

# Manufacturing Europe's future

REINHILDE VEUGELERS (EDITOR)



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**EDITED BY REINHILDE VEUGELERS**

**BRUEGEL BLUEPRINT SERIES**

## **BRUEGEL BLUEPRINT SERIES**

Volume XXI

### **Manufacturing Europe's future**

Reinhilde Veugelers (editor)

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# Foreword

'Industrial policy is back!' This is the message given in the European Commission's October 2012 communication on industrial policy (COM (2012) 582 final), which seeks to reverse the declining role of the manufacturing industry, and increase its share of European Union GDP from about 16 percent currently to above 20 percent. Historical evidence suggests that the goal is unlikely to be achieved. Manufacturing's share of GDP has decreased around the world over the last 30 years. Paradoxically, this relative decline has been a reflection of manufacturing's strength. Higher productivity growth in manufacturing than in the economy overall resulted in relative decline. A strategy to reverse this trend and move to an industrial share of above 20 percent might therefore risk undermining the original strength of industry – higher productivity growth.

This Blueprint therefore takes a different approach. It starts by looking in depth into the manufacturing sector and how it is developing. It emphasises the extent to which European industry has become integrated with other parts of the economy, in particular with the increasingly specialised services sector, and how both sectors depend on each other. It convincingly argues that industrial activity is increasingly spread through global value chains. As a result, employment in the sector has increasingly become highly skilled, while those parts of production for which high skill levels are not needed have been shifted to regions with lower labour costs.

But this splitting up of production is not driving the apparent manufacturing decline. Participation in global value chains within Europe is strongly EU-oriented with a central position for the EU15 and in particular Germany in EU manufacturing. This internationalisation of production has resulted in deeper integration of EU manufacturing, with member states specialising in sectors according to their comparative advantage. It has therefore helped to raise productivity and growth. As a result, the foreign content of countries' exports has increased. Germany, in particular, has been able to benefit from the greater possibilities to outsource parts of production to central and eastern Europe and to emerging markets, and is in fact one of the countries with the smallest manufacturing share declines in the last 15 years. The Blueprint also highlights the importance of energy for the structure and specialisation of manufacturing.

Capital-intensive manufacturing faces both urgent challenges and medium-term challenges. In the short-term, one of the most pressing problems is the fragmentation of financial markets in Europe, which undermines access to finance. This affects small- to medium-sized firms in particular because they are the most dependent on bank credit. In some southern European countries, even the financing of working capital is endangered. It should therefore be a high priority for policymakers to fix Europe's banking problems and create better functioning capital markets, including for venture capital.

A second important conclusion is that, given the strong links between innovation, internationalisation and firm productivity, it is important to erase the dividing lines between industrial policy, single market policy, ICT policy and service sector policy. A highly integrated economic system needs a coherent set of policies that aim at improving business conditions everywhere. Attempts to promote one sector at the expense of another one are likely to result in significant inefficiencies and weaker overall growth. Governments are notoriously bad at picking winners. Instead, Europe needs policies that are conducive to a better business climate, less-burdensome regulations and the right framework conditions.

Third, public policies need to be more supportive of industry and other parts of the economy. For example, the education system is of central importance for the economy and needs to be adapted to the needs of modern economies. The single market is important for both manufacturing and services and progress is needed to unleash its potential for growth. Reducing trade barriers is particularly important for industrial firms that increasingly rely in global value chains. Distortions in energy prices are also detrimental to industrial activity and should be avoided.

'Manufacturing Europe's future' therefore means getting the policies right for firms to grow and prosper. It is not about picking one sector over another, but primarily about setting the right framework conditions for growth, innovation and jobs.

*Guntram Wolff, Director of Bruegel  
Brussels, September 2013*

# 1 Manufacturing Europe's future growth

BY REINHILDE VEUGELERS

A new and important debate on the future of manufacturing has emerged recently in Europe, the United States and Japan. Manufacturing is in relative decline compared to services, but the financial crisis has brought back into focus the benefits of a stable manufacturing base. In order to consider the questions raised by this, we need to know why manufacturing has been declining, and if this is, in fact, a problem for our economies. Should steps be taken to stop the decline, and if so, what steps? Can economies prosper without a substantial manufacturing base, and what role should manufacturing play to help bring economies out of the crisis and put them back on a sustainable growth path?

