a quantitative comparative approach and compare trends and developments in the EU with a focus on analysing and describing differences in the evolution of services–industry inter-linkages across EU countries (and partly in terms of the trends of the EU's major competitors).

In particular, it aims to quantify the relationship between business services and manufacturing sectors and the extent to which this relates to productivity and growth in manufacturing industries. This will be the subject of Sections 2 and 3 of the report. Section 2 furthermore provides an overview of general trends concerning the specialisation patterns in manufacturing and business services over the period 1995–2011 and examines the potentially underlying explanations based on performance indicators such as productivity and unit labour costs. Section 3 takes an econometric approach, investigating the role of business services and the respective inter-linkages with manufacturing performance. In both sections the role of domestic and foreign-sourced business services will be highlighted.

This is followed by Section 4, which provides a novel approach to exploring the value added associated with manufacturing. This approach takes account of all those value added-creating activities along the value chain of a specific country that contribute to the production of a specific manufactured product – or, more generally, to the production of final products worldwide of a specific industry. Thus a specific service activity (e.g. R&D, advertising) of a country can directly and indirectly contribute to the production of the final manufactured product (e.g. a car), which would be considered part of the manufacturing value chain.

However, as indicated above, the interaction of manufacturing and services is a rather complex issue, and not all aspects can be covered by using a purely quantitative approach. The quantitative analysis is complemented, therefore, with a more qualitative, interview-based approach for a selection of six countries and four industries characterised by differences with respect to past developments, their use of domestically and foreign-sourced business services and framework conditions. Specifically, Section 5 highlights cross-country differences in the use and provision of business services in the manufacturing process in a comparative manner. Subsequently, Section 6 focuses on the differences in cross-border flows of business services and potential hindrances and barriers to these flows.

# 2. Performance and interdependence of industries and services

## 2.1. MANUFACTURING AND SERVICES PERFORMANCE

### 2.1.1. THE IMPORTANCE OF (BUSINESS) SERVICES IN THE ECONOMIES

Though the focus of this study is the interaction between manufacturing and service sectors – and business services in particular – this section starts with a comparative overview across countries of developments in these two sectors within the total economy (for classification issues, see Box 2.1). It is a well-known fact that the share of manufacturing is declining worldwide (with a few exceptions, such as China and Korea), whereas the share of the service industries is increasing. With respect to the advanced nations, the manufacturing shares have decreased, whereas the shares of business services have increased, as shown in Table 2.1. The shares of the other service sectors remained more or less stable.

**Table 2.1 / Shares of manufacturing and services in total GDP, as a percentage**

| | Manufacturing | | Distribution | | Transport and communication | | Business services | | Non-market services | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2011 | 1995 | 2011 | 1995 | 2011 | 1995 | 2011 | 1995 | 2011 |
| EU-27 | 20.1 | 15.8 | 28.3 | 29.7 | 6.7 | 6.8 | 14.3 | 17.9 | 18.0 | 18.8 |
| USA | 15.5 | 12.3 | 32.3 | 30.3 | 6.1 | 5.2 | 17.8 | 23.1 | 19.6 | 20.8 |
| Japan | 22.6 | 18.6 | 32.7 | 33.8 | 6.6 | 6.5 | 11.7 | 13.2 | 13.7 | 18.3 |
| Austria | 19.6 | 18.5 | 28.9 | 31.8 | 7.6 | 6.0 | 11.8 | 14.8 | 18.4 | 17.2 |
| Belgium | 20.3 | 14.5 | 26.4 | 26.5 | 8.2 | 7.7 | 15.7 | 20.5 | 19.8 | 22.3 |
| Bulgaria | 22.0 | 17.6 | 25.3 | 27.7 | 6.6 | 11.5 | 10.4 | 9.1 | 9.9 | 13.5 |
| Cyprus | 11.8 | 6.8 | 37.6 | 37.5 | 8.0 | 7.4 | 9.9 | 14.7 | 16.9 | 20.7 |
| Czech Republic | 24.3 | 25.8 | 23.7 | 21.2 | 10.4 | 10.2 | 9.6 | 14.0 | 13.0 | 14.3 |
| Denmark | 17.1 | 11.5 | 29.7 | 28.9 | 7.6 | 7.4 | 11.8 | 15.7 | 22.4 | 24.3 |
| Estonia | 21.0 | 14.3 | 28.2 | 28.6 | 11.2 | 11.0 | 7.0 | 14.0 | 14.8 | 17.4 |
| Finland | 25.4 | 18.6 | 24.6 | 28.2 | 9.1 | 7.8 | 9.4 | 12.7 | 19.2 | 20.2 |
| France | 14.2 | 10.1 | 28.1 | 31.3 | 6.3 | 6.6 | 16.9 | 19.6 | 20.7 | 22.4 |
| Germany | 22.6 | 22.4 | 28.4 | 28.3 | 5.7 | 5.5 | 15.2 | 17.8 | 17.3 | 17.8 |
| Greece | 12.0 | 10.3 | 38.7 | 39.7 | 5.9 | 9.5 | 7.8 | 8.9 | 17.1 | 21.0 |
| Hungary | 21.3 | 25.3 | 24.6 | 24.6 | 7.6 | 7.2 | 11.6 | 14.0 | 18.7 | 16.3 |
| Ireland | 30.2 | 26.8 | 18.9 | 19.3 | 5.5 | 5.3 | 13.6 | 21.8 | 17.0 | 19.1 |
| Italy | 22.2 | 16.6 | 31.9 | 33.6 | 7.0 | 7.3 | 11.7 | 14.9 | 15.8 | 17.4 |
| Latvia | 20.7 | 9.9 | 20.3 | 32.7 | 14.5 | 11.4 | 8.8 | 14.9 | 16.9 | 17.1 |
| Lithuania | 19.1 | 16.4 | 28.6 | 29.8 | 8.4 | 13.8 | 3.7 | 8.2 | 16.8 | 18.0 |
| Luxembourg | 13.7 | 6.5 | 26.8 | 25.0 | 8.2 | 8.7 | 28.7 | 38.6 | 13.5 | 14.3 |
| Malta | 21.7 | 13.3 | 32.9 | 34.0 | 9.2 | 9.2 | 9.8 | 15.8 | 16.8 | 19.4 |
| Netherlands | 17.4 | 14.1 | 25.5 | 24.8 | 6.9 | 6.0 | 16.7 | 20.7 | 20.0 | 22.0 |
| Poland | 21.1 | 18.1 | 29.6 | 31.8 | 6.3 | 7.2 | 6.4 | 11.0 | 14.5 | 14.4 |
| Portugal | 18.4 | 13.4 | 27.7 | 29.8 | 6.5 | 6.9 | 12.4 | 15.3 | 19.3 | 22.8 |
| Romania | 25.6 | 23.6 | 19.8 | 24.5 | 6.7 | 10.5 | 9.8 | 7.7 | 6.1 | 11.9 |
| Slovak Republic | 26.8 | 19.6 | 24.4 | 27.3 | 10.5 | 7.1 | 9.3 | 12.7 | 12.1 | 13.9 |
| Slovenia | 25.7 | 19.6 | 25.8 | 26.3 | 6.8 | 7.2 | 11.9 | 15.3 | 16.0 | 17.7 |
| Spain | 19.2 | 13.2 | 30.8 | 33.6 | 7.1 | 7.2 | 10.5 | 13.0 | 16.4 | 18.3 |
| Sweden | 22.4 | 16.7 | 26.6 | 26.1 | 7.9 | 7.0 | 11.8 | 16.8 | 20.2 | 21.1 |
| United Kingdom | 20.9 | 11.7 | 25.7 | 28.1 | 7.7 | 6.8 | 16.6 | 25.5 | 17.5 | 16.6 |

*Note*: These figures are based on value added at basic prices as provided in the World Input-Output Tables (WIOT).
*Source*: WIOD; wiiw calculations.

## BOX 2.1 / BUSINESS SERVICES IN NACE REV. 1 AND NACE REV. 2

For official purposes many of the definitions of 'business services' and 'knowledge-intensive business services (KIBS)' stem from industry classifications. As this study is mostly concerned with the inter-linkages between manufacturing and services industries, it relies heavily on information from supply and use and input-output tables. For a large sample of countries, these are (so far) only available at the NACE Rev. 1 2-digit level – or are even more aggregated (e.g. in the WIOD database). Therefore a pragmatic approach has to be taken in this study to the definition of business services. Based on NACE classification Revision 1, the following industries are counted as 'business services' (with a particular focus on the activities marked in bold):

| NACE aggregate | NACE Rev. 1 | Description |
|---|---|---|
| J | 65 | Financial intermediation services, except insurance and pension funding services |
| J | 66 | Insurance and pension funding services, except compulsory social security services |
| J | 67 | Services auxiliary to financial intermediation |
| **71t74** | **71** | **Renting services of machinery and equipment without operator etc.** |
| **71t74** | **72** | **Computer and related services** |
| **71t74** | **73** | **Research and development services** |
| **71t74** | **74** | **Other business services** |

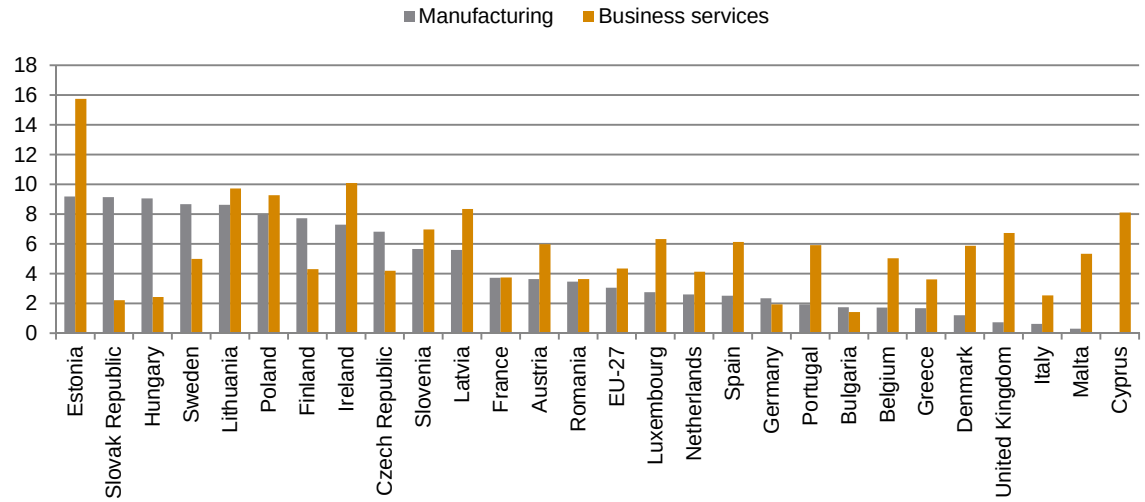
This includes financial activities, together with renting activities, computer and related services, R&D and the category Other business services, which unfortunately includes a diverse range of service activities. The lumping together of renting services (NACE Rev. 1 71) with services such as R&D and computer services is dictated by the WIOD database, which – at the industry level – reports only aggregate 71t74. Information that draws on supply and use tables will, however, split this group into the four activities listed above.

As mentioned elsewhere, in order to study the role of knowledge-intensive business services or a sub-group (such as R&D services, engineering services, computer services, etc.) further details would be necessary at the 3- or 4-digit level of NACE Rev. 1; however, this would not allow investigation of the interactions between manufacturing and services because of the lack of detailed supply and use or input-output tables for a broader range of countries. Fortunately, however, the recently adopted revised classification, NACE Revision 2, splits the service sectors into more detailed activities, as listed in the following table (this study focuses particularly on the activities marked in bold).

| CPA | Description |
|---|---|
| J58 | Publishing activities |
| J59-J60 | Motion picture, video, television programme production; programming and broadcasting |
| J61 | Telecommunications |
| **J62-J63** | **Computer programming, consultancy, and information service activities** |
| K64 | Financial service activities, except insurance and pension funding |
| K65 | Insurance, reinsurance and pension funding, except compulsory social security |
| K66 | Activities auxiliary to financial services and insurance activities |
| M69-M70 | Legal and accounting activities; activities of head offices; management consultancy activities |
| **M71** | **Architectural and engineering activities; technical testing and analysis** |
| **M72** | **Scientific research and development** |
| **M73** | **Advertising and market research** |
| **M74-M75** | **Other professional, scientific and technical activities; veterinary activities** |
| N77 | Rental and leasing activities |
| N78 | Employment activities |
| N79 | Travel agency, tour operator reservation service and related activities |
| N80-N82 | Security and investigation, service and landscape, office administrative and support activities |

It should be stressed, however, that – despite the declining manufacturing share – most countries experienced overall positive real growth rates in manufacturing activities, at least up until the crisis; thus one should not see manufacturing as a 'declining sector'. In most countries, both the manufacturing and (business) services have experienced positive growth rates of value added in real terms; the rates for business services have, in most cases, been larger, indicating a shift towards services.

**Figure 2.1 / Real growth rates of manufacturing and business services as a percentage, 1995–2007**



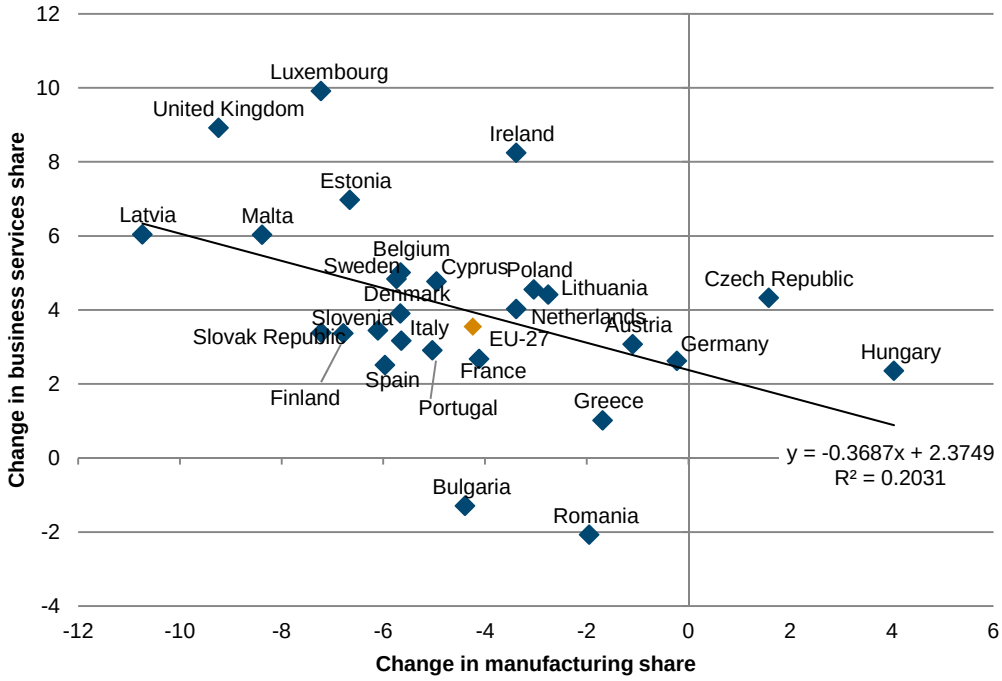

*Source*: WIOD; wiiw calculations.

However, within Europe these differentiated growth rates indicate quite divergent patterns and trends across Member States, as presented in Table 2.1. In 2011, the manufacturing shares ranged from slightly above 10% (or less in some small countries) to more than 25% (e.g. in some of the New Member States). But the trends have also been rather different across countries, with a strong decline in some countries (e.g. UK) and quite a stable share in others (e.g. Germany). On the other hand, the shares of business service sectors in most countries have increased and now range from 25.5% in the UK (and almost 40% in Luxembourg) to less than 10% in Bulgaria, Greece, Lithuania and Romania. From this perspective, it is interesting to note that on average manufacturing shares declined (though with some exceptions), whereas the share of services in the economy rose, mostly due to an increase in the share of business services; meanwhile the shares of the other service categories are rather stable. This is particularly true when one considers the larger economies, such as the EU-27, the United States and Japan (Table 2.1). However, at the level of individual EU Member States, the trends have been more diverse, as Figure 2.2 shows; it plots the changes in the share of manufacturing and business services in total GDP in percentage points over the period 1995–2011.

In all countries (with the exceptions of the Czech Republic and Hungary), the share of manufacturing declined, whereas the share of business services increased (with the exceptions of Bulgaria and Romania). However, these changes are differentiated across countries. Two contrasting patterns of development can be observed for the UK and Germany, which started from very similar shares of about 20% in 1995: the UK, for example, lost about 10 percentage points in the share of manufacturing in GDP, but it gained about 10% in terms of business services. In Germany, the share of business services

has increased by about 3 percentage points, but it kept its share of manufacturing in GDP more or less constant. However, in general the changes are not one to one: a simple regression suggests that a 1 percentage point decline in manufacturing goes hand in hand with less than a 0.5 percentage point increase in business services. Though the negative relationship is to be expected (as this is expressed in terms of shares), it highlights the different specialisation patterns across the EU Member States.

**Figure 2.2 / Percentage point changes in manufacturing and business services shares, 1995–2011**




*Source*: WIOD; wiiw calculations.

This can be seen even better from Figure 2.3, which shows the dynamics of specialisation of European countries between 1995 and 2011. More precisely, the figure plots the deviation in 1995 (green dots) and 2011 (red dots) of each country's share of manufacturing and business services, in per cent of GDP, from the shares for the EU-27 generally.

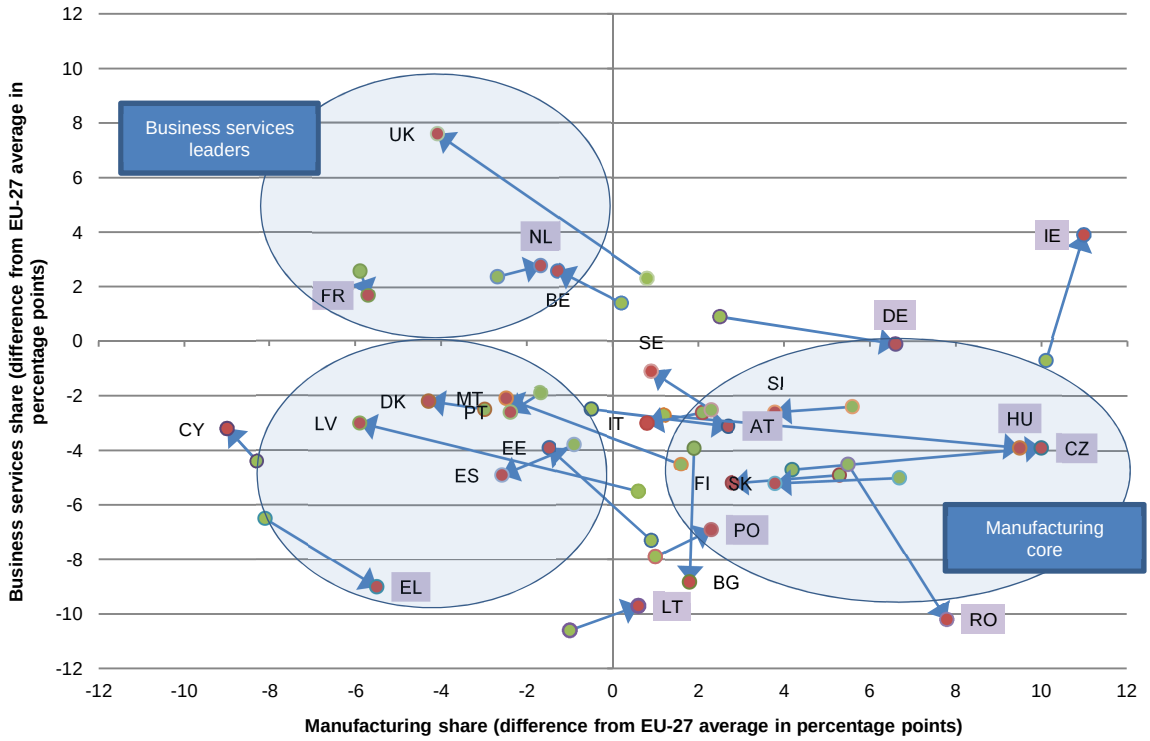
In 1995, the average share of manufacturing in the EU-27 was about 20% of GDP. A number of countries were above this level, with some smaller (particularly Eastern European) countries showing much larger levels. A few countries – Greece, Cyprus, Denmark and France – had levels far below the EU average. With respect to business services, the average was about 14% of GDP for the EU-27. Most countries were below that level, the exceptions being France, the Netherlands, Belgium and the United Kingdom. Thus, apart from a few exceptions, shares were clustered around the EU-27 average. This situation had changed significantly in 2011, as indicated by the red dots in Figure 2.3. For the EU-27, the share of manufacturing had declined from 20% to about 16%, whereas the share of business services had increased from about 14% to 18%. But more importantly, country shares have become much more differentiated. Put differently, specialisation patterns are more pronounced and three groups of countries can be identified:

**Manufacturing core countries:** Some countries have been trending towards a strengthening of their relative orientation to manufacturing. These include Germany, Austria, Poland, Hungary and the Czech Republic, and – to a lesser extent – Ireland. A group of other countries still maintain a relatively high share of manufacturing, but nonetheless show a relative weakening of their orientation towards manufacturing. This group includes Finland, the Slovak Republic, Slovenia, and also Italy and Sweden.

**Business services leaders:** Some countries maintained their relative position of specialisation in business services – France and the Netherlands, though both of those saw a minor increase in their manufacturing share. Great Britain and Luxembourg[10] showed the most important shifts towards business services and away from manufacturing.

**Low manufacturing and low business services:** The third group consists of countries which have been able neither to maintain a manufacturing share (even above the anyway declining EU average) nor to develop a large share of business services in their economies. This group comprises a number of small and peripheral countries, such as the Baltic countries (with the patterns being less clear in Estonia and Lithuania), Cyprus, Malta and Portugal, but also Spain, Denmark, and Greece. From a policy perspective, this could imply a need for different and specific approaches towards business services for these countries if they cannot develop a stronger manufacturing sector.

**Figure 2.3 / European manufacturing and business service specialisation dynamics, 1995-2011**




*Note*: Green dots indicate the deviation in the shares of manufacturing and business services in GDP from the EU-27 share in 1995, whereas red dots indicate these deviations in 2011. Countries characterised by increasing manufacturing shares are highlighted in grey.
*Source*: WIOD; own calculations.

[10] Luxembourg is not shown in the figure.

This section has so far focused on the relative importance of the manufacturing and business services sector in the EU Member States, highlighting the differentiated specialisation dynamics across countries. Some countries have been able to maintain an above-EU-average share of manufacturing in their GDP (e.g. Germany and Sweden), together with a relatively stable or increasing share of business services in their economies – a share that is close to the EU average. Other countries – like the Czech Republic and Poland – also maintained or increased their share of manufacturing in GDP at above the EU average, but had a much lower (and, relative to the EU-average, quite constant) share of business services in GDP. Finally, the manufacturing share decreased strongly in other countries, or else remained well below the EU average. Only some of these countries (e.g. France) managed to specialise in business service activities (or at least to preserve an above-EU-average specialisation in business services), whereas other countries have specialised less in business services (like Denmark). As such, one finds more pronounced patterns of specialisation in manufacturing and business services than was the case a decade and a half ago. The performance of the manufacturing sectors in these countries just mentioned and the specific relationship to service activities will be discussed in more detail in Section 5, shedding light on the patterns of interaction between manufacturing and (business) services.

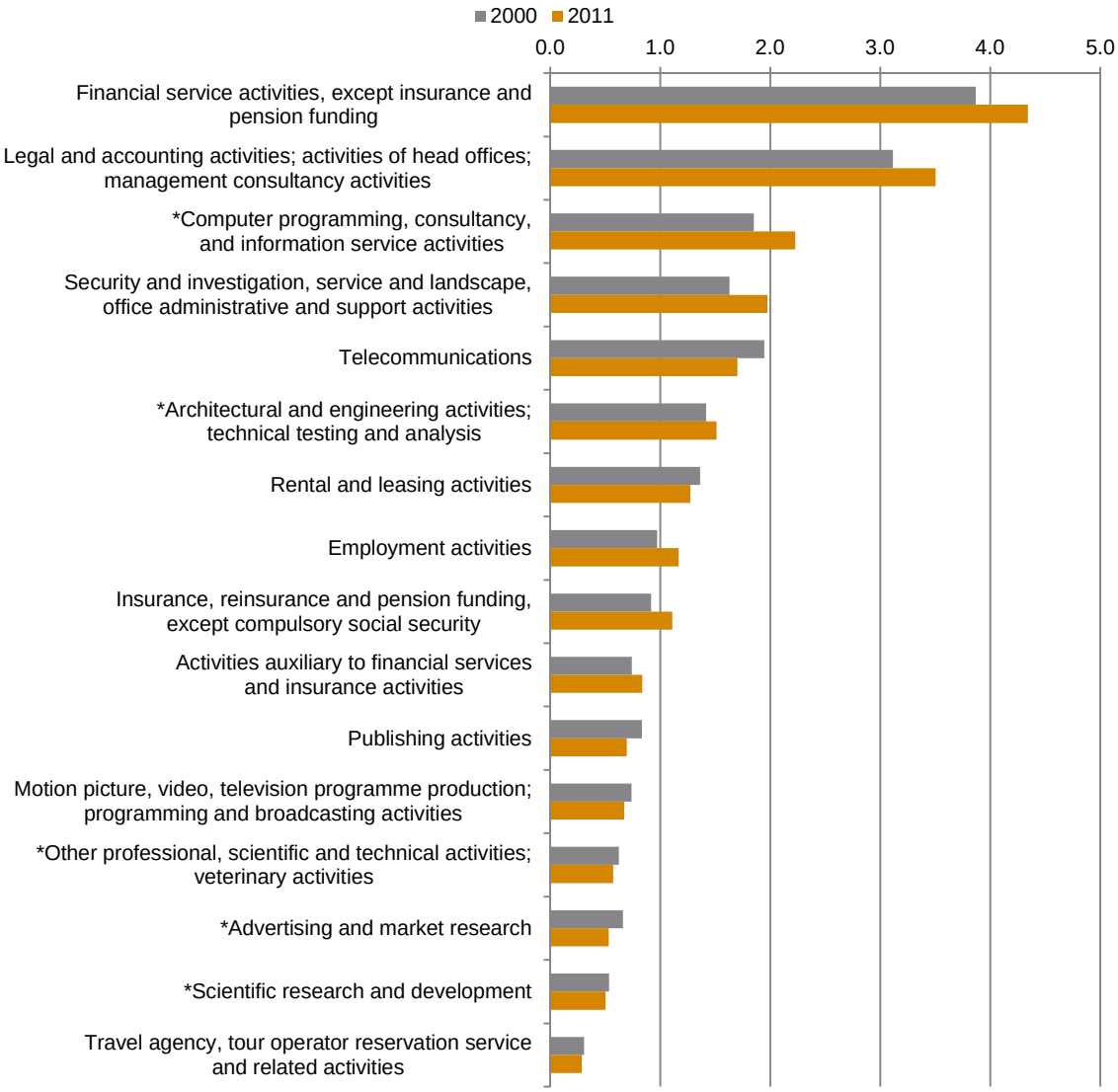
### 2.1.2. DIFFERENTIATED DEVELOPMENTS OF THE BUSINESS SERVICES CATEGORIES

From the viewpoint of this study, it is interesting to look at the evolution of the business services sector in more detail. Therefore, Figure 2.4 presents the respective shares in total GDP for the EU-28 countries and years 2000 and 2011 (the latest year for which data are available) according to the NACE Rev. 2 classification.[11] In total, business services account for slightly more than 20% of overall GDP, with only a slight increase over time (from 21.5% to slightly under 23% between 2000 and 2011). The most important business services are financial service activities (NACE Rev. 2 K64) and legal and accounting activities, etc. (NACE Rev. 2 M69-M70). This is followed by computer programming consultancy, etc. (NACE Rev. 2 J62-J63). These three categories also show the largest increases in terms of share. Focusing on performance-related business services, which make up about 5% of GDP, the most important are computer programming, computer consultancy, etc. (NACE Rev. 2 J62-J63) with a share of 2.2% in 2011, and architectural and engineering activities, etc. (NACE Rev. 2 M71) with about 1.4%. Each of the other categories – other professional, scientific and technical activities, etc. (NACE Rev. 2 M74-M75), advertising and market research (NACE Rev. 2 M73) and scientific research and development (NACE Rev. 2 M72) – accounts for about 0.5% of total GDP, with slight declines over time.

Figure 2.5 shows the structure of the performance-enhancing business services (including legal and accounting services) in the various EU Member States. Legal and accounting services make up the bulk of business services in terms of GDP in most countries, with the shares notably large in Belgium, Luxembourg and Cyprus. Computer programming comes second on average, with shares ranging from less than 1% to more than 3%. Architectural and engineering services are particularly important in Sweden (with more than 3%), while the share in the other countries ranges from 1% to 2%. The other service categories considered in Figure 2.5 are less important, with shares below 1% in general.

[11] As indicated in Box 2.1, the new NACE classification (NACE Rev. 2) allows one to provide interesting details concerning the evolution of business services that could not be provided when using NACE Revision 1.

**Figure 2.4 / Share of business services according to NACE Rev. 2 in GDP for EU-28, as a percentage of GDP**

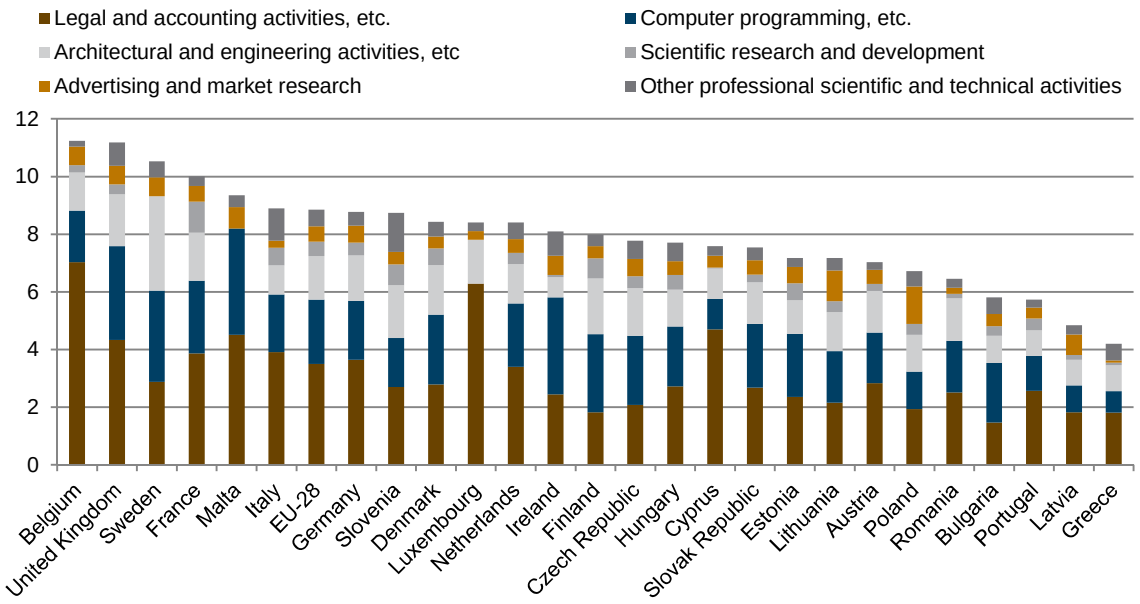



*Note*: * Denotes the set of knowledge-intensive business services which is focused on here.
*Source*: Eurostat; wiiw calculations.

Figure 2.6 presents the percentage point change in these shares of business services in overall GDP. It is easy to detect that in most countries the increase in business services was due to an increase in legal and accounting services and in computer programming and related activities. The latter was particularly important in Malta and a number of Eastern European countries, together with Finland and Denmark, whereas shares were stable or even slightly reduced for some sectors in Italy, Germany and the Netherlands (and more significantly in Spain). The rise of legal and accounting services – which was particularly significant in the accession countries – could be due to EU legal requirements, whereas in the old Member States the above-mentioned specialisation patterns across countries play a role.[12]

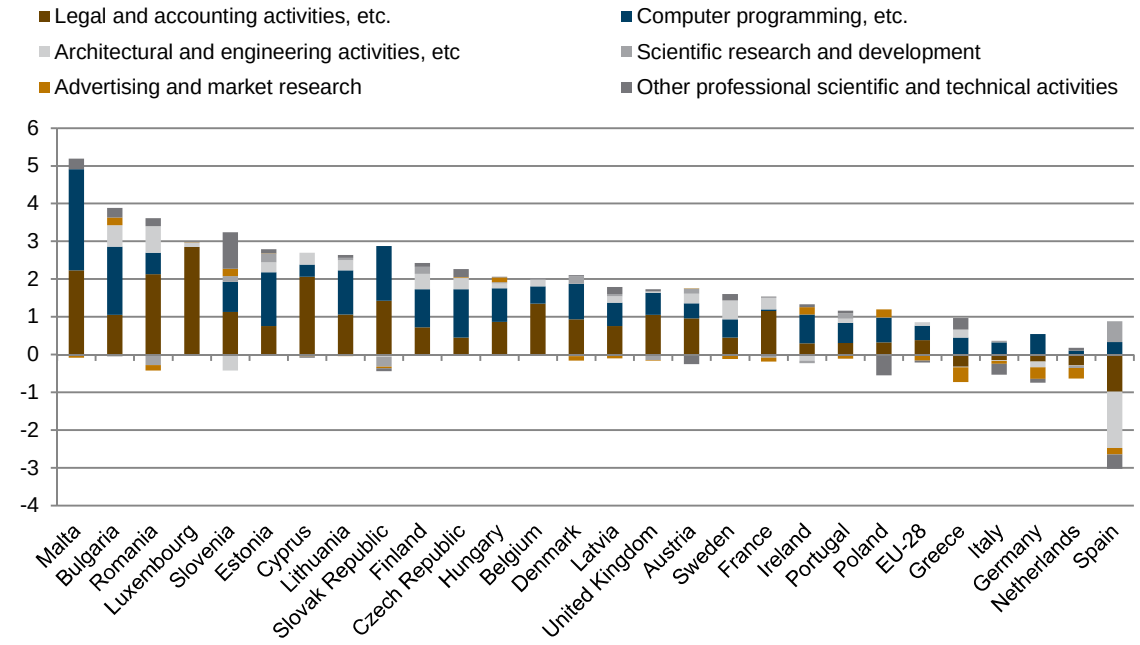
[12] The decline in the respective shares in Romania and Bulgaria (visible in Figure 2.2) is driven by the period 1995–2000.

**Figure 2.5 / Share of selected business services according to NACE Rev. 2, as a percentage of GDP, 2011**




*Note*: Lithuania (2010); Spain (2009).
*Source*: Eurostat; wiiw calculations.

**Figure 2.6 / Percentage point changes in share of selected business services, 2000–2011**




*Note*: Lithuania (2000–2010); Spain (2000–2009).
*Source*: Eurostat; wiiw calculations.

### 2.1.3. PERFORMANCE OF MANUFACTURING AND SERVICE SECTORS

Having considered the differentiated developments in the manufacturing and business services sector across countries, the next step is to analyse the performance of these industries over time, and in particular to look at the extent to which performance of the business services sector correlates with developments in terms of specialisation, as discussed above.

*Performance indicators of manufacturing and services in large economies*

Though the focus is on developments across EU Member States, as a starting point performance indicators are compared across large economies, the EU-27, the USA and Japan. Table 2.2 presents the developments in labour productivity, based on value added and gross output, growth rates of employment and value added, developments of wage rates, resulting developments of unit labour costs and the price indexes of both value added and gross output based on the WIOD Socio-Economic Accounts data. This table includes measures based on gross output, since the role of intermediates has to be considered, when focusing on total costs.[13] The period considered is 1995–2007, i.e. not including the crisis period.[14] The results are based on constant 1995 prices, and are presented for the total economy, the manufacturing industries, and three broad service sectors.

**Table 2.2 / Performance indicators for large economies, growth rates as a percentage over period, 1995–2007**

| | | Value added | Employment | Labour productivity (VA) | Labour productivity (GO) |
|---|---|---|---|---|---|
| Total | EU-27 | 3.5 | 1.0 | 1.7 | 2.3 |
| | USA | 3.6 | 1.1 | 2.5 | 2.1 |
| | Japan | 1.6 | -0.3 | 1.9 | 1.4 |
| Manufacturing | EU-27 | 6.2 | -0.6 | 3.6 | 4.4 |
| | USA | 4.4 | -1.8 | 6.2 | 3.8 |
| | Japan | 2.7 | -1.8 | 4.5 | 3.2 |
| Distribution, etc. | EU-27 | 2.9 | 1.9 | 0.7 | 0.8 |
| | USA | 4.5 | 1.2 | 3.2 | 2.4 |
| | Japan | 0.3 | -0.4 | 0.7 | 0.7 |
| Transport and communication | EU-27 | 4.2 | 0.7 | 3.7 | 4.4 |
| | USA | 4.3 | 0.4 | 3.8 | 3.2 |
| | Japan | 1.9 | -0.4 | 2.3 | 2.2 |
| Business services | EU-27 | 3.8 | 3.7 | 0.4 | 1.2 |
| | USA | 4.5 | 2.1 | 2.4 | 3.6 |
| | Japan | 3.5 | 2.0 | 1.4 | 1.2 |

*Source*: WIOD; wiiw calculations.

Starting with value added growth, it can be seen that the ranking is fairly consistent: the US grew faster (in real terms) in all distribution and business services. The growth rates in the EU-27 were higher in manufacturing. In all cases, these two economies performed better than Japan, though in business services the growth differential is small. In terms of employment growth, the performance of the EU-27 is

[13] In the econometric analysis in Section 3, results will also be provided for gross output-based performance measures.

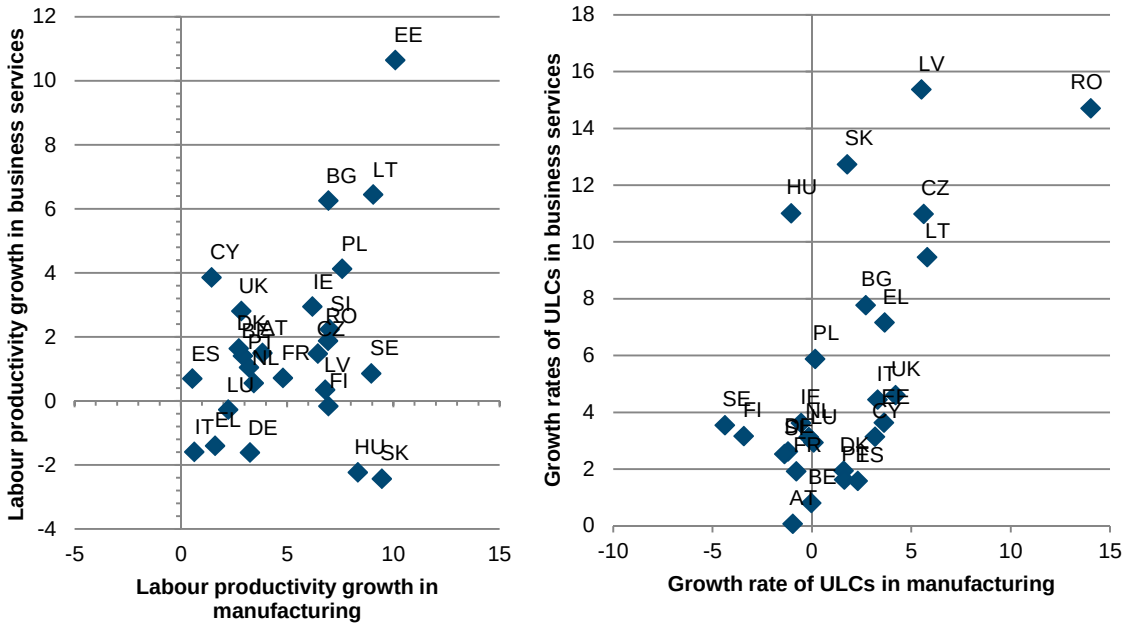
[14] Results are, however, qualitatively similar when considering the full period or a shorter period such as 2000–2007. Analysis up to a more recent year is hindered by lack of data and the break in the NACE classification.

in most cases better than that of the US. With respect to labour productivity growth, the US reports larger productivity growth rates in value-added terms in manufacturing, distribution and business services. In manufacturing, the EU-27 did better when considering productivity based on gross output.

*Performance indicators of manufacturing and services across EU member countries*

Figure 2.3 highlighted the differentiated specialisation patterns of manufacturing and service activities across Europe. Figure 2.7 presents growth rates in labour productivity and unit labour costs (ULC) in the manufacturing and business service sectors.