After a long period of decline for manufacturing, there are some encouraging signs. Recently, the pace of decline has stopped or at least slowed. The offshoring of jobs to Asia has also slowed, with even some reshoring taking place. The debate about a new re-industrialiation phase has mostly taken place in the US (see eg Boston Consulting Group, 2011; Simchi-Levi, 2012; Morgan Stanley, 2013). The US manufacturing revival has been further helped by the shale gas windfall, reducing energy costs for US manufacturers.

Other trends point to a brighter future for global manufacturing. These include new sources of demand for manufactured goods, with a large pool of consumers in emerging economies who will enter the global consumer class for manufactured goods. On the manufacturing supply side there is a pipeline of new technologies waiting to be further exploited to bring new kinds of manufactured products to the market, reinvent existing products and improve the efficiency of manufacturing processes. Examples include additive manufacturing using 3D printers, robotics, nanotechnology, smart communication systems and 'big data' management.

Questions that arise from these trends figure prominently in European Union policy discussions. Decision makers want to know how the potential for industrial rejuvenation can be realised, and if it will also take place in Europe. Will the outcome be a larger manufacturing sector or will the sector continue its decline overall with only improvements in some niches? In which sectors, companies and countries will manufacturing growth take place? Even if Europe can take up the new opportunities, the question remains of whether they will generate the same number and type of manufacturing jobs as in the past.

These considerations are part of the heated and repeated discussions on what kind of industrial policy Europe should pursue. Proponents of a 'vertical' approach want to support specific sectors and firms, while proponents of a 'horizontal' approach see the role for policy as providing the framework conditions and incentives for investment and eliminating barriers faced by entrepreneurs. While in the 1970s and 1980s, targeted approaches were more common, the consensus since the early 1990s at EU level has moved to a more holistic, integrated approach to industrial policy, leveraging the EU's internal market and competition instruments and stimulating R&D and innovation. Various EU policy communications on industrial policy, the Lisbon Agenda and the current EU2020 strategy all embody this horizontal integrated approach towards industrial policy. This does not mean that sectoral policies have been absent, as the attention paid to information and communication technologies illustrates.

In 2012, the European Commission published a new industrial policy communication (European Commission, 2012), which starts from the premise that *"Europe needs industry"* and sets out a roadmap for reindustrialising Europe, with the aim of *"raising the share of industry in GDP from the current level of around 16 percent to as much as 20 percent in 2020"*. Although the Commission stressed the need for a comprehensive vision *"mobilising all the levers available at EU level, notably the single market, trade policy, SME policy, competition policy, environmental and research policy in favour of European companies' competitiveness"*, the communication returned to a more targeted approach, identifying six priority action lines (including key enabling technologies, clean vehicles and smart grids). The communication was followed up with action plans for specific sectors, such as steel (European Commission, 2013).

Identifying the right policies to support the manufacturing sector's contribution to Europe's future growth requires an understanding of the changing role of manufacturing in Europe's growth agenda. It is doubtful if the European Commission communication, by targeting a minimum share of GDP for manufacturing and focusing on specific sectors and technologies, approaches the discussion from the right angle.

The issue is not whether manufacturing is or should be important for economies, nor is it how many manufacturing jobs to have or save. Rather it is what type of activities Europe should focus on in the value chain for goods, which will allow the creation of sustainable jobs and growth in Europe, and within what global networks these activities should be developed. This discussion cuts across sectoral boundaries. We need a clearer horizontal picture of Europe's relative strengths and weaknesses, at the level of activities rather than a sectoral view. The discussion should be about establishing the right conditions for economies to create and capture value from activities that are part of the production and selling of manufactured goods, and which contribute most strongly and sustainably to Europe's growth and external competitiveness.

Chapter 2, *Trends, challenges and prospects for manufacturing in Europe* by Reinhilde Veugelers, takes stock of the evidence about manufacturing decline and the shifts in the sector's contribution to overall economic growth. The EU is compared with other regions and the various manufacturing sub-sectors are examined. Chapter 2 documents how, despite the continued shift in almost all EU countries and in almost all manufacturing sectors from manufacturing towards services jobs, manufacturing still matters, but its contribution to European economies is changing: creating fewer but more skillintensive jobs. With this new profile, manufacturing remains a major contributor to productivity growth, innovation performance and Europe's external competitiveness, despite its shrinking share of GDP. The shift away from low-skilled activities towards the high end is happening in all types of sectors, even in low-tech sectors such as textiles and food. Manufacturing jobs also increasingly resemble service-type jobs in areas such as design, R&D, and after-sales and support services related to manufactured goods. At the same time, the manufacturing sector is an important buyer of services (both locally and internationally), and manufactured capital goods are an important contributor to productivity growth in services. Manufacturing and services thus complement rather than substitute for each other.

Of specific concern in Europe are the growth prospects of southern European countries. Chapter 3, *Manufacturing as a source of growth for Southern Europe: opportunities and obstacles* by Erkki Vihriälä and Guntram Wolff, assesses the degree to which disparities in growth performance between the north and the south are due to diverging manufacturing trends, and considers the measures the south needs to take so that manufacturing can help drive growth in southern Europe. The relatively small size of manufacturing in the southern euro-area countries is explained by structural factors that inhibit firm growth, weak integration into global production chains and declining price competitiveness. Additionally, current tight funding conditions constrain growth further and increase the required labour-market adjustment. However, chapter 3 also

shows that the strength of manufacturing in Germany is unusual. Behind this different pattern in Germany are the integration of the German economy with central and eastern Europe and changes to the German corporate model. Recent strong export growth in parts of southern Europe indicates the potential of the region's firms, but access to finance is a central obstacle to growth and is creating an uneven playing field compared to competitors in the north. The completion of banking union and the continued pursuit of structural reforms remain necessary.

Manufacturers are involved in an intense global competition. The drive for efficiency has led to a slicing up of the value chain for goods and allocation of each component of the value chain to wherever in the world it can be most effectively performed, with the challenge being to coordinate and integrate the geographically dispersed activities. The resulting global value chains (GVCs) have dramatically changed European manufacturing because they have fostered industrial restructuring in different EU economies and between the EU and the rest of the world. Chapters 4 and 5 delve deeper into GVCs.

Chapter 4, *Manufacturing in global value chains* by Koen DeBacker, Sébastien Miroudot and Alexandros Ragoussis. Looks at the recent evidence on the involvement of European countries and sectors in GVCs. The chapter documents the increasing trend of outsourcing, offshoring and embodying of foreign content in export flows. The authors find that EU countries on average are as involved in GVC activities as other large economies such as the US and Japan. Within the EU, size and industrial structure explain to a great extent the differences in countries' involvement in GVCs. Global manufacturing is regionally organised, with production concentrated around hubs in Europe, North America and Asia. Within Europe, the EU15 and in particular Germany are the focus for GVCs. The organisation of production in European value chains has resulted in the deeper integration of EU manufacturing, with different member states specialising in different industries/activities according to their comparative advantage. This has resulted in EU exports having an increasingly foreign (primarily EU) content, but has also significantly benefitted the competitiveness of the EU and its member states in a global perspective. Confronted with growing competition from emerging economies, the competitiveness of EU manufacturing is increasingly driven by innovation, knowledge-based capital and embodied/embedded services. The positive effect of knowledge-based capital on a nation's competitiveness is greater in industries that are offshoring-intensive, suggesting a strong complementarity between knowledge-based capital and integration in GVCs.

In chapter 5, *Meeting the manufacturing firms involved in global value chains*, Reinhilde Veugelers, Francesca Barbiero and Michael Blanga-Gubbay use the EFIGE