**Figure 2.7 / Productivity and unit labour cost developments, growth rates 1995–2007, as a percentage**

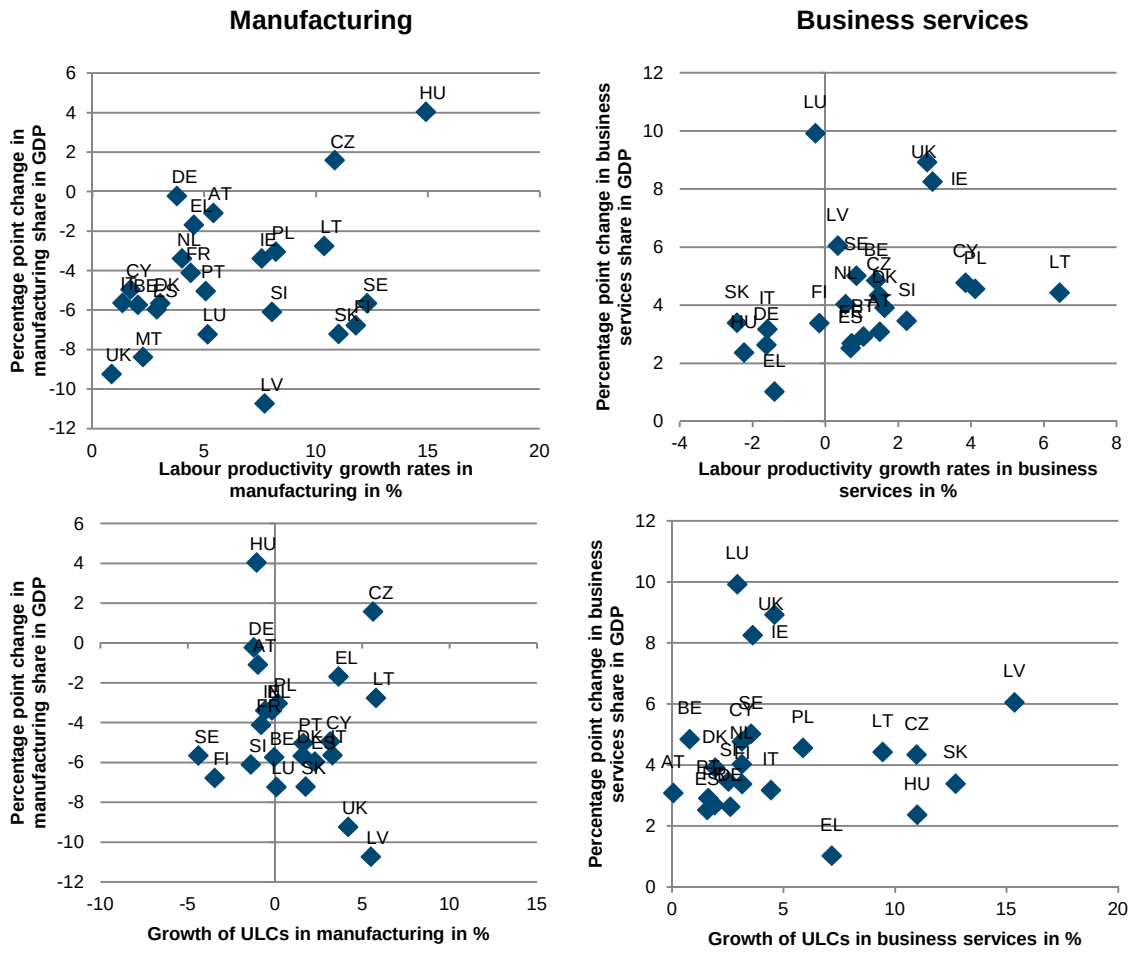



*Source*: WIOD; wiiw calculations.

First, when comparing labour productivity performance of these two sectors, it turns out that labour productivity growth rates range from almost zero to about 10%: the Eastern European countries, and also Finland and Sweden, have particularly high growth rates in manufacturing. Disregarding Bulgaria, Lithuania and Estonia, the growth rates for labour productivity in the business services sector are less differentiated, ranging from -2% to 4%. These growth rates are even negative for some large economies such as Italy, Greece, Germany, Hungary and the Slovak Republic, and it is this that explains the low EU growth rate. The UK, Denmark, Belgium and the Netherlands have above-EU-average growth rates. Concerning unit labour cost growth, a differentiated pattern is observed, as ULCs have a much larger spread in business services than manufacturing (disregarding Romania). Again, this is particularly driven by the performance of the Eastern European countries. A simple explanation for the differentiated patterns in terms of labour productivity and ULC growth is that wage rates tend to grow at similar rates across sectors. Particularly in the Eastern European countries, manufacturing productivity growth sparked wage increases in services, too, though there was no similar productivity gain in services. A similar pattern is observed for the EU-15 only: Italy and the UK, but also Denmark, Portugal and Spain,

experienced much larger ULC growth rates in manufacturing (i.e. the tradable sectors) than other countries; and the UK and Italy experienced higher growth rates in the business services sector, which is less tradable directly.

**Figure 2.8 / Performance and specialisation dynamics 1995–2007**




*Source*: WIOD; wiiw calculations.

Finally, the question of the extent to which this differentiated productivity and ULC dynamics has shaped the specialisation patterns, as shown in Figure 2.3 above, has to be addressed. Figure 2.8 presents the percentage point changes in the manufacturing and business services shares of GDP, relative to the performance measures of labour productivity growth (upper panel) and unit labour cost growth (lower panel). With the exception of a few outliers, there seems to be a positive relation between the growth rates of labour productivity in both manufacturing and business services and the respective percentage point changes in their shares in GDP. A negative correlation can also be seen when considering ULC growth and the share in GDP of manufacturing (with a few outliers), though this is less the case for business services. Thus, in a broad sense the countries in the manufacturing core have been characterised by *relatively* higher productivity growth rates and *relatively* lower growth rates of unit labour costs. This has contributed (among other things, e.g. the emergence of production networks in specific high-tech sectors, FDI flows and the exploitation of economies of scale) to the development of the European manufacturing core. Other countries have been more successful in specialising in

(business) services, partly because of their relatively better performance in the service industries. It should be noted here that for (business) service activities, too, factors such as integration via FDI, economies of scale, learning effects, etc. do play a role, thus indicating that a clustering of these activities is likely to occur. Taken all together, this resulted in the differentiated specialisation dynamics across Europe, as indicated in Figure 2.3.

## 2.2. INDICATORS CAPTURING THE INTER-LINKAGES BETWEEN MANUFACTURING AND SERVICES INDUSTRIES

These aspects and the observed patterns of specialisation are particularly important when – as is the focus of this study – investigating the interaction of manufacturing and services activities. Questions arising include (i) the role and relative importance of business services in manufacturing activities, and (ii) the role of the cross-border provision of business services in case of increased specialisation across countries. This section therefore sheds light on these interactions, based on quantitative indicators concerning the inter-linkages, which will subsequently be used in an econometric investigation studying the impact on manufacturing performance (Section 3). Sections 5 and 6 then investigate in more detail the role of business services in manufacturing activities and the role of cross-border flows for a selection of countries and industries.

### 2.2.1. SECONDARY PRODUCTION

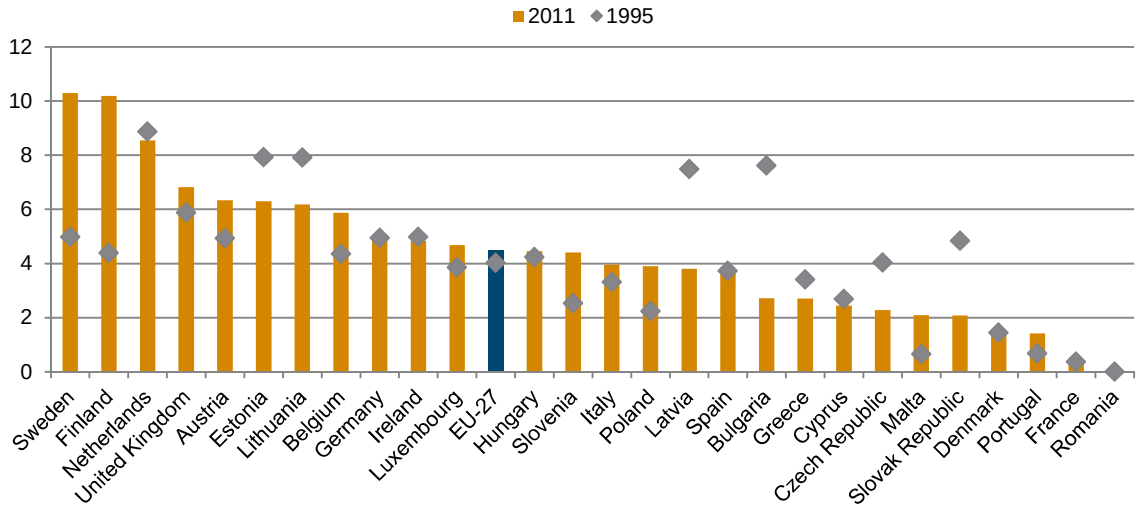
Manufacturing firms provide additional output in such services as maintenance and repair services, business advisory services (e.g. accounting, legal, advertising, management consulting, software consultancy), pre-sale services, sales services (e.g. installation and training), automobile financing, procurement services, and after-sales services (Magnusson et al., 2007). Such 'secondary production' can be calculated by using information from the supply tables, which list the output of firms classified as manufacturing or services by product (according to the Classification of Products by Activity (CPA) classification). Secondary production in the input-output framework include subsidiary products (i.e. secondary products that are technologically unrelated to the primary product), by-products (products that are produced simultaneously with another product, but which can be regarded as secondary to that product) and joint products (i.e. products that are produced simultaneously with another product, but which cannot be said to be primary). The share of secondary production in Europe is generally low (see Eurostat, 2008, Chapter 11, for details), as is shown in Figure 2.9.

The share of secondary production in the gross output of EU-27 manufacturing industries is about 4.5%, and only a slight increase has been observed since 1995. However, there exist large differences across EU Member States, as shares range from about 10% in Sweden and Finland to less than 1% in France and Romania. In most of the EU-15 countries, the share has been increasing slightly, whereas pronounced declines are reported for most of the EU-12 countries.[15] Remarkable increases are, however, observed for Sweden and Finland. These results support the findings of Falk and Jarocinska (2010), Stehrer et al. (2012) and Dachs et al. (2012). Dachs et al. further argue that there is a strong positive relationship between the share of secondary service production in manufacturing and R&D intensity, measured as government expenditures on R&D (GERD) relative to GDP. They further point

[15] These declines are observed in most (though not all) countries between 1995 and 2000. Romania reports a secondary production of zero.

out a strong relationship between service output and innovation-intensive industries (defined according to Peneder, 2010), with the electrical and optical equipment industry being the most pronounced in this respect. The shares of products delivered as secondary products differ, however.

**Figure 2.9 / Secondary service production of manufacturing industries, as a percentage of gross output**




*Source*: WIOD; wiiw calculations.

In 2011, the share of non-tradable market services (comprising repair, wholesale and retail trade) in the EU-27 accounted for slightly less than two-thirds, and business services (Financial Intermediation, NACE Revision 1 J, and Renting of M&Eq and Other Business Activities, NACE Rev. 1 71t74) accounted for about one-third of the services[16] supplied by manufacturing industries, whereas transport and communication and non-market services were only marginal.[17] This pattern is more or less the same – or is even more pronounced in terms of the relatively high importance of non-tradable market services – when considering individual EU Member States. Particularly, the secondary production of business services is relatively more important for Denmark, Finland and France, but also for Luxembourg, Sweden and Portugal (although in the case of Portugal the overall share of secondary products is relatively low). The significant increase in the share of secondary service production in Finland and Sweden was mostly due to an increase in non-tradable market services and (even more so) business services. However, even though the share of business services increased in the majority of Member States, there is no common trend.

These differences across countries and the changes over time lead to the question of whether these patterns and changes differ across industries. Considering the EU-27, secondary service production is largest in medium-high and high-tech industries and lowest in medium-low-tech industries. In the medium-high and high-tech industries, business services play a relatively large role and changes have also been stronger, particularly in Finland and Sweden.

[16] For some of the EU-12 countries, these shares are much larger, however. Falk and Jarocinska (2010) report an unweighted share of about 50% of business services in manufacturing services turnover.

[17] Dachs et al. (2012) report a larger share of KIBS in manufacturing output using a slightly different definition of KIBS.

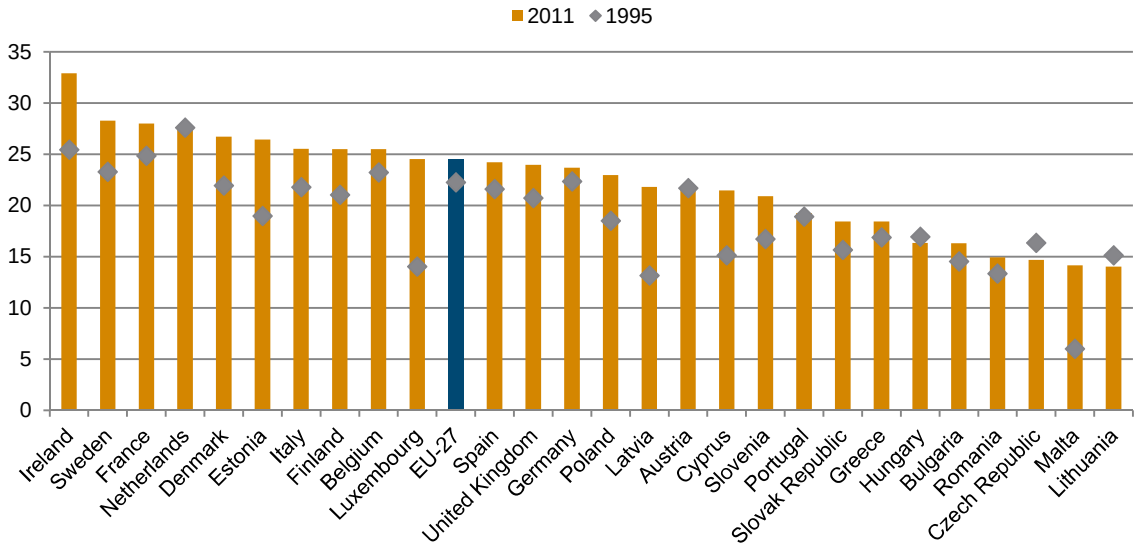
Concerning the secondary manufacturing production of service industries, the data indicate that these shares are generally rather small: e.g. 0.8% for the EU-27 in 2011. With respect to individual Member States, the share of secondary production of manufactured products in service sectors accounts for less than 1% on average. For some countries (e.g. Belgium, Italy and a number of Eastern European economies), slightly larger shares are found, with the largest being 4.3% in the Slovak Republic. There is no common trend over time, though the average has been decreasing slightly since 1995.

Thus, generally the share of secondary production is rather small, and there is some country heterogeneity. However, it should be noted that this indicator – as defined in official statistics – by no means fully captures the role of the 'servitisation' of production, which is highlighted in more detail in Section 5.

### 2.2.2. DIRECT COST SHARES

Manufacturing industries use services to a large extent as an important input in their production processes. The value of gross output produced by an industry (or firm) consists of inputs of primary factors, such as labour and capital services (and the respective factor payments to them), and of intermediary inputs from other manufacturing industries and services (from both domestic and foreign sources). This is the information that is reported in the use or input-output tables, which are closely related to the national accounts statistics. Figure 2.10 provides the results concerning the importance of service inputs in terms of (direct) cost shares, i.e. service inputs in per cent of gross output, in the manufacturing industry, for the EU-27 countries.

**Figure 2.10 / Cost share of services in manufacturing, as a percentage of gross output**



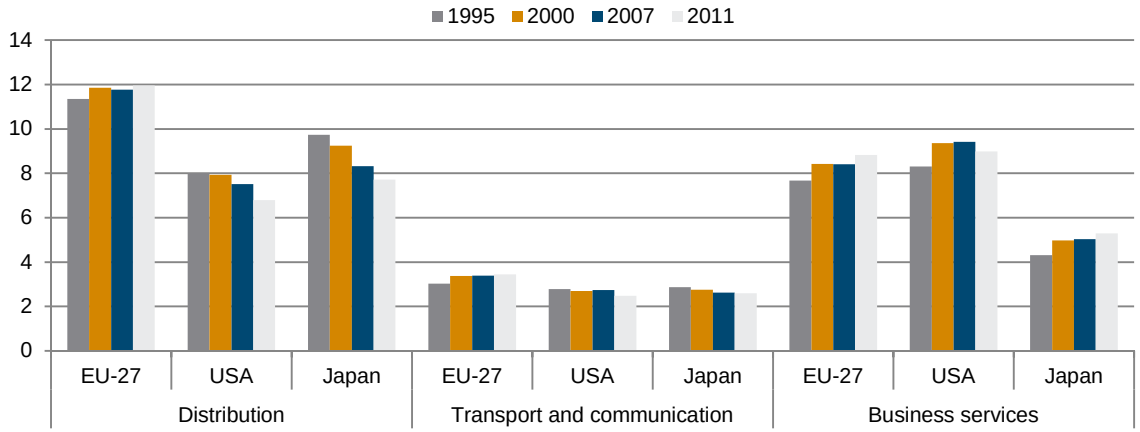

*Source*: WIOD; wiiw calculations.

For the EU-27, this share was about 25% in 2011, a slight increase from about 22% in 1995. However, the shares vary markedly across countries: from more than 30% in Ireland to less than 15% in the Czech Republic, Malta and Lithuania. With a few exceptions, the shares have been rising (or have at least

remained stable) in most countries. Particularly strong increases are observed for Luxembourg, Latvia, and Malta, which, however, all started from rather low levels. Generally, these service cost shares tend to be lower in the EU-12 countries, together with Greece and Portugal.

Two questions might arise from this broad pattern. First, to what extent are these cross-country differences driven by the sectoral composition or by differences in the respective direct cost shares? And, second, what explains the changes over time? Concerning the first question, it turns out that the differences across countries mostly result from differences in services use (as measured by cost shares), rather than from industry composition. A similar result holds when considering the changes over time, i.e. the dominant effect concerning the changes in service intensities are changes in the direct cost shares, rather than changes in the structure of manufacturing.

**Figure 2.11 / Cost share of services in manufacturing, as a percentage of gross output**



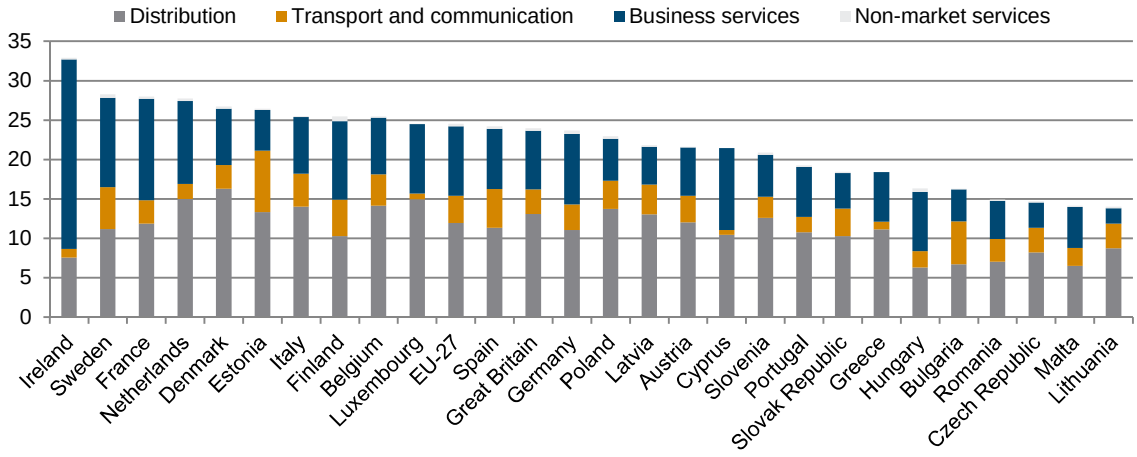

*Source*: WIOD; wiiw calculations.

Whereas Figure 2.10 presented overall service cost shares in manufacturing, the next figures provide more detailed information on service cost shares split into distribution and other services, transport and communication services, business services (including financial services) and non-market services.[18] For a broad overview, Figure 2.11 first presents these shares for the EU-27, the US and Japan. The share of distribution services is highest in the EU-27, with about 12%, as compared to the US (with about 7%) and Japan (with slightly less than 8%). The cost shares of transport and communication services are more similar, though also slightly higher in the EU-27 (3.5%) than in the US or Japan (about 2.5%). Finally, the share of business services is about 9% in both the EU-27 and the US, with the EU-27 slowly converging with the US. This share is rather low in Japan (about 5%), though it is also increasing slightly.

[18] Distribution and other services include Sale, Maintenance and Repair of Motor Vehicles and Motorcycles, Retail Sale of Fuel (NACE Rev. 1 50), Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles (NACE Rev. 1 51), Retail Trade, Except of Motor Vehicles and Motorcycles (NACE Rev. 1 52); Repair of Household Goods (NACE Rev. 1 52), and Real Estate Activities (NACE Rev. 70) and Private Households with Employed Persons (NACE Rev. 1 P). Transport and communication services include Hotels and Restaurants (NACE Rev. 1 H), Inland, Water and Air transport and other supporting auxiliary transport services (NACE Rev. 1 60–63) and Post and Telecommunications (NACE Rev. 1 64). Business services include Financial intermediation services (NACE Rev. 1 70) and Renting of M&Eq and Other Business Activities (NACE Rev. 1 71t74). Non market services comprise the remaining categories Public Admin and Defence, and Compulsory Social Security (NACE Rev. 1 L), Education (NACE Rev. 1 M), Health and Social Work (NACE Rev. 1 N), and Other Community, Social and Personal Services (NACE Rev. 1 O).

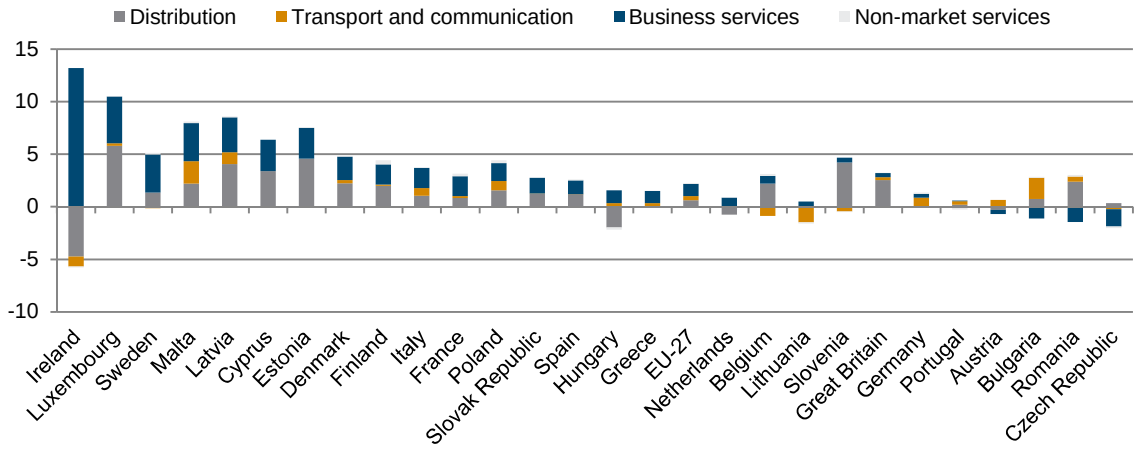
Cross-country differences in the structure of service cost shares in manufacturing are highlighted in Figure 2.12. Across the EU Member States, the share of distribution services ranged in 2011 from slightly above 6% in Bulgaria, Hungary and Malta, to 16.3% in Denmark, 15% in the Netherlands and 14.9% in Luxembourg. The cost shares of transportation and communication services are again more balanced, though these are relatively low in Cyprus, Greece and Luxembourg. Importantly, the direct cost shares of business services are much more diverse across countries. They range from 24% in Ireland, 12.9% in France, about 10% in Cyprus, Finland, the Netherlands and Sweden, down to 4–5% in most of the other countries. The share is particularly low in Lithuania, at only 2%. Generally, these shares have increased over time, particularly with respect to business services and (in some countries) transport and communication services, as highlighted in Figure 2.13.

**Figure 2.12 / Structure of service cost shares as a percentage of gross output, 2011**




*Source*: WIOD; wiiw calculations.

**Figure 2.13 / Percentage point changes in service cost shares in manufacturing, 1995–2011**




*Source*: WIOD; wiiw calculations.

Unfortunately, the CPA category Other business services (CPA 74) accounts for the major part of cost shares, with in most cases more than 50% (or 5.6% of gross output). This category, however, includes a rather large range of different service activities (e.g. cleaning, advertising, consultancy, etc.). Differences across countries with respect to business service inputs are largely driven by differences in the share of this category Other business services (CPA 74). This is particularly the case for Ireland, where the share of other business services is 18%, compared to less than 6% for the EU-27.

*Performance related services: A detailed look based on revised CPA classification*

However, as indicated in Box 2.1, the revised NACE classification allows for a better split within business services, and a number of countries have already provided supply and use or input-output tables for 2010. This information can be used to shed more detailed light on the structure of business services used in manufacturing industries. Table 2.3, therefore, presents the shares of business services in gross output, based on the new CPA categories, which closely correspond to the business service activities as used above.

**Table 2.3 / Share of business services according to CPA Rev. 2 in EU-27*, 2010**

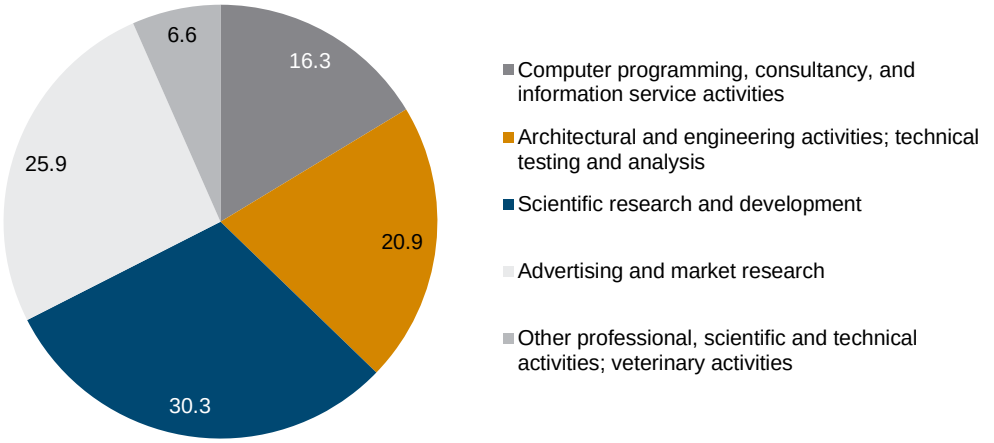
| CPA | Description | in % of gross output | in % of business services |
|---|---|---|---|
| J58 | Publishing activities | 0.2 | 1.8 |
| J59-J60 | Motion picture, video, television programme production; programming and broadcasting | 0.1 | 0.8 |
| J61 | Telecommunications | 0.2 | 2.5 |
| *J62-J63 | Computer programming, consultancy, and information service activities | 0.6 | 5.9 |
| K64 | Financial service activities, except insurance and pension funding | 1.1 | 10.9 |
| K65 | Insurance, reinsurance and pension funding, except compulsory social security | 0.2 | 2.3 |
| K66 | Activities auxiliary to financial services and insurance activities | 0.1 | 1.0 |
| M69-M70 | Legal and accounting activities; activities of head offices; management consultancy activities | 1.8 | 17.6 |
| *M71 | Architectural and engineering activities; technical testing and analysis | 0.8 | 7.5 |
| *M72 | Scientific research and development | 1.1 | 10.9 |
| *M73 | Advertising and market research | 0.9 | 9.3 |
| *M74-M75 | Other professional, scientific and technical activities; veterinary activities | 0.2 | 2.4 |
| N77 | Rental and leasing activities | 1.0 | 10.3 |
| N78 | Employment activities | 0.8 | 8.0 |
| N79 | Travel agency, tour operator reservation service and related activities | 0.1 | 0.6 |
| N80-N82 | Security and investigation, service and landscape, office administrative and support activities | 0.8 | 8.3 |
| | | 10.1 | 100.0 |

*Note*: EU-27 does not include Cyprus, Denmark, Malta, Poland or Spain.
*Source*: Eurostat; wiiw calculations.

The total share in gross output accounts for about 10% (which is comparable to the figure of about 9% based on the old classification). When those activities that are also captured in the old CPA categories (i.e. CPA categories J62-J63, K, M72, N77) are not taken into account, the remaining categories account for about 6% of gross output, which is relatively close to the share of other business services observed when using the old classification. Assuming that these categories (highlighted in light grey in Table 2.3) account for other business services, the structure of that category would be as presented in Figure 2.14. Important categories which are probably related to industry performance would, however, only be a subset of these: Computer programming (CPA J62-J63), Architectural and engineering activities, etc.

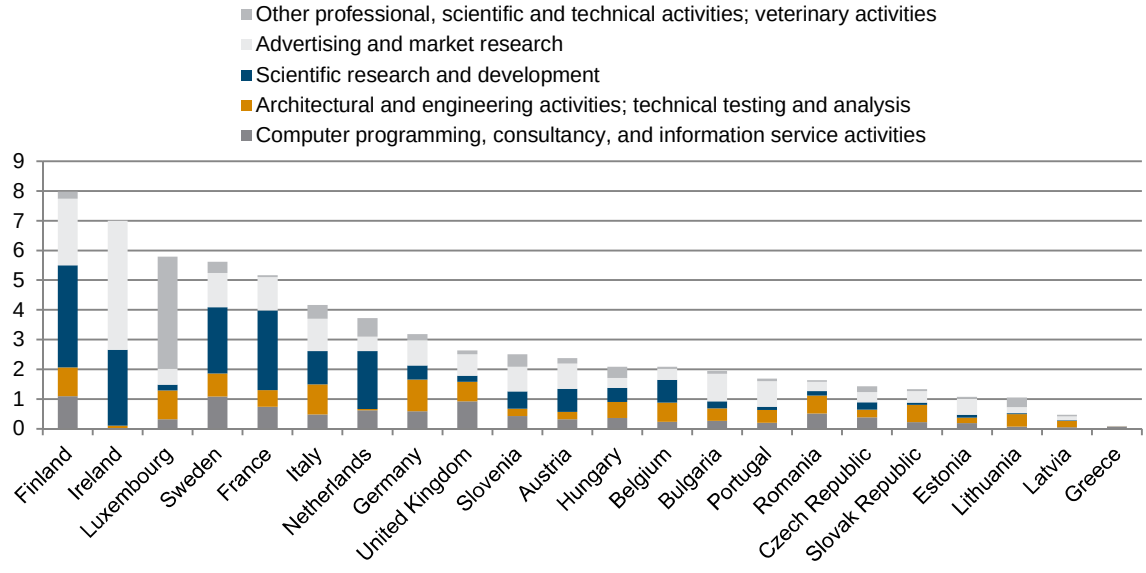
(CPA M71), Scientific research and development (M72), Advertising and market research (M73) and Other professional etc. activities (M74-M75), which together account for a share of 3.6% of gross output. The relative importance of these activities is plotted in Figure 2.14. Scientific research and development (M72) accounts for about 30%, followed by Advertising and market research (M73) with 25.9%, and Architectural and engineering activities, etc. (CPA M71) with 20.9%. Computer programming (CPA J62-J63) accounts for about 16% and the category Other professional etc. activities (M74-M75) for slightly above 6%.

**Figure 2.14 / Structure of performance-related services, 2010**




*Note*: These performance-related services account for 3.6% of gross output.
*Source*: Eurostat; wiiw calculations.

**Figure 2.15 / Structure of use of performance-related services in manufacturing, as a percentage of gross output, 2010**




*Source*: Eurostat; wiiw calculations.

An analogous exercise can be undertaken at the level of the individual Member States. Figure 2.15 presents the share of gross output for the performance-related categories. As with the results above, those countries with the highest shares are the Nordic countries, Ireland and the larger economies. The smaller economies have input shares of less than 3%. These differences are mostly driven by differences in the shares of scientific research and development, and advertising and market research.

The direct cost share of services in gross output in the EU-27 accounts for about 25% in 2011, with only a relatively small increase observed since 1995; distribution and business services show the largest shares. However, the results point to a wide range for these shares across countries; this is mostly driven by business services. More detailed results based on the new NACE classification also highlight country differences with respect to scientific research and development, and advertising and market research. It needs to be stressed that these direct cost shares only capture bought-in services, and do not take in-house provision of services into account.

### 2.2.3. IMPORTED SERVICES COST SHARES

Part of the (business) services used in manufacturing industries as intermediate inputs are imported from other countries. This becomes more and more important when taking account of the increasing specialisation across Europe, as indicated above. As the bulk of imported services for most countries are in business services, and since these are also the services that are the focus of this study,[19] it needs to be emphasised that in distinguishing between domestic and imported intermediaries (and therefore also business services), in line with national accounting principles it is the location of production that matters, rather than ownership of the provider firms. Furthermore, it should be stressed that these figures only include Mode 1 and Mode 2 services trade.[20] Figure 2.16 presents the share of imported business services used in manufacturing, as a percentage of gross output for individual Member States.[21]

For individual Member States, the share of imported services as a percentage of gross output ranges from more than 5% in Luxembourg to 1–2% (or less) in a number of countries; in fact, in 17 countries the share fell below 2% in 2011. This group comprises both large countries – such as Germany, Italy, Great Britain and France – and most of the Eastern European countries. Larger shares are observed for the Netherlands, Finland, Sweden and Hungary (about 3%). In most countries, the share has been increasing over time.

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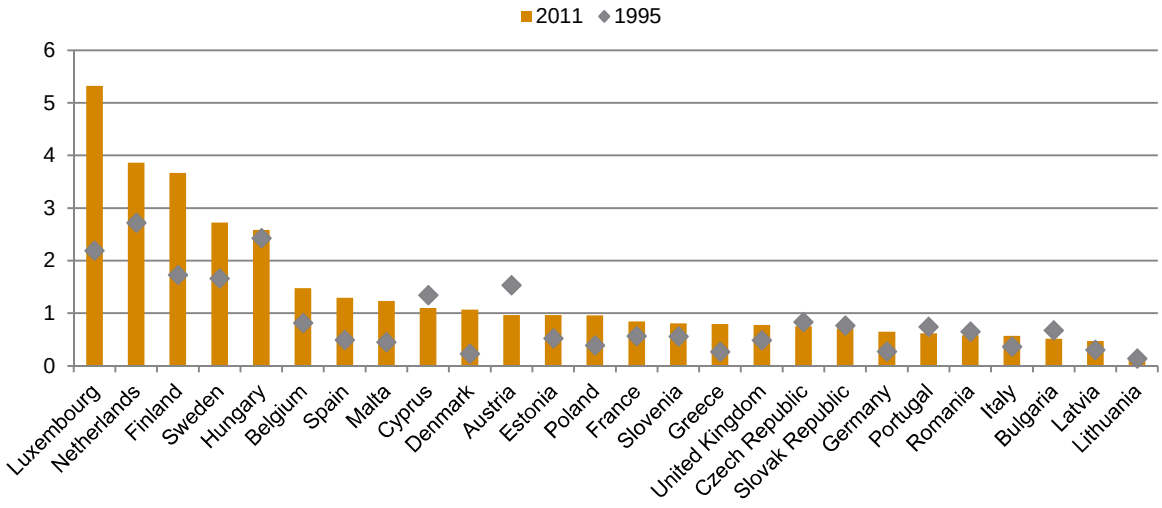
[19] Imports of transport and communication services in manufacturing play a relatively important role in e.g. Sweden, Belgium, Austria and Denmark, with a cost share of about 1%. Distribution services show cost shares of less than 1% in general.

[20] These two modes characterise services supply where the supplier is not present within the territory of the member: Mode 1 (cross-border services supply) is defined as delivery of a service from the territory of one country into the territory of another country, whereas Mode 2 (consumption abroad) comprises consumption abroad (supply of a service in a country to the service consumer of any other country). Mode 3 (commercial presence) and Mode 4 (presence of a natural person) are service deliveries where the supplier is present in the territory of the partner.

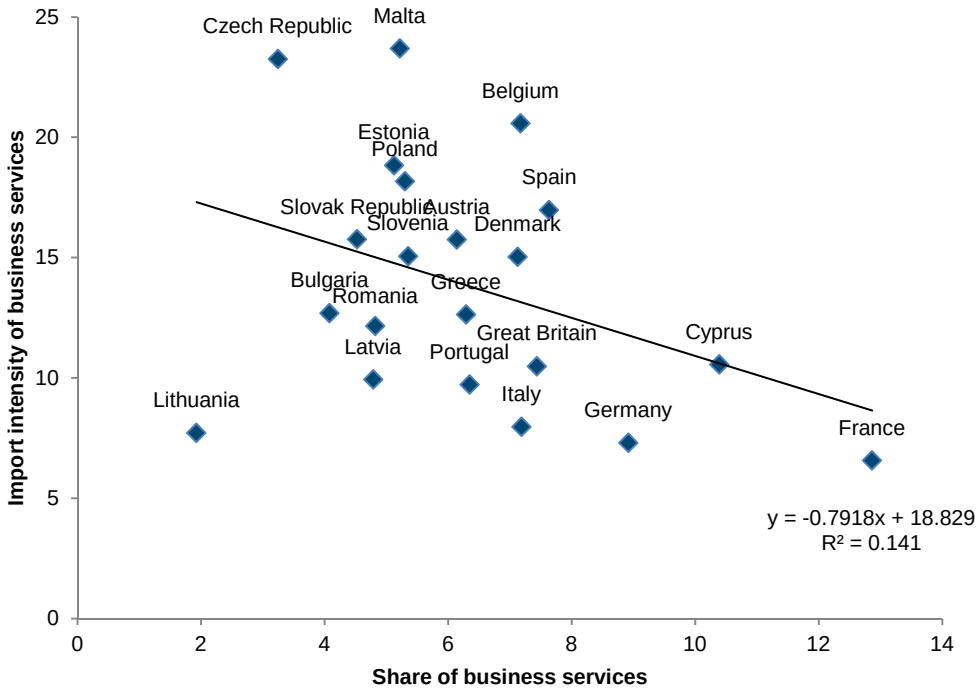
[21] Comparing the EU-27 (extra-EU imports) with the US and Japan reveals that for these large countries imported services account for a very small share only (usually less than 1%). These are slightly higher for the EU-27, as some European economies (e.g. Switzerland, Norway) are included in the rest-of-world category. This is also the reason why shares for individual EU Member States are generally larger when including intra-EU imports.

**Figure 2.16 / Direct cost shares of imported business services in manufacturing, as a percentage of gross output**




*Note*: Ireland is not reported.
*Source*: WIOD; wiiw calculations.

**Figure 2.17 / Import intensities and the cost share of business services in manufacturing, as a percentage, 2011**

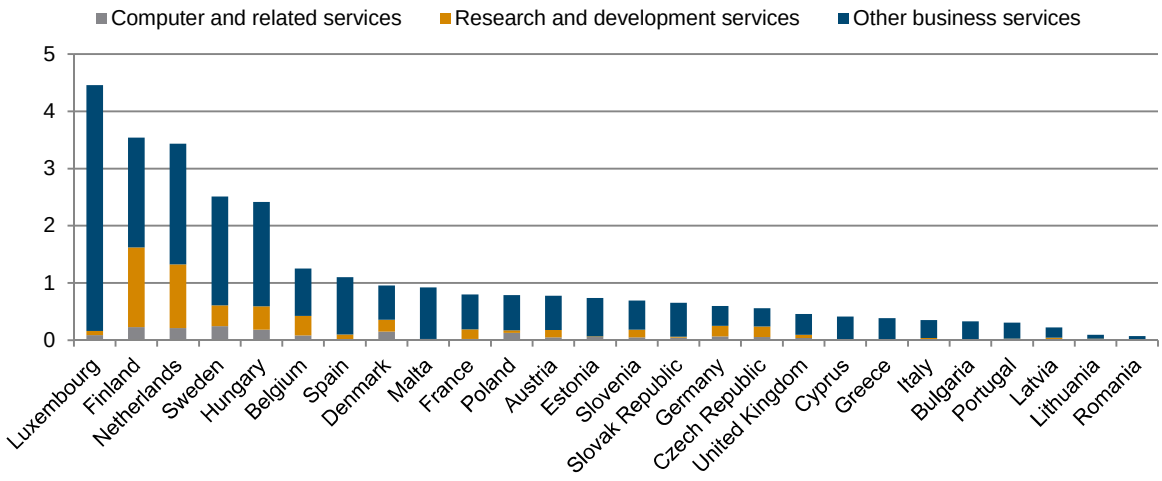



*Note*: Excluded are Finland, Netherlands, Hungary, Ireland, Luxembourg and Sweden.
*Source*: WIOD; wiiw calculations.