database<sup>1</sup> to study how widespread GVC involvement is, and what impact GVC involvement has at the firm level. GVC-involved firms are identified as those firms that simultaneously import components, have production activities located abroad and sell their produced goods abroad. Sector and country patterns of GVC involvement are consistent with the patterns reported in chapter 4. But even within sectors and countries that are typically identified in the GVC literature as being more GVC-involved (countries such as Hungary and France, and sectors such as electronics, textiles and chemicals), there is still substantial heterogeneity in terms of how intensively firms within these sectors and within these countries are GVC-involved. Only a few firms are intensively involved in GVCs, but these few firms matter for Europe's knowledge-based growth and competitiveness performance, because they are large, trade-intensive, more innovative and more productive. These firms substantially drive the creation of total value added, employment and, particularly, trade flows in most sectors and economies. The analysis also shows that the, often smaller, firms that produce intermediate goods for GVCs can be very productive when they have unique innovative capacities. In line with the findings of chapter 4, the international activities of most European manufacturing firms take place within the EU. These firms involved in European value chains do not experience any productivity discount or premium compared to firms involved in global value chains, suggesting that for European value chain firms, the foregone opportunities of global sourcing are cancelled out by avoiding the higher coordination costs of global value chain organisation. Overall, the firm-level analysis confirms that firms involved in GVCs are well placed to be the engines of Europe's innovation-based growth and to drive its external competitiveness on the basis of globally sustainable comparative advantage.

When looking at the set of location factors determining where manufacturing investments will be made, affordable and reliable access to energy and raw materials are important because they account for a significant part of the cost in many industries. Higher and rapidly rising energy prices in Europe compared to other regions have led to concerns about a loss of European manufacturing competitiveness. Chapter 6, *Energy competitiveness* by Georg Zachmann, looks at the importance of energy prices as a location factor for manufacturing, and as a driver for countries to specialise in specific sectors. The chapter documents recent developments in energy prices, and explores the reasons behind price trends. Electricity and natural gas prices in Europe are higher than in the US. This is partly because of different resource availability and partly because of different policies. But there are multiple channels through which energy prices tend to equalise. The second part of the chapter provides an empirical

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1. <http://www.efige.org/>.

assessment of which sectors are likely to be most affected by international energy price disadvantages, and what this implies for overall competitiveness. The assessment finds that countries with lower energy prices than their competitors, specialise in different sectors to countries with higher energy prices. The sectors that low-energy price countries typically specialise in (eg basic precious and non-ferrous metals) are unsurprisingly more energy intensive. High-energy-price countries tend to specialise in more heterogenous sectors, developing competitiveness on the basis of non-energy sensitive assets.

The concluding chapter, *Policies to manufacture the EU's future growth*, by Reinhilde Veugelers and André Sapir makes recommendations for EU policymaking, based on the evidence presented in this Blueprint. That evidence shows that the challenge for policymakers is how to attract those high-value manufacturing activities within global manufacturing chains that are the basis for sustainable growth and competitiveness. These will be activities based on unique innovative capabilities, for goods that will be produced and traded within international value chains. Such high-value activities can be identified within all manufacturing sectors, both low-tech and high-tech, and do not necessarily require all the activities of the whole value chain to be located at home.

GVCs challenge prevailing approaches to competitiveness policy. The growing upstream and downstream interconnections increase the interdependence of countries and limit the effectiveness of national policies, requiring more coordination of policies internationally, which for European countries, because of the regional focus of European firms involved in GVCs, means first and foremost at EU level. Enabling GVC participation implies that all kinds of trade costs should be reduced, and inter-connecting infrastructure should be prioritised. This is however not only about 'border' policies; a holistic 'behind-the-border' policy framework is required. As large, open and interconnected product markets remain a major location factor, effective internal market and competition policy instruments will and should remain an EU priority. Completing the single market, particularly the single market for supporting services (including cross-border transport, broadband and energy infrastructure) is perhaps the most important goal in order to reinforce manufacturing's role in driving growth. A further challenge is the structural shift from classic production jobs towards higher value added types of jobs, and the implications this has for the labour market. Governments will need to facilitate this structural shift. As the challenges and trends are common for all manufacturing sectors, any type of government intervention should be sufficiently horizontal, and governments should not succumb to the temptation to pick particular industries to support.

# 2 Trends, challenges and prospects for manufacturing in Europe

BY REINHILDE VEUGELERS

How much does manufacturing contribute to Europe's growth and jobs? Will Europe's manufacturing employment decline continue? What kind of manufacturing will support future growth in Europe?

This chapter provides empirical evidence to help answer these questions. We compare Europe to other economies, particularly the United States and Asian economies, and look at the heterogeneity within Europe. Section 2.1 considers current trends in manufacturing. Section 2.2 examines trends at the level of individual manufacturing sub-sectors. Section 2.3 takes a snapshot view of the challenges ahead for manufacturing. We conclude by digesting the evidence and analysing the implications for the future of manufacturing in Europe.