There is a wide range of import intensities – defined as the share of imported business services as a percentage of total business services used in manufacturing: from more than 50% in Ireland and Luxembourg to less than 10% in France, Germany, Italy and others. The arithmetic EU average was 20% in 2011. These patterns are highlighted in Figure 2.17. The share has increased over time in most countries, with just a few exceptions such as Austria, the Slovak Republic, Hungary, Latvia, Cyprus and Malta. One potential reason for this pattern in the latter countries could be that some headquarters have moved their activities to these countries. These figures allow one to study the relationship between import intensities and the overall share of business services used in manufacturing. Disregarding those countries that have very high import intensities (such as Finland, Hungary, Ireland, Luxembourg and Sweden), there is a rather clear negative relationship. Particularly high import intensities can be seen for smaller countries, where therefore imports of business services play a more important role in the manufacturing process than is the case for larger countries.

These results suggest that it is worth having a look at the more detailed business services categories. Focusing on the performance-related business services only, the category Other business services (CPA 74) is the most important one highlighted in Figure 2.18. Only in Finland and the Netherlands are imports of Research and development (CPA 73) relatively important. This can be compared with the same indicator, but based on NACE Rev. 2 (for those countries reporting import-output tables), as is done in Figure 2.19 for the performance-related business services, where research and development predominates, together with legal and accounting activities. In Ireland, the import of advertising and market research services activities is also important.

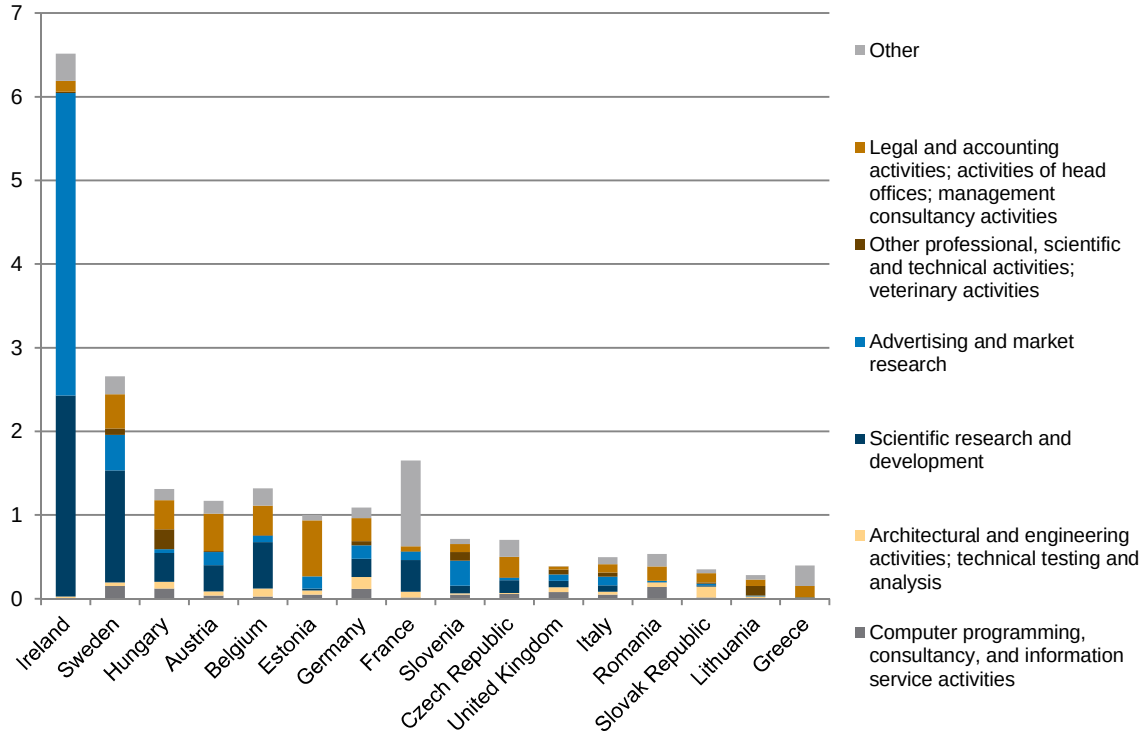
**Figure 2.18 / Cost shares of imported business services used in manufacturing, as a percentage of gross output, 2011**




*Note*: These figures do not include financial intermediation services.
*Source*: Eurostat; wiiw calculations.

The role of imported business services is rather small on average, making up about 1% as a direct cost share in gross output. For a few countries only, these shares are higher (up to 5%). Smaller countries – and the Eastern European countries in particular – are characterised by higher import intensities of business services. The most important item is other business services and R&D for some countries.

**Figure 2.19 / Cost shares of imported performance-related business services used in manufacturing, based on NACE/CPA Rev. 2, as a percentage of gross output, 2011**




*Source*: Eurostat; wiiw calculations.

### 2.2.4. DIRECT AND INDIRECT PRODUCTION LINKAGES

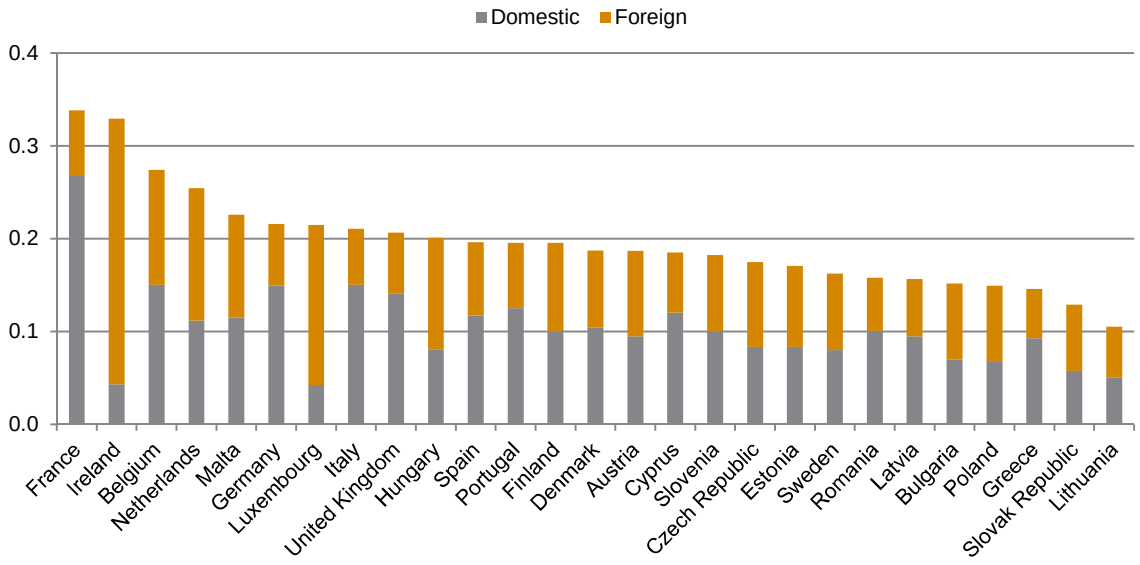
Having considered the service inputs into manufacturing in terms of direct cost shares (and those of manufacturing into services, though these are less important), this section goes a step further and provides descriptive indicators concerning the backward (and forward) linkages between manufacturing and services, which later on are also used in the econometric analysis (see Section 3). These (direct and indirect) linkage effects are further distinguished with respect to domestically and foreign-sourced inputs, by analogy with domestic and foreign cost shares. Methodologically this follows the multiplier concept in input-output analysis. In broad terms, the interaction between the manufacturing sector and services can be considered in two ways. On the one hand, the manufacturing sector buys inputs from the service sector, e.g. transport services for sourcing its intermediate products, R&D services, marketing, etc. On the other hand, manufacturing supplies its (intermediate) products to the service sector. While the first relationship is termed ‘backward linkages’ (from the viewpoint of manufacturing), the second is termed ‘forward linkages’, with the focus being on the first indicator. As a measure, we use the gross output multiplier (as defined in standard input-output analysis), which shows the direct and indirect effects on output in the respective service categories of a change in final demand in manufacturing.

**BOX 2.2 / BACKWARD LINKAGES**

Backward linkages show how much additional input is required to produce one unit of additional final demand. An increase in final demand in a specific sector requires output from that sector. However, for the production of this additional output, that sector also uses inputs from other sectors, which themselves need inputs from other sectors, etc. Technically, backward linkages can therefore be calculated as the column sum of the Leontief inverse derived from an input-output model. The column sum can be split into the various contributing sectors – or even countries, if a world input-output table exists. Formally, therefore, $BL_k^c = \mathbf{1}\,\mathbf{l}_k^c$, where $\mathbf{l}_k^c$ denotes the column for country c and sector k in the Leontief inverse. Focusing on the role of services (and business services in particular), the results are presented by summing together the respective delivering sectors, distinguishing between domestic and foreign linkages.

Focusing on manufacturing backward linkages with *business services*, highlighted in Figure 2.20, domestic linkages are very large for France; some distance behind come Italy, Belgium, Germany and the United Kingdom. Domestic linkages were lowest for Lithuania, Ireland and Luxembourg. Foreign linkages, on the other hand, were very high for Ireland, followed by Luxembourg, the Netherlands and Hungary. Looking again at both domestic and foreign backward linkages together, domestic linkages are larger in 16 countries, and foreign linkages are larger in 11. In relative terms, domestic linkages are more important than foreign ones in France, Italy and Germany, while foreign linkages are more pronounced than domestic ones in Ireland and Luxembourg.

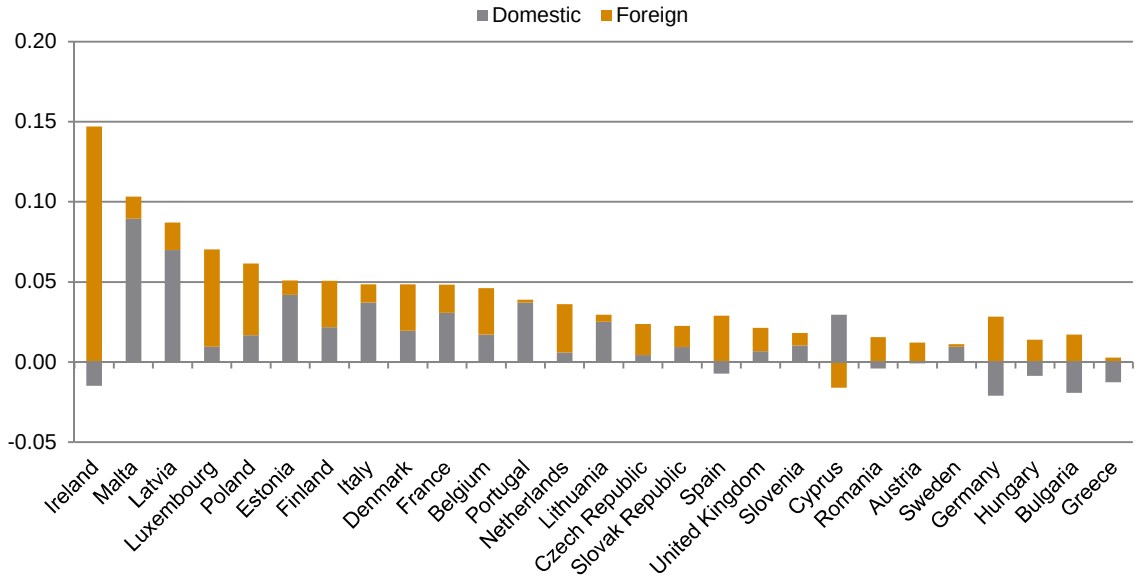
**Figure 2.20 / Domestic and foreign backward linkages of manufacturing sectors with business services, 2011**




*Source*: WIOD, wiiw calculations.

Next, we investigate how backward linkages have evolved over time. Whereas total domestic backward linkages remained mostly constant over time, foreign backward linkages have increased due to international fragmentation and increasing internationalisation of production. In addition, outsourcing of service functions from manufacturing to services should also have increased backward linkages with service sectors in general, which is one of the concerns of this study. Figure 2.21 illustrates the change in manufacturing backward linkages in the business service sectors between 1995 and 2011. In general, both domestic and foreign backward linkages with the service sectors increased over this time period. Domestic increases predominate in Malta, Latvia, Estonia, Italy, France, Portugal and Cyprus. Generally, however, the increases tend to be rather small (10–15% over the whole period).

**Figure 2.21 / Changes in backward linkages of manufacturing sectors with business services, 1995–2011**




*Source*: WIOD, wiiw calculations.

Considering backward linkages allows one to study the role of directly and indirectly used business services in manufacturing production, and to distinguish between domestic and foreign linkages. Whereas in most countries domestic linkages still predominate – though not necessarily in smaller countries – the role of foreign linkages is more significant and is increasing over time in most countries.

### 2.2.5. DOMESTIC AND FOREIGN SERVICE CONTENT OF MANUFACTURING

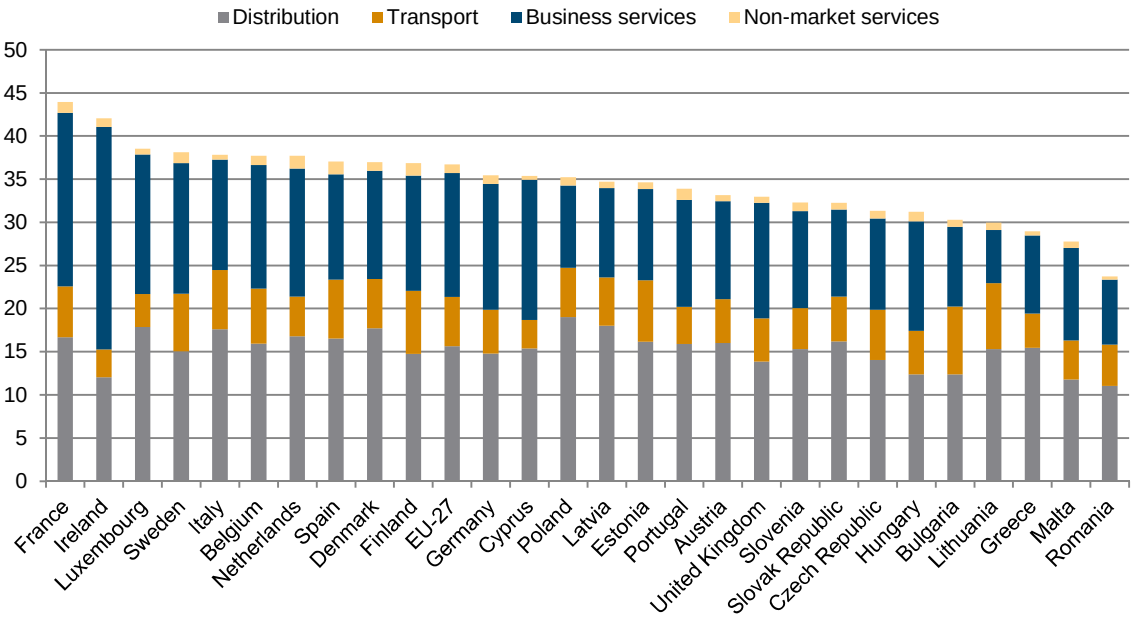
The production of a manufacturing final product requires primary inputs not only from the specific manufacturing sector itself, but also from other industries nationally and from foreign countries. This was picked up on above when considering the simple cost shares in manufacturing production by country and industry. However, this measure does not take into account the indirect effects of linkages when using intermediate inputs from other industries and countries. The concern of this section is, therefore, to present the direct and indirect service content of manufacturing production of final demand (for both domestic and foreign demand) or export goods (both intermediate and final demand exports).

**BOX 2.3 / DIRECT AND INDIRECT VALUE-ADDED CONTENT OF MANUFACTURING OUTPUT**

Formally, the direct and indirect service content in manufacturing output is calculated by pre-multiplying the final output of the manufacturing industries under consideration by the value-added coefficients vector of the supplying industries and countries of interest. More specifically, to assess the value-added content of, for example, business services in final goods production of industry k of the domestic economy, one has to calculate $\mathbf{v}_i^r \mathbf{L} \mathbf{f}_k^r$ where $\mathbf{v}_i^r$ denotes a 1xNC vector of value-added coefficients in country r and industry i (the supplying industry), $\mathbf{L}$ denotes the global Leontief inverse and $\mathbf{f}_k^r$ denotes a NXx1 vector of final output of industry k in country r and zeros otherwise. Alternatively, this can be replaced by a vector of exports denoted by $\mathbf{x}_k^r$.

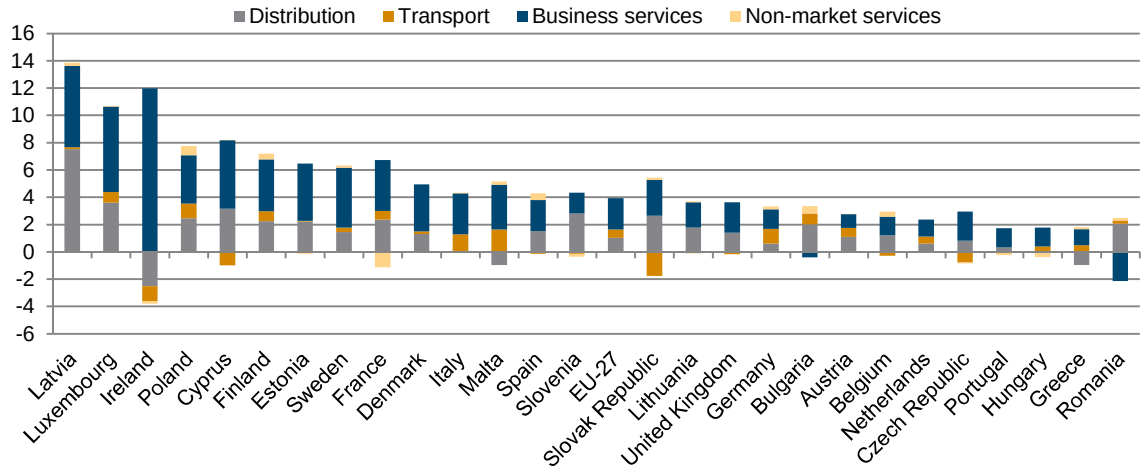
Figure 2.22 plots the direct and indirect service content of manufacturing final goods production, distinguishing four service categories. Distribution and business services comprise the largest direct and indirect shares in the value of final goods production (with more than 10% in most cases), followed by transport services (with about 4–5%). Concerning the share of business services, there are cross-country patterns that are similar to those observed above: within Europe, the share ranges from 6.1% in Lithuania, through 14–15% in a number of countries, to 20% in France and 25.8% in Ireland. Across countries, these patterns strongly resemble the simple cost shares already reported above; in fact, there is a strong correlation (0.9) between the simple cost shares and the direct and indirect service content. This also holds for the changes to the service content shares: business services are again the most dynamic component (see Figure 2.23).

**Figure 2.22 / Structure of service content of manufacturing final goods production, 2011, as a percentage of final goods production**




*Note*: Ranked according to direct and indirect service content share.
*Source*: WIOD; wiiw calculations.

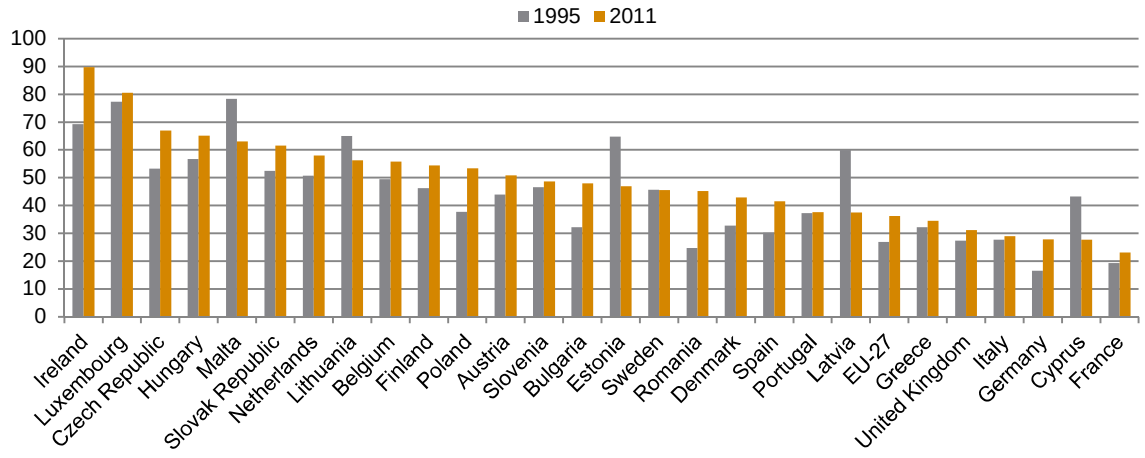
**Figure 2.23 / Change in structure of service content of manufacturing final goods production, 1995–2011, percentage points**




*Source*: WIOD; wiiw calculations.

Part of the direct and indirect service content is imported from other economies. Comparing EU Member States, the share of imported direct and indirect service content (as a percentage of final demand) reaches 23% in Ireland and 12% in Luxembourg; generally, however, the shares are at levels of between just under 4% and 8%. The share of imported direct and indirect business services content in total direct and indirect business services use ranges from almost 90% in Ireland to about 20% in France (see Figure 2.24). Larger countries, such as France, Germany and Great Britain, tend to have lower imported shares, resembling the patterns of direct import cost shares above. With a few exceptions, these imported shares have increased since 1995.

**Figure 2.24 / Imported direct and indirect business services content of manufacturing final goods production, 2011, as a percentage of total**




*Note*: EU-27 average includes intra-EU trade.
*Source*: WIOD; wiiw calculations.

## 2.3. SUMMARY

This section first presented the relative importance of manufacturing and business services in a country's GDP, highlighting the differentiated specialisation patterns across European economies over the period 1995–2011. Whereas some countries managed to maintain a stronghold in manufacturing, others succeeded in specialising in business services; some countries, however, could neither hold their manufacturing base nor specialise strongly in business services. To a certain extent, these differentiated patterns of specialisation might be explained by relative growth performance in productivity levels and wage costs across countries and industries. It further needs to be emphasised that manufacturing in all countries has been growing in real terms, though at a lower rate than services.

A number of indicators concerning the inter-linkages between manufacturing and services were presented, and the most important results are summarised as follows. The share of secondary production of services for the EU-27 amounts to about 4% of manufacturing gross output, though the range across countries is quite wide. Distribution and business services account for the bulk of secondary production of manufacturing industries. Over time there has been a slight increase in these shares – a trend that is particularly pronounced in Sweden and Finland. It should, however, be emphasised that the figures do not include the services provided in-house or the servitisation activities of manufacturing firms.

The second indicator considered was the direct cost share of service inputs into manufacturing industries, which accounted for about 25% of total costs (i.e. including value-added costs) in manufacturing in 2011 for the EU-27 services (up only slightly from 1995). Again, there are remarkable differences across countries. Differentiating by service category shows that distribution (12% on average) and business services (9% on average) are generally the most important service inputs. Over time, the share of business services is the most dynamic component in the majority of countries. The cost share of imported services in manufacturing gross output is about 1% for most countries; only a few countries show a significantly larger share. These patterns are dominated by imports of business services, which account for about 50% of service imports. Most of the smaller countries tend to have a lower share of business services in manufacturing output, together with relatively larger imports, resulting in a greater 'import intensity'. The most important items imported for use in manufacturing are scientific research and development, legal and accounting activities, followed by advertising and market research according to the NACE/CPA Rev. 2 classification. Again, there is a wide heterogeneity across countries.

These direct and indirect production linkages – driven by the use of other industries' output – are captured using an indicator of backward linkages. Concerning business services, larger countries tend to have larger backward linkages, which are mostly domestically oriented (particularly in France). Smaller countries (including the Eastern European countries) are characterised by relatively larger foreign linkages. These linkages, and in particular foreign linkages, have generally increased over time, though at a slow pace. Domestic increases predominate in a few countries only.

Taken together, the results show that services account for slightly less than 40% of the value of final manufacturing production in the EU-27 as a whole, the bulk of which is accounted for by distribution services and business services (about 15% apiece). The share ranges from over 40% in France and Ireland to less than 30% in Greece, Malta and Romania. Over time, the share has increased, largely due to a change in the respective content of business services, confirming the results already found when considering direct cost shares.

# 3. Assessing the role of business services linkages for manufacturing performance in EU Member States

## 3.1. INTRODUCTION

The previous section provided an overview of the patterns and magnitudes of manufacturing–services interactions, based on information from input-output tables. In this section, light is shed on the role these interactions play in the performance of – or in the performance improvements observable in – the manufacturing sector. The analysis focuses on the business services[22] linkages discussed in Section 2.2.4, since business services are considered more relevant and more important as sources of spillovers for the manufacturing sector than are other types of services. Additionally, the analysis accounts for geographic sourcing strategies and their likely effects on performance changes in the manufacturing sector, and accordingly differentiates between (i) business service linkages which are sourced domestically, and (ii) business service linkages which are sourced from abroad.

## 3.2. DATA AND METHODOLOGY

The empirical analysis uses a number of different data sources. As in Section 2, the analysis draws on the World Input-Output Database (WIOD), which covers the time horizon from 1995 to 2011 (Dietzenbacher et al., 2013; Timmer, 2012). However, to avoid any crisis-related distortions, the ensuing empirical analysis focuses on the period between 1995 and 2007. Indicators such as domestic and foreign business service linkages, the share of high-, medium- and low-skilled labour, and exports are taken from the corresponding WIOD satellite accounts. These data are complemented by a number of additional data sources: information on R&D expenditure stems from the OECD Analytical Business Enterprise Research and Development database (OECD ANBERD, ISIC Rev. 3), while data on inward FDI stocks are taken from the OECD International Direct Investment Statistics (OECD IDI, ISIC Rev. 3). Moreover, given the scarcity of data in the OECD IDI – particularly for New Member States – inward FDI stocks for the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia are taken from the wiiw FDI Database.

To take account of prevailing cross-country and cross-industry differences and the different business service linkage effects that may arise, results are presented for a number of different groupings:

› The first grouping differentiates between the group of EU-15 member countries and the group of New Member States (EU-12) – referred to as EU membership status (as countries joined the EU in different years). In particular, in the period under consideration the group of EU-12 underwent strong growth

[22] Business services comprise Financial intermediation services (NACE Rev. 1 70) and Renting of M&Eq and Other Business Activities (NACE Rev. 1 71t74).

and convergence processes and initiated key financial market and trade liberalisation policies; as a result, they became strongly integrated into the EU and global markets.

› The second grouping is based on country size and differentiates between the group of the five largest economies in the EU (France, Germany, Italy, Spain and the UK) and the remaining 22 medium and small EU economies. Throughout the period under consideration, the five largest EU economies together accounted for about 70% of total EU-27 GDP. Given the size of their internal markets, size-related differences in business service linkages are evident and differences with respect to performance effects can be expected. This is particularly the case for the domestic and foreign sourcing patterns, as shown above.

› Finally, the third grouping accounts for the cross-industry heterogeneity in the sample and differentiates by the technology intensity of industries. In particular, in accordance with the R&D intensity-based OECD technology intensity definition,[23] it draws a three-way distinction: there are the medium-high- and high-technology industries (MHT) of Chemicals (ISIC 24), Machinery and equipment (ISIC 29), Electrical machinery (ISIC 30t33) and Motor vehicles (ISIC 34t35); the medium-low-technology industries (MLT) of Coke and refined petroleum products (ISIC 23), Rubber and plastic (ISIC 25), Non-metallic mineral product (ISIC 26) and Basic and fabricated metal products (ISIC 27t28); and the low-technology industries (LT) of Food, beverages and tobacco (ISIC 15t16), Textiles and wearing apparel (ISIC 17t18), Leather and leather products (ISIC 19), Wood and wood products (ISIC 20), Paper, paper products, printing and publishing (ISIC 21t22) and Manufacturing n.e.c. and recycling (ISIC 36t37).

Methodologically, since the descriptive analysis above clearly reveals that linkages between services and manufacturing show little variation over time, and that most variation is across countries and industries, a growth-equation approach is chosen as the most meaningful and promising approach to capture long-term trends. In particular, the following specification is used to shed light on the performance effects in manufacturing of *domestic* and *foreign* business service linkages between manufacturing and services:

$$\begin{aligned} \text{grLPVA}_{ik}^{manuf} &= \beta_0 + \beta_1 \text{initLPVA}_{ik}^{manuf} + \beta_2 \text{BSlink}_{ik}^{dom} + \beta_3 \text{BSlink}_{ik}^{for} + \beta_4 \text{HS}_{ik}^{manuf} + \beta_5 \text{LS}_{ik}^{manuf} + \ldots \\ &\ldots + \beta_6 \text{FDIint}_{ik}^{manuf} + \beta_7 \text{RDint}_{ik}^{manuf} + \nu_k + \varepsilon_{ik} \end{aligned} \quad (3.1)$$

where $\text{grLPVA}_{ik}^{manuf}$ refers to the manufacturing sector performance indicator in terms of the real (1995 prices) Purchasing Power Parity (PPP)-adjusted average labour productivity growth rate (value-added based) in manufacturing in country $i$ and industry $k$ and $\text{initLPVA}_{ik}^{manuf}$ is the real (1995 prices) PPP-adjusted initial level of labour productivity (value-added based) in manufacturing in 1995, included to capture the process of the convergence of productivities over time. The two major variables of interest are $\text{BSlink}_{ik}^{dom}$ and $\text{BSlink}_{ik}^{for}$ which serve to capture performance-improvement effects emanating from linkages between manufacturing and business services, differentiated by sourcing strategy, where $dom$ and $for$ refer to domestic and foreign, respectively (see Section 2.2.4 for a discussion of these linkage indicators). Furthermore, a set of additional control variables is included: $\text{HS}_{ik}^{manuf}$ and $\text{LS}_{ik}^{manuf}$ are human capital proxies which refer to the share of high-skilled and low-skilled labour, respectively, in an

[23] The OECD classification had to be adapted to the slightly more aggregated industry classification in the WIOD.

industry. Two more variables are included to account for the role of intangibles in labour productivity growth. In particular, $FDIint_{ik}^{manuf}$ is the inward FDI intensity (as the share of inward FDI stock in gross output) of industry $k$ in country $i$ to control for intra- and inter-industry spillover effects emanating from the presence of (more productive) foreign-owned firms; while to capture productivity improvements stemming from innovative activities, $RDint_{ik}^{manuf}$ refers to the R&D intensity (as the share of R&D expenditure in gross output) of industry $k$ in country $i$. Finally, $\nu_k$ are industry fixed effects, while $\varepsilon_{ik}$ denotes the error term.

## 3.3. DIFFERENTIATED IMPACT OF BUSINESS SERVICES LINKAGES ON MANUFACTURING PERFORMANCE

Table 3.1 reports selected results concerning the impact of business services linkages on manufacturing performance and other variables, as outlined above, focusing on the role of business services in manufacturing linkages. Results by *EU membership status* point to the presence of non-negligible business service linkage effects: for the EU as a whole, strong business service linkages are associated with significantly higher labour productivity growth in manufacturing. However, these backward linkage effects depend strongly on the particular sourcing strategy, and are only significant in the case of strong *foreign* business service linkages. This finding also holds both for the EU-15 and the EU-12.

When differentiating by ***size of economy*****,** the results again consistently point to the presence of non-negligible business service linkage effects, which, however, depend on the country sample analysed and the sourcing strategy considered. In particular, for the group of the five largest EU economies, strong *domestic* business service linkages are associated with significant labour productivity improvements in manufacturing. With respect to foreign business service linkages, the results suggest a positive, though insignificant, relationship. However, for the group of remaining small and medium-sized EU economies, the opposite holds: strong *foreign* business service linkages are associated with labour productivity improvements in manufacturing. This result is in line with findings in the descriptive part that smaller countries tend to have a larger share of imported business services, which makes both directly and indirectly sourced foreign service inputs an important factor in these countries' manufacturing performance.

Finally, when the sample is differentiated by the *technology intensity of industries*, the results highlight the fact that strong business service linkages only matter for the group of MHT industries. More specifically, strong *foreign* business service linkages are associated with significant increases in labour productivity growth in MHT industries only, while no significant backward linkage effects emerge for either MLT or LT industries. A reason for that is that MHT industries are generally characterised by, on average, more and more complex international production linkages (e.g. in terms of the varieties of international/imported inputs used in production and the diversity of locations from which they are sourced), which renders foreign linkages important sources of performance improvements (see Backer and Mirodout, 2013, for evidence).[24]

[24] Generally, low-tech sectors such as textiles can have a high level of internationalisation, but a relatively low level of complexity of international production linkages.

**Table 3.1 / Selected results of business service linkages and manufacturing performance**

**Dependent variable: Labour productivity growth rates (VA-based)**

| | Membership status | | | Country size | | Technology intensity | | |
|---|---|---|---|---|---|---|---|---|
| | EU-27 | EU-15 | EU-12 | Large | Small | Medium-high | Medium-low | Low tech |
| Initial VA-based LP | -0.038*** | -0.014* | -0.048*** | -0.028*** | -0.038*** | -0.049*** | -0.048*** | -0.020* |
| | (-7.84) | (-1.88) | (-4.91) | (-3.23) | (-6.42) | (-6.57) | (-4.76) | (-1.92) |
| Business service linkages: domestic | -0.017 | 0.007 | 0.279 | 0.240*** | -0.211 | 0.144 | -0.280 | 0.028 |
| | (-0.21) | (0.10) | (0.87) | (2.93) | (-1.14) | (1.58) | (-1.23) | (0.22) |
| Business service linkages: foreign | 0.274** | 0.281*** | 0.517** | 0.452 | 0.264** | 0.396*** | -0.115 | 0.086 |
| | (2.60) | (2.87) | (2.13) | (1.28) | (2.11) | (4.05) | (-0.32) | (0.51) |
| Share high-skilled labour | 0.042 | -0.079 | 0.214 | 0.026 | 0.032 | -0.047 | 0.057 | 0.099 |
| | (0.85) | (-1.34) | (1.59) | (0.38) | (0.45) | (-0.83) | (0.44) | (1.31) |
| Share low-skilled labour | -0.045** | -0.059** | -0.254*** | -0.038 | -0.035 | -0.058*** | -0.014 | -0.062** |
| | (-2.27) | (-2.48) | (-2.74) | (-1.10) | (-1.32) | (-2.77) | (-0.27) | (-2.31) |
| Inward FDI intensity | 0.010 | -0.008 | -0.011 | 0.066 | 0.010 | 0.019 | 0.010 | -0.009 |
| | (0.54) | (-0.47) | (-0.20) | (1.02) | (0.48) | (1.19) | (0.22) | (-0.17) |
| R&D intensity | 0.592*** | 0.385** | 2.066*** | 0.219 | 0.739*** | 0.327* | 2.046 | -0.237 |
| | (3.17) | (2.38) | (3.04) | (0.95) | (2.94) | (1.93) | (1.59) | (-0.10) |
| Constant | 0.156*** | 0.092** | 0.150*** | 0.064 | 0.171*** | 0.191*** | 0.237*** | 0.096*** |
| | (8.36) | (2.54) | (2.80) | (1.28) | (6.88) | (9.04) | (4.30) | (3.36) |
| No. of observations | 189 | 106 | 83 | 44 | 145 | 76 | 59 | 54 |
| Adjusted $R^2$ | 0.371 | 0.201 | 0.431 | 0.582 | 0.281 | 0.579 | 0.375 | 0.226 |

*Note*: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Concerning the other control variables, in all cases there is evidence of productivity convergence, which tends to be stronger in more technology-intensive industries when the sample is split according to technology intensity. Higher R&D intensities are associated with significantly higher labour productivity growth in manufacturing, which holds for the group of small and medium-sized EU economies only when the sample is split by country size. Furthermore, the positive relationship between R&D intensity and labour productivity growth is evident only for the group of MHT industries. Concerning the human capital endowment indicators, larger shares of low-skilled labour are associated with significantly lower labour productivity growth. This effect is more consistent among the group of small and medium-sized EU economies, however, and particularly holds for MHT and for low-tech industries. There is no evidence that higher inward FDI intensity is associated with higher labour productivity growth, irrespective of country sample considered.[25]

Moreover, a number of sensitivity checks were conducted to determine the robustness of the main results with respect to (i) alternative industry classifications, to account for (on the one hand) the changed status of Textiles and wearing apparel (ISIC 17t18) from a low-technology to a medium-low-technology industry, and (on the other hand) for the particular characteristics of the Coke and refined petroleum products industry (ISIC 23), (ii) the inclusion of additional control variables, such as export intensity, ICT investment or the OECD Regulation Impact Indicator, to capture the presence and degree of service regulation,[26] (iii) different weighting strategies of spillover effects, to test whether domestic and foreign business service linkage effects are stronger in industries with either a greater share of high-skilled labour or higher labour productivity levels (value-added based), or (iv) alternative measures of performance in manufacturing, such as labour productivity growth (gross-output based), total factor productivity (TFP) growth (value-added based), or value-added growth. Generally, the results from all robustness checks consistently confirm the main findings that (i) for the EU-27 as a whole and for the group of EU-15 economies, for the group of small and medium-sized economies and for the group of MHT industries, strong *foreign* business service linkages are positively associated with productivity improvements in manufacturing, while (ii) for the group of the five largest economies in the EU (Germany, France, Italy, Spain and the UK), higher *domestic* business service linkages are associated with performance improvements in manufacturing.

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[25] This finding is particularly surprising for the group of new Member States, which experienced strong inward FDI flows and a rapid accumulation of inward FDI stocks after the fall of the Iron Curtain. However, there are a number of reasons for the absence of any positive effect in this group of countries: firstl the strongest push in inward FDI accumulation took place in the initial transition phase of the 1990s, a period not properly covered by the analysis due to low data quality and limited availability in either the OECD International Direct Investment statistics or the wiiw FDI databases. Secondly, firm-level analyses (e.g. Evenett and Voicu, 2001) find support for 'cherry picking', i.e. foreign firms are found to invest in domestic firms which are more productive ex ante, so that hardly any productivity effects materialise as a result of the investment. And even if productivity improvements occur at the micro-level, aggregation tends to blur the effects.

[26] Finally, information on regulations that create barriers to entrepreneurship and restrict competition in domestic markets is taken from the OECD Regulation Impact Indicator (OECD RII, ISIC Rev. 3). This indicator measures the potential costs of anti-competitive regulation in selected non-manufacturing sectors on sectors of the economy that use the output of non-manufacturing sectors as intermediate inputs in their production process. It is constructed from non-manufacturing regulation indicators for three different groups of sectors, namely (i) energy (covering electricity and gas), transport (comprising airlines, rail and road) and communications (comprising post and telecoms), (ii) retail distribution and some business services, and (iii) the finance sector. The set of indicators used to construct sector-specific regulation indices covers the following main areas: state control, barriers to entry, involvement in business operations and, in some cases, market structure.

## 3.4. SUMMARY

To summarise, when it comes to the backward linkages of manufacturing industries with business services, the effect on the growth rate of labour productivity in manufacturing is significant and positive at the EU level, but only for foreign linkages for the EU-27 countries. A similar result holds when the sample is split into EU-15 and EU-12. This result is, however, qualified when the sample is differentiated by country size, since for the larger economies only domestic backward linkages have a positive impact on labour productivity growth in manufacturing, while foreign linkages showing a positive but insignificant coefficient. By contrast, for the smaller countries only foreign backward linkages are significant. A potential reason for this is that foreign business services are relatively more important for smaller countries. When the sample is differentiated by the technology intensity of industries, it turns out that the positive effect of foreign backward linkages with business services holds only for MHT industries: these industries are highly integrated into the most complex and diverse international production networks and value chains.

# 4. Services in the manufacturing value chain

## 4.1. THE VALUE CHAIN PERSPECTIVE

As is clear from the above, manufacturing production involves not only activities from the respective manufacturing industries, but also inputs from other sectors (e.g. services) which are produced in the domestic or foreign economies (again by use of intermediate inputs and primary factors, such as labour and capital). Still, the 'classical' perspective when studying the size and volume of the manufacturing sector is to consider only the value added created through pure manufacturing activities; this will be referred to as the 'industry perspective'. The alternative perspective would focus on value added created at all production stages of the final manufacturing product: manufacturing is then composed of the sum of all (domestic) activities (including, in particular, services), along the whole production chain, that are involved in creating a final product. The focus is on the contribution of a specific country. This 'value chain perspective' was introduced and analysed at a global level in Timmer et al. (2013; 2014). This perspective basically considers 'vertically integrated' production processes, theoretically introduced in Pasinetti (1983). Figure 4.1 schematically depicts the calculation of the different shares according to the two different approaches.