## 2.1 The contribution of manufacturing to the European economy

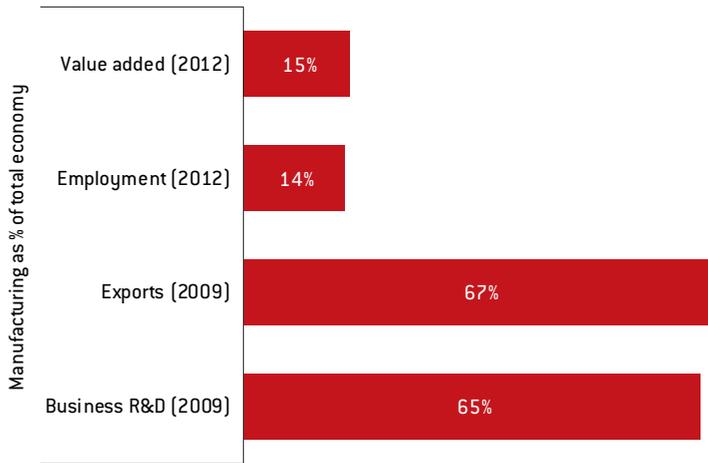
Manufacturing employment and manufacturing's share in GDP has continuously declined over a number of years in the European Union and currently represents about 15 percent of value added and 14 percent of total employment<sup>1</sup>. Despite its declining and currently small share of value added and employment, manufacturing still plays an important role in the European economy, contributing disproportionately to exports

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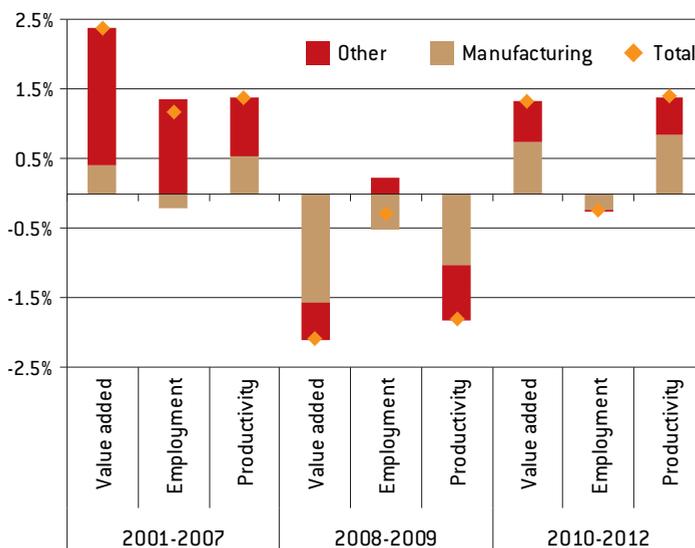
1. Unless otherwise stated, manufacturing includes all activities in section C of the NACE rev 2 used by Eurostat. Section C includes all activities involving the physical or chemical transformation of materials, substances or components into new products. In ISIC 3, manufacturing includes divisions 15-37.

and research and development. It also contributes disproportionately to productivity growth, particularly since 2010. These trends and characteristics of manufacturing (Figures 1 and 2) are not specific to Europe. Trends in manufacturing in other western economies are similar, most notably in the US (McKinsey, 2012).

**Figure 1: The importance of manufacturing for the EU economy: some key numbers**



Source: Bruegel based on Eurostat database and OECD TiVA. Note: Growth rates computed as annual average growth rates over the period. Exports within the EU27 account for 40 percent; exports out of the EU27 account for 27 percent. Business R&D expenditure data as of 2009, excluding Greece and Luxembourg from the EU aggregate. Value added: the gross value added at basic price is defined as the difference between output at basic prices and intermediate consumption at purchasers' prices.

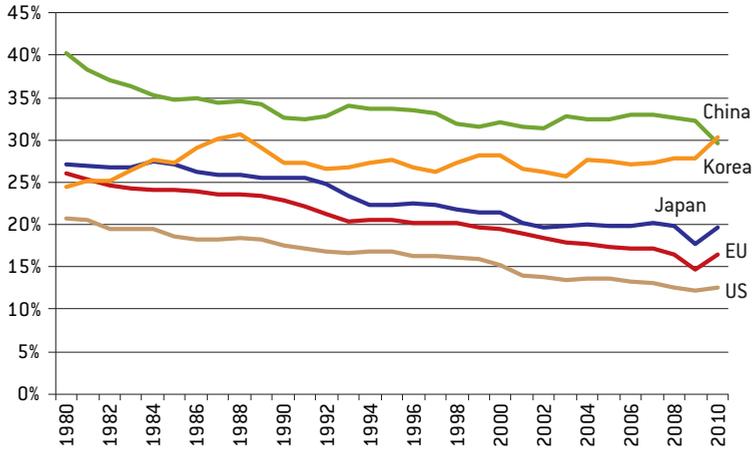
**Figure 2: Manufacturing and total EU economy growth rates**

Source: Bruegel based on Eurostat. Note: Growth rates computed as annual average growth rates over the periods. Total (economy) excludes 'agriculture, forestry and fishing'.

### 2.1.1 Manufacturing's declining share of value added

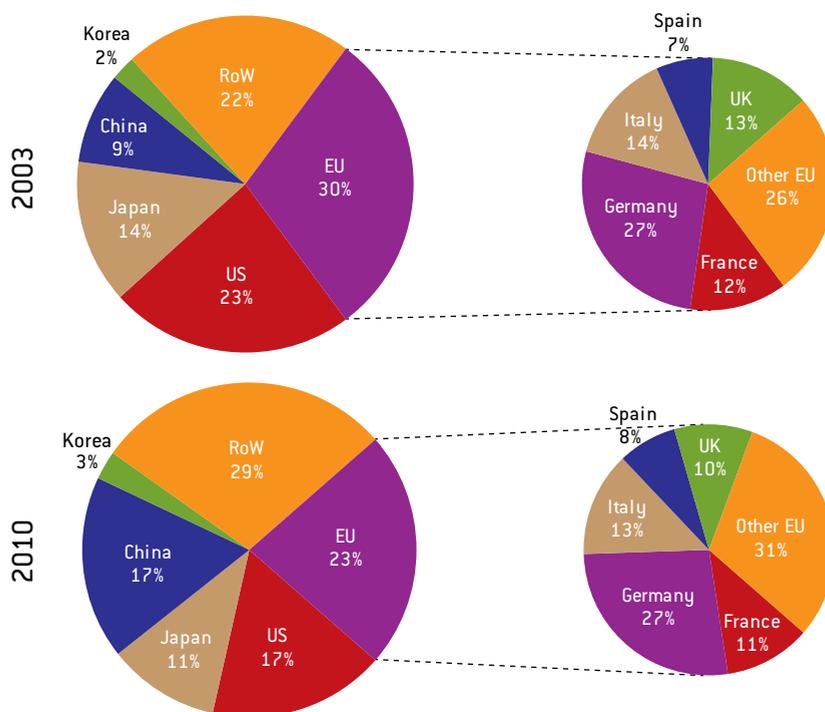
Manufacturing's share of total value added (GDP) has gradually and steadily declined in all western economies since the 1970s. This is most evident in the US, where manufacturing now accounts for about 12 percent of value added. The situation in Asia is more heterogeneous. In Japan, like in the west, manufacturing has been losing value-added share. In contrast, despite a downward trend, manufacturing still accounts for about one third of total value added in China, while in Korea, the manufacturing share of value added has risen.

**Figure 3: Manufacturing share of value added, 1980-2010, EU and other economies**



Source: Bruegel on the basis of World Bank and OECD.

Part of the loss of manufacturing value added in the west is often attributed to a shift towards new emerging markets, most notably China. China indeed has increased its share of global manufacturing and has become the biggest manufacturing nation in the world, slightly bigger than the US. The European Union's share of global manufacturing value added dropped from 30 percent in 2003 to only 23 percent in 2010, somewhat more than the US. Within the European Union, the most important contributors to manufacturing value added are Germany, Italy, France and the United Kingdom.