**Figure 4.1 / Industry and value chain perspective of the manufacturing process**

| | | | | **Value chain perspective** |
|---|---|---|---|---|
| | VA created in 'other industries' to satisfy final demand for 'other' products | VA created in manufacturing to satisfy final demand for 'other' products | VA created in services to satisfy final demand for 'other' products | VA created to satisfy final demand for 'other' products |
| | VA created in 'other industries' to satisfy final demand for manufactured products | **VA created in manufacturing to satisfy final demand for manufactured products** | VA created in services to satisfy final demand for manufactured products | VA created to satisfy final demand for manufactured products |
| | VA created in 'other industries' to satisfy final demand for services products | VA created in manufacturing to satisfy final demand for services | VA created in services to satisfy final demand for services products | VA created to satisfy final demand for services products |
| **Industry perspective** | VA created in 'other industries' to satisfy final demand | VA created in manufacturing to satisfy final demand | VA created in services to satisfy final demand | Total VA (= GDP) |

The following example highlights the difference between the two perspectives.

***Industry perspective***: final demand for any product – be it a manufacturing product (such as a car) or a service (such as in tourism), whether domestic or foreign – requires inputs from the particular sector and from other sectors via inter-industry linkages. The production of these inputs generates income, i.e. value added, in each sector of the economy. Summing up the value added according to the origins of the inputs (i.e. service inputs accrue to the service industry, etc.) yields the value added created in a particular industry, as is reported in industry statistics. In Figure 4.1 this is represented as the column sum for a specific industry, e.g. total 'manufacturing' is the sum of the three central cells of the matrix.

***Value chain perspective***: alternatively, one might consider the value added created in any industry – be it manufacturing or services – due to final demand for a final manufactured product (where final demand can be domestic or foreign).[27] This perspective, first, circumvents the argument that the share of manufacturing declined because of (domestic) outsourcing of service activities from the manufacturing industries to service industries or firms: for example, if design or marketing activities were originally carried out in-house by the manufacturing firms, but then outsourced to a service provider, the value chain perspective still considers them to be a part of the manufacturing process. Second, the role of specialisation due to offshoring activities is also viewed differently. For example, a country offshoring the assembly process, but keeping other activities related to the manufacturing production – either in the manufacturing industries or services – retains these shares of the manufacturing value chain.

**Table 4.1 / Value added creation in EU-27 as a percentage of total value added (GDP), 1995 and 2011**

| | Other | Manufacturing | Services | Value chain perspective |
|---|---|---|---|---|
| | | 1995 | | |
| Other | 8.2 | 2.4 | 4.0 | 14.6 |
| Manufacturing | 2.3 | 14.8 | 8.5 | 25.7 |
| Services | 2.3 | 3.8 | 53.7 | 59.7 |
| Industry perspective | 12.8 | 21.0 | 66.2 | 100.0 |
| | | 2011 | | |
| Other | 7.4 | 2.1 | 4.2 | 13.7 |
| Manufacturing | 1.7 | 11.8 | 8.6 | 22.0 |
| Services | 2.1 | 3.4 | 58.8 | 64.3 |
| Industry perspective | 11.2 | 17.2 | 71.6 | 100.0 |

*Source*: WIOD; wiiw calculations.

In Figure 4.1 this is represented by the sum of the row of 'final demand products', e.g. in manufacturing.[28] Consider the most extreme case: a country in which no direct manufacturing activities are carried out any longer could still be involved in the manufacturing value chain, by providing service

[27] To be even more specific, 'final demand' includes domestic demand for a domestic or foreign final manufactured product, foreign demand for a domestic or foreign final manufactured product.

[28] Results reported in this section are based on figures for gross domestic product at market prices, including international transport margins. These have been calculated as the difference between gross output and intermediate inputs in the WIOTs.

activities that are required for production. For example, countries specialising in pre- and post-production activities, such as design and sales, would still be regarded as generating value added in the manufacturing value chain. To highlight the differences between the two perspectives, Table 4.1 provides the numbers in line with the concept set out in Figure 4.1 above for the EU-27 in 1995 and 2011.[29]

In 2011, the manufacturing share of GDP was slightly above 17%, whereas more than 70% of total GDP in the EU-27 was created in the service industries, and the remaining 11% in other industries such as agriculture, mining and construction. The assessment changes substantially when one recognises that the value created to meet final demand for products also includes contributions from services and other industries; from this perspective, a higher share of value added created by manufacturing final goods production is reported. In fact, about 22% of the EU-27 overall GDP is related to manufacturing production, i.e. about 5 percentage points more than is reflected by the shares based on industry classifications. Similarly, an increase is also observed for 'other' activities which, from the value chain perspective, show a share of 13.7%, compared to 11.2%. The share of services declines, however, from the value chain perspective to 64.3%, i.e. by more than 7 percentage points.

For a more detailed view of the inter-linkages between these sectors from a value chain perspective, Table 4.2 presents the shares in industry and value chain totals, respectively, with the figures for manufacturing highlighted.

**Table 4.2 / Structure of the value creation process in EU-27, 2011**

| | Other | Manufacturing | Services | Value chain perspective |
|---|---|---|---|---|
| Other | 66.0 | 12.0 | 5.9 | 13.7 |
| Manufacturing | 15.1 | 68.4 | 12.0 | 22.0 |
| Services | 18.9 | 19.6 | 82.1 | 64.3 |
| Industry perspective | 100.0 | 100.0 | 100.0 | 100.0 |

| | Other | Manufacturing | Services | Value chain perspective |
|---|---|---|---|---|
| Other | 53.9 | 15.1 | 31.0 | 100.0 |
| Manufacturing | 7.7 | 53.4 | 38.9 | 100.0 |
| Services | 3.3 | 5.2 | 91.5 | 100.0 |
| Industry perspective | 11.2 | 17.2 | 71.6 | 100.0 |

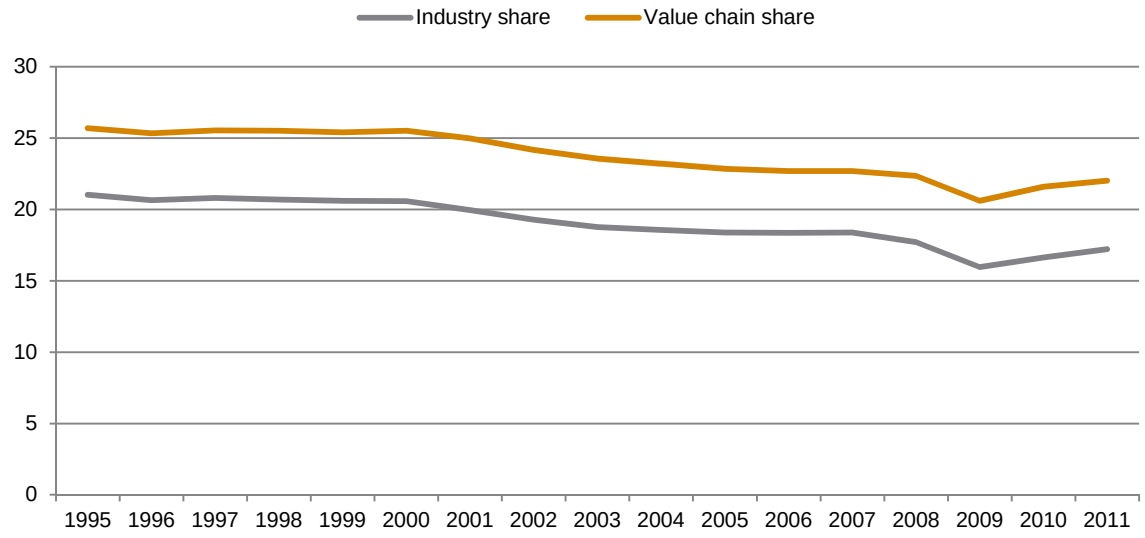
*Source*: WIOD; wiiw calculations.

Within the classical manufacturing activities, the upper panel of this table shows that 12% of value added created in manufacturing was due to final demand in the 'other' industries and about 20% was due to final demand in services. Almost 70% of value added created in manufacturing was created due to final demand for manufactured products. However, the value chain perspective indicates that almost 40% of value added related to the production of manufacturing final products was attributable to services, and 53.4% to manufacturing; this again highlights the important role of services in the manufacturing process.

[29] Using value added at basic prices, the corresponding numbers for 2011 would be 15.8% from the industry perspective (according to Table 2.1) and 21.2% from the global value chain perspective, respectively.

Considering the changes over time depicted in Figure 4.2, one finds that both shares declined after 1995 at a fairly uniform pace. The share of manufacturing value added according to the industry perspective declined from more than 21% in 1995 to about 17% in 2011, i.e. by slightly less than 4 percentage points. But the share of manufacturing from the value chain perspective also declined from 25.7% to 22% over the same period, i.e. again by about 4 percentage points. In both cases the shares remained fairly constant up to 2000 and started to decline only then. Furthermore, it seems that the decline flattened, apart from during the crisis period.

**Figure 4.2 / Industry and value chain shares for manufacturing, as a percentage of GDP, EU-27**



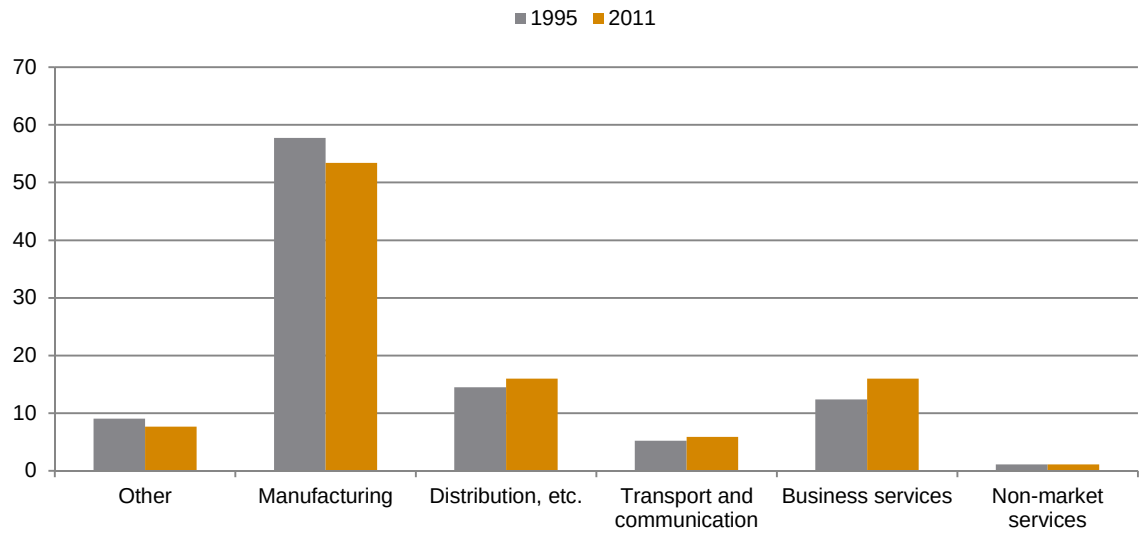

*Source*: WIOD; wiiw calculations.

A number of reasons might contribute to the overall decline in the manufacturing share in the EU (and, more generally, other) economies. The actual composition of industries changes due to changes in real income and related demand patterns. Changes in relative prices might also play a role: on the one hand, a price increase for services, relative to manufactured products, during the time period under consideration would lead to a somewhat lower demand for services. However, on the other hand, this would contribute to the overall trend towards an increasing share in nominal terms and would therefore exacerbate additional structural effects. This can be interpreted as a national accounting effect, whose mechanics are somewhat similar to Baumol's disease. A further potential reason for a declining manufacturing sector may be the overall specialisation of a country (or the EU) as a provider of services in a global economy as trade structures change (e.g. manufactured products such as textiles are going to be imported from emerging countries). A further important structural contributor to the decline in the manufacturing share is the offshoring of manufacturing activities beyond the borders of the EU, with some other activities, particularly service activities, still being undertaken domestically. To explain why a similar tendency is found in the value chain approach, one has to take a more detailed look at the structure of the manufacturing value chain.

Thus, the structural changes also affect the share of manufacturing when measured using the value chain approach. The reason for this is that inter-sectoral linkages still predominate within manufacturing

and within service sectors, implying that the inter-linkages between manufacturing and services (as discussed in Section 2) are – despite the modest increases – not strong enough to compensate. For this more detailed analysis, one can further split the manufacturing value chain into the contributions by the different components. This is shown in Figure 4.3, in which the service contributions are further differentiated. Within the manufacturing value chain of the EU-27, the increase in the share of service activities was mainly driven by the strong development of business services and distribution services. This is in line with the findings of other studies, indicating that it is mainly knowledge-intensive industries and services that are driving the current shift towards larger service shares across the board. These results are also in line with previous results that consider cost shares and the service content of manufacturing production.

**Figure 4.3 / The structure of manufacturing value chains, as a percentage, EU-27**




*Source*: WIOD; wiiw calculations.

## 4.2. MANUFACTURING VALUE CHAINS IN EU MEMBER STATES

The same approach can be taken for individual Member States. Table 4.3 presents the indicators, as discussed above for the EU-27, now for each individual Member State. Thus this table presents the share of manufacturing in GDP, as usually measured, and the share of the manufacturing value chain in GDP. Furthermore, it also includes the share of services and business services in the manufacturing value chain of each country.

**Table 4.3 / Manufacturing value chain indicators, by Member State**

| | Value added share | | Value chain share | | Share of services in manufacturing value chain | | Share of business services in manufacturing value chain | |
|---|---|---|---|---|---|---|---|---|
| | 1995 | 2011 | 1995 | 2011 | 1995 | 2011 | 1995 | 2011 |
| Hungary | 21.3 | 25.3 | 29.9 | 32.6 | 28.8 | 28.8 | 9.2 | 11.0 |
| Czech Republic | 24.3 | 25.8 | 29.9 | 31.6 | 28.5 | 28.8 | 7.0 | 8.2 |
| Germany | 22.6 | 22.4 | 27.7 | 28.9 | 32.0 | 35.9 | 13.7 | 15.9 |
| Slovak Republic | 26.8 | 19.6 | 29.8 | 27.8 | 28.0 | 33.3 | 6.8 | 8.4 |
| Ireland | 30.2 | 26.8 | 35.0 | 27.5 | 25.6 | 26.8 | 9.6 | 15.6 |
| Poland | 21.1 | 18.1 | 28.4 | 27.0 | 26.2 | 36.1 | 4.9 | 7.9 |
| Romania | 25.6 | 23.6 | 33.3 | 26.6 | 22.1 | 24.2 | 10.1 | 6.7 |
| Bulgaria | 22.0 | 17.6 | 32.6 | 25.7 | 23.3 | 30.9 | 9.9 | 8.3 |
| Italy | 22.2 | 16.6 | 29.1 | 23.3 | 33.7 | 40.0 | 9.4 | 13.9 |
| Slovenia | 25.7 | 19.6 | 30.1 | 23.1 | 26.6 | 33.0 | 8.7 | 10.9 |
| Sweden | 22.4 | 16.7 | 26.0 | 23.1 | 30.8 | 40.4 | 9.3 | 16.1 |
| Austria | 19.6 | 18.5 | 23.7 | 23.1 | 31.2 | 34.7 | 10.3 | 12.4 |
| Netherlands | 17.4 | 14.1 | 25.6 | 22.6 | 36.4 | 39.8 | 12.5 | 15.7 |
| Belgium | 20.3 | 14.5 | 27.0 | 22.1 | 36.7 | 45.2 | 13.6 | 17.8 |
| EU-27 | 21.0 | 17.2 | 25.7 | 22.0 | 33.2 | 38.9 | 12.4 | 16.0 |
| Lithuania | 19.1 | 16.4 | 26.0 | 21.5 | 26.0 | 34.2 | 2.8 | 5.6 |
| Finland | 25.4 | 18.6 | 25.9 | 20.2 | 27.5 | 35.8 | 7.6 | 12.6 |
| Estonia | 21.0 | 14.3 | 29.3 | 20.1 | 28.7 | 41.1 | 5.2 | 12.5 |
| Denmark | 17.1 | 11.5 | 23.9 | 19.1 | 33.3 | 39.6 | 8.6 | 12.2 |
| France | 14.2 | 10.1 | 21.4 | 18.3 | 40.1 | 48.5 | 17.7 | 23.7 |
| Malta | 21.7 | 13.3 | 27.6 | 17.9 | 24.4 | 36.8 | 6.4 | 13.4 |
| Portugal | 18.4 | 13.4 | 24.7 | 17.8 | 32.9 | 36.5 | 10.5 | 12.7 |
| Spain | 19.2 | 13.2 | 23.6 | 17.4 | 33.0 | 39.4 | 9.5 | 12.2 |
| Luxembourg | 13.7 | 6.5 | 20.7 | 17.2 | 49.7 | 73.0 | 28.5 | 45.4 |
| United Kingdom | 20.9 | 11.7 | 24.6 | 15.9 | 30.2 | 39.4 | 12.3 | 20.5 |
| Latvia | 20.7 | 9.9 | 24.1 | 14.8 | 27.0 | 44.7 | 4.9 | 11.2 |
| Greece | 12.0 | 10.3 | 16.8 | 13.3 | 28.2 | 35.3 | 6.9 | 8.5 |
| Cyprus | 11.8 | 6.8 | 15.8 | 9.1 | 30.5 | 46.1 | 9.8 | 16.4 |

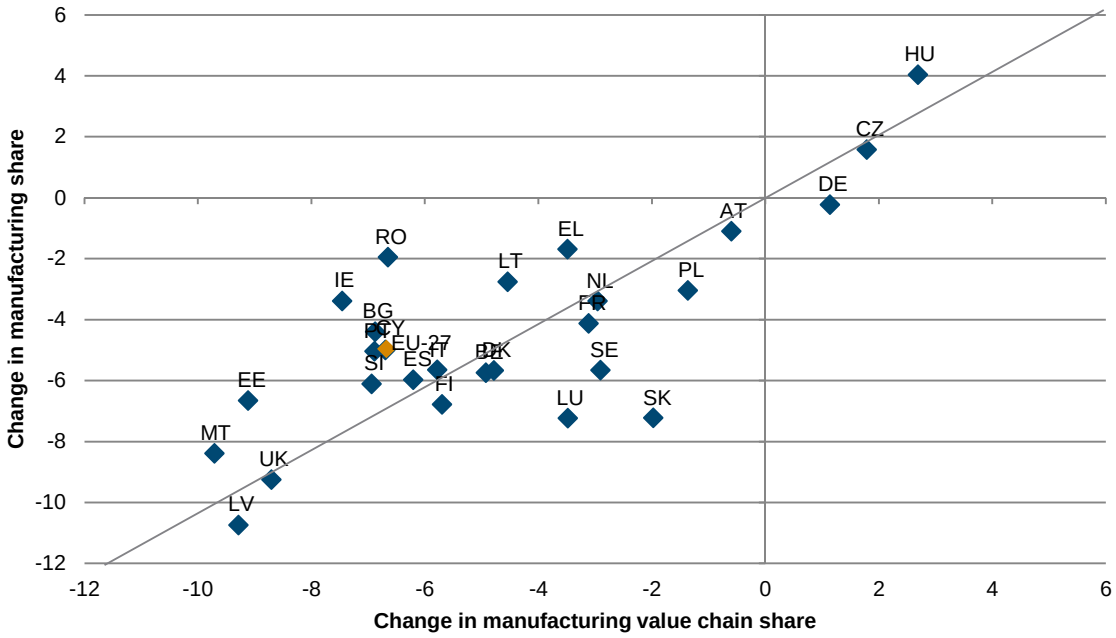
*Note*: Countries are ranked according to value chain share in 2011.
*Source*: WIOD; wiiw calculations.

Since the share of manufacturing in the GDP of the various countries (and how this share has changed) has already been discussed), the focus here can be on how that relates to the changes in the manufacturing value chains and the role of business services therein. First, there is a close positive relationship between the manufacturing share and the manufacturing value chain share – i.e. a higher manufacturing share also implies a higher manufacturing value chain share. This also implies a strong correlation of the respective changes, as depicted in Figure 4.4.

Most countries are close to the 45 degree line, which indicates that their manufacturing value chain share changed more or less in line with the share of manufacturing in their GDP (as with the EU-27 as a whole) (Figure 4.4). There are a few notable exceptions: in some countries – Sweden, the Slovak Republic, Luxembourg, Poland – the decline in the manufacturing share has been stronger than in the manufacturing value chain share, indicating that these countries are contributing to global manufacturing final demand by providing more and more value added created in services (or the non-manufacturing sectors). Another set of countries – Ireland, Romania, Bulgaria, Portugal, Greece and Lithuania –

experienced a stronger decline in their manufacturing value chain share than in the manufacturing share in GDP.

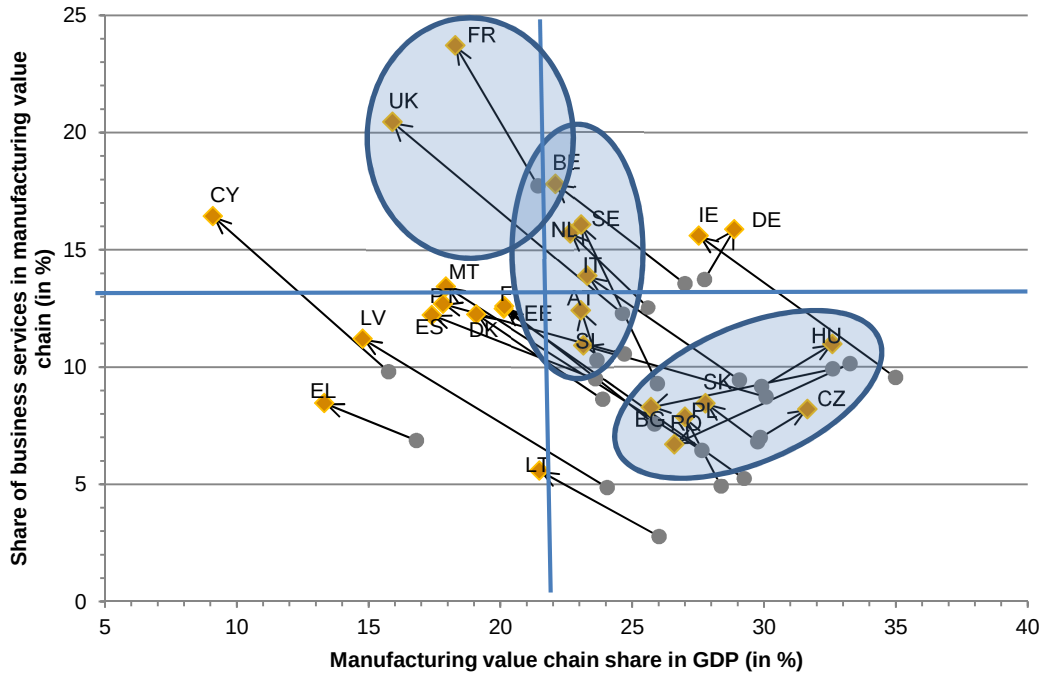
**Figure 4.4 / Changes in manufacturing and manufacturing value chain share, in percentage points, 1995–2011**




*Source*: WIOD; wiiw calculations.

How is this related to the role of business services in the manufacturing value chain? Figure 4.5 presents the share of the manufacturing value chain income in total GDP on the horizontal axis and the share of business services on the vertical axis. Maybe surprisingly, for 2011 it turns out that countries with a larger share of business services in their manufacturing value chain tend to have – on average – a lower share of manufacturing in GDP. The situation in 1995, however, looked quite different, as both indicators clustered together (grey dots in Figure 4.5). In 2011 basically four groups of countries emerged – of which three are highlighted. The first group – consisting of the EU-12 Member States – comprises countries with a relatively high share of manufacturing value chain income in GDP and a relatively small share of business services in this value chain, with relatively small dynamics over time. The second group comprises countries for which the share of business services increased over time and which saw a relatively small change in the value chain share. A number of countries in these two groups were – together with Germany – classified in Figure 2.3 as among the manufacturing core countries which maintained a relatively high share of manufacturing in GDP. The third group of countries is characterised by a strong increase in the share of business services, in combination with a rather significant decline in the value chain share. This group mostly consists of the 'business services leaders', as shown in Figure 2.3. Finally, the fourth group increased their share of business services, but also lost significant shares of manufacturing value chain income in GDP. This shows that most countries have been successful at increasing the services component in their manufacturing value chain; however, in a few countries the share of manufacturing remained stable.

**Figure 4.5 / Manufacturing value chain shares and structures, 1995 and 2011**




*Note*: Grey dots show situation in 1995; yellow dots in 2011. The blue vertical and horizontal lines indicate the arithmetic averages in 2011.
*Source*: WIOD; wiiw calculations.

## 4.3. SUMMARY

In this section a 'manufacturing value chain approach' is applied. According to this approach, all value added generated in a particular economy which contributes to world-wide final demand for manufactured products is assigned to manufacturing, thus taking into account service activities which are – together with the core manufacturing activity – provided in-house by a manufacturing firm and service activities which are outsourced to a domestic service provider as part of the manufacturing value chain of a particular country. Furthermore, service activities undertaken in a particular economy which contribute to the manufacturing process in other countries are also counted as part of the manufacturing value chain of the country under consideration.

Results suggest that in 2011, 22% of value added generated in the EU was due to the contribution to world final demand for manufactured products. Over time this share – like the share of manufacturing in GDP – declined from more than 25% in 1995 to about 22%. Within the manufacturing value chain, the major part of value added came from manufacturing industries, but almost 40% came from services. The share of the manufacturing contribution declined over time, whereas that of business services and distribution services increased in line with the results presented in Section 2. Countries with larger shares of manufacturing also tend to have larger shares of the manufacturing value chain in their GDP. Over time, countries that are characterised by a declining share of manufacturing value added in GDP could only partly compensate these declines with further contributions to the manufacturing value chain by providing corresponding business services, a result in line with the diverse patterns of specialisation documented in Section 2.

# 5. Exploring patterns of manufacturing–services interaction and international linkages for specific country–industry cases

## 5.1. INTRODUCTION

This section presents the results of fieldwork, involving interviews to gain deeper insights into the interaction of manufacturing and services. Given the complex nature of the interactions and their many dimensions (see Section 1), the fieldwork sought to identify linkages between the two sectors, focusing on performance-enhancing activities – something that cannot be achieved solely by taking a quantitative approach and applying econometric methods. It becomes clear that the nature of services – as well as their importance for, and their economic effects on, manufacturing – differs from industry to industry, depending on its structure and the specific environment. The analysis therefore focuses on a few industries, only taking into account issues of technology intensity, market environment, and performance in (and exposure to) international competition.

Section 5.2 explains the rationale behind the selection of countries and industries, as well as some comments on the fieldwork interviews; Section 5.3 provides an overall economic background for the sectors under consideration; and Section 5.4 presents the results of the fieldwork, with each industry discussed in a separate sub-section, highlighting the differences among countries by industry.

## 5.2. METHODOLOGY

### 5.2.1. INTERVIEWS

A number of face-to-face and telephone interviews were carried out with representatives of firms and industry associations. However, it turned out to be difficult to get hold of experts with knowledge of the relationship between services and manufacturing: only a few interviewees were able to provide a comprehensive view of the broad range of different fields in which services and manufacturing interact. Most interviewees were experts in specific areas, for which they provided detailed insights. Most of the interviews therefore focused on performance-enhancing services, such as IT services, IT-based services, R&D and engineering, which are precisely the areas that experienced the most pronounced and important changes in the period under investigation and where improvements in companies' economic performance could be expected. This does not necessarily imply that these services are the most important in terms of their monetary value procured by manufacturing companies. For example, services such as wage and tax accounting, together with advertising, are responsible for a substantial, and more or less stable, share of business services (see Section 2).

### 5.2.2. SELECTION OF COUNTRIES AND INDUSTRIES

Four industries and six Member States were selected for this detailed investigation. The selection was partly based on the quantitative results reported in Section 2. The selection was supposed to represent three groups of countries for which distinct descriptive and econometric results were observed: large established Member States with mature economies are represented by France and Germany; for the smaller, advanced and open economies Denmark and Sweden are included; and finally, the Czech Republic and Poland represent the relatively new Central and Eastern European Member States.

Four manufacturing industries were selected: two medium-high- to -tech industries (transport equipment and machinery) and two so-called low-tech industries (textiles/clothing and food/beverages). The regression results reported in Section 3 suggest on average stronger productivity effects of services use for the first two industries, and weaker (or even insignificant) relationships for the latter two, although differences across countries and within industries are expected to be important.

The **machinery industry** is dominated by smaller enterprises, which – in spite of global reach by sales – have remained locally anchored. Typically, a machinery company's production requires a broad range of different intermediaries, with the European supply chains supporting a competitive industrial cluster. Companies in the machinery industry are leading suppliers of services to their clients. In particular, manufacturers of final investment goods already gain large portions of their revenue from servitisation, such as maintenance.

The focus within the **transport equipment industry** is on the automotive industry, which has long been a trendsetter in advanced management methods and tools, in particular in supply chain management. Unlike the machinery industry, the automotive industry is characterised by large players and has been an early mover to invest globally, particularly in important sales markets. Foreign direct investment (FDI) is not only a strategy for individual larger players, but also for groups of companies and their suppliers. For example, original equipment manufacturers (OEM) and their important subcontractors have invested in new locations and have created manufacturing clusters.

The two low-tech industries selected for in-depth analysis – textiles and clothing, and food and beverages – deliver products mainly to meet private household demand. The upstream linkages of these industries focus more on value chain management than is the case with the machinery and the automotive industries, which put more emphasis on R&D and engineering. However, one must bear in mind that the industries are characterised by a dichotomy of different players. On the one hand, there are global players with footholds in nearly all important sales markets; they command large shares in their respective markets. On the other hand, most of the companies in both industries are medium-sized, with the majority focusing on regional markets or specific market niches.

In that respect, the **textiles and clothing** industry is a globalisation front-runner, with the production of clothing being labour intensive and carried out predominantly in low-wage countries. Spinning, weaving and other more automated upstream manufacturing processes have lost their proximity to downstream clothing manufacturers. This has caused much of the production of yarns, fabrics, etc. to follow its downstream clients to foreign locations. European manufacturers have come under pressure from two sides: first, from low-wage countries outside Europe and, second, from (European) distributors and retailers, who are increasingly able to exploit their bargaining-power advantages. In extreme cases,

companies have ceased to be manufacturers and have become providers of comprehensive services for the design, production, marketing and distribution of clothes. To this end, advanced supply chain management and servitisation have contributed to the survival of EU companies in a hostile market environment, albeit sometimes with the home countries having no remaining manufacturing capacities of their own.

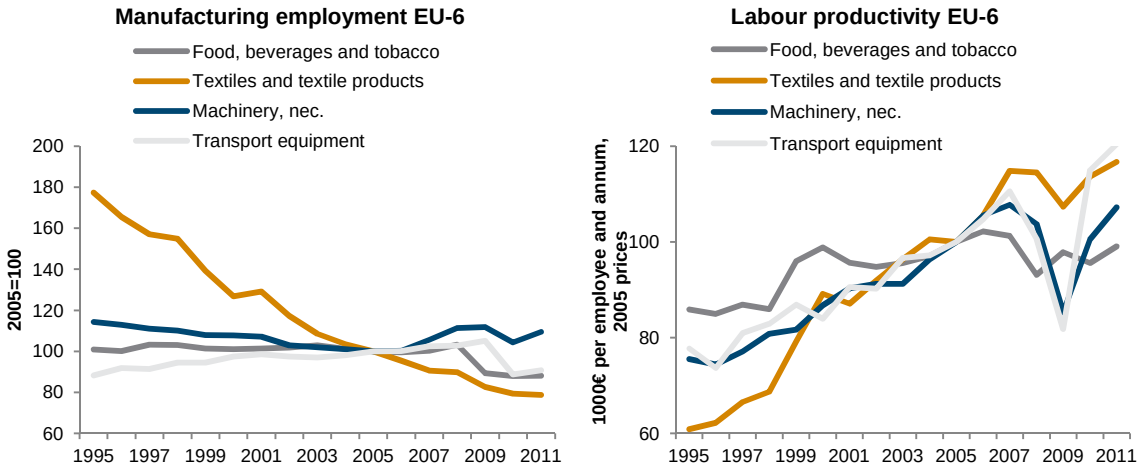
The **food and beverages** industry is similarly heterogeneous. Some segments are dominated by large players, in particular the capital-intensive manufacture of intermediate products and of mass-market final products. Other segments are characterised by smaller enterprises, and the respective manufacturing activities are predominantly labour intensive. In contrast to the textiles and clothing industry, the food and beverages industry has remained regionally anchored. This is explained by several factors. First, there is a close linkage to the EU agricultural sector, and first-stage processing capacities are frequently located close to agricultural production. Second, the storage life of agricultural products and legal requirements (such as proof of origin) favour regional proximity. And, third, downstream linkages to distribution and retailing have become more important for successful enterprises, as with the textiles and clothing industry.

## 5.3. GENERAL DEVELOPMENTS IN THE SELECTED INDUSTRIES

Before the results are presented from the firms' perspective (as derived from the interviews conducted), an overview of the developments in the selected industries and countries is provided. The evolution of employment and labour productivity is discussed, highlighting important differences in performance and changes in capacities. In line with Section 4, indicators based on the traditional industry approach (IA) and the value chain approach (VC) are presented.

### 5.3.1. DEVELOPMENTS IN EMPLOYMENT AND PRODUCTIVITY

**Figure 5.1 / Employment and productivity by industry (EU-6)**



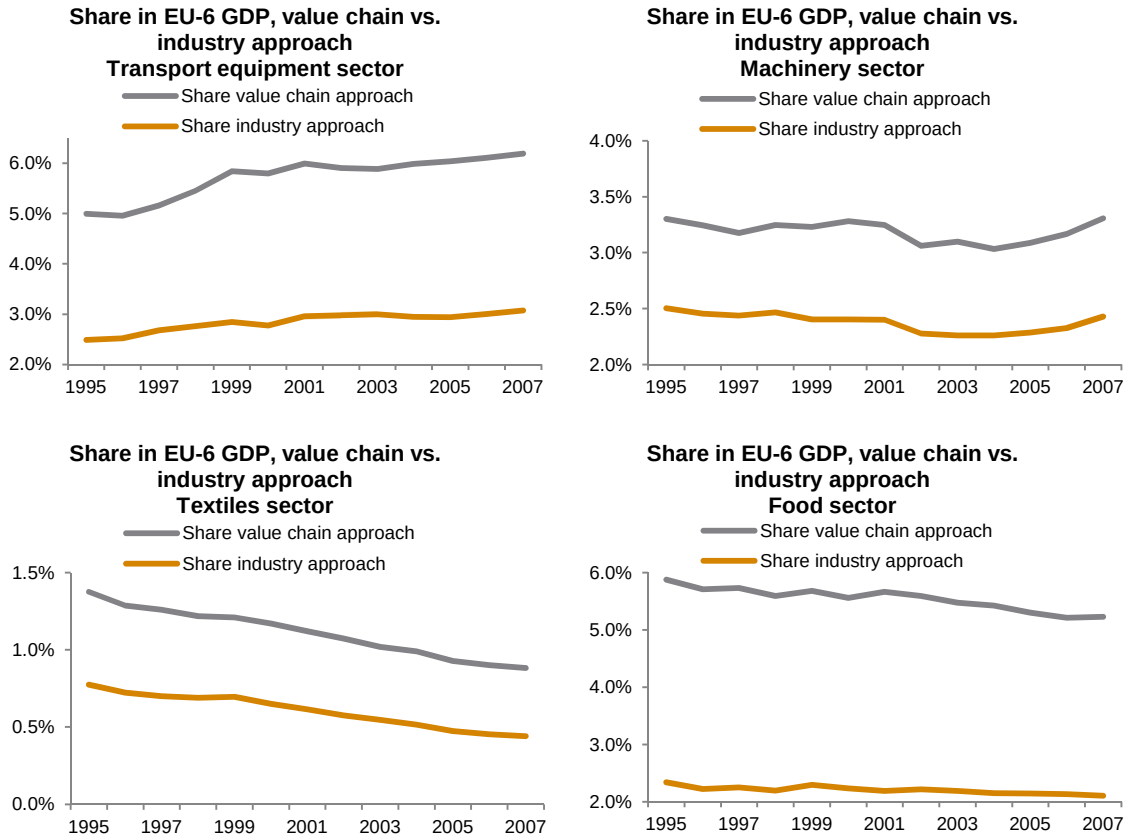

*Source*: WIOD; ifo calculations.

The manufacturing of textiles and clothing has experienced a dramatic decline in employment, which has seemingly not yet come to an end (see Figure 5.1), whereas employment in the other industries has remained relatively stable. Over the 15 years between 1995 and 2011, employment in the textiles and clothing industry declined by more than 50%, which had major implications for the industrial structure: automation and the closure of unprofitable facilities positively affected labour productivity in textiles and clothing industry, resulting in the strongest productivity growth of the four selected industries – even ahead of the machinery industry and transport equipment. The other industries displayed far more stable development and were able more or less to maintain employment levels, while simultaneously increasing productivity.

### 5.3.2. DEVELOPMENTS IN TERMS OF GDP AND THE ROLE OF SERVICES

Figure 5.2 illustrates both the relevance of services for manufacturing and the weight of each of the four industries in GDP for the selected countries.

**Figure 5.2 / Sectoral shares in GDP in EU-6: industry approach versus value chain approach as a percentage in GDP**




*Source*: WIOD; ifo calculations.

Over the period under consideration, the **transport equipment sector** became the largest in terms of its share of GDP. Its production contributed 2.5% to GDP in 1995, but steadily increased and exceeded 3% in 2007. Note that the growth in the services attributable to the transport equipment sector using the

value chain approach even outpaced the growth in the production value, indicating a general increase in the importance of services. The transport equipment industry was the only one of the industries under investigation that was able to maintain its employment level in spite of a 10% slump caused by the financial crisis. Only during the early years of the whole period did its increase in labour productivity lag behind the textiles and clothing industry; in the years thereafter, it increased at roughly the same pace. Over the whole period, the transport equipment industry was second in the ranking of labour productivity across the industries considered here.

The development in the **machinery sector** development was slightly less dynamic. In 1995, its contribution to GDP was more or less of the same magnitude as for transport equipment. Over the period under investigation, it lost some of its weight, and service inputs play a somewhat less important role than in the transport equipment sector, though their relative importance has increased over the whole period as well. As measured by the value chain approach the machinery sector's contribution to GDP was roughly the same in 1995 and 2007, at about 3.3%.

The **textiles and clothing sector** showed a steady decline in its share of GDP, and there was no indication of stabilisation, either for the IA or for the VC approach (Figure 5.2). The sector's contribution to GDP declined by almost half – from around 0.8% (1995) to below 0.5% (2007); the respective figures for the VC approach indicate a less pronounced decline – from 1.4% to 0.9%. Interestingly, therefore, despite the decline in textile manufacturing, the related services display considerable resilience.

In 1995, **food and beverages** was the largest of the four sectors under consideration. Much of the sector's weight is due to the outstanding importance of services. The food sector's weight in terms of GDP – based on the VC approach – was nearly 6% in 1995 and 5.2% in 2007. The figures for the IA were 2.4% and 2.1%.

Thus, the overall decline in manufacturing as a percentage of EU GDP – as measured by the value chain approach and the industry approach – is significant for the two low-tech industries under consideration, but not for transport equipment or machinery. This is explained by the higher-tech industries' above-average performance compared to the other industries. Moreover, with Germany, Poland and the Czech Republic, there are three countries among the six Member States under consideration that experienced strong growth in manufacturing, and particularly in those industries.

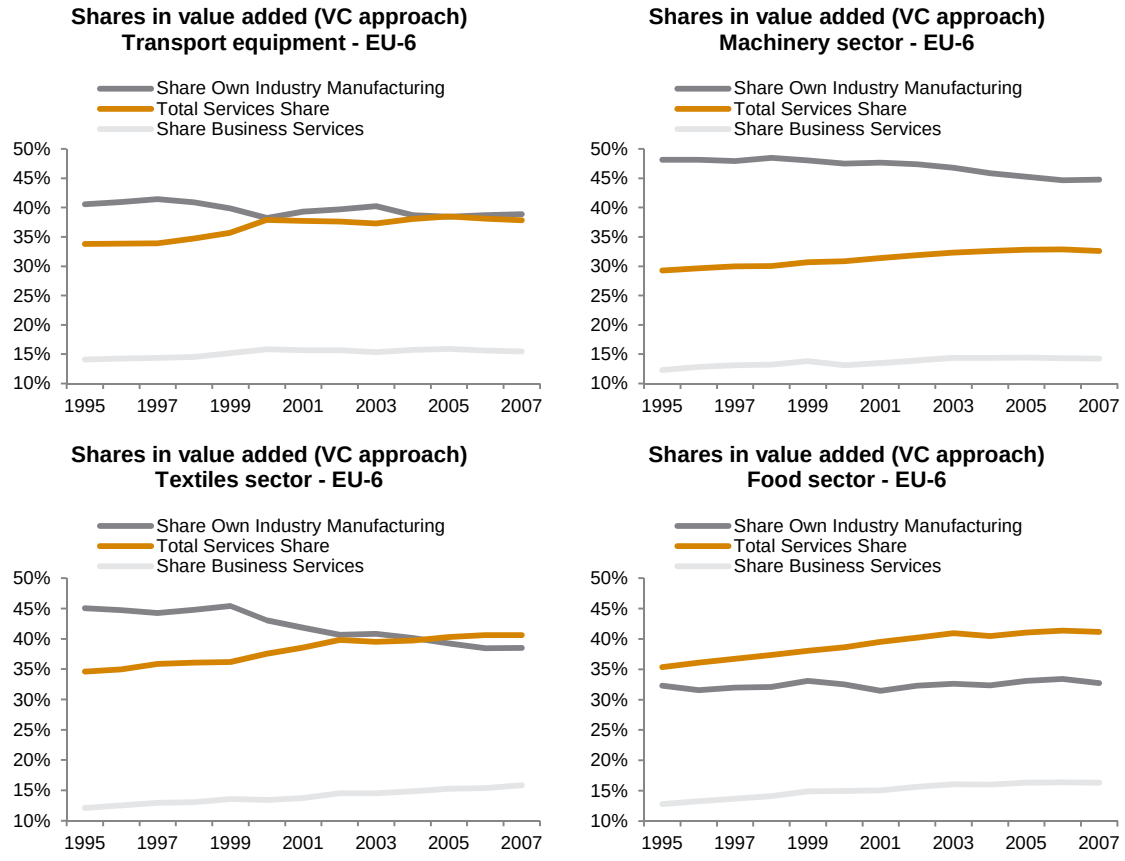
### 5.3.3. THE RELATIVE IMPORTANCE OF BUSINESS SERVICES

The next step is to analyse the contribution of industrial production and services to the total value added of the four sectors, based on the value chain approach. Figure 5.3 shows that the share of value added created by manufacturing, relative to services, differs substantially across the four sectors. The value added created in the manufacturing part of these industries' supply chains has lost some of its former weight: only in the case of the food and beverages sector has its share remained at roughly the same levels. As for machinery, although the industrial production share in that industry's value chain has declined, its share remained the highest (45%), followed by textiles and clothing, transport equipment and food and beverages (38%, 37% and 31%, respectively). Food and beverages manufacturing has been least affected by global competition and offshoring activities because of its strong regional roots, proximity to suppliers and customers. Most affected in this respect has been textiles and clothing

manufacturing, which experienced losses of 7 percentage points over the whole period, while food and beverages lost only 1 percentage point. For both the other medium-high- to high-tech industries, losses were more moderate – around 3% to 4%.

Turning to services, all four industries show remarkable similarities concerning the contribution of business services. Their share in the total value chain income ranges from 16% to 18%, based on the most recently available figures, with similar trends over time. This upward trend of business services has been generally accompanied by a growing weight of non-business services, which reached about 25% for the two low-tech industries, whereas for the transport equipment and the machinery industries the cost share reached 23% and 19%, respectively.

**Figure 5.3 / Value chain approach: share of manufacturing, total and business services, by industry (EU-6), as a percentage of total GVC income**




*Source*: WIOD; ifo calculations.

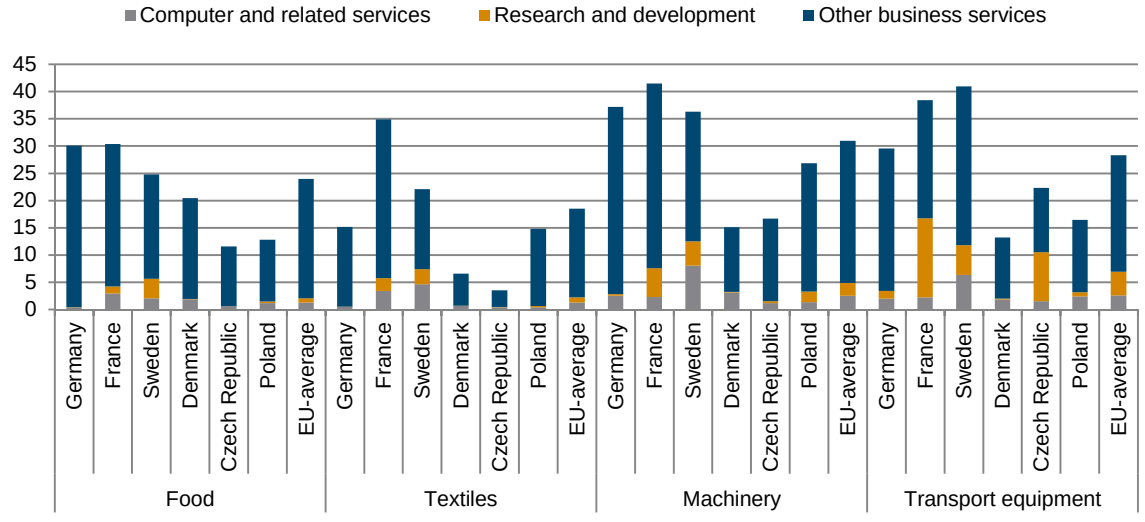
### 5.3.4. SPECIFIC SERVICES USE IN SELECTED COUNTRIES AND INDUSTRIES

As highlighted in Section 2, the use of business services and the individual categories differ widely across countries. This is now considered across the selected countries and industries in Figure 5.4 (based on WIOD in NACE Rev. 1) and Figure 5.5 for NACE Rev. 2 classification, which provides some

more details concerning the category Other business services, as discussed in Section 2.[30] In a departure from Section 2, business services are now expressed as a share of total services used in manufacturing. The figures highlight noteworthy differences in the application of business services as a percentage of total services. For most of the industries considered, business services play a more important role for Germany, France and Sweden than for Poland and the Czech Republic. Denmark is the only long-term EU Member State with a lower share of business services than the two Member States which joined the EU only in 2004. This result was confirmed during the fieldwork and is perceived as an explanation for the Danish manufacturing sector's loss of competitiveness.

The **machinery sector** is (on average) relatively more technology intensive and is characterised by a 'long' supply chain, with strong international backward and forward linkages. Since the machinery sector is relatively more technology intensive, one could assume that the somewhat higher share of R&D services input into the manufacturing sector (on average 2.4% of total intermediate services input) is used for product and process innovation (see Figure 5.4). As in the other industries considered here, other business services are the services most often used in the machinery sector, too, with France using the largest share of performance-enhancing services – a trend that is driven by a higher-than-average use of externally bought-in R&D services. This does not mean that France's machinery sector is more R&D intensive than Germany's, as it may be that the German sector undertakes more 'in-house' R&D. Sweden has a higher-than-average share of IT services in the production of machinery equipment. In line with the findings in the textiles and food sectors, Denmark, the Czech Republic and Poland buy in significantly fewer performance-enhancing services than the EU average.

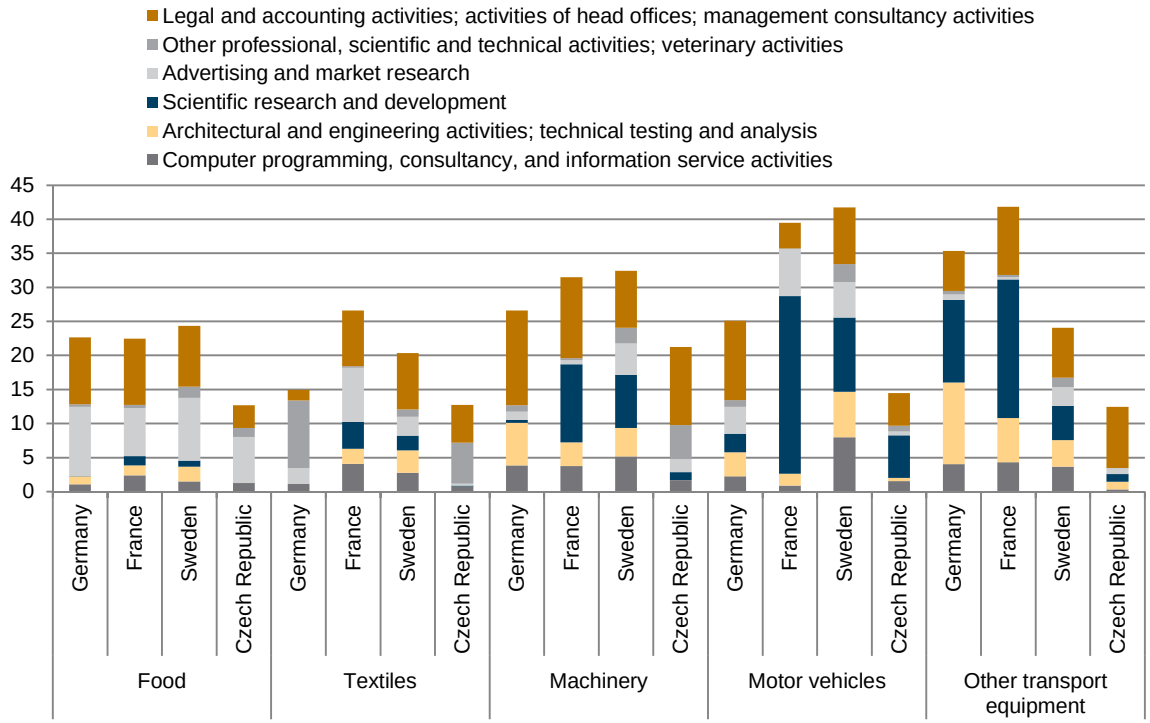
**Figure 5.4 / Share of business services as a percentage of total services used in manufacturing industries, 2011**




*Source:* WIOD, wiiw calculations.

[30] Since the WIOD data refer to 2011 and the Other business services category in the WIOD database also includes some services that do not fall under the definition of 'performance-enhancing services', the total shares for other business services from the WIOD database and from Eurostat do not correspond exactly. However, the patterns provided by the Eurostat data allow us to acquire a better overview of the differences in the use of various types of other business services across sectors and across countries. As, however, the supply and use tables using the new classifications are not yet available for Denmark and Poland, both figures are presented.

**Figure 5.5 / Share of business services as a percentage of total services used in manufacturing industries, 2010**




*Source*: Eurostat, wiiw calculations.

The dominant use of other business services prompts a closer look at a more detailed split based on NACE Rev. 2 data from Eurostat on the machinery sector. Unlike the food sector, for example, where a large share of output consists of consumer products and thus requires a large share of advertising and market research spending, many machinery goods reflect capital expenditure by customers, and so production-related services matter more. As Figure 5.5 shows, the share of engineering and technical testing activities in Germany, France and Sweden is high. Still, the largest share of costs in the machinery sector is made up of legal and accounting activities (on average 11% of total intermediate services inputs in the four selected Member States). Sweden uses significantly more advertising and market research services, as the country hosts the headquarters of large global players.

Figure 5.4 shows the use of performance-enhancing services in the **transport equipment sector** in the selected Member States. Sweden and France use a very large share of performance-enhancing services, mostly triggered by a large share of R&D services. German industry does not use much externally bought-in R&D services,[31] which largely explains the overall lower input of performance-enhancing services in the sector. The Czech Republic and Poland use less than the average of performance-enhancing services in their transport equipment industry, but the share of R&D service inputs into the Czech transport equipment sector is significant (40% of total performance-enhancing services inputs). Denmark again shows a lower-than-average use of performance-enhancing services in industry, but the small size of the transport equipment sector in that country might distort the picture.

[31] This, for reasons mentioned above, does not directly imply that the German production process is less R&D intensive, since the R&D activity could be generated within firm boundaries.

Also consistent with findings for the other sectors is the relatively high use of IT services in the Swedish manufacturing industry. Technical testing and engineering activities, on the other hand, are more important for the 'other transport equipment' sector (especially in Germany – where these services constitute almost two-thirds of overall business service inputs – and France). The overall input of other business services, however, does not differ markedly between the two sectors for the selected Member States. In line with the overall use of performance-enhancing services, Sweden uses other business services most intensively.

The **textiles and clothing** sector in Europe has been subject to significant changes over the past decades, as noted above, with the relocation of production playing an important role. Figure 5.4 shows that the overall use of performance-enhancing services in the EU textiles sector (approximately 18% of total intermediate service inputs) is lower than in the food sector. The graph also shows that France buys in significantly more performance-enhancing services than does Germany; Sweden significantly more than Denmark; and Poland significantly more than the Czech Republic. France and Sweden also use more bought-in IT and R&D services than the EU average in their production of textile products. The dominant category of other business services used in the textiles sector in Germany, France, Sweden and the Czech Republic signals that the focus for particular countries is on different activities in the textiles supply chain. France, where the textiles industry is dominated by large high-end wearing apparel and fashion industries, uses significantly more advertising and market research services than does Germany, where the industry seems to focus on specific production processes (high use of scientific and technical activities). Sweden and the Czech Republic have small production bases, but use mostly technical and legal services.

In the **food, beverages and tobacco sector**, the use of other business services dominates the sourcing of performance-enhancing services by food manufacturers in the sector (on average 92% of total performance-enhancing service inputs in 2011). France and Germany use on average more performance-enhancing services (approximately 30% of total intermediate service inputs), Denmark and Sweden use an average amount of service inputs (about 24%), whereas Poland and the Czech Republic both use a (much) lower amount of performance-enhancing services in production (about 11%) than the EU. France and Sweden use above-average amounts of IT services inputs, whereas Germany hardly buys in any IT service inputs for its production process. Sweden uses above-average R&D service inputs (3.6% of total intermediate service inputs) in its food production industry. Since the 'other business services' type of services constitutes by far the largest share of inputs in the food sector within performance-enhancing services, it is worth studying more detailed supply and use data, which allow other business services to be broken down in more detail (see Figure 5.5). Legal and accounting[32] activities constitute the largest cost share in the food industry in Germany, France and Sweden. The Czech Republic uses significantly fewer such services. The pattern of use of advertising and market research services is more stable across the four countries and constitutes the second-largest input of externally supplied services to food manufacturing firms. Since most products produced in this sector are consumer products and are sold through retail, wholesale and catering services, advertising and consumer preferences research is extremely important for the sector. The large share of advertising and market research spending (on average 47% of total other business services inputs) can thus largely be explained by this demand characteristic.

[32] This includes headquarters services and management consultancy activities. However, due to the set-up of the World Input-Output Database, which only records transactions from externally bought-in service suppliers (not within-firm transactions), it is unlikely that headquarters services play a large role in this service category.

## 5.4. QUALITATIVE RESULTS CONCERNING MANUFACTURING–SERVICES INTERACTIONS

### 5.4.1. MACHINERY INDUSTRY

As noted above, the machinery industry is an medium-high- to high-tech sector which faced a decline in the total number of employees of 10% between 1995 and 2005. Thereafter the industry recorded employment growth, despite a setback caused by the financial crisis. Growth in labour productivity has been relatively slow, largely on account of developments in German machine manufacturing, where employment growth has been positive, but where labour productivity has stagnated. By contrast, developments in France – the selective outflow of roughly one-fifth of employment over the whole period, with sustained value added – contributed to productivity growth. Moreover, the machinery industries of the two countries display considerable differences in their use of services. These factors make it interesting to take a closer look at this country pair when investigating the relationship between manufacturing and services.[33]

Remarkable differences exist when comparing the French and the German industry. According to French interview partners, subcontractors within the French machinery industry often have little or no engineering capability and are exposed to strong price competition, which puts pressure on domestic production locations. By contrast, the competitiveness of German firms benefits from their own engineering know-how, while mere production firms do not play a considerable role. Data show that the French machinery industry not only experienced higher growth in labour productivity, but also registered much stronger real output increases than its German counterpart. However, German enterprises generated stronger growth in revenues, which is explained by differences in price developments. Thus German enterprises successfully increased prices while simultaneously expanding overall employment, whereas the French machinery industry suffered from falling prices.

This may be explained by certain segments within the machinery market being predominantly served by German, but not by French firms. Specific technologies, customer orientation, quality, etc. might play a role in the ability of companies to increase their market share without excessive price pressure. This is underpinned by the interviews conducted, which revealed that German firms have huge trust in their own specialised engineering capabilities. This development indicates that German machinery manufacturers target markets where they can exploit their comparative advantages in terms of their engineering capabilities, while French firms are more exposed to price competition, relying more on contracted engineering capacities with broader and more general know-how offered by engineering service providers (ESPs). Overall cost-cutting pressures and less flexible labour regulations are important drivers of these differences, and to a certain extent this explains the much higher cost share of business services in the French machinery sector (Figure 5.6).

[33] The other countries are covered in detail in the comprehensive industry reports.

**BOX 5.1 / THE INTERACTION OF DIFFERENT TYPES OF COMPANIES IN THE MACHINERY AND THE TRANSPORT EQUIPMENT INDUSTRIES IN PRODUCT DEVELOPMENT**

In both the machinery and the transport equipment industries, different types of companies interact. Their relationship can best be described by using the value chain approach. It involves original equipment manufacturers (OEMs), Tier-x suppliers and engineering services providers (ESPs). OEMs are manufacturers and system integrators. Tier-x suppliers are manufacturers of subsystems, components and parts. There is a division of labour not only in terms of subcontracting, but also in terms of the development of new products. Working packages are assigned to Tier-x suppliers with engineering capacities and to ESPs. There are Tier-x suppliers who are involved in product development and manufacturing, while others are mere manufacturers in the supply chain. ESPs are only involved in product development and prototyping, but production is carried out by OEMs or Tier-x suppliers.

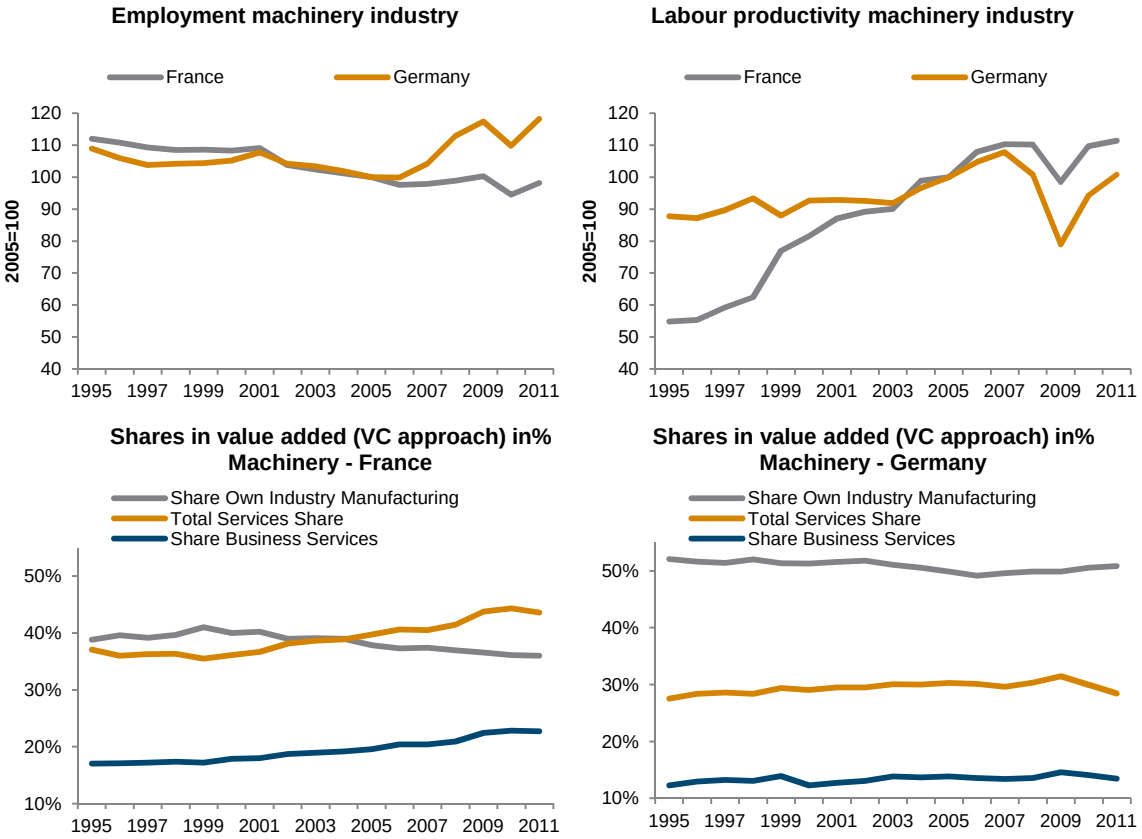
The division of labour between these three types of company in product development may vary significantly. Interviews revealed typical differences between French and German companies. While German firms prefer to employ their own staff, French firms are more inclined to employ contracted engineers or to outsource to ESPs. This is largely attributed to stronger cost pressure from sales markets and to stricter labour market regulation in France than in Germany. This has an impact on the WIOD statistics. There is a bias toward the use of higher shares of R&D and engineering services in France. The shares are lower for German firms in the machinery and automotive industries, with their reliance on internal capacity.

## INTERRELATIONSHIP OF MANUFACTURING AND SERVICES

In general, it is because of the machinery industry's particular characteristics that geographical proximity along the supply chain still offers advantages for companies in the era of globalisation, due to the importance of small-batch production, customisation and specifics of intermediary products. Offshoring and overseas procurement are evolutionary trends which do not have as radical effects on the industry's structure as, for instance, in the case of textiles and clothing. As a consequence, supply chain management and the introduction of IT tools are primarily dedicated to improving transactions and communication. To this end, structural changes through the closure of the least productive capacities are of smaller importance. Agreements on standards and the integration of real-time and non-real-time communication contribute to moderate but steady efficiency gains.

Enterprises in this industry are predominantly medium-sized, and thus the outsourcing of business operations and services plays a limited role. Facility management, transport, warehousing and IT departments were among those outsourcing activities mentioned most frequently in the expert interviews. Only large enterprises place greater emphasis on outsourcing, with all non-core business operations being considered (e.g. administrative activities, such as accounting). These outsourcing activities, undertaken mainly by large firms, have not yet come to an end, according to the interviewees, although – compared to other industries – such activities will remain limited.

**Figure 5.6 / Comparison of the French and German machinery industry**




*Source*: WIOD; ifo calculations.

In view of the above, the machinery companies' productivity gains are, for the most part, expected to result primarily from IT-driven reorganisation, and not from outsourcing to specialised service providers. Important measures to be undertaken in the coming years will relate to the virtualisation of IT systems. This will contribute to an increase in IT staff productivity, and will simultaneously ease the employees' use of IT tools. Another IT novelty – 'cloud computing' – will further enhance the efficiency of operations, thanks to its potential to integrate data and processes from different locations, an important feature for machinery companies with global distribution networks and several production sites.[34]

The machinery industry's capacity for product innovation is linked to engineering and customised solutions. These activities are regarded as core competencies, and in Germany are mostly done in-house. The growing sophistication of products and the need to integrate different technologies have contributed to more complex innovation processes. As a consequence, the efficiency of development processes has emerged as a topic of growing importance. Project management and IT-supported processes have been introduced to strengthen cooperation and coordination and to reduce throughput

[34] Typically, the combination of the general nature (i.e. lack of client specificity) of network-type services and the associated economies of scale in their provision means that in-house production is usually neither a viable nor a cost-effective option (ECORYS, 2008). That is why 'cloud computing' has the potential to change the machinery industry's decision-making on outsourcing of business operations. The offering of IT services can become more attractive by services providers' abilities to exploit scale effects through cloud computing and to encourage machinery manufacturers to relocate their business operations.

times, ensuring timely delivery, while simultaneously increasing the quality of results. For more than a decade, the supply of adequate IT tools and organisational structures has become a business field for consultants and IT service providers. In Germany, in particular, this kind of IT-supported integrated product innovation process is widespread. By contrast, similar activities have not been reported by French experts in the industry.

Among the industries studied, machinery has a long-standing tradition of servitisation. Services provision has been an important driver of growth, with services having contributed to EU manufacturers' competitiveness in international markets. The focus is on maintenance, repair and overhaul (MRO) and other services complementary to physical products. According to the experts interviewed, the profitability of these after-sales services substantially surpasses that of physical merchandise. Servitisation is an important and continuously growing business field for machinery manufacturers and is pivotal for success in international competition. To a large extent, these services are provided by subsidiaries or independent representatives abroad. Up to now, full integration of these internationally located establishments into a single enterprise IT system has not taken place in the machinery industry. This increases the potential for cloud computing to be a useful tool to accelerate the integration of IT systems, just as soon as security concerns have been tackled and resolved.

More recent technologies, such as remote supervision and in-situ monitoring of machine operations at the clients' premises, allow companies to offer clients new services. These are part of a more comprehensive approach, referred to as product lifecycle management (PLM). This concept comprises the whole lifecycle – from product innovation to the end of a product's life-span. In particular, the permanent monitoring of machines enables repairs to be made in advance of a breakdown. It increases the availability of machines and strengthens the linkages between manufacturers and clients. There is a feedback loop to product innovation by collecting data from a broad range of clients. In turn, the data are used in the development of machines more focused on clients' needs and greater reliability.[35] The application of IT-supported tools (such as cloud computing, 'big data', etc.) contributes to new and more efficient services. Since the turn of the millennium, IT-supported services related to PLM have gained in importance and will get additional stimuli, in particular from cloud computing. These services represent a growth potential for machinery manufacturers through the provision of new business opportunities. The necessary infrastructure might be based on proprietary systems or provided by service providers, but no trend has been identified so far. These advanced services are supplied in addition to the more traditional services, such as MRO.

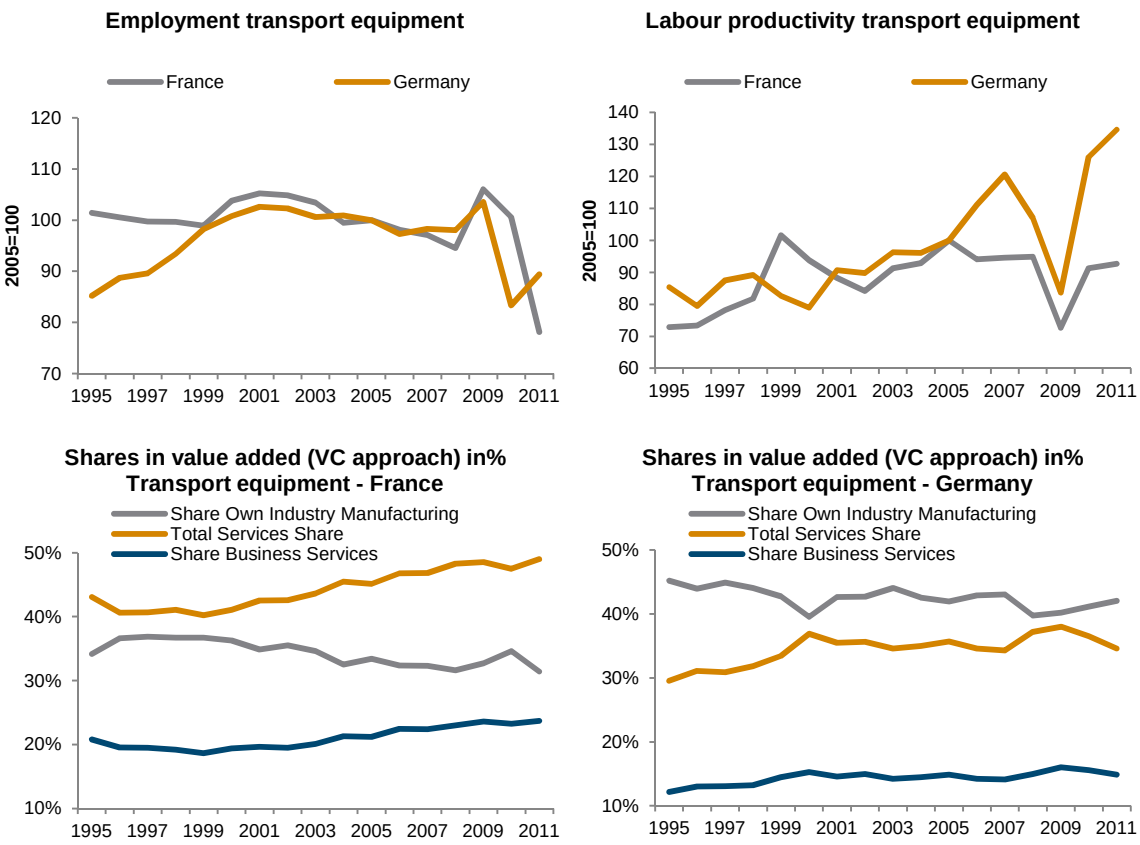
In particular, larger manufacturers have tapped new business areas that are not closely related to physical products, such as financing, contracting, Build–Operate–Transfer (BOT), etc. The overall share of servitisation in the EU machinery industry is estimated to be between 5% and 10% of total revenue, although some companies' turnover in services reaches 30%, depending on their product programmes.

[35] The latter is mainly of importance for manufacturers of serial products in large quantities.

### 5.4.2. TRANSPORT EQUIPMENT

The transport equipment industry is the second medium-high- to high-tech industry under consideration. It accounts for the best employment record of the EU-6 over the whole period, and grew steadily until 2009. During the financial crisis, the industry suffered a major setback. If the whole period is considered, labour productivity grew at a similar pace to textiles and clothing.

**Figure 5.7 / Comparison of the French and German transport equipment industry**




*Source*: WIOD; ifo calculations.

A comparison of Germany and France again reveals important developments and discrepancies for the two advanced economies with mature domestic automotive industries. A recurring fact – also observed for other technology-intensive industries – that appears puzzling is the much higher services cost share in French manufacturing than in German. Over the entire period under consideration, the average difference was around 6 percentage points. Figure 5.7 shows the development of manufacturing and services cost shares over time. Over the whole period, the total services share in France was at least 10 percentage points higher than in Germany, starting out at about 43% in 1995 and steadily increasing to almost 50% by 2011. By contrast, the share in Germany increased from about 30% to about 36% between 1995 and 2001 and more or less stopped growing after that. This reflects the introduction of IT services into the industry, which took place at a very rapid pace prior to 2000 and slowed subsequently. It is therefore the (generally considered performance-enhancing) business services, including R&D, that account for almost the entire difference in the shares of the two countries: in France, they build to more

than 20% of value added (increasing throughout), whereas in Germany they start out at only 12% and level off at around 15% of value added. French productivity growth outpaced Germany's, yet this does not necessarily signify overall economic success: while the French industry lost employment during the period under consideration, employment in Germany grew at a yearly rate of 3.6%. One has to remember that the higher services share in France is explained by the higher degree of externalisation of R&D/engineering services, compared to Germany. The economic performance of the industry in both countries suggests that the use of internal, rather than external, R&D/engineering services is advantageous in the design of high-performance vehicles. However, competitive pressure is growing, and permanent cost-cutting is pivotal to securing market share, because losses in mass markets would endanger OEMs' future strategic positioning. This has led – among other initiatives – to increasing transparency in the value chain, by splitting manufacturing and engineering into individual organisations, which allows for a more economical procurement of intermediary products and services. The challenge for OEMs and their suppliers arising from this development is to maintain technological leadership and economic performance at the same time.

According to findings from the interviews conducted with industry experts, the different use of ESPs largely explains this pattern. In the German automotive industry, there are substantial upstream R&D and engineering capacities: according to industry estimates, almost a third of R&D value added is created by Tier-1+ suppliers, while the share of dedicated ESPs is only around 9%. By contrast, according to interviews with French experts, French upstream firms have far fewer engineering capacities of their own, since the OEM typically provides finalised blueprints to subcontractors for the production of parts and components. While in Germany, the development of parts and systems is often outsourced to the supplier jointly with production (in the context of which R&D services do not appear in WIOD statistics), in France OEMs hire engineers from ESPs for internal projects. This is a result of the (historically evolved) industry structure: in France, ESPs play a very important role in manufacturing generally, with a strong focus on the areas of aerospace, machinery and defence.[36] Even though these are not purely focused on automotive engineering, they are established and important partners of the French automotive industry. There is a historically established division of labour between ESPs and (manufacturing) suppliers. By contrast, most German automotive suppliers – both the largest firms, such as Bosch and Continental, and the small and medium-sized enterprises (SMEs) – are located close to their core engineering firms. They do not contribute less in the way of R&D services, but since these are embedded in the parts produced, they do not appear in official statistics to the same extent. As a result, one does not observe differential productivity effects of the service levels for France and Germany. But along with an increase in the role of engineering service providers in the German market (they are already a fixture of French manufacturing), one should expect this service gap to close in the automotive sector in the future. (For a detailed discussion see Box 5.2.)[37] Note that other clients of ESPs include the aerospace, railway, machinery and defence industries.

[36] French industry leaders such as AKKA or Altran employ staff exceeding 10,000 engineers.

[37] Knowledge-intensive business services typically require the retention of a complementary in-house knowledge base. This is assumed to be one factor explaining the better performance by the German machinery and transport equipment industries than the French industries, which rely more on external engineering services. (For the role of KIBS as catalysts of innovation, see Muller and Doloreux, 2007.)

**BOX 5.2 / THE RISE OF ENGINEERING SERVICE PROVIDERS IN TECHNOLOGY-INTENSIVE INDUSTRIES**

ESPs have emerged over the past decades to become an indispensable part of the automotive value chain. One of the major growth drivers for ESPs was the modularisation and accompanying model profusion beginning in the early to mid-1990s. ESPs focus solely on R&D tasks, which therefore become completely separated from the manufacturing process. Serial production of the parts designed by the ESP has to be carried out either by the client (OEM) or by upstream suppliers in the value chain, which then produce the parts according to the specifications set out in the ESP's blueprints. This has two effects. On the one hand, the R&D efforts become more visible in national statistics, since they are procured separately. On the other hand, there is less differentiation potential for the producer of the designed part, as the innovative aspects of the task are no longer directly linked to production. Typically, this is exacerbated by the fact that the OEM assumes intellectual property rights for the ESP's developments and even inventions. In the long run, this separation of research and production will make outsourcing to more distant destinations such as North African countries (e.g. Dacia's major investments in Tangier) more feasible.

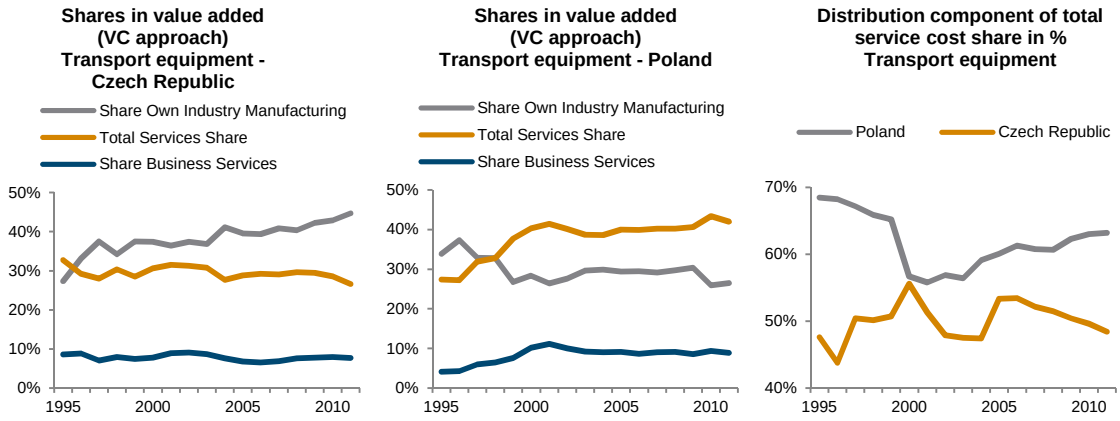
Most ESPs are involved in the development of new components and systems, often with a technological specialisation, such as car bodies, interior, electronics, engines, power trains. More specialised fields of expertise include simulation and testing (e.g. company AVL), as well as quality and project management, which play a central role in outsourcing and (even more so) offshoring processes. Other engineering tasks carried out by ESPs in the automotive industry are factory planning and management, as well as the development of design systems for OEMs. A further central role that ESPs have played in the past is the provision of temporary engineering human resources.

Many newer ESPs are spin-offs from suppliers of physical parts in the automotive supply chain. These companies sometimes remain affiliated to manufacturing companies, for instance Schaeffler Engineering or MAHLE Engineering. In accordance with this, since the financial crisis hit, a new trend can be observed which could potentially threaten the viability of production facilities in the EU in the long run: large upstream manufacturers in the automotive value chain are separating their advanced engineering and design efforts from their other activities. In many cases, engineering capacities are bundled in subsidiaries or affiliates within the group. The rationale from the perspective of the suppliers is to generate higher returns from their engineering activities in the short run by being able to charge and account for these separately. The flipside is that this keeps them with the low-margin serial manufacturing business and, in the process, exerts further pressure on the mark-ups that can be charged for production. From the perspective of the OEMs, this increases cost transparency with regard to their suppliers, by introducing task-based accounting for engineering and design services irrespective of part production. As a result of these developments, the competitive pressure on manufacturing sites will increase.

A general trend in the industry is represented by the shifts in production and assembly location patterns both within the EU and globally. Box 5.2 above explains how the separation of the development of blueprints and the production of parts may further enable the offshoring of production to destinations within and outside the EU. Two countries in our sample, Poland and the Czech Republic, have both become important production destinations for international car manufacturers and their suppliers producing for the European market. Both display a strong dependence on the development of the German car industry. However, in Poland Asian manufacturers play an important role. Among the sectors studied, the transport equipment sector in the Czech Republic has experienced the strongest sustained productivity growth over the entire period, with an average growth rate of 11.5%. A comparison with neighbouring Poland reveals that this cannot be attributed solely to convergence: while the two countries registered similar levels of labour productivity in 1995 (around USD 20,000, purchasing power parity adjusted, per employed person), the growth rates in the Czech Republic outpaced those in Poland by 7% per year on average between 1995 and 2007. The Czech Republic's much better performance in labour productivity is partly explained by an even larger growth differential in value added. Beyond scale and learning effects, structural differences may have contributed to the more favourable development of the Czech automotive industry.

Both countries are destinations for production outsourcing from western European, in particular German, firms, but the Czech Republic boasted a more developed native auto industry (in particular Skoda), which became part of the Volkswagen group back in 1991. This head-start in skills and (foreign) investment is reflected in the country's business services share in the early period, which was almost 3 percentage points higher than Poland's share. This was associated with much stronger output growth in the early period in the Czech Republic. In the years around 2000, the share of business services in Poland increased markedly, reflecting investment in the IT infrastructure of firms and production sites, which is a prerequisite for modern supply chain planning, as discussed above. As Figure 5.8 shows, around 2001 the cost shares of services associated with distribution (e.g. dealerships) and similar activities reached almost identical levels in the two countries; at the same time, the Polish automotive industry experienced a period of very strong productivity growth.

**Figure 5.8 / Value chain approach for the Czech Republic and Poland, in %**




*Sources:* WIOD, ifo calculations.

After 2001, in Poland the production volume increased at almost the same rate as employment (resulting in stalling productivity), whereas it soared in the Czech Republic. Czech manufacturers were able to enter into higher-value-added activities due to the structure of the industry. In Poland, the (non-performance-enhancing) distribution component of services has been steadily increasing since 2001, whereas in the Czech Republic it reached its peak in 2001. Largely due to the direct link between Skoda and VW, the Czech automotive industry has been more successful at transforming itself into a provider of (higher-value-added) R&D activities than has Poland, whose success has so far been limited to larger ESPs opening subsidiaries to take advantage of cheaper wages among engineers. The Czech Republic has benefited from closer ties to the value chain of the largest European automobile manufacturer,[38] while Polish suppliers have so far remained more on the periphery of the European supply network. There are a few notable exceptions of Polish firms attempting to obtain sizeable contracts through foreign acquisitions; current examples of this development are the Polish firm Stomil Sanok's activities in France and the negotiations to acquire Draftex Automotive, a German manufacturer of gaskets.

To summarise, both country comparisons reveal that technology competition and the associated R&D efforts have been crucial factors in the success of automotive firms in the period under consideration here. In the past, the 'German model' of linking upstream R&D with part production[39] has been at least as successful as the 'French approach', in which R&D is more likely to be procured separately. Nevertheless, it appears that the tendency points increasingly towards the French approach, which could facilitate further offshoring of production in future. Comparison of the Polish and Czech industries reveals that the very large differences in productivity developments are largely attributable to the different levels of integration into the European supplier network. Due to its more advanced local brands at an early stage and the strategic decision of a major player (VW) to make Skoda an important part of its brand strategy, the Czech Republic has been able to attain higher-value-added activities (such as Tier-1 production and R&D), while the Polish automotive industry has remained focused on (volume) production of parts. In the following, we briefly discuss the most important services categories for the automotive industry in the past, as well as service concepts that may help the industry cope with future challenges.

## INTERRELATIONSHIP OF MANUFACTURING AND SERVICES

In the recent past, the central drivers of efficiency and productivity with respect to services in the transport equipment industry have been in the areas of logistics and R&D. IT services and interfaces have played an important role in enhancing processes in these two areas and making their widespread application possible.