**Figure 4: Countries' shares of world manufacturing value added**

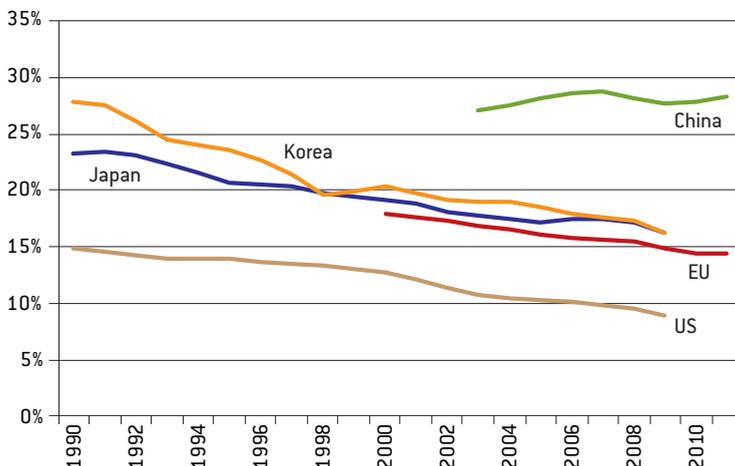
Source: Bruegel on the basis of World Bank data. Note: Manufacturing refers to industries belonging to ISIC 3, divisions 15-37. Data in current US dollars.

Manufacturing's contribution to value added can be decomposed into its contribution to employment and to (labour) productivity. Much of the recent debate about de-industrialisation and the potential decline of the manufacturing base has focused on the loss of manufacturing employment. This will be discussed in section 2.1.2. The contribution through (labour) productivity will be discussed in section 2.1.3. The effect of the declining prices of manufactured goods is discussed in section 2.1.6.

### *2.1.2 Dwindling manufacturing jobs*

The EU has seen a steady decline in the share of manufacturing in total employment: manufacturing jobs have been lost, or manufacturing employment has increased less than employment in other sectors, most notably services.

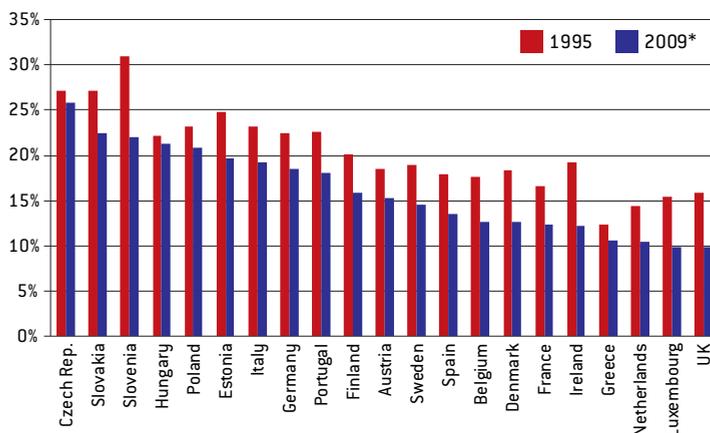
**Figure 5: Manufacturing employment as % of total employment, EU and other economies, 1990-2011 (or most recent year)**



Source: Eurostat, OECO STAN and National Bureau of Statistics China (data available from 2003).

The US has witnessed the most marked decline in manufacturing employment, which currently represents less than 10 percent of total US employment. The trend has also been downward in the EU, but the EU still has a higher share of manufacturing employment in total employment than the US: about 15 percent in 2011, similar to Japan and Korea. China is the outlier case: the former high levels of manufacturing employment were initially reduced in line with the process of market opening and restructuring of state owned enterprises. But Chinese manufacturing employment has been slowly increasing since 2003 to stand at almost 30 percent of total employment in 2010.

Manufacturing's share of total employment has declined in all European countries, but there are some marked differences between countries. The UK has seen the strongest decline and currently has one of the lowest shares within Europe. France also has a relatively low share of manufacturing employment in total employment. Although Germany has also seen a major decline in manufacturing employment, it still remains at a relatively high level within Europe. Italy also has a relatively high level and has been through a more modest decline relative to other EU countries, the US and Japan.

**Figure 6: Manufacturing employment as a share of total employment, 1995-2009**

Source: OECD Statistics, 2009 or most recent year.