**Logistics**, i.e. storage of parts and delivery to suit the OEM's production process, is a core service function of automotive suppliers.[40] Warehousing and IT management can therefore be considered servitisation by intermediary goods manufacturers. With the rise of just in time (JIT) procurement,[41]

[38] This advantage is relative; Czech suppliers also face difficulties of their own, as noted by, for example, Pavlinek (2012).

[39] See Felli et al. (2011) for a detailed discussion of the underlying mechanisms.

[40] For a more detailed explanation of part classification and sourcing decisions in the automotive industry, see e.g. Felli et al. (2011).

[41] With JIT, the supplier delivers parts only and exactly at the time specified, thereby reducing the OEM's required storage space and inventory and thus cutting waste and increasing efficiency. This form of procurement also shifts demand risks upstream, which further contributes to its value for OEMs.

pioneered by Japanese automobile firms in the late 1980s and early 1990s, the optimisation of supply chains was an important driver of productivity in the industry throughout the 1990s. Coordination requirements make the geographical proximity of the production facilities of OEMs to the suppliers of critical parts a necessity; this has benefited high-cost production locations which offer the required technological, IT and transport infrastructure. Efficiency gains from JIT are considered to be largely exploited – further developments such as 'just in sequence' procurement have not been widely adopted, since considerations of set-up costs, interface requirements and risk make it economically unattractive (see, for example, Wagner and Silveira-Camargos, 2011). Even though it is being discussed in the context of the increased importance of services for the automotive industry, decentralised production through micro-factory retailing appears highly unlikely to gain importance in the industry.[42] One can therefore conclude that, while logistics have in the past been an important driver of efficiency, further gains through this channel are likely to be marginal in the present framework conditions (e.g. improvements in peripheral production locations and further diffusion of IT). Improving the internal market for transport and logistics might lead to further efficiency gains.

**Research and development** carried out by suppliers play a central role in the industry, as discussed in detail above. Unlike logistics, the productivity and value gains from R&D are a sustainable source of future growth for the industry. In the past, Tier-1 suppliers were the main drivers of the development of integral safety features, such as anti-lock braking systems or the electronic stabilising programme. In general, when planning a new model, the OEM will approach a subset of suppliers for a given part and ask them to develop a technical blueprint that meets detailed specifications.[43] Typically, only a relatively small share of development efforts in this classical approach are reimbursed by the OEM directly (in the order of 10–20% of costs, as found by Felli et al., 2011); these are accounted for in the national statistics. Instead, reimbursement for research and design costs comes from a mark-up on the price of parts when series production is awarded to the supplier who produces the best blueprint at the lowest cost. In terms of the organisation of R&D, marked differences have been identified between the automotive industries of France and Germany (and were presented at the start of this section).

Due to the complexity of the procurement network and the need for timely delivery, **IT services and interfaces** between firms and advanced IT services in the areas of enterprise resource planning (ERP) and computer-aided design (CAD) are particularly important for efficient transactions and communication. Specialised solutions for the automotive industry have been developed by service providers specialising in the automotive industry's needs. These solutions are attuned mainly to the large OEMs, as well as to the most important Tier-1 suppliers who are able to handle such complex software systems. According to our interviews conducted in Germany and Poland, the major players in the area of ERP (especially Oracle and SAP) are fully operational in every automotive market in Europe. The situation is somewhat different for smaller suppliers, for whom the full-fledged ERP solutions of the big players would involve too great a burden on resources, especially with regard to personnel and expertise. Here, the path forward currently seems to differ by country. Primarily in Germany, industry experts observe dedicated suppliers of ERP solutions for automotive SMEs. Parallel to this development, the large IT service providers are developing and marketing solutions for SMEs, which

[42] See, for example, Williams (2006) on the potential application of this concept in the automotive sector.

[43] Some OEMs also utilise online procurement auction platforms to reach a much greater number of suppliers – an approach that is more widespread in the United States. This approach is seldom used in Europe, and then mostly for commodity-type parts.

they see as a remaining area with mostly untapped growth potential and a core part of their business strategy.[44]

Finally, beyond after-sale services closely related to vehicles, only few innovative downstream services have been provided by OEMs; this is why industry observers consider servitisation in the automotive industry to be still in its infancy. For large firms, OEMs offer sophisticated fleet management services with complex leasing and maintenance schemes. For individual buyers, they offer two main services: financial services attached to the purchase of the car (often through a banking subsidiary) and, mainly in the high-end car segment, customised built-to-order production of vehicles. 'Virtual showrooms' – online platforms where customers can configure their desired car model – have been directly integrated into the ordering system of high-end suppliers, giving the customer the opportunity to choose from millions of different configuration options for a new car,[45] while the direct integration into the supply chain keeps delivery times relatively short. Automobile financing has turned from a service to attract additional customers into a lucrative business model of its own – car firms are extremely well informed with regard to the important collateral of the loan (the car itself) and are extremely adept at profiling customers, thereby gaining advantages in managing their portfolio risks.

A third group of customers will substantially change the role of services in the automotive industry in the coming decades: customers who demand **individual mobility solutions**, but are unwilling to purchase a car – due to personal preference, overcrowded city streets or financial constraints. According to all of our sources, this last group is expected to grow substantially in importance – in Western European metropolitan cities such as Paris, London or Munich, new services have begun to target this consumer group. The providers include both classic transportation service companies, such as the German railway company Deutsche Bahn, with its car-sharing concept Flinkster, and car companies searching for sustainable business models if the importance of car ownership decreases further (such as BMW, with its service concept 'Drive Now'). In discussions with German industry experts, it was emphasised that especially the service concepts implemented by OEMs can be seen as a first step towards a future in which electric cars are the most important means of individual transportation within cities. In this case, customers may personally own an electrically powered vehicle for shorter daily commutes and make use of mobility services for longer excursions (or vice versa).

The quantitatively most important classical downstream services in the automotive industry are sales/distribution and repair and maintenance, all of which are carried out both by independent retailers and by the retail units of OEMs, who are competing for customers.[46] According to the WIOD database, distribution, repair and similar services constitute between 37% (in France, where advanced R&D services are carried out by specialised separate entities) and about 63% (Poland) of the total volume of services in the automotive industry.

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[44] Interviews highlighted a positive relationship between manufacturing and the associated business services. German interviewees from the transport equipment and machinery industries perceive a mutual reinforcement. This confirms findings reported in the literature, see Meliciani and Savona (2011); Castellani and Mirra (2013).

[45] The BMW car configurator, for example, enabled 1,032 potential configuration options, thus allowing about 1 quintillion possibilities.

[46] In this field, additional competition was generated through the European Block Exemption legislation in 2003, and more recently, in 2010.

Competition functions widely in this sector, so that margins for OEMs have been stagnating or declining. One way in which OEMs try to counter this is by applying 'big data' analysis in order to increase information about the maintenance of vehicles. For modern vehicles, every maintenance job or repair is accompanied by an electronic assessment of the vehicle's status, during which every required maintenance step is automatically recorded. This gives OEMs a substantial advantage, since they are able to accumulate extensive data on the existing vehicle fleet on the streets. The current efforts of OEMs are focused on predicting patterns in part failures, and thus being able to prevent them, as well as on better profiling driver behaviour and thereby learning more about their customers (which can benefit the engineering and design divisions, as well as marketing and the financial arm of firms). Since OEMs do not necessarily consider 'big data' analysis to be one of their core competencies at the current time, one can observe spin-offs specialising in scrutinising this type of data, e.g. the Retail Performance Company, a spin-off from BMW. These efforts play a much larger role in the most developed automotive markets (Germany and France) of Europe than elsewhere.

The latest important downstream service trend, which may change the face of the industry in the coming decade, is automated driving. On the hardware side of this engineering issue, all large Tier-1 suppliers are currently undertaking serious efforts, with Continental being among the technology leaders in Europe with its 'Continental Driver Assistance Systems'. On the software side, which requires up-to-the-second map data, among other things, Google is developing as the clear frontrunner, with Apple among its potential serious competitors, to produce operating systems for automatically driving cars. Industry experts consider it unlikely that either of these firms will venture into producing complete systems (i.e. cars), but the producer of the dominant operating system will have an extremely strong bargaining position vis-à-vis OEMs, akin to Microsoft in the early 1990s. In the current regulatory environment (the Vienna Convention on Road Traffic, which incidentally addresses both drivers and handlers of animals in road traffic), drivers must be in control or be able to assume immediate control of the vehicle whenever it moves, and therefore regulatory changes are required for these concepts to become feasible for the mass market.

### 5.4.3. TEXTILES AND CLOTHING

Between 1995 and 2011, the EU textiles and clothing industry lost 55% of its employment (Figure 5.1), which is the strongest decline in employment of the sectors under consideration. In particular, a million jobs were destroyed in manufacturing, but half a million were created in retail between 2005 and 2009. Regarding the six EU countries under consideration, one finds significant employment reductions in this industry. The Polish textiles and clothing industry was by far the largest in absolute terms, with more than half a million employees in 1995; it was followed by Germany and France, with 330,000 and 280,000 workplaces, respectively. More recent figures indicate that the Polish textiles and clothing industry is as large as the German, French and Czech industries put together, with nearly 300,000 employees. Despite the massive loss of workplaces in Poland, the shrinkage was less pronounced than in the other countries (with the exception of Sweden). However, the Swedish textiles and clothing sector is quite small, and recently available figures show a domestic industrial base of only about 10,000 employees.

The industry underwent a painful structural change, in spite of its strengths in design and haute couture. Yet the biggest brands worldwide are still based in Europe (Inditex-Zara, H&M, etc.), where the 'fast

fashion' was invented. These brands are strongly based on fashion design and creativity: new articles are presented once a month on average. In terms of production, logistics, IT and processes, this rhythm is very challenging. Part of the related manufacturing is based in Southern and Eastern Europe (Spain, Portugal, Romania, Bulgaria) and South Mediterranean countries (Tunisia, Morocco, Turkey) despite massive offshoring to Asian countries. Offshoring of large parts of production affected not only mass-produced, low-quality products, but even some premium fashionable products. The luxury segment is nevertheless an exception in this regard, as new manufacturing facilities have been created in Europe in recent years. The EU is dominant in the high-end segment for personal goods and other luxury goods, with a market share of 70% of the luxury global market and over 1 million direct jobs. Over 10% of EU exports are luxury goods. It is worth noting that, even in the luxury segment, profits are not mainly from garments, but from other diversified products (small leather products, jewellery, perfumes, foulards, etc.).

The structural change affecting the mass-market segment has been accelerated by the gradual reduction in quota regulations by the World Trade Organization (WTO) during the 1990s and 2000s and by the accompanying international liberalisation of market entrance for low-cost countries from outside the EU. This has led to a relocation of least productive workplaces, most of which have been low-wage employment segments. Asia, South Mediterranean countries and, more recently, Bulgaria and Romania are the main suppliers. In turn, as EU companies are still selling their products worldwide, productivity has increased and roughly doubled within the past 16 years: it has even exceeded productivity trends in the two medium-high- to high-tech industries under consideration. The way forward in countries such as Germany and France has been to develop technical textiles with applications in cars, aeronautics, construction and health. According to Euratex, the European association for textile and clothing industries, a third of the textile industry's turnover now comes from technical textiles.

Poland and Sweden are indicative examples of two different developments in the EU textiles and clothing industry. The Polish textiles and clothing industry, with its strong manufacturing base, has benefited from the country's transition from a state-planned to a market-driven economy, while the Swedish textiles and clothing industry has benefited from its strong focus on innovation, as well as from being home to two large players – H&M (clothes) and IKEA (home textiles) – with global production and distribution networks. The Polish textiles and clothing industry has in fact experienced three different phases. During the early phase of transition, up to 2000, employment declined markedly – a trend mirrored in the growth of labour productivity. The second phase (until 2005) was characterised by a more moderate evolution. And in the years following EU accession, structural change accelerated once more, highlighted by soaring labour productivity, whereas the decline in employment decelerated (Figure 5.9). The Swedish textiles and clothing industry shed more than a third of its employees between 1995 and 2011, and simultaneously experienced strong growth in labour productivity until 2005, after which productivity growth slowed down. However, although both countries experienced positive trends in productivity, these originate from completely different sources, as will be described below.

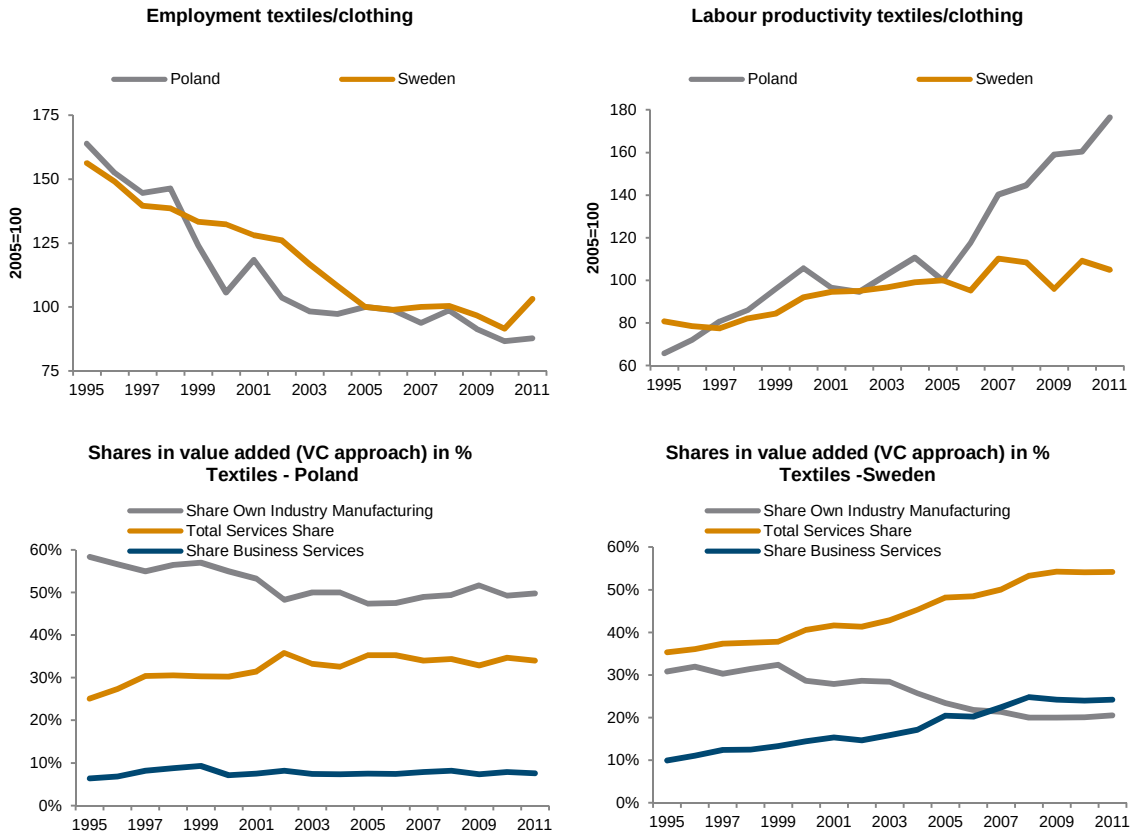
In contrast to Poland, and to a larger extent than any other Member State under consideration, the Swedish textiles and clothing industry developed into a service-driven industry – a development that is not observed in any of the other three industries investigated in this country. The contribution of manufacturing to total output fell by 10 percentage points over the whole period, and now stands at about 20%. Simultaneously, business services gained 15 percentage points and now have a cost share of 25%. The cost share of non-business services increased as well, to reach about 30% of total output.

According to industry representatives, the above-average growth in business services mirrors Swedish R&D efforts. Considering the small manufacturing base, there is a remarkably large textiles and clothing cluster, dedicated to the development of new technologies. An important business target is sustainability of production processes through an increase in resource efficiency, including the use of dry dyeing, the recycling of textiles and the development of cellulose-based fibres. For example, Sweden is about to exploit opportunities to apply cellulose as a raw material in the textile industry. There is public interest in opening up new sales markets for the Swedish forestry industry, which is expected to suffer from falling demand from the pulp and paper industry. Moreover, the recycling of textiles is an important field of research in striving for a circular economy. Sweden is a frontrunner in this respect, though the EU too has launched similar initiatives. Representatives of the Swedish textiles and clothing industry also reported that the sector attracts young people. This contrasts with reports from other countries and is testament to the positive perception of large companies and their brands. Despite these tendencies, there is no indication that the developments will provide much impetus for an in-shoring of the textiles and clothing industry. However, Swedish companies that find themselves at the leading edge of technology and that possess the necessary design capabilities can build on their strengths to dominate global value chains through their knowledge and can trust in their position in the long run.

For the Polish textiles and clothing industry, the value chain approach shows a quite different situation. Up to the early 2000s, the cost share of services increased, driven primarily by non-business services. In the years thereafter, the share of total services hovered at between 30% and 35%, while the share of manufacturing stabilised at about 50% (a quite similar evolution and structure is found for the Czech textiles and clothing industry, another EU country experiencing a transition). This suggests that much of the labour productivity growth was driven by structural changes within the industry, e.g. the closure of the least productive plants and relocation to lower-wage countries. However, according to industry representatives, offshoring does not yet play an outstanding role in Poland. More precisely, it has been reported that employment shedding has lost momentum in recent years, though manufacturers' profitability is extremely low. Subcontractors to well-known international brands and domestically owned companies serving final consumers experience strong competition from the Balkans and non-EU locations, which is why further consolidation must be expected.

The most dramatic period of transition is over, and a significant industrial basis remains in Poland. However, low profitability and the existence of numerous subcontractors to large clients indicate that structural change will continue, although at a more modest pace. To improve the robustness of the Polish textiles and clothing industry in international competition, additional efforts directed towards upstream and downstream integration of the value creation process are necessary. This means manufacturers have to use the know-how of service providers (for instance for the set-up of advanced supply chain management systems), as well as to offer services downstream and directly access final consumers via online sales, outlet stores, advertisements, social media, etc.

**Figure 5.9 / Comparison of the Polish and Swedish textiles and clothing industry**




*Source*: WIOD; ifo calculations.

## INTERRELATIONSHIP OF MANUFACTURING AND SERVICES

The offshoring of production, in particular in the long-standing Member States of the EU, has left numerous manufacturers of clothing with only small – if any – domestic production capacities. Companies have become more focused on value-creating business operations, R&D, design, marketing and distribution. Much of manufacturing employment has been shed, which is reflected in the significant decline in workplaces. This massive job displacement is the main explanation for the high growth in productivity over the whole period.

Taking a closer look at the services that have emerged within the textiles and clothing sector and/or in interrelation with the low but still existing manufacturing bases, it is the manufacturing companies that compete with large vertically integrated groups with a strong focus on design, branding and marketing. A particular example in this respect is the Swedish firm H&M. The company's supply chain management allows it to respond quickly to consumer preferences and to offer up to twelve collections per year.

Supply chain management has become an indispensable feature in many market segments. It is especially the precise planning of production across all stages of the supply chain (firms' own capacities, as well as subcontractors) that enables companies to respond quickly to clients' needs and to compete on level terms with other large vertically integrated groups. The traditional order system, where new

orders feed through the supply chain step by step, is no longer in place for fashionable merchandise, but only for low-margin standard products manufactured for stock. Due to the fact that the textiles and clothing industry is still transforming itself and optimising its processes towards global production networks, IT support and expertise has become pivotal know-how within supply chain management. This kind of supply chain management has been widely applied by companies. Also, successful medium-sized enterprises have invested heavily in the extension of their supply chain management.

However, it is key for the textile and clothing industries to be creative and able to offer fashionable products to customers, who are not as loyal as in the past. What makes the difference between the individual economic operators in this business (even those involved in 'fast fashion') is the constant capacity to create more intensively than ever before (every month) products that will attract clients to their shops or websites. All processes, logistics and IT are quite common and developed by roughly the same consulting companies: they do not represent a differentiating factor – what matters in this industry is creativity.

R&D engagement in the textiles and clothing industry primarily concerns innovations in fibres, yarns, fabrics and dyeing. Many of these research activities are executed in cooperation with enterprises from the chemical and machinery industries. Basic R&D is of major importance for technical textiles. In contrast, the value chain of the apparel industry focuses more on design. There is no other industry with such a pace of product innovation and short-lived product cycles. Beyond the design of fashionable, leisure and sportswear, the development of cutting patterns is still seen as a core competence. However, Asian service providers have already started to develop cutting patterns at reasonable prices for EU manufacturers. This is perceived as a threat to European players, who fear they will lose a key ability to command the value creation in the long run.

Simultaneously with the ongoing trends and changes in upstream processes, there have been changes in downstream value chains, especially the growing importance of manufacturers' access to final consumer markets. Due to the increased direct customer access via outlet stores and business-to-consumer (B2C) platforms, accompanying services such as market research, advertising and branding have grown in importance, too. Only two decades ago, department stores and retail chains were able to fend off manufacturers' attempts to access sales markets directly. However, these days direct market access by manufacturers has led to a shift in bargaining power between traditional trading and manufacturing companies. Some manufacturers run consignment stores with retailers, and take over planning and logistics. In this respect servitisation has become a strategic tool to tap new business areas downstream and to enter into new sources of profit. In particular, the improved market access spills over into the industry's value creation, as this enables companies to sell their products at higher margins.

Reaping the benefits of enhanced market access is supported by the emergence of new services – in addition to traditional media channels – arising from the utilisation of IT applications, such as services in the field of social media. The latter are a useful strategic supplement to traditional marketing concepts, especially as younger generations are increasingly using social media platforms. Hence, social media enable companies to target customers more directly by placing customised advertising via appropriate platforms. However, as social media are still in their infancy, the importance of this channel for advertising cannot yet be assessed, and nor is it yet clear whether it has the potential to fully replace traditional marketing concepts.

Taking stock, upstream and downstream activities in the EU textiles and clothing industry have driven the cost share of business services up to the levels of transport equipment and machinery. However, this increase is, above all, driven by services to improve market access, whereas for the other two industries R&D efforts have been more important. Beyond business services, downstream linkages to distribution and retailing via related services explain the remarkably high percentage of non-business services in the EU textiles and clothing industry, as depicted in Figure 5.3. However, the strongest impact on productivity in the textiles and clothing industry stems from the still ongoing structural change of relocating the least productive workplaces to low-wage countries. Alternatively, in the case of EU countries that no longer have a comparative advantage in producing textiles and clothing domestically, services provide an appropriate means to preserve the competitiveness of the industry on the world markets.

### 5.4.4. FOOD AND BEVERAGES

Regarding its overall economic development, the EU food and beverages sector on average experienced strong growth in output and productivity during the second half of the 1990s. Since then, the industry's labour productivity has stagnated, lagging far behind the other industries under consideration. Employment was mostly stable up to 2008, but during the financial crisis about a tenth was shed and employment has not recovered in recent years. This corresponds to long-term perspectives for nutrition markets in mature economies, which are expected to show only muted growth. Time series depict a limited increase in productivity for the latest years available in the statistics (Figure 5.1).

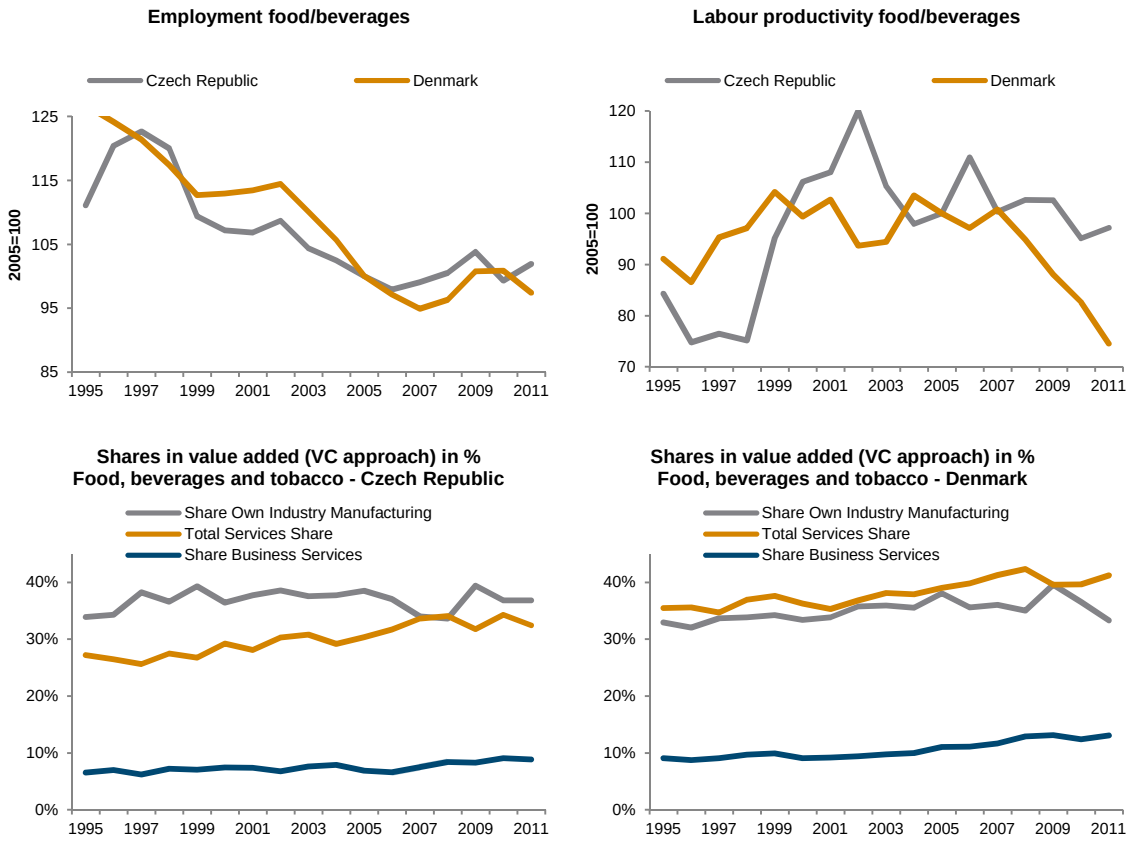
France, Germany and Sweden suffered the strongest declines in employment around 2009. For France and Germany, the reduction in staff was accompanied by strong declines in output. The other countries considered were able to maintain employment by and large at the 2005 levels. Poland is the only one of the six countries with ongoing growth in output, clearly exceeding former levels.

The examples of the Czech Republic and Denmark provide some insight into the different development paths in the food and beverages industry, which mirror the situation in the other Member States under consideration. The Danish food industry is well known for its dairy and meat cluster and for the close linkages to agriculture and the machinery industry, important for automated manufacturing processes in a high-wage economy. Danish manufacturing has experienced growing problems due to stagnating productivity since the turn of the millennium. Mostly stable employment with simultaneously shrinking value added is reflected in a substantial decline in labour productivity (Figure 5.10). This relatively weak development in Denmark is comparable to similar developments in all industries under investigation, but it is most pronounced in the food and beverages sector. The wage reductions agreed by firms and the unions will not bring lasting relief, although some production was relocated from Poland back to Denmark.

Recently the Danish government and the Confederation of Danish Industry acknowledged the problem and launched initiatives to raise productivity. The measures focus on small companies, which play an outstanding role in Danish manufacturing but whose productivity development has been lagging. One Danish expert pointed to expensive domestic services as a serious burden (especially for food and beverages producers on tight margins), in particular legal consultancy, book-keeping and facility

management. However, except for language barriers and geographical distance, there were no indications of barriers to imports of services. The high price of services helps explain the low importance (measured by cost share) of business services for the food and beverages industry in Denmark. Furthermore, as was shown in Section 2, in Sweden business services play a more important role, which, however, is less the case in the food and beverages sector. At 25% of the total services use in manufacturing, the cost share of business services in food and beverages is even below that of Germany or France (about 30%) (see Figure 5.4).

**Figure 5.10 / Comparison of the Czech and Danish food and beverages industry**




*Source*: WIOD; ifo calculations.

In the Czech Republic, the food and beverages sector (which overall displays a very similar development to that in Poland) saw a fall in employment during the transition phase, which was accompanied by strong growth in labour productivity. In the early 2000s, this phase of productivity growth ended, with relatively strong fluctuations but no apparent trend in overall productivity. The value chain approach shows a stable contribution of close to 40% in the food and beverages industry, well above the levels for the more advanced Member States, which – with the exception of Denmark – steadily declined over the period under investigation. Business services do not play a substantial role compared to those countries. This might be attributable to the importance of FDI, which led to a notable share of foreign-owned production sites during the phase of transition.

To conclude, the Czech – and the Polish – food and beverages industry proved resilient during the financial crisis and the years thereafter. This is, to a certain extent, explained by the presence of FDI and the relocation of production from other Member States. Business services play a comparatively small role in both countries, but this has not yet become a problem because the numerous small manufacturers with labour-intensive processes can build on competitive wages. This is in contrast to Denmark, which also features a large number of small manufacturers: for more than a decade, they have remained production-focused enterprises and have lost price competitiveness. Strategies to apply services to meet the challenges from international competition may have contributed much more to a 'managed' structural change and thus kept large workplace losses at bay. This is particularly the case for services dedicated to integration into the value creation chain: upstream, for instance for the production of regional and organic food, and downstream, to strengthen the contact with final clients via advertising and social media.

## INTERRELATIONSHIP OF MANUFACTURING AND SERVICES

Technological change in the food and beverages industry tends to be mostly incremental (improved products, e.g. better packaging) instead of radical (inventing completely new products), as is argued in Winger and Wall (2006). Some development can mainly be observed in the areas of organic, convenience and health food. The fact that the majority of newly launched products fail on the market (less than 1% of newly introduced products are still sold after five years) adds to the effective development costs. While a limited number of product innovations may contribute to long-term growth in the sector (such as lactose-free products, which will benefit from demographic changes), for the above reasons it appears that overall productivity effects generated by product innovations remain limited.

Food and beverages show large differences in the level of process innovations. The pace of progress in production technology (for example, with regard to resource efficiency) for intermediaries is high. Further downstream, there is not much progress: in particular, meat, fruit and vegetable processing has remained largely labour intensive.

Three important market segments are served by the food and beverages sector:

› Wholesale trade, which traditionally provides smaller quantities to independent retail shops and restaurants. Its role has been markedly diminished in the more developed economies, due to the emergence of retail chains with their own procurement departments.

› Retail chains, which build on their bargaining power to get certified quality and timely delivery, while exerting price pressure. A recent trend (whose overall effects on upstream manufacturers and consumers have not yet been carefully studied) is the development of 'store brands', typically produced by upstream firms, but marketed by retailers and sold with their labels on them.

› Fast food and catering trade is a strongly growing market segment which benefits from societal change and corresponding consumer behaviour.

As Figure 5.5 shows, advertising is the most important single business service for the food and beverages sector. Establishing brand value is an important strategic tool for producers, to create

countervailing market power vis-à-vis retailers and to improve market access. Direct access to consumers, e.g. through marketing and advertising campaigns, is mostly limited to global groups and larger companies with sufficient budgets. Due to certain characteristics of the market, producers of food and beverages are at a disadvantage compared to textiles and clothing manufacturers with regard to access to consumers: B2C has not yet become a substantive distribution channel for food and beverages, even for the large corporations, except for a few niche players. Reasons for this include consumer preferences, but also the fragmented manufacturing base, as well as the market and bargaining power of large retail chains.

Long-term relations between manufacturers and retailers have evolved through the production of store brand goods, as well as the development and delivery of products for fast food and catering. However, this is mainly an opportunity for larger industrialised firms with a sufficient potential to provide quantity and quality, often with a high degree of flexibility, as required by the client. Though their importance and utilisation is currently still relatively low (see Figure 5.5), IT and related services can enhance the efficiency of supply chains if manufacturers increasingly operate IT systems that allow for permanent control by, and automated electronic data exchange with, the retailers' systems.

One example that is currently being adopted is 'Optimal Shelf Availability'. This is a business service that optimises the coordination of the quantity delivered to the retailers and has been introduced as a company-specific ordering procedure. Such services incorporate the potential for more long-term stable relationships between manufacturers and retail chains.

To summarise, up until now many business services – such as advertising and branding – used by food and beverages manufacturers (mostly larger corporations) have aimed at improving manufacturers' position and their relative bargaining power in sales markets. Productivity gains through more direct access to customers and associated strategies, as for example discussed in the context of textiles and clothing manufacturers, are currently limited for food and beverages manufacturers. Though it appears that there is potential for improved efficiency through more widespread utilisation of IT applications, it is likely that the benefits of these will be limited and, in most cases, appropriated by large retailing chains due to their superior bargaining power.

## 5.5. CONCLUSION

The fieldwork reported in this section focused on those aspects of the interrelationship between manufacturing and services that could not be identified by desk research, as reported in Sections 2 and 3. It particularly tried to identify the kinds of services that have been important factors in the economic performance of the industries under investigation.

The findings – based on expert interviews – show that the relative importance and the impact of services depend heavily on the characteristics of industries: know-how, R&D intensity, applied and produced technologies and their environments, exposure to international competition, etc. Results from the interviews further suggest that the direct impact of the services used by manufacturing companies on productivity and growth is – with the exception of mere rationalisation – not immediately clear. Most performance-enhancing services pursue a complex set of aims. For instance, the IT-supported restructuring of engineering processes in the machinery industry is intended to streamline processes,

reduce throughput time, and improve the flexibility and quality of the output. However, the effects on productivity and growth are indirect and can hardly be identified quantitatively. Similarly, advertising services for clothing manufacturers have a direct effect on bargaining power and market share, which in turn have only an implicit impact on productivity and growth.

### 5.5.1. INDUSTRY SPECIFICITIES

Two of the four industries under consideration – transport equipment and machinery – are *high- to medium-tech industries*. Both industries supply highly sophisticated and complex products that require the integration of a broad range of different technologies. Companies contend on R&D and engineering with their non-EU competitors. The EU provides supportive framework conditions for manufacturing, in the form of good infrastructure and the availability of qualified labour. The EU supply chain is internationally competitive, although the integration of overseas production capacities in supply chains is growing. Whereas for the machinery industry's supply chain the predominant flow of products is directed towards the EU, the transport equipment industry has invested heavily in major markets and has created clusters of original equipment manufacturers (OEMs) with Tier-x suppliers in their vicinity. However, both industries rely strongly on their EU production networks. For the long-term competitiveness of the EU locations, the EU should remain at the leading edge of technology and should not lose competencies. Mature technologies, deceleration in the pace of innovation and increased price competition would increase the risk of production being relocated to low-cost countries.

In the fieldwork, the growing importance of services related to product innovation in high- to medium-tech industries was emphasised. The trend towards more sophisticated products and the integration of quite different technologies has led to a division of development tasks between companies in the value chain and specialised service providers. This development is more pronounced in the transport equipment industry than in machinery. Over the past decades, ESPs have gained larger shares in development projects. It is expected that this trend – in line with the growing cost share of services – will even accelerate. The reason is that there is a tendency for Tier-x manufacturers to split their engineering and manufacturing units, a development that stems from OEMs' interest in greater market transparency. This kind of unbundling raises the cost share of bought-in services further. As mentioned above, the intercompany division of labour in R&D/engineering projects does not play an equally important role for the machinery industry and for transport equipment. However, the use of external services has gained in importance with respect to better structured and streamlined procedures concerning product innovations within machine-manufacturing companies.

Therefore**,** the cost share of services in medium-high- to high-tech industries has been growing and is expected to increase further through outsourcing of R&D/engineering services and structural changes (in particular the spin-off of R&D and engineering units), and because of the need to set up more efficient and effective development processes. Important drivers behind this trend are the growing complexity of products and the integration of different technologies. Growing competitive pressures and cost reduction strategies via outsourcing of engineering add to this trend. The findings indicate that the success of R&D and engineering projects is, to a certain extent, dependent on the interaction of the different players involved. It is recommended that public schemes directed at innovation should not focus on technologies only, but need to involve the specific participants, their objectives and interactions.

Both of the so-called *low-tech industries* considered here are, in essence, consumer goods industries, where by and large product innovation is closely related to market research and consumer preferences. As both sectors depend significantly on final consumer markets, public relations and advertising are activities of pivotal importance for success. Most of these activities are carried out by specialised agencies. With the internet and social media, the channels by which consumers can be reached have multiplied. For companies in both industries, it is crucial to address the final client directly and to stimulate preferences. Successful initiatives strengthen manufacturers' bargaining power vis-à-vis distributors and retailers, with a positive effect on their economic performance.

In general, global competition among low-tech industries is, to a larger extent than among medium-high- to high-tech industries, driven by cost conditions in different production locations. Production capacities depend strongly on factor price levels (labour, energy and intermediary inputs) and to a far greater extent have been relocated from the EU to overseas low-wage countries. This has caused a dramatic loss of workplaces, in particular in the production of textiles and clothing, one of the low-tech industries under consideration.

For the other industry investigated (the manufacturing of food and beverages), the situation is slightly different. This industry is, to a significant extent, regionally anchored and employment has remained broadly stable. Value chain management has turned out to be an area of interaction between manufacturers and service providers that is of pivotal importance for companies' success in both industries.

For textiles and clothing, the management of international supply chains to meet clients' requirements concerning short lead times and flexible deliveries is important, whereas for food and beverages what is important is compliance with regulations, safe ingredients and proof of origin. Manufacturers have invested heavily in setting up IT-supported tools for communication along the value chain and for the exchange of data. Service providers are employed in establishing and updating organisations and systems, as well as in the standardisation of data formats. The exploitation of services – in particular business services – has contributed much to the success of manufacturers in low-tech industries. Above all, textiles and clothing companies that have invested heavily in value chain management and related upstream and downstream services have been able to meet the challenges of globalisation. They keep control of their international supply chains and compensate for the reduction in domestic production capacities by tapping new business areas. Their success will foster a growing interconnection between services and manufacturing. Although services might not be sufficient to compensate fully for losses of manufacturing activities, they increase EU companies' competitiveness and reduce frictions caused by structural change in low-tech industries in the course of globalisation. EU support for the development of adequate tools and initiatives to standardise the exchange of data has contributed to the beneficial use of services, and further initiatives should be taken in this direction.

Summarising the empirical findings for the four industries under consideration, it is obvious that there are significant differences in the priority fields for the interaction of manufacturers and service providers. For the medium-high- to high-tech industries it turns out that R&D and engineering are fields of close interaction between manufacturers and service providers, and are of pivotal importance for competitiveness and economic performance. For the low-tech industries, downstream activities have gained much in importance, enabled through the internet and innovative IT tools. In spite of these discrepancies between the two groups of industries, the overall cost shares of business services across

the four industries investigated do not differ much with regard to levels and their evolution over the period under consideration. For all four industries, performance-enhancing business services are of similar and growing importance. For non-business services, differences in the volume of services have been identified: the low-tech industries show a higher cost share of industrial output devoted to transport and distribution services, which is explained by the industries' deliveries into consumer markets.

The differences in the interaction of services and manufacturing across the industries under consideration suggest that public policies need to take these specificities into account. If schemes are set up that are dedicated to improving competitiveness through the use of services, a sectoral approach is to be recommended, in order to intensify the interaction of service providers and manufacturers. For instance, value chain management is highly relevant for low-tech industry companies if they are stay on top of global production networks. IT-supported communication, monitoring and the exchange of data are all pivotal for an efficient and effective functioning of international value chains. In spite of some initiatives already taken by manufacturers and service providers, much remains to be done for the development of standardised interfaces and data formats allowing for automated communication. In particular, smaller companies are challenged if firms cannot apply recognised standards, whereas large players impose their proprietary standards. EU policies dedicated to enforcing international environmental standards, minimum labour and safety requirements in the workplace require additional monitoring and reporting along the value chain. The documentation of proof of origin, eco standards, etc. will bring an additional administrative burden. In this respect, public initiatives to stimulate the cooperation of manufacturers and service providers could contribute to the competitiveness of smaller EU manufacturers, in particular those in the textile and clothing industry, where minimum labour standards have become an important topic. Initiatives to create standardised interfaces for communication and the exchange of data should be taken by bringing together service providers and manufacturers at the EU level.

### 5.5.2. COUNTRY SPECIFICITIES

Typical patterns have been identified for the interaction of service providers and manufacturers, though these differ across the industries analysed. There is much leeway for companies concerning the form of cooperation and the choice of services most important for them. In addition, it turns out that the interrelationship of services and manufacturing shows quite different patterns across the Member States under consideration.

The predominant strategies pursued by manufacturers in using services result in differentiation not only in the levels of services, as measured by their contribution to industrial output, but also in the kind of service and the objectives. The most striking finding in this respect is the use of R&D and engineering services in medium-high- to -tech industries. R&D and engineering services are well suited to contributing to manufacturers' economic performance and their supply of technologically leading, high-performance products. However, their impact on sustainability and long-term competitiveness is above all dependent on the objectives pursued by manufacturers. Outsourcing driven exclusively by the intention to reach economic targets bears the risk of ending up in a vicious cycle. That said, the amount of services used by an industry in one Member State does not tell much about the benefits exploited by manufacturers. It is crucial to know the underlying drivers, in order to make an assessment of future

viability and performance in international competition. The comprehensive use of services is not a clear indication for a viable and sustainable industry. It is of importance to consider the underlying objectives.

For example, there are significant differences in the amount of external services used by French and German companies. French companies are more inclined to outsource, whereas German firms build to a larger extent on internal activities and specific know-how. Outsourcing is not only driven by the sophistication of products and the integration of numerous different technologies, but also by opportunities to improve the manufacturers' economic performance. This last point is of greater importance to French companies, because many of them struggle in a difficult environment. By contrast, technology-driven outsourcing benefits much from specialisation and is a prerequisite for innovative products at the cutting edge of technology with outstanding characteristics.[47]

A striking specific of the Danish manufacturing sector is the contribution of services to industrial output – a contribution that is much lower than for any of the other long-term Member States under consideration. The fieldwork revealed that the Danish manufacturing sector is struggling with a loss of competitiveness and that manufacturers do not exploit services sufficiently. This cannot be blamed on the size of the economy, since, like other Scandinavian countries, the Danish economy is internationally open and foreign service providers do not face any major hindrances. The Danish example highlights the importance of the interaction of service providers and manufacturers for sustainable development. Services incorporate the potential to strengthen the EU manufacturing sector's competitiveness, and manufacturers are called upon to exploit their advantages better. Still, while services are necessary for the long-term competitiveness of the EU manufacturing sector, they will not stop the changes in the international division of labour and the relocation of manufacturing capacities. In this respect, the Swedish textiles and clothing industry provides a good example of maintaining a viable industry through services activities. Although only marginal manufacturing capacities are left in Sweden, the industry is viable, provides attractive workplaces, is strong in R&D and design and is maintaining its position in the global value chain.

[47] OEMs show growing interest in more transparent procurement markets. Some German Tier-x suppliers have responded and split their manufacturing and engineering units into separate firms. It is too early to assess these structural changes with regard to the German automotive industry's technological excellence in future. Exclusively economically driven activities that do not take account of technological competence and interaction with manufacturing would incorporate the risk of Germany losing its position on the global automotive market.

# 6. Cross-border services provision and the international dimension of manufacturing services linkages for specific country–industry cases

Section 3 showed that the most dynamic component of the productivity-enhancing relationship between the industry sector and the services sector is determined by the use of imported services by the manufacturing sector. This relationship is significant for all EU economies, especially for smaller EU economies which do not have a significant productivity-enhancing relationship between manufacturing and the domestic services industry. Since the use of foreign-sourced business services is found to increase the productivity of manufacturing sectors in all EU Member States, this section analyses the use of imported services that have a significant potential to increase productivity (performance-enhancing (PE) services) in the selected sectors and Member States, mostly small Member States, and aims to identify the factors that inhibit the provision of services by foreign providers to manufacturers. Potential barriers to the provision of PE services in EU Member States would namely reduce access to (or increase the cost of) these services, which could inhibit further productivity increases in the EU's manufacturing sectors. The section starts with a general discussion of the way services can be supplied abroad, and explains that, depending on the mode of supply, the factors that influence services trade can differ. After reviewing the use of foreign services by the selected manufacturing industries, the section conducts an analysis of potential barriers that could hinder the provision of services to manufacturers in the EU. This is followed by a summary.

## 6.1. TRADABILITY OF SERVICES AND FRAGMENTATION OF SERVICES SUPPLY

Fundamentally, international trade in services does not differ from trade in goods. Both involve exchange of a 'product' between two parties located in different countries. For goods trade, however, this reflects an exchange involving a physical product. In the case of services trade, the 'product' traded is something intangible. By definition, a service is also a flow (it cannot be stored) and thus often requires the proximity (either digitally or physically) of supplier and customer. For some services, the need for proximity between supplier and customer is a more stringent requirement (e.g. hairdressing) than for other services which can more easily be provided at a distance. The characteristics of a service thus define to a large extent the 'tradability' of a service, the degree to which it can be supplied cross-border. Jensen and Kletzer (2010) developed a methodology to measure the potential for services to be traded across borders by comparing the concentration of production and demand. For services where production (employment) is more geographically concentrated than demand, the services will be exchanged at a distance, and thus also the potential for international trade is higher. This methodology has been applied to France by Barlet et al. (2010), which is believed to provide an accurate reflection of the EU average. The index for concentration (and thus the potential for cross-border trade) is highest for all types of transport services and, from our selection of services, is also high for *R&D services* and

*computer services*. The tradability of *advertising and market research* is relatively high, but is fairly low for *architecture and engineering services* and other professional services. For service providers wishing to supply services in another country, the degree of tradability of the service will largely determine the way in which they choose to supply the foreign market. As argued in Smith (2014), the two options for a service provider to serve a foreign market are either through exports or through foreign direct investment (FDI). He argues – based on the conditions favourable to FDI (Dunning, 1989) and the tradability of the various services categories (Barlet et al., 2010) – that services are likely to be provided abroad largely through FDI (commercial presence) when the demand for a service requires production to take place close to the user, because of a requirement for strong interaction between both, the repetitive nature of purchases, oligopolistic market structures that discourage import penetration, or cultural factors that require service tailoring to local needs. For example, many operational services necessarily need to be supplied in proximity to the production activities that they support. Also the contribution of externally supplied services to the performance of manufacturing will depend to a large extent on prevailing conditions in local service markets. On the other hand, for internally supplied services, factors influencing FDI conditions for service activities are likely to be important. In this respect, we can notice two opposing forces operating at the same time: (i) services without a direct relationship to the industrial product are increasingly outsourced to specialised service firms, allowing companies to concentrate on their core competences; (ii) services which are more directly related to the manufactured product ('product-accompanying services') are growing in importance within manufacturing companies, and are less likely to be outsourced. These outsourcing strategies for service inputs, in turn, also relate to similar decisions concerning the organisation of industrial production activities, particularly in terms of the relocation of core fabrication and assembly activities – especially those with high labour intensity and/or low labour skill requirements – to lower-cost production locations. The tradability of the service activity plays an important role here as *foreign* lower-cost production locations might be preferred when the service can be easily supplied cross-border. A related concern is, for example, that the loss of certain manufacturing activities in the EU could be accompanied by a subsequent loss of R&D, engineering and similar service activities that require a high level of interaction with industrial production processes.

Other recent dynamic forces that influence the tradability of a service and the concomitant choice of international services provision are also at play. In particular, the fact that many knowledge and information services are amenable to codification means that ICT-enabled forms of digital transmission can radically affect the tradability (both geographically and in time) of service outputs and the possibilities for service providers to interact with their clients 'at distance'.[48] Equally, the increased importance of intangible capital assets derived from services as drivers of competitiveness may place a premium on situating service functions in locations that offer favourable environments for the protection of service-related intellectual property. Finally, knowledge spillovers linked to the specialised capabilities required for the delivery of knowledge-intensive services is likely to favour a degree of locational concentration of service providers. This, in turn, may contribute to an increase in service trade, as industrial clients seek out specialised service providers.

Overall, we can see that there is a mixture of centripetal and centrifugal forces at play, the balance of which will influence the organisational (ownership) and spatial (geographical) location of service activities within (global) value chains. On the one hand, there are factors that tend to pull towards the co-location of manufacturing activities and associated services (i.e. agglomeration of services around

[48] Cloud computing incorporates the potential for basic changes in the interaction between service providers and manufacturers, and an increased outsourcing of manufacturers' business operations; see Section 5.

production locations) and, on the other hand, there are factors that support the de-location of services and that may support locational specialisation of service activities. Interviews (see Section 6.4) with representatives from the selected service industries in this report were conducted to understand more about the degree of cross-border trade of the different service categories. The next sub-section elaborates on how the two different ways of services provision may lead to different sets of factors that could potentially hinder international trade in services (to EU manufacturers).

### 6.1.1. RELATED FRAMEWORK CONDITIONS INFLUENCING THE INTERNATIONAL TRADE IN SERVICES

Since the analysis in Section 3 showed the importance of foreign-sourced business services for EU manufacturers, it is crucial for policy makers to know whether there are factors that still inhibit the international trade in services with EU manufacturers, i.e. make the trade transaction more costly than it need be. It is important to note that perhaps the most important factor (or 'barrier') with respect to services trade is defining how the service is provided abroad (commercial presence, exports or through temporary movement). This implicit barrier (called the 'proximity burden' in literature) to international trade in services captures 'soft' factors, such as distance, differences in culture and language that, given the frequent need for co-creation of services with clients, constitute a 'natural' cost burden on the cross-border supply of services (Francois and Hoekman, 2010). For services where the burden is too large, a commercial presence will be the preferred mode of supplying services abroad. Differences in these soft factors cannot easily be addressed, but if the barriers to trading in services cross-border (export), through local affiliates (commercial presence) and through temporary movement are as low as possible, then there would still be a free and open environment allowing for unrestricted use of foreign services. Many of the barriers that currently still exist for each of the different forms of international services trade and that can be tackled by policy makers are of a regulatory nature. The regulatory framework influencing trade in services is a translation of a myriad domestic, EU and international regulations, where *differences* between countries' regulatory regimes matter most for the cross-border trade in services. When regulatory regimes differ strongly between regions, exporting involves additional costs of familiarising oneself with another regulatory environment, adding costs to exporting (and as a result favouring business through commercial presence). Discriminatory regulation or excessive red tape with respect to foreign investments might depress services trade through local affiliates. Lastly, restrictions on the movement of people can make it more difficult to provide services abroad through a temporary presence.

Section 6.3 explores the presence of different types of regulatory barriers for the selected services, using data available in public databases. Section 6.4 discusses other barriers that might play a role in hindering (performance-enhancing) services provision to EU manufacturers. However, first, the degree of foreign-sourced performance-enhancing services in different manufacturing sectors is reviewed in the next section, in order to understand which services are typically imported, so that the characteristics of these services (and the resulting expectations as to the mode of supply) can be taken into account in discussing barriers to services trade.

## 6.2. USE OF IMPORTED PERFORMANCE-ENHANCING SERVICES

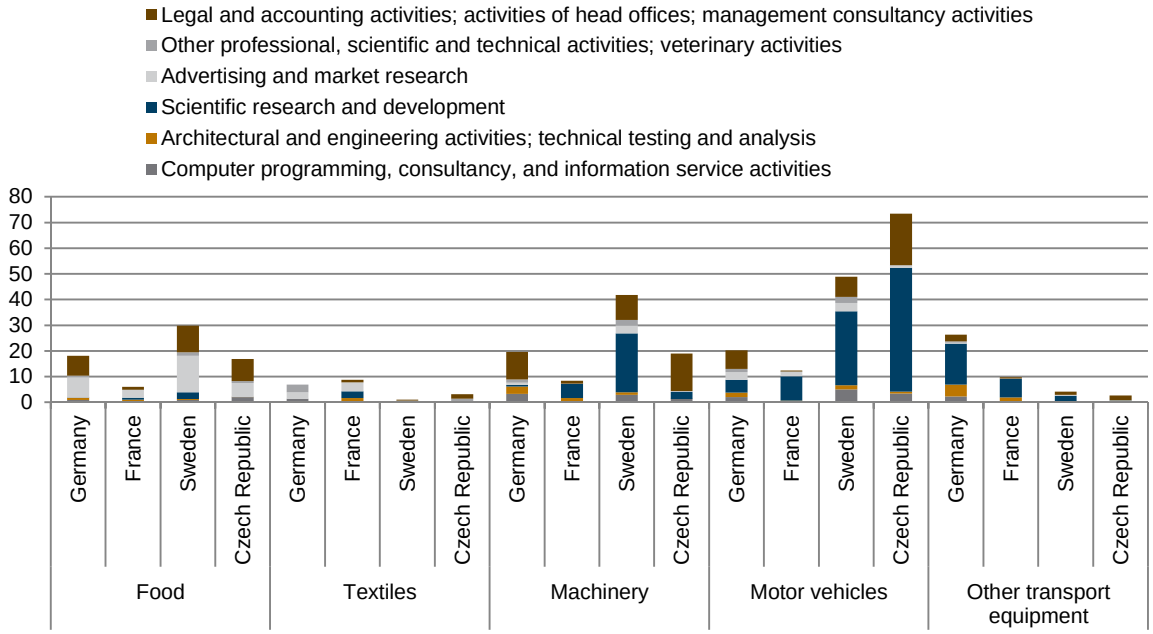
As highlighted in Section 2, there are important cross-country differences in the use of imported versus domestically produced services, which also impact differently across country groups (see Section 3). To follow up on these findings, this section explores patterns of imported performance-enhancing (PE)[49] business services for the selected countries and industries.

### 6.2.1. IMPORTS OF PE SERVICES IN SELECTED INDUSTRIES AND COUNTRIES

Figure 6.1 presents the shares of imported PE services (together with legal and accounting services) as a percentage of total use of PE services in the selected countries for which data are available (Eurostat NACE Rev. 2 tables) and the four selected industries (with the transport equipment industry split into motor vehicles and other transport equipment). When evaluating the figure, it should be recalled that estimates based on input-output data reflect the cost shares of bought-in services from external providers, but typically do not capture services that are supplied within a firm's (enterprise) boundaries.

In the **food, beverages and tobacco sector**, Sweden has the highest share of imported PE services (some 30% of total PE service inputs in this sector) and France the lowest (6%). Across all countries, the main PE services bought in from international service suppliers are advertising and market research services, as well as legal, accountancy and consultancy activities (approximately 80% of all imported PE services).

**Figure 6.1 / Share of imported PE services as a percentage of PE services, 2011**




*Source:* Eurostat; wiiw calculations.

[49] Performance-enhancing business services are those that were under investigation above, i.e. Computer programming, consultancy and information service activities (J62-63), Architectural and engineering activities, technical testing and analysis (M71), Scientific research and development (M72), Advertising and market research (M73), Other professional, scientific and technical service activities; veterinary activities (M74-M75).

Sweden is the only country that imports a significant share of R&D services (3% of total use of PE services in the sector), which implies that Sweden imports (rather than sourcing domestically) a relatively large share of total R&D service inputs. Lastly, for the Czech Republic imports are almost entirely of computer and related services: since the share of imports constitutes 2% of total PE services and the overall use of computer services is also close to 2%. The Czech food and beverages industry (as indeed the Polish) has experienced strong FDI inflows from large foreign groups, which to a certain extent explains the high share of foreign services.

In line with the findings for the food and beverages industry, the patterns of use of PE services in the **textiles sector** show that France is also the most intensive user of imported PE services, largely driven by the international sourcing of R&D services and advertising and market research activities. It may also be noted that the French textiles sector imports most of the R&D services used in that sector. Still, the overall use of imported PE services in all countries is rather low (< 10% of total PE services input). [50] Germany's textile sector seems more strongly oriented to technological production activities, signalled by the higher share of technical and computer programming service imports. The low use of imported PE services in Sweden should be interpreted with caution, for Sweden has virtually no domestic textiles production left (and nor has the Czech Republic).

Similarly to the food and beverages sector, Sweden imports the largest share of PE services in the **machinery sector** (more than 40% of total PE services input in the sector), largely driven by a significant component of R&D imports. Both Sweden and (though to a lesser extent) France appear to source a large share of total R&D services inputs from abroad; although, overall, the French industry has a much stronger domestic orientation for the total use of PE service inputs.[51] Whereas total PE service imports in France and Sweden are dominated by R&D, imports in the Czech Republic and Germany are largely driven by legal, accounting and consultancy activities.

Finally, international sourcing of intermediate PE services in the **transport equipment sector** appears to be of greater importance than for other reported sectors. The finding from the econometric results (that imported business services are most important for smaller EU economies) is best illustrated in this sector. Both Germany and France show relatively low shares of imported PE services, compared to the Czech Republic and Sweden. The Czech transport equipment sector[52] is highly integrated into international supply chains, as over 70% of its total PE services is sourced from other countries (largely driven by imports of R&D and legal and accountancy services). Swedish imported PE services are again significant and largely driven by R&D imports (disregarding the *other transport equipment* segment, in which Sweden does not produce a large volume of output). Across all countries, most of the imported services constitute R&D service inputs.

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[50] The overall low share of imports is explained by foreign service providers' difficulties in accessing the French market. Interviewees reported cultural barriers as an important determinant. However, compared to the other countries under consideration, the share of service imports in total performance-enhancing services is higher. This is due to the global reach of the French *haute couture*.

[51] Generally speaking, the Swedish economy is one of the most internationally open economies. The country is home to the headquarters of some large global players. Interviewees reported that Swedish R&D is focused and does not cover the breadth of technologies required by the machinery industry. This is an important factor explaining the high share of R&D imports.

[52] Not taking into account the other transport equipment segment, which constituted 8% of total output in the combined sector in 2010.

Consideration of the geographical sourcing structure of these imported business services in manufacturing industries is less straightforward, as this is reported neither in the supply and use and input-output tables (which provide only information on total imported use by industry, as presented above) nor in WIOD (which, however, applies a 'row proportionality' assumption, which implies that there is no differentiation concerning the share of imports of specific service activities for particular industries). In Table 6.1, therefore, only the broad structures of service imports by intra- and extra-EU sources as a percentage of total imports based on balance-of-payment data are reported.

**Table 6.1 / Geographical structure of service imports as a percentage of total imports of this service category, 2011**

| | Germany | France | Denmark | Sweden | Czech Republic | Poland |
|---|---|---|---|---|---|---|
| | | | **Computer and information services** | | | |
| Intra-EU share | 67% | 92% | 76% | 76% | 67% | 75% |
| Extra-EU share | 33% | 8% | 24% | 24% | 33% | 25% |
| | | | **Research and development** | | | |
| Intra-EU share | 37% | 66% | 58% | 27% | 81% | 97% |
| Extra-EU share | 63% | 34% | 42% | 73% | 19% | 3% |
| | | | **Advertising and market research** | | | |
| Intra-EU share | 37% | 74% | 67% | 29% | 49% | 60% |
| Extra-EU share | 63% | 26% | 33% | 71% | 51% | 40% |
| | | | **Other business services** | | | |
| Intra-EU share | 56% | 71% | 60% | 40% | 67% | 62% |
| Extra-EU share | 44% | 29% | 40% | 60% | 33% | 38% |

*Source*: BoP statistics (WIOD); Ecorys calculations.

The most important points are that the Czech Republic and Poland rely more strongly on imports from other EU countries, which could largely be explained by FDI, particularly from other Member States. If FDI is of a vertical nature (consolidation across the supply chain), one would indeed expect trade in goods and services between the headquarter firm and the local affiliate to increase, i.e. there is a complementarity between FDI and foreign affiliates trade. Denmark and (particularly) Sweden rely relatively heavily on extra-EU sources).[53] The more detailed data indicate that inside the EU, the UK (and Ireland for computer services) supplies a significant share of PE services to all selected countries, whereas the top extra-EU trading partner – especially for R&D services – for most countries is the USA.

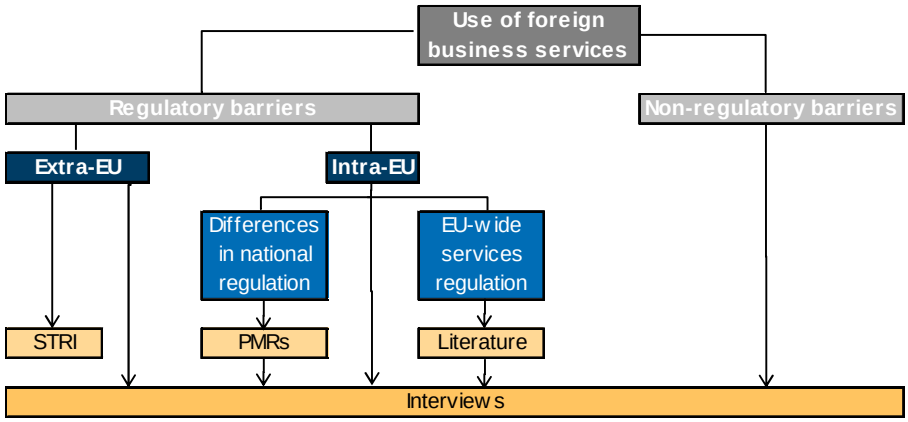
## 6.3. BARRIERS AND FRAMEWORK CONDITIONS IN SERVICES TRADE

The introductory section explained that many barriers to services trade (which can be influenced by policy) are of a regulatory nature. Part of the regulation potentially hindering services trade stems from the fact that some service markets are typically subject to 'natural' market failures. An example of such market failures is the information asymmetries that exist in the provision of professional services, where the 'quality' of the service is more difficult to judge from the outside than for a physical product. Much of this regulation is often national, and no binding regulation on services exists in an international context. This regulation does not have to be a barrier to services trade when it is effectively applied in a non-discriminatory manner; but unjustified regulation (not tackling market failures directly) or regulation

[53] In particular, US IT service providers command high market shares in Scandinavia. An interviewee reported that tough competition aggravates access to this region.

applied in a discriminatory manner often do exist, giving rise to difficulties for (foreign) service suppliers to enter a market or provide a service (Mustilli and Pelkmans, 2013). The enforcement of existing regulation plays an important role here; for example, regulation might *in theory* be well designed, but if implementation fails then the business environment can become more uncertain, thus hurting services trade. The difference between EU-level trade (intra-EU) and international-level trade (extra-EU) becomes important here, as the enforcement of effectively applied and non-discriminatory regulation is different at the two levels. The Treaty on the Functioning of the European Union provides for free movement and free establishment of services within the EU. Resulting regulation at the EU level (such as the Services Directive[54]) provide for the right to demand non-discriminatory access to a market. Outside the EU, international agreements such as the General Agreement on Trade in Services (GATS) do not encompass all countries in the world and are not as binding as EU regulation. Thus, the legislative framework for services trade within the EU is better able to address regulatory barriers to services trade. Still, a truly free and open market for services is not reached and might perhaps be impossible to reach due to the 'proximity' burden problem described at the start of the section. Recent evaluations of the implementation of the Services Directive show that the Directive indeed addresses sources of barriers to cross-border services trade within the EU, but that there are still gains to be achieved from better implemention of the Directive (Mustilli and Pelkmans, 2013; Monteagudo et al., 2012). Due to the differing regulatory 'tools' available at the intra-EU and the extra-EU level, we will differentiate between barriers that exist to intra-EU trade and barriers that exist to extra-EU trade in (performance-enhancing) services.

**Figure 6.2 / Schematic overview of approach**




*Notes*: STRI = Services Trade Restrictiveness Index; PMR = Product Market Regulation.

Building on the notion that barriers to services trade typically arise from regulation (differences in regulation, qualification requirements, etc.) and constitute behind-the-border trade measures, this section aims to explore the sources and nature of regulatory barriers to services trade (see the methodological scheme below). Since factors inhibiting the flow of services trade can arise from a wide variety of sources, we distinguish between the factors that are of a regulatory nature and the factors that are of a non-regulatory ('soft') nature. We aim to identify the significant factors from three perspectives. In order to identify regulatory factors, this section explores two publicly available databases that contain indicators on barriers that can inhibit trade in services and that aim to capture common sources of regulatory divergence between countries. The OECD-STRI aims to capture barriers to trade with

[54] Directive 2006/123

extra-EU partners,[55] and the OECD-Product Market Regulation indices, which reflect the restrictiveness of domestic regulatory environments, should capture differences in the regulatory regimes of Member States with regard to firm conduct and entry, since these differences can be a barrier to services trade within the EU. However, translating regulatory barriers into a comparable index across countries that aims to capture the effect of these 'barriers' to the business decisions of firms that trade in services is courageous, and will give only a rough estimation at best. Thus secondly, a review of the literature on EU regulation is conducted to identify the barriers to services trade that should already be tackled by EU regulation. Additionally, interviews and literature reviews were conducted to identify the regulatory factors and non-regulatory factors that are not captured by the databases or picked up in the literature. The interviews also serve as verification of the findings from the literature and the data.

### 6.3.1. BARRIERS TO IMPORT OF SERVICES FROM OUTSIDE THE EU

Factors that influence the import of services from partners outside the EU can take many forms. In a recent effort by the OECD, some regulations and measures that affect the trade in services have been mapped in the Services Trade Restrictiveness Index (STRI), which is a measure that quantifies the degree to which services are restricted for entry into a particular country by translating trade-restricting policies into an index. The STRI indices are defined by services industry and by country, and take a value from 0 to 1, where 0 is completely open to trade in services and 1 is completely closed. The index is based on the trade and investment regulations and policies currently in force with respect to import from outside the EU. The STRI distinguishes between five types of restrictions that potentially affect trade in services: (i) *Restrictions on foreign ownership and other market entry conditions,* (ii) *Restrictions on the movement of people,* (iii) *Other discriminatory measures and international standards,* (iv) *Barriers to competition and public ownership, and* (v) *Regulatory transparency and administrative requirements*.

**Table 6.2 / STRI scores**

| | Computer services | Engineering services | Architecture services | Mean |
|---|---|---|---|---|
| Czech Republic | 0.21 | 0.24 | 0.24 | 0.23 |
| Denmark | 0.10 | 0.07 | 0.08 | 0.08 |
| France | 0.12 | 0.10 | 0.19 | 0.14 |
| Germany | 0.08 | 0.17 | 0.17 | 0.14 |
| Poland | 0.11 | 0.46 | 0.47 | 0.35 |
| Sweden | 0.17 | 0.11 | 0.11 | 0.13 |

*Source*: OECD-STRI database.

The type and number of measures that a country has in place and that restrict trade in services will determine the overall restrictiveness score for a country, using a formula of weighing the different restrictions across the five groups. The STRI is defined for 18 different service industries. From these 18 industries, the following correspond to the definition of PE services, as adopted in this study, i.e. *architecture services, engineering services,*[56] *and computer services*[57] – listed in Table 6.2.

[55] The OECD STRI also includes data on barriers to services from EU countries, but all indicators included in the STRI should be covered by EU regulation, such as the Services Directive, and thus should mainly apply to extra-EU trading partners.

[56] Architecture and engineering services cover Architectural and engineering activities; technical testing and analysis (NACE rev. 2 category 71).

Unfortunately, no separate data on the restrictiveness of services trade are available for R&D services, which were shown to be the type of services mostly imported by manufacturing industries.

**BOX 6.1 / RESTRICTIONS ACCORDING TO STRI DATABASE**

***Labour market tests*** are needed in all countries (except for Sweden and the Czech Republic) and relate to the check by the authorities on whether similarly qualified domestic professionals are not able to provide the service. These tests thus often require the authorities to test the added value to the economy of the service provision in question. Particularly in the case of France, the gross salary for intra-corporate transferees from outside the EU should be at least 1.5 times the minimum wage in France (which might discourage the transfer of non-EU employees to France for low-wage jobs). Although it is not a labour market test in the proper definition, in Sweden the legislation for providing architectural or engineering services contains a clause that the vacancy needs to have been posted for at least 10 days in the European Economic Area (EEA), before it is opened up to outside EU markets. This is a clear barrier for service suppliers from outside the EU.

***Limitations on stays for service suppliers*** relate to the length of visas granted for service suppliers or the requirements to obtain a visa for these service suppliers. Limitations on stay are most stringent in the Czech Republic. For all three professions, the maximum stay is six months, after which a residence permit is needed. Worth noting is the restriction that German regulation introduces for contracted service suppliers in all three service sectors. For both architects and engineers, the theoretical limitation on stay is 36 months, though in practice the yearly admittance is zero according to the database, as the national regulation does not cover contractual service suppliers.

Regulations on the movement of people play a less important role in the ***computer services*** segment, but still make up the most important share of the total number of restrictions to computer services trade. Unlike architecture and engineering services, computer services can be traded across borders much more easily, via electronic networks. But cross-border services need to be supported by visits to the premises of the customer, with business travel for technical support and longer visits to work with clients – for instance on organisational reforms to maximise the benefit of new software. Two countries stand out in terms of additional regulatory barriers to engineers and architects. The first, Poland, has a nationality requirement for a licence to practise. Both engineers and architects need to be EU nationals or have proof of EU citizenship. The second country in this example, the Czech Republic, requires engineers and architects to possess permanent residency before a licence is granted. Moreover, the Czech Republic has a requirement that extra-EU suppliers must take a local examination before being accepted as a full member of the profession. As measured by the (time) costs to complete all official procedures and the number of procedures, regulatory transparency in the Czech Republic is ranked particularly low and thus acts as a barrier to service inputs for the architectural and engineering services. Some restrictions to foreign entry exist in the other countries, but the burden on services trade is relatively low.

[57] Computer services cover computer programming, consultancy and related activities and Information service activities (NACE rev. 2 categories 62 and 63).

On average, the largest barriers for extra-EU service providers in the six selected countries exist in Poland and the Czech Republic, which have scores of 0.35 and 0.23, respectively. The least restrictive country in this sample is Denmark, with a score of 0.08. A more detailed look at the data shows that the most restrictive conditions for the provision of extra-EU services in all selected countries fall in the category of 'restrictions on movement of people' (more than half of the total barrier for most countries and services). Particularly, *labour market tests* and *limitations on the duration of stay for services suppliers* can still be perceived as significant barriers in the selected countries. In the former category, France is rather strict, though Poland, Denmark and Germany are also relatively demanding. The Czech Republic stands out when it comes to the limitation on stay: only six-month visas are issued, after which the service supplier is required to apply for a residence permit. Moreover, a local, Czech, architecture or engineering examination needs to be passed in order to qualify for full membership of the professional association, which is often required for recognition of the services provided. Box 6.1 provides some more details by country and restriction.

### 6.3.2. EU LEGISLATION WITH RESPECT TO SERVICES

According to article 56 of the Treaty of the Functioning of the European Union (TFEU), free movement of services is one of the four freedoms of the EU. European policy is thus aimed at removing any barriers to the functioning of the internal market, allowing optimal use of imported services within the EU. Any barriers remaining to intra-EU trade may reduce the use of services, in particular PE services, thus limiting the possibilities for cooperation between services and manufacturing and negatively impacting on the growth and productivity potential resulting from this cooperation. Specifically, the Services Directive (Dir. 2006/123/EC) provides the legal framework that aims to abolish (most of) the restrictions on the provision of services between Member States. Combined with the Directive on the Recognition of Professional Qualifications (Dir. 2005/36/EC), the EU provides a regulatory framework that is conducive to the provision of services between Member States. This framework has been amended by Directive 2013/33/EU, to allow for changes in Member States' educational and training systems, though the Directive's transposition period for the Member States is still ongoing.[58] For services that are covered by the Services Directive, there should not be any additional requirements for foreign services suppliers, over and above those for national services suppliers. Any requirements placed on foreign suppliers should meet the principles of non-discrimination, necessity and proportionality,[59] thus ensuring the equal and fair treatment of foreign suppliers. Unless there is a direct threat to public policy, public health, public safety or the environment, Member States are not allowed to introduce barriers to certain services provided from other EU Member States. Most services included in the focus of this study are covered by the Services Directive (i.e. most business services, such as engineers, accountants, advertising and IT services fall under the Directive). Some of these services are provided by regulated professions.[60] Regulated professions are, in addition to the Services Directive, also covered by Directive 2005/36/EC, which deals with the recognition of professional qualifications. This Directive prescribes a general system in which the service provider only needs to show that s/he fulfils the requirements of the home Member State in order to be allowed to provide services in the host Member State. The Directive

[58] See http://ec.europa.eu/internal_market/qualifications/policy_developments/index_en.htm

[59] Art. 5 of the Treaty on the European Union (TEU) states, in the context of the principle of proportionality, that 'the content and form of Union action shall not exceed what is necessary to achieve the objectives of the Treaties'.

[60] A regulated profession is defined in Directive 2005/36/EC as a professional activity which requires specific professional qualifications, in particular the use of a professional title that is limited by national provisions in a Member State.

demands automatic recognition of professional qualifications for some professions (mostly medical professions and architects). Engineers do not enjoy automatic recognition, but they may qualify for the European Professional Card (EPC), which is part of the modernised Professional Qualifications Directive (as amended by Directive 2013/33/EU). This EPC aims to simplify the recognition procedure across borders.[61] Also, Title II of Directive 2005/36/EC allows service providers to supply their services abroad without a check of their professional qualifications if this occurs on a temporary or occasional basis (with the exception of the public health and safety sector).

In order to be effective, the Directives need to be properly implemented in national law and require compliance. Performance checks are conducted by Commission staff to see how the Directives are applied 'on the ground'. According to their performance checks, there remains a degree of incomplete or incorrect implementation of the Directives, resulting in differences between Member States in terms of their openness to intra-EU services trade.[62] Mustilli and Pelkmans (2013) found remaining barriers with respect to the removal of compulsory authorisation and entry registration. Some 11 sectors have restrictions remaining, despite the introduction of EU Directives. Moreover, the fact that in federal states these authorisation procedures may need to be repeated at the subnational level is another barrier. The requirement to notify the authorities of cross-border service provision is still prevalent in half of the Member States. The last set of restrictions remaining in a few Member States is a combination of 'other requirements', including requirements on certain equipment, insurance and ID cards for service providers who aim to supply their services across the border. Jointly, Commission calculations show that if all Member States implement the Services Directive correctly and completely, there would be a total economic benefit of 2.6% of GDP (Monteagudo et al., 2012). Corugedo and Ruiz (2014) argue that article 15 of the Services Directive gives Member States too much leeway in judging what national protective regulations could remain in place to protect the public interest. Their policy proposals include one for the transfer of competency from national governments to a (politically independent) national competition authority, set up to judge what is in the public interest. Greater cooperation between the national competition authorities would then allow a larger degree of conformity with the Directive and its aims.

### 6.3.3. DIFFERENCES IN NATIONAL REGULATION AS A SOURCE OF INTRA-EU SERVICE TRADE BARRIERS

As explained in the introduction, *differences* between Member States' regulations affecting the provision of business services to manufacturers could be another impediment to cross-border service provision. In particular, national regulation could form barriers to cross-border trade, for example if the requirements placed on the service providers in one country exceed the lower criteria applied in another. There exists EU-wide regulation specifically aimed at easing services trade, but its effectiveness depends on implementation. In this context, the analysis is extended by focusing on differences in national regulations for professional services more generally, insofar as they are not yet covered by European regulation. If national regulation indeed forms a barrier to cross-border trade, we would expect to see countries with a high level of national regulation importing fewer services than countries with lower levels of regulation.

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[61] Available at: http://ec.europa.eu/internal_market/qualifications/policy_developments/european_professional_card/index_en.htm

[62] Available at: http://ec.europa.eu/internal_market/services/services-dir/implementation/mutual_evaluation/index_en.htm

The Product Market Regulation (PMR) database of the OECD contains a comprehensive set of indicators measuring the restrictiveness of a country's regulatory regime. Specifically, the indicators for conduct and entry regulation could be informative in terms of the degree of regulatory 'difficulty' for foreign providers to supply services in that country, which would constitute an implicit barrier to trade. The indicators represent internationally comparable data on certain economy-wide and industry-specific economic and administrative regulations that affect product markets where competition is viable (Koske et al., 2015).[63] Economic regulation covers a wide range of restrictions and incentive mechanisms that affect market access, the use of inputs, output choices, pricing and international trade and investment. Administrative regulation covers the way in which the regulatory requirements are disseminated to the public, and also compliance procedures. The PMR indicators are complemented by a set of indicators that provide information not by regulatory domain, but by sector. The sector covered by the PMR that is relevant to this study is the professional services sector, which includes legal, accounting, engineering and architecture services.[64] The numerical value of the indicator represents the stringency of economic and administrative regulation on a scale from 0 to 6, with 0 indicating a policy environment that is deemed to be most conducive to competition.[65]

**Table 6.3 / PMR indices (2013)**

| | Accounting services | Legal services | Architecture services | Engineering services |
|---|---|---|---|---|
| Czech Republic | 2.4 | 3.3 | 2.1 | 1.7 |
| Denmark | 1.0 | 2.2 | 0.2 | 0.0 |
| France | 2.9 | 3.2 | 3.3 | 0.0 |
| Germany | 2.6 | 3.6 | 2.6 | 1.7 |
| Sweden | 1.6 | 0.6 | 0.0 | 0.0 |

*Source*: OECD.

Table 6.3 shows the overall PMR indicator for professional services, including a breakdown into accounting, legal, architecture and engineering services for the six countries analysed, with the exception of Poland, which is not covered by the PMR database.[66] Denmark and Sweden have the most conducive regulatory environment in professional services. Of the four professional services, accounting and legal services are the most heavily regulated in the selected countries (as indeed they are in the rest of the OECD countries). Engineering services are the least regulated: the scores for Denmark, France and Sweden are 0, implying that regulation in the sector is the least restrictive to competition (or not restriction exists at all). Box 6.2 provides more details on specific regulations pertaining to the selected business service sectors, resulting from a more detailed analysis of the different regulatory indicators available in the PMR database for the selected countries and sectors, where particular attention is paid to the indicators capturing discriminatory regulation (entry and conduct). Section 6.4.1 aims to link the general findings to the patterns of use of imported performance-enhancing services by the manufacturing industries in the selected countries.

63 The PMR indicators do not include other regulatory areas, such as environmental and health and safety regulations.

64 Other sectors covered in the database are retail distribution, network sector (telecoms, electricity, gas, post, rail, air passenger transport and road).

65 The value for a category of indicators is calculated as a simple average of the individual indicators.

66 All indicators show the values of the index that is calculated for the beginning of the year; thus they do not reflect reforms that took place later in the year.

## 6.4. LINKING BARRIERS TO SERVICES TRADE TO THE USE OF IMPORTED SERVICES BY EU MANUFACTURERS

Using the above findings, the framework introduced at the start of the section can now partially be filled in with findings on regulatory barriers captured by the PMRs and STRI and the literature on the EU-wide Services Directive. This allows us to make some preliminary comparisons between the use of imported performance-enhancing services by EU manufacturers and the restrictiveness of the surrounding regulatory framework. In the next section, the overall analysis will be completed by discussing the findings from the interviews with service representatives.

### 6.4.1. THE RESTRICTIVENESS OF THE OVERALL NATIONAL REGULATORY FRAMEWORK AND SERVICES TRADE

In general, literature specifically dealing with barriers to the import of performance-enhancing services by manufacturers is scarce, but the impact of regulation as quantified in the STRI and the PMRs on cross-border services is more commonly investigated. Recently, van Der Marel and Shepherd (2013) measured the impact of regulation on cross-border services trade at the sectoral level. They found that policy barriers, as measured by the overall Services Trade Restrictiveness Index for each sector, have a negative and significant effect on total services trade, as well as trade in business and financial services. Restrictions of national rules, as presented by the PMR measure, are found to have a negative impact on trade in all sectors, except wholesale and retail trade.

Our analysis using STRI and PMR data focused both on examining the source data on which the STRI and PMR indicators are built, in order to identify which specific individual policies might have a trade-inhibiting effect, and on analysing whether the overall regulatory restrictiveness levels (as measured by the overall STRI and PMR scores) can explain the degree to which imported business services are used by manufacturers.

For Poland and the Czech Republic, which both display a high share of intra-EU services sourcing (more than 60% of other business services imports from intra-EU sources), the STRI indicates specific restrictions on engineers and architects from extra-EU service providers. Poland applies (EU) nationality requirements to professionals who wish to provide such services in Poland, so that service providers from outside the EU (who do not enjoy the advantages provided by EU-wide legislation) might – all other things being equal – face a competitive disadvantage. In the Czech Republic, several procedures for extra-EU professionals are required before they are able to supply services in the country (such as residency requirements and the need for a qualification test). Sweden is characterised by a low regulatory burden for extra-EU suppliers (the STRI index is one of the lowest for all three services considered) and a relaxed general regulatory environment (the PMR showed only some light restrictions on accounting services). Sweden also displays a high use of imported services, with imports from extra-EU partners often dominating. The generally lax regulatory environment (and unregulated architect and legal professions) could play a role in attracting extra-EU services provision to Sweden. On the other hand, the pattern of use of imported services in France shows that nearly all French manufacturing industries largely rely on domestic services provision (except for R&D, but that is not covered by the STRI or PMR). The STRI analysis shows that, for the three services reviewed, the most significant barrier concerns the salary requirements for intra-corporate transferees from outside the EU; however, as WIOD does not pick up intra-firm services provision, this cannot be correlated to the low import shares observed for France. On the intra-EU side, the PMR analysis shows that French regulations

mostly place restrictions on entry requirements. A closer look at the nature of the barriers identified reveals that most should be tackled by the Services Directive. At the same time, however, French manufacturing industries use relatively few foreign business services, whereas the PMR and STRI for France do not show any particular barriers inhibiting trade. It should, however, not be forgotten that demand preferences and the structures of the local industries strongly determine the need for (imported) performance-enhancing services (see also Section 5), and thus also the real extent to which the factors captured by the STRI or PMR form a prohibitive barrier to manufacturers in these countries accessing foreign services.

**BOX 6.2 / A DETAILED LOOK AT PMR**

With respect to *regulatory barriers in professional services*, Germany scores a bit higher than the other countries, while Sweden scores much lower. Denmark has the least restrictive regulatory environment for **accounting services**, while France, by contrast, has the most restrictive environment for accounting and architecture services. Entry regulations in accounting services are mainly to be found in France, Germany and the Czech Republic, and to a lesser extent in Sweden and Denmark. A similar pattern is observed in conduct regulation, though the scores are considerably lower. In **legal services**, Germany and Sweden have the highest and the lowest scores, respectively, among the selected countries – i.e. they have the most and the least restrictive regulatory environment, respectively. While in terms of conduct regulation, the Czech Republic has the most restrictive environment. In addition, in **engineering services**, the Czech Republic and Germany have the highest scores on the PMR indicator, while the other countries under investigation have a less restrictive regulatory environment. Denmark, Sweden and France have the least restrictions on engineering services. The Czech Republic imposes only entry regulations: exclusive rights, education requirements and compulsory chamber membership. Germany has both entry and conduct regulation in the areas of exclusive rights, education requirements, fees and prices and advertising.

Turning to the specific indicators, it can be observed that there is a similarity in terms of the categories that erect most regulatory barriers, namely **entry regulation** (with the exception of Sweden, where entry regulation is present only in accounting services). Among the different types of entry regulation, the most prevalent is the regulation concerning the exclusivity of rights and compulsory chamber membership. For all the countries analysed there are no quotas, and thus there were no restrictions on the number of foreign professionals permitted to practise in professional services in 2013.[67] **Entry regulation** is again the least restrictive to competition in Sweden, followed by Denmark. The Czech Republic, France and Germany impose regulations on exclusive rights and compulsory chamber membership; thus those countries are the most restrictive in these areas.

In terms of **conduct regulation**, regulations on the form of business and on prices and fees are less common in professional services, and are mostly present in legal services. In Denmark, only conduct regulations are imposed on legal services, while in Germany conduct regulation is present in all professional services. In terms of **conduct regulation**, the Czech Republic, Denmark and Sweden are the countries with the lowest scores, meaning that they have the most conducive environments to competition. Germany has the most restrictions on prices and fees.

[67] There were restrictions on the number of foreign professionals practising professional services (accounting, legal, architecture and engineering) in Germany in 1998.

At a more general level, analysis of the correlation between the share of imported performance-enhancing services used by EU manufacturing industries and the overall height of the STRI (for extra-EU imports) and the PMRs (for intra-EU imports) finds that there is no overall systematic relationship. For the imports from extra-EU partners, we find that both high and low overall STRI scores correspond to identical import shares, while equally high indices correspond to sometimes large differences in import shares. For the import of performance-enhancing services from countries within the EU, the size of the PMRs in selected countries did not correlate with the size of the import shares of PE services in manufacturing. Only national regulation of conduct (see Box 6.2) seemed to correspond with levels of services import from other EU Member States. Since even the presence of correlation cannot be used to argue that a causal relationship exists between two variables, we are not able to draw any meaningful conclusions about the overall relation between the (potentially inhibiting) regulatory aspects captured by the STRI and the PMRs and the degree to which foreign services can be imported by countries. This might not be surprising, as the introduction to this section explained that regulatory barriers to services trade are numerous and that the STRI and PMRs at best capture only a fraction of the plethora of potential barriers. Also, the overall PMRs and STRI scores are constructed in such a way that a potentially very burdensome regulatory barrier to services trade might exist in one particular category, but if no particularly restrictive policies are found in the remaining categories, then the overall index might still be relatively low. It is also important to recall the discussion of how the tradability of services and location factors influence the preferred mode of entry by a service provider into a foreign market and how, in turn, the different modes of service provision are affected by different (regulatory) framework conditions. The data available to measure the shares of intra- and extra-EU imports only cover the Mode 1 (cross-border trade) and – to some extent – Mode 2 (consumption abroad) categories of foreign service provision. Performance-enhancing services, however, often fulfil many of the characteristics that encourage supply of the service through a commercial presence (as discussed in the introduction and confirmed by interviews, see Section 6.4), i.e. Mode 3 type of trade in services. Measuring the use of imported business services (at a distance, Mode 1) might thus exclude a large share of foreign business services. In addition, most of the barriers to performance-enhancing services trade that are identified from the PMR and STRI databases relate to restrictions on the movement of people, which directly relates to the Mode 4 type of service provision.

In order to identify the type of regulatory or non-regulatory barriers that are not captured by the indices, but that could play a significant role in influencing (PE) services provision to EU manufacturers, additional interviews with representatives from manufacturing and services suppliers were conducted.

### 6.4.2. REGULATORY AND NON-REGULATORY BARRIERS FROM THE PERSPECTIVE OF INDUSTRY

Overall, the findings from interviews both with service providers and with manufacturers sourcing business services reveal that non-regulatory barriers (capturing ‘soft’ factors) play an important role in influencing cross-border provision of business services in EU Member States. The factors relating to cultural and linguistic differences, trust and control, and an understanding of the local business environment seem very important in determining the extent to which EU manufacturers use foreign performance-enhancing services. They also have a strong influence on the way in which performance-enhancing services are provided abroad. Moreover, the interviews also find some specific regulatory factors to be inhibiting cross-border services trade in particular sectors.

## FROM THE MANUFACTURING POINT OF VIEW: PROCUREMENT OF CROSS-BORDER SERVICES

Problems with manufacturing companies' access to business services, whether from domestic or foreign suppliers, was not highlighted as a problem by representatives of industry associations and manufacturing companies; this topic has been discussed in particular with representatives of smaller economies. At the same time, it was mentioned that the lack of perceived problems could reflect a broader lack of knowledge of the possible advantages of seeking out foreign supply. Moreover, interviewees from the manufacturing sector even underscored the fact that if there are difficulties in cross-border services supply, then it would be the responsibility of foreign services providers to overcome these difficulties, rather than the responsibility of their clients. To this end it is not surprising that no evidence was highlighted during the interviews.

Additionally, the lack of perceived hindrances to the cross-border supply of services might be caused by the fact that in particular the more sophisticated business services require close communication, in a broader sense, between the client and its service provider. For less complex services, such as transport and warehousing, different languages do not impede cross-border activities. But difficulties were reported by interviewees with expertise in IT services, where linguistic skills are critical to the success of service projects, such as the implementation of IT systems. Proper mutual understanding is indispensable for project definition and execution. Moreover, social skills and cultural specifics have to be considered – in particular in the direct contact providers have with the employees concerned to create the necessary mutual trust. To this end, software houses run their own subsidiaries in important sales markets or co-operate with small IT firms in target markets. The employment of native speakers seems to be indispensable, at least for the direct and permanent contact with a foreign company in the field of IT services.

## FROM THE MANUFACTURING POINT OF VIEW: SERVICES PROVIDED BY MANUFACTURERS CROSS-BORDER (SERVITISATION)

It might have been expected that the interviews with manufacturers would have shed light on their own experience of impediments to the cross-border provision of services. However, there was not much evidence of impediments reported by interviewees. The German machinery association, which is aware of possible hindrances, has not yet received much evidence. Only the free movement of workers is sometimes delayed by intra-EU administrative provisions. In several Member States (Sweden, Belgium, Luxembourg, Estonia, Austria) the registration of foreign employees working is obligatory, if the tasks exceed a certain number of days. For Sweden, initially problems were reported concerning a revised online registration procedure. Problems were mentioned only in the case of Switzerland which is not part of the EU. Registration is frequently related to the enforcement of Member States' minimum wage regulations. Other problems arise from different legal provisions (Member States' provisions on safety in the workplace, health and environment) and from a lack of knowledge of the regulations.

## FROM THE SERVICES POINT OF VIEW: PROVISION OF PERFORMANCE-ENHANCING SERVICES TO EU MANUFACTURERS

As mentioned at the start of the section, trading services across borders (as compared to trading goods across borders) suffers from the 'proximity burden': services often need to be provided jointly with the client (e.g. 'co-creation' and 'co-production') and require the kind of interaction and exchange between client and contractor that make such 'soft' factors as culture, language and habits a large natural barrier. Interviews[68] revealed that knowledge about the client and the local market (regulatory environment, the particular business environment in which the services are to be provided, culture, etc.) have a strong influence on the provision of most PE services. We can conclude that on average for PE services, the proximity burden is heavy. The need for interaction in the same language, understanding of the culture and close interaction with the client has resulted in the dominant mode for PE service provision abroad to be through local affiliates (Mode 3). This particularly holds for the professional services (architects, engineers, designers) and advertising and marketing services. Only more 'standardised' service products (or products that lend themselves to codification, such as software development) or simpler industrial design activities are more often provided at a distance – increasingly from low-wage countries outside the EU (as a result of the location advantages trade-off discussed earlier). Secondly, the need for knowledge of the local business environment and regulations gives rise to a large source of barriers to services trade stemming from *differences in national regulation* between the host country of the service provider and the destination country of services provision. Particularly in the case of services provided to manufacturers, it is not only the regulatory environment surrounding the trade in services that matters, but also the regulatory environment surrounding the final products created by manufacturers. In the industrial design sector, for example, the sketches might need to take into account local requirements (which could be local market requirements, e.g. due to differences in consumer preferences, and regulatory barriers). The larger the difference in such local requirements, the more local knowledge of the market is needed; this in turn increases the costs of exporting or gives rise to the need to establish a local office. Lastly, due to the knowledge-intensive nature of PE services, differences in training and educational systems across Member States (or between EU and non-EU countries) increases uncertainty surrounding the quality of services offered from foreign regions to a manufacturer in a particular country. An important difference between extra-EU service providers and intra-EU service providers still exists, as the EU addresses many of the above issues through the Directive on Recognition of Professional Qualifications, the Services Directive and the general alignment of the educational systems (Bologna Process). The findings from interviews show that, generally speaking, these regulatory measures are relatively effective at addressing the source of the problem, but that further improvement is possible with respect to their implementation.

The specific regulatory and non-regulatory barriers that were identified in the interviews differed by the type of performance-enhancing service. For the provision of **advertising, marketing and communication services** within the EU, service providers still face differentiated legislation across Member States, and this is the greatest source of uncertainty – and thus the greatest impediment to services trade. This does not concern regulations covering services provision *per se*, but rather the goods and products for which the advertising and communication services are used (an indirect barrier). For example, differences exist in national regulations governing the advertising of products such as alcoholic beverages and food, while there may also be different approaches and sensitivities concerning

[68] With representatives from the advertising, communication, marketing, industrial design, engineering consultancy, architects and computer services sectors.

things such as gender issues or children. These different rules are known, and so they do not constitute a large barrier; but they can still hinder the free provision of services. Advertising and communication service providers from outside the EU are not regarded as strong competition to European service providers.

In the **industrial design sector**, there is generally little cross-border provision of services, even though some design-related activities are quite conducive to exports, since they can often be provided via electronic platforms. For the Dutch and Polish industrial design industries, for example, domestic clients are most important by far (in the Netherlands, exports represent 8% of total revenue). If a cross-border element is present in their sales, then it is usually catered for through subsidiaries (branches) in the targeted country. The introduction of the Services Directive seemingly had little effect on international trade flows because of this dominant mode of services provision. The small effect of regulation is also confirmed by the perception that the most important trade barrier for Sweden and Denmark is the strong domestic competition (strong design community and local preferences); while for Germany and France the main barriers are language and culture (combined with a large local design industry). Specifically regarding the use of industrial designers in the transport equipment sector in Poland, those manufacturers that use foreign design services are larger companies that source the services mostly from within the EU, and do so either because of historic relations with a particular partner country or because of personal relationships with the management in foreign countries. The most important barriers experienced in the design sector and that are associated with the regulatory environment concern the risk of non-payment (and the repatriation of payments) and tax compliance issues. For non-European design service providers, the situation is quite similar to that of European providers, with the potential addition of a (non-trade) barrier in the form of language needs.

In the **engineering and architecture services** sector two main issues emerge regarding the cross-border provision of services in the EU. The first concerns the regulated nature of the professions in many countries and the concomitant uncertainty surrounding the guarantee of quality of supply and recognition of qualifications. Even in the absence of trade barriers, manufacturers might still often prefer local professionals, due to a lack of trust in the quality of foreign services provision; for example, this may arise from differences in qualifications or education systems. In the EU, the Directive on Recognition of Professional Qualifications provides the right (non-discriminatory) legal environment for architects (automatic recognition once the minimum training requirements are met). However, the administrative burden can often be considered high, especially for engineers, whose qualifications are not automatically recognised. As a result, private initiatives from engineering industry associations have emerged to provide mutually recognised professional cards (recognising credentials) or a recognised engineering title. This facilitates the application of EU-wide regulation and might place extra-EU professionals at a disadvantage. Secondly, the issue of insuring projects was mentioned as a significant barrier to doing business abroad. In the worst case, foreign engineering service providers could find themselves trapped in a vicious circle, whereby winning a project abroad requires showing insurance cover for that particular potential project, but where local insurance cover is only available to foreign service providers that have already won the project. The engineering firm could turn to a domestic insurance provider for foreign cover, but will often be charged a premium for the extra risk associated with a project undertaken in an environment with which the domestic insurance provider is less familiar (and where the culture of claiming could be different). These extra costs for insurance cover could place a foreign services provider at a competitive disadvantage compared to a domestic service provider.

Regarding **computer (-related) services**, it would appear from interviews that, compared to other PE business services, on average more services are provided cross-border without the need for a local affiliate. Non-trade-related barriers, such as language and culture, are believed to become less important due to the increasing sophistication of software. The most dominant barrier to cross-border provision of services was found to be differing regulations on data protection and privacy, and local rules governing local data processing or storage centres, which increase the cost of exporting services. Streamlining regulation on this matter would help. The (temporary) movement of persons is crucial for many IT projects where experts are needed on the ground to install systems. Within the EU, according to the findings from STRI, some restrictive measures remain on the movement of certain Eastern European nationals, as well as on non-EU nationals who have migrated to the EU for work. EU employers also incur a larger administrative burden when they send these experts to work temporarily in other EU countries, since they do not automatically enjoy the benefits of EU regulation on the free movement of people. Furthermore, temporary travel within the EU might be burdensome and could act as a barrier to services provision abroad. A medium-sized German IT service provider with a European-wide distribution network also mentioned that linguistic skills are crucial to the success of projects that are concerned with more traditional types of computer services activities (IT interface or network design). On a national basis, it has been reported that markets in Scandinavian countries are subject to strong competition from US services providers, while access to the French market is difficult due to the strong preference of French companies for domestic service suppliers, so that local representation alone is not seen as sufficient to access the market. It appears that the French situation applies to smaller and larger firms, both of which are more inclined to use domestic suppliers. This finding is in line with the patterns observed in the data (Section 6.2) that most performance-enhancing services in France are provided by domestic suppliers. Another interviewee – a representative of an ESP – highlighted the fact that in individual cases the procurement provisions of large manufacturers are designed to discriminate against foreign suppliers.

## 6.5. SUMMARY

Following on from the empirical finding of a positive relationship between the use of foreign business service inputs and manufacturing performance, the aim of this section has been to explore whether there is any observable correspondence between patterns of use of foreign (imported) performance-enhancing business services and corresponding regulatory environments. In keeping with the approach of the study, the analysis has focused on a limited set of countries and manufacturing sectors. For this sample, two databases that include indicators on the regulatory restrictiveness of the business environment for professional services (PMR) and on discriminatory regulation for foreign services providers (STRI) were examined. Moreover, a short review of the (functioning of) EU-wide legislation affecting services trade was conducted. The ‘bottom-line’ conclusion from the analysis using PMRs and STRI is that there is no evidence of cross-country patterns in the use of foreign performance-enhancing business services that would suggest a systematic relationship between the size of the indices and patterns of foreign services use. This conclusion does not imply that regulatory frameworks are unimportant when it comes to trade in services. On the contrary, a number of limitations both surrounding the construction of the indices and surrounding the data that measure the use of foreign services in manufacturing affect the analysis. An examination of some of the underlying source data on which the indicators are built suggests that some Member States can still tackle lingering discriminatory legislation, particularly with respect to extra-EU service providers. Moreover, this is also in line with the

finding by Ecorys (2011) that differences in regulatory regimes are significant determinants of trade in services between Member States.

Additional interviews conducted with industry also found that some specific regulatory barriers still exist across different performance-enhancing service categories. The introductory section explained that certain characteristics of services define the 'tradability' of a service, which in turn strongly drives the entry strategy of a foreign services provider into a particular market (i.e. through exporting or through FDI). The importance of a local presence for the professional services under consideration in this study tends to favour the provision of services through local affiliates. Results from the interviews confirmed that proximity requirements (e.g. the need for a local presence) and 'soft' factors (e.g. linguistic and cultural differences) are very important determinants that influence the provision of performance-enhancing services to EU manufacturers and that drive foreign service suppliers generally to enter foreign markets not through direct exports, but through investment in affiliates. These findings suggest that, as well as any additional efforts to strengthen legislative frameworks (and improve their implementation), further enhancing the international dimension of inter-linkages between industry and services may best be supported through policy initiatives that target 'soft' factors within both services and industry (such as differences in language, recognition of qualifications, or better information/understanding about local regulatory environments). Not all of these can be tackled by policy (such as language), but some can be alleviated, such as the recognition of qualifications. Monitoring of correct implementation and enforcement is key here as well. Lastly, in the context of service–manufacturing linkages, policy efforts should be targeted at removing barriers to entry and investment by foreign services providers – the dominant mode of foreign services provision for the knowledge-intensive business services that were the focus of this study.

# 7. Summary of main findings

This study focuses on the interaction between manufacturing and services and – in particular – the way the latter contribute to productivity and value creation in the former. First and foremost, interest in this subject is triggered by the fact that the share of manufacturing in most industrialised economies in the world is declining, whereas the share of services – and business-related services in particular – is rising. This pattern is observed for the EU as a whole, although there is not a homogeneous development across European countries: some countries have faced rather strong declines in their manufacturing shares, whereas other countries have succeeded in keeping their shares more or less constant. Second, there is the question of the extent to which both industries are dependent on each other, with the focus in this study being on the manufacturing sector as a user of activities provided by the (business) services industries. To the extent that this is the case, manufacturing plays an important 'carrier function' of services, as a share of the value of output (and therefore also exports) produced in manufacturing embodies value added created in services. As a consequence, countries facing a declining share of manufacturing might still provide inputs to manufacturing activities at home or abroad via the provision of services. One question is, therefore, to what extent the specialisation in business service activities – and particularly business services related to manufacturing – has compensated for the loss in manufacturing activities. Third, given the differentiated specialisation patterns within Europe – with a set of countries keeping a stronghold in manufacturing industries, whereas others are specialising in the provision of related services – an important issue is the role of cross-border flows of services and the patterns of outsourcing and offshoring of such activities across Europe.

This study first sketches the complexity and multifaceted dimensions of the issue of manufacturing–services interaction and the role that services and services performance play, first, within manufacturing industries, within service sectors and, in particular, at the interface between the manufacturing and the services industry. This is best seen when considering a manufacturing activity – i.e. the provision of a manufacturing final product – in terms of its underlying value chain. From this perspective, services can be categorised relative to their position in the value chain as (i) upstream (development) services, including activities such as R&D and design; (ii) core (production) services, including supply management, production and process engineering and other technical services; and (iii) downstream (market) services, which are also manifestations of the 'servitisation' of manufactured products through which firms increasingly tend to supply hybrid goods and service combinations or services solutions, rather than just supplying the physical goods as such. The important point is that industry–service interactions occur throughout the value chain and that at each stage potential choices exist in terms of (i) whether to provide services 'in-house' or to 'buy in' services from an external service provider, and (ii) in the latter case, whether to source services locally, i.e. domestically, or from a foreign supplier. These decisions can be influenced by prevailing framework conditions at all levels.

The first sections of the study are based on available quantitative indicators – most of them from input-output data – allowing one to study the relative importance of the manufacturing–services interaction, differences across countries, industries and services activities, and the respective changes over time. Sections 5 and 6 highlight important dimensions of services use in manufacturing and issues related to

services trade in that respect for selected industries and countries, incorporating both quantitative and qualitative insights.

## 7.1. PERFORMANCE OF MANUFACTURING AND SERVICES AND THEIR INTER-LINKAGES

The first specific aim of the study is to quantify the magnitudes and patterns of interactions between manufacturing and services, focusing on service activities which are bought in from manufacturing industries, particularly in relation to performance-related business services, such as advertising, R&D, engineering, etc.

### 7.1.1. RELATIVE PERFORMANCE OF MANUFACTURING AND SERVICES AND PATTERNS OF SPECIALISATION

Before delving into the details of the inter-linkages between manufacturing and services, the report provides an overview of performance indicators, by first considering the evolution of manufacturing and services categories as a proportion of GDP. The share of manufacturing in total GDP declined from 20% to slightly less than 16% in the EU-27 over the period 1995–2011, compared to a decline from 15.5% to 12.3% in the United States. By contrast, the share of business services increased in the EU-27 over the same period from 14.3% to 18% (for comparison, the US experienced an increase from 18% to 23%), with the share of other services categories remaining relatively stable. Similar trends can be observed for individual EU Member States, with the manufacturing share declining in most countries, though the magnitude varies widely across countries. The share of business services has increased in most countries. However, the relative pattern of development points to the emergence of a 'European manufacturing core' based around Germany and including countries such as Austria, the Czech Republic, Hungary and the Slovak Republic; there is another group of countries – 'business services leaders' – which have succeeded in specialising in service activities (e.g. the UK, the Netherlands and Belgium); and there is a third group of countries that fall into neither of these categories. As a consequence, as compared to the mid-1990s, the European economic landscape nowadays looks much more differentiated with respect to specialisation patterns in manufacturing and services.

A second set of performance indicators which were looked at are productivity growth and unit labour cost dynamics. There has been a rather diverse pattern of relative productivity developments across countries in both the manufacturing and the business service sectors. By contrast, the growth rates of wages across sectors are far more similar within countries. As a consequence, this gives rise to a 'dynamic Ricardian specialisation'[69] pattern: the specialisation pattern within the EU mentioned above – with some countries specialising in business services, while others keep a relatively high share of manufacturing in GDP – can to a certain extent be explained by relative differences in productivity growth in manufacturing and services and wage drift across sectors. Other factors, such as agglomeration and scale effects, FDI patterns and the evolution of production linkages, are likely to play an additional role in both manufacturing and service activities. These patterns underpin the increasing

[69] A Ricardian specialisation pattern is determined by relative productivity differences across countries and sectors, with wages across sectors being equalised. Analogously, a dynamic Ricardian specialisation arises due to differential growth rates of productivities while wage growth rates are similar.

need for cross-border flows of services within Europe, particularly so for those smaller countries that have maintained a significant share in manufacturing activities.

### 7.1.2. MANUFACTURING–SERVICES LINKAGES

Analysing the mutual dependence of manufacturing and services has been the particular focus of this study. A first aim was to assess the magnitude of these interactions and the respective changes over time. A number of indicators have been presented which are summarised as follows.

The first indicator considered is the role and magnitude of **secondary production** of services in manufacturing industries, i.e. those services which are sold to the market additionally to the main product.[70] For the EU-27, about 4% of manufacturing gross output is due to secondary services production, although there is a wide range – from 10% to less than 2% – across countries. Within services use, distribution and business services account for the bulk of the secondary production of manufacturing industries. Over time there has been a slight increase in these shares, which is particularly pronounced in Sweden and Finland. On the opposite side, the share of secondary production of manufactured products in services industries is on average less than 1%, with a slight decline since 1995. Only a few countries report larger shares. These numbers do not, however, capture the role of services provided in combination with the delivered product.

The second indicator considered is the **direct cost share** of service inputs in manufacturing industries, with a special focus on the role of business services. Overall, in the EU-27, services accounted for about 25% of total costs in manufacturing (i.e. including value-added costs) in 2011. This share had increased only slightly since 1995. There are some differences across countries, with shares at the lower end being about 15%, which is the case for most of the East European countries. Significantly higher shares are only observed for Ireland, which experienced a rather strong increase from 1995. Only a few countries have experienced significant changes over time. Differentiating by service categories shows that distribution (with about 12%) and business services (with about 9%) are the most important service inputs on average. Across countries, larger shares of business services correlate with a larger overall share of services use in manufacturing industries in most cases, particularly in Ireland, Sweden, France and the Netherlands. The share of business services is also the most dynamic component over time in the majority of countries.

Looking into the more detailed structure of business services, the item Other business services (NACE Rev. 1 CPA 74) accounts for the bulk of business service inputs (in the EU-27, 5.6%, compared to 8.8% of the total direct cost share of business services). The new NACE/CPA classification allows one to split this heterogeneous category into a more detailed structure: about 30% of the costs of other business services (about 2% in terms of gross output) is made up by legal and accounting activities; about 13% (0.8% in terms of gross output) by architectural and engineering activities; 16% (0.9% in terms of gross output) by advertising and market research; and 4.1% (0.2% in terms of gross output) by other professional and scientific activities. Of the remaining performance-related business services, about

[70] These are products which are sold in addition to the company's main product on the market, and can include maintenance and repair services, business advisory, pre-sales and sales services. In the input-output framework, these include subsidiary products, by-products and joint products. It should be emphasised that this indicator does not fully capture the role of 'servitisation of manufactured products', i.e. other services supplied with the particular manufactured products.

0.6% of gross output is for computer programming, etc. and 1.1% for scientific research and development. This last category – scientific research and development – is compared to other countries particularly important as a cost share of inputs in manufacturing in Finland, Ireland, Sweden, France and the Netherlands. The direct cost share of manufacturing inputs in services production is generally low, on average 2%. Here one has to consider, however, that manufacturing plays an important role in delivering investment goods supporting the provision of output in the services sector. Input-output data do not identify the costs of capital formation, which means that use of manufactured goods by services is underestimated.

Related to the overall direct cost share of services in manufacturing production is the **share of imported services** in the overall cost of production, which – as mentioned above – is likely to become more important, given the diverse specialisation patterns in Europe. The cost share of imported services in manufacturing gross output is, on average, about 2%, with some countries (such as Luxembourg, the Netherlands, Finland and Sweden) having a share of more than 4%, and Hungary, Denmark, Austria, Belgium and Malta more than 3%, with smaller and Central and Eastern European countries experiencing higher import intensities. These patterns and shares are dominated by imports of businesses services, which account for about 50% of service imports. The largest parts of these are due to imports in the category Other business services (CPA 74). Despite a positive relationship between the overall share of (business) services used in manufacturing and the imported share in gross output, the import intensity, i.e. the share of imported business services in total buy-in of business services, is negatively correlated with the overall buy-in. This pattern is mostly driven by country size, as most of the smaller countries tend to have a lower share of business services in manufacturing output, together with relatively larger imports. Within the category of business services, the most important items imported for use in manufacturing are scientific research and development and legal and accounting activities, followed by advertising and market research according to NACE/CPA Rev. 2 classification, though there is again a wide heterogeneity across countries.

The use of other industries' outputs as a means of production (which enters as an intermediary input and therefore a cost item in the producing industry) that is then further used as an intermediate input in the production stages in other industries implies that industries' outputs – and in particular outputs from services – are directly and indirectly used in other industries. These **direct and indirect production linkages** are captured in this study by an indicator of backward linkages (which is closely related to the multiplier concept in input-output literature) that focuses on services, and business services in particular. Focusing on business services, larger countries tend to have larger backward linkages, which are mostly domestically oriented. In particular, France has the largest domestic backward linkages in business services. In the smaller countries (including the Eastern European countries) these domestic linkages are smaller, and foreign linkages therefore play a more important role. These linkages have generally increased over time, though at a slow pace, with domestic increases dominating in a few countries only.

Therefore, as services are used in the production processes of a manufactured product, the value of a final manufactured product embodies directly and indirectly value added, created in services to a large extent. This **domestic and foreign services content of manufactured products** can make up a large proportion of manufacturing output, underpinning the relevance of the services sector for manufacturing production – or, vice versa, the role of manufacturing as having a 'carrier function' for (business) services: services account for slightly less than 40% of the value of a final manufactured product in the EU-27 as a whole, where the bulk stems from distribution services and business services (about 15%

each). This share is larger than in the US, mostly due to differences in the share of distribution services (a potential reason for that could be that distribution and retailing depends on Member States' specifics). Across EU countries, the share ranges from more than 40% in France and Ireland to less than 30% in Greece, Malta and Romania. The largest part of these differences is due to differences in the direct and indirect value-added content of business services, in line with the findings concerning direct cost share. Over time, this share has increased, mostly due to a change in the respective content of business services, confirming the results already found when considering direct cost share.

## 7.2. MANUFACTURING–SERVICES INTERACTION AND MANUFACTURING PERFORMANCE

Based on these indicators, the next part of the study focused on the issue of whether increased linkages have an impact on the performance of manufacturing industries and on the potential determinants of these linkages across industries and countries. Based on the results of Section 2, a distinct econometric exercise was undertaken with the aim of revealing the importance of manufacturing service linkages to manufacturing performance. This exercise considered the productivity effects of interactions between manufacturing and services across countries and industries. When considering the impacts of backward linkages of manufacturing with business services on the growth rate of labour productivity in manufacturing for all EU-27 countries, significantly positive effects are found for foreign linkages only. A similar result holds when the sample is split into the EU-15 and EU-12. This result is, however, qualified when the sample is split by country size: for the larger economies, only domestic backward linkages impact positively on labour productivity growth in manufacturing, whereas for the smaller countries only foreign backward linkages matter. This result is in line with the fact (from Section 2) that foreign business services are relatively more important for smaller countries. When the sample is split by the technology intensity of industries, it turns out that the positive effect of foreign backward linkages with business services holds only for medium-high- and high-tech industries.

## 7.3. SERVICES IN THE MANUFACTURING VALUE CHAIN

The fact that manufacturing output (measured either in terms of final goods produced or in terms of exports) embodies value added created in services may imply that 'manufacturing' has to be defined in a broader sense, namely by considering all activities related to the production of manufactured final products as part of the 'manufacturing value chain'. This approach is reported as the **manufacturing value chain approach** and calculates (by means of input-output analysis) all value added generated in a particular economy which contributes to world-wide final demand for manufactured products. This measure accounts for service activities which are – together with the core manufacturing activity – provided in-house by a manufacturing firm, and also service activities which are outsourced to a domestic service provider as part of the manufacturing value chain of the particular country. Furthermore, service activities undertaken in a particular economy which contribute to the manufacturing process in other countries, too, are accounted for as being part of the manufacturing value chain of the country under consideration.

For the EU-27 as a whole, this perspective reveals that in 2011 some 22% of value added generated in the EU was due to contribution to the world final demand for manufactured products (the 'value chain perspective'), which compares with about 16% when considering the share of manufacturing in the

EU-27 (the 'classical industry perspective'). Over time, this share – as with the share of manufacturing in GDP – declined from more than 25% in 1995 to the above-mentioned 22%. Within the manufacturing value chain, about 40% of value added is contributed by service activities (a figure more or less in line with the services content of manufacturing mentioned above), slightly more than 50% by manufacturing industries, and less than 10% by the remaining industries. Over time, the share of the manufacturing contribution has declined, whereas the share of business services and distribution services has increased – the former (business services) from about 11% to 16%, and the latter (distribution) from about 13% to 15%.

Across EU Member States, these value chain shares correlate positively with the share of manufacturing in GDP. From a dynamic perspective, countries which lost their share of manufacturing value added in GDP could however only partly compensate for this loss in the manufacturing value chain by providing corresponding business services. The results indicate that an increase in business services in the manufacturing value chain may be a necessary condition for avoiding a stronger decline in the manufacturing value chain share in a country's GDP (though this is less the case for the share of manufacturing in GDP), but it is not sufficient to keep the manufacturing value chain share or the manufacturing share of GDP at a constant level.

This result is in line with the diverse patterns of specialisation documented above. In the European context, the specialisation patterns observed for both the manufacturing and the services industries therefore necessitate a proper functioning of the single market not only for goods, but especially for business services trade. The emergence of manufacturing and business service clusters in Europe makes service trade flows even more important.

## 7.4. A DETAILED LOOK AT MANUFACTURING–SERVICES INTER-LINKAGES AND BUSINESS SERVICES TRADE

As mentioned above, the issue concerning the interrelationship between manufacturing and services and the role of services production in the manufacturing value chain is rather complex and multi-faceted, with the quantitative approach only shedding light on certain aspects. Therefore the quantitative analysis was complemented by in-depth qualitative research focusing on specific cases. The selection for this analysis was grounded in considering the indicators developed above at a detailed country–industry level. In the end, a set of four industries (representing low and high-tech industries: food and beverages, textiles and clothing, machinery and transport equipment) in six countries (representing small and large, developed and emerging countries: Germany and France, Sweden and Denmark, the Czech Republic and Poland) were selected for investigation into the role of performance-enhancing business services – like R&D, advertising, engineering, etc. A number of interviews were conducted to gain insight into the interaction between manufacturing and services, such as cannot be gained by the quantitative approach and the application of econometric methods. These interviews confirmed that there are major discrepancies between the industries and countries under investigation. The differences are, to a certain extent, explained by different challenges from globalisation, production technologies, innovativeness and the resources required, with countries and industries being affected differently. In particular, there are notable differences between Member States that are explained by supply-side specifics and different framework conditions. The results provide a wide panorama of the interaction between manufacturing and services in various economic circumstances, documented and analysed above.

The second part of the qualitative approach was to study the patterns of imported versus domestically sourced performance-related services and to investigate the factors that influence the use of foreign-sourced knowledge-intensive business services. In terms of the three different types of performance-related services, the data clearly show that R&D services have the highest share of imports (in total use by the six selected countries and the four selected manufacturing sectors): on average 35% of total R&D service inputs, compared to 19% for computer services and 15% for other business services. The largest differences, however, stem from the use of imported performance-related services across different Member States. From the six selected countries, France imports structurally a (much) lower share of these services than the EU average, whereas Sweden and the Czech Republic (and to a lesser extent Denmark) import higher shares than the EU average. Poland imports a particularly large share of its *computer and related services* as intermediate inputs for its manufacturing sector (more than four times the EU average).

Accordingly, the 'larger' countries of Germany and France seem to rely more on domestic sources of performance-related service supply, especially for the *other business services* (except for R&D services, which Germany largely imports (49%) and France sources domestically (92%)). The Czech Republic and Poland rely more heavily on imports from other EU countries, and the 'small but open' economies of Sweden and Denmark more heavily on extra-EU sources. Particularly Sweden sources a relatively large share of these services from extra-EU sources. Inside the EU, the UK (and Ireland for computer services) supplies a significant share of performance-related services to all selected countries, whereas for most countries the top extra-EU trading partner – especially for R&D services – is the USA.

The subsequent analysis of the barriers to trade in performance-enhancing services sought to understand the factors that influence the provision of services to EU manufacturers from within and outside the EU. It is important to note that, due to the characteristics of trade in services, perhaps the most important factor (or 'barrier') that defines services trade is a natural barrier, called the 'proximity burden' in the literature, which resembles 'soft' (non-regulatory) factors such as distance and differences in culture and language. For services where the proximity burden is large, foreign service providers tend to prefer to serve the market through a local commercial presence, rather than exporting at a distance. For these services, barriers to entry and investment matter more; whereas for services that can be traded at a distance, differences in national regulation and barriers to the movement of people could constitute significant barriers. Since most barriers to services trade are regulatory in nature (i.e. not tariffs), two databases that capture elements of regulatory barriers to services trade were studied: (i) the recently released OECD-STRI index, which captures regulatory barriers to the provision of services from outside the EU , and (ii) the OECD PMRs, which capture the overall restrictiveness of the regulatory environment surrounding specific professional business service sectors. However, the potential sources of regulatory barriers that inhibit trade are diverse, and the indicators of the STRI and PMRs only measure certain regulatory barriers. In order to complement the analysis of regulatory barriers and to find other possible sources of barriers to services trade in the EU, additional literature on the impact of EU services regulation was reviewed and interviews with EU services industry representatives were conducted. The overall conclusion from analysis of the PMRs and STRI is that there is no evidence of cross-country patterns in the use of foreign performance-enhancing business services that would suggest a systematic relationship between the size of the overall indices and the patterns of foreign services use. Several limitations on the construction of the indices and the manner in which use of foreign business services is measured make it difficult to draw meaningful conclusions as to the aggregate level of the influence of the regulatory measures captured by the STRI and PMRs. However,

some of the underlying source data on which the indicators are built suggest that some Member States still need to address lingering discriminatory legislation, particularly with respect to extra-EU service providers. The findings from the STRI analysis shows that particularly the 'newer' and smaller EU Member States of Poland and the Czech Republic still maintain some restrictions on the movement of people from extra-EU countries.

In order to complement the analysis of the possible sources of regulatory or non-regulatory barriers to services trade, interviews were conducted with knowledge-intensive service providers. These revealed that 'soft' factors such as language, culture and knowledge of the local (regulatory) environment play the most important role in influencing services provision to EU manufacturers. This so-called 'proximity burden' not only works as a 'barrier' to overall services trade, but it also influences the way in which service providers prefer to serve a foreign market. This holds especially for the performance-enhancing service providers that supply very knowledge-intensive services, for which local requirements determine provision. The interviews also revealed some specific regulatory barriers to trade for individual performance-enhancing service types.

Some specific areas for policy attention were pinpointed by the analysis of the barriers inhibiting the provision of cross-border services in the EU. First, due to the clear need for local knowledge and interaction, **barriers to the movement of people** should be addressed. Within the EU, the Services Directive and the Directive on the Recognition of Professional Qualifications are believed to provide a good legislative basis for removing barriers to the intra-EU movement of professionals, but differences in implementation of the Directives give rise to variations between Member States, and there is room for further improvement. Additionally, the underlying data for the STRI show that for some countries (particularly Poland and the Czech Republic) some restrictions on architects and engineers from outside the EU remain.

Second, the need for local knowledge and interaction has also determined that the dominant mode of supply of services across borders is through the **establishment of local affiliates** that use local staff and have the local presence to overcome the 'proximity burden'. Barriers to investment or to entry should thus also be addressed, especially in the case of performance-enhancing services, where the need for interaction is particularly great. Maximum foreign ownership requirements (such as in the computer sector in Sweden), or requirements regarding the legal form of establishment in a country (present in nearly all six selected Member States) could still be considered a burden to entry for the establishment of such local affiliates.

Third, even though existing EU regulation addresses some regulatory barriers to performance-enhancing services provision within the EU, **effective implementation** of EU-wide regulation remains crucial, and the burden of complying with the regulation should not be too high. Evidence from the engineering services sector – where private industry initiatives regarding the mutual recognition of engineering titles and professional cards have emerged to facilitate the process of complying with EU regulation – shows that regulation that is overly complicated or difficult to comply with could create costs to exporting and thus barriers to trade itself. The performance reviews of the European Parliament on the effectiveness of the Services Directive also suggest that differences in implementation and interpretation of the Directive still give rise to uncertainty regarding the cross-border provision of services. This uncertainty should be addressed, in order to reap the full benefits of the productivity-enhancing use of imported services.

Fourth, even though of lesser importance, regulatory factors that were mentioned as still inhibiting the provision of services abroad relate to finance and tax issues (from the industrial design sector). Obtaining insurance abroad can sometimes still be difficult if insurance cover is required in order to secure a project abroad, but foreign insurers are only willing to issue cover once the project is actually acquired; a home-country insurer may also charge a premium for the extra risk incurred from insuring a project in an environment with which it is less familiar (and which might have a different claim culture). Also the administrative burden regarding tax compliance and the risk of non-payment abroad were found sometimes to add extra uncertainty and cost to providing performance-enhancing services abroad.

Lastly, due to the focus on services provided to manufacturers and the emphasis on productivity-enhancing relations, future policy to improve this link through the use of foreign business services should consider not only regulatory barriers to services trade, but also regulatory differences across nations in terms of product requirements or the regulation of final manufactured products. In the advertising, marketing and communications sector, differences in the national regulation of products (alcohol advertising, or gender issues) in communication increase the need for local knowledge and add (sunk) costs for foreign service providers.

Representatives from the manufacturing sector, on the other hand, mentioned no particular problems with manufacturing companies' access to services, whether domestic or foreign. The lack of perceived hindrances to the cross-border supply of services might be caused by the fact that in particular the more sophisticated business services require close communication between the client and the service provider, which is less the case for less sophisticated services such as transport and warehousing (where, for example, different languages do not impede cross-border activities). Difficulties that were reported are, for instance, in the realm of linguistic skills, social skills and cultural and country specifics. Concerning the cross-border flow of services provided by manufacturers, it was mostly hindrances to the free movement of workers that were mentioned. These are sometimes caused by intra-EU administrative provisions or country-specific regulations (e.g. concerning labour market regulations, recognition of qualifications). Other problems that were mentioned arise from different legal provisions (Member States' provisions on safety in the workplace, health and environment) and a lack of knowledge of the regulations.

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