Different trends in different countries are correlated with different levels of development. The strongest relative decline in manufacturing employment and the lowest levels of manufacturing employment overall are in the EU15 countries, while central and eastern European countries and Portugal have seen smaller declines and still have higher shares of manufacturing employment. Outliers in this development pattern are Italy and Germany, two EU15 economies with relatively high manufacturing employment shares, and Greece and Ireland, two former cohesion countries with relatively low manufacturing employment shares.

The drop in manufacturing employment in the EU, as in other economies, is a consequence of a combination of:

- Productivity effects (labour saving)
- Trade effects (shift towards lower-cost countries)
- Demand effects (drop in demand for manufactured goods relative to services)

There is considerable controversy over which of these factors is the most significant<sup>2</sup>, but we leave this to one side and discuss each of the factors in turn.

2. There is a lively debate in the US on the importance of productivity growth and trade effects for manufacturing job losses. Most analysts support the importance of productivity growth [eg McKinsey 2011], but Brookings (2012) puts a greater weight on trade effects; Edwards and Lawrence (2013) argue that much of the relative decline in manufacturing can be explained by the fact that high productivity growth in the sector has not been matched by an offsetting increase in demand.

### *2.1.3 Manufacturing's superior productivity growth*

#### *2.1.3.1. The contribution of manufacturing to total productivity growth*

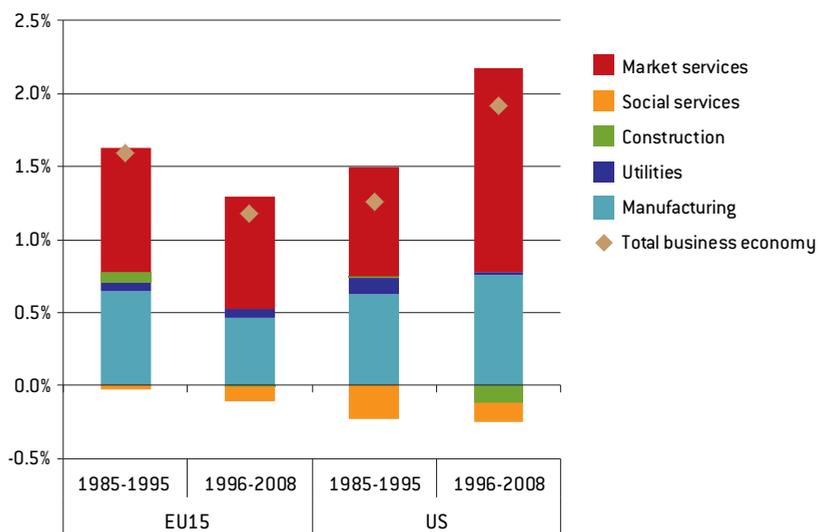
Despite its relative decline within the total economy, manufacturing output and employment continue to contribute substantially to overall economic growth, because of strong manufacturing productivity growth. The contribution of the manufacturing sector to total productivity growth (1995-2009) is substantially higher than its share of value added, reflecting the superior productivity performance of the manufacturing sector compared to the rest of the economy (Figures 1 and 2).

In the central and eastern European countries, manufacturing was the strongest force driving productivity growth, especially in Hungary, Poland and Slovakia. Manufacturing also made a substantial contribution to the high productivity growth rates seen in Finland and Sweden during the past decade. In France and Germany, manufacturing accounted for the bulk of aggregate productivity growth. In several other countries, including Greece, Portugal and the United Kingdom, however, manufacturing accounted for only a small share of aggregate productivity growth over the past decade. In the UK case, this is because of specialisation in service sectors. In Portugal, it is a result of below-average productivity growth within manufacturing sectors.

The contribution of manufacturing to productivity growth in the US has been markedly greater than in the EU15 in the post 1995 period<sup>3</sup>.

---

3. Because of major differences in productivity performance between pre-2004 EU members and those that joined the EU in 2004 and after, the analysis in this subsection will split the EU into the EU15 and central and eastern Europe, and will compare the EU15 with the US.

**Figure 7: The contribution of different sectors to productivity**

Source: Bruegel based on OECD. Note: 'EU15' includes Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain and UK. The value-added based measure of labour productivity by industry is constructed by the difference in the aggregate rates of change of value added and employment respectively, computed as share-weighted averages of industry-specific rates of change of value added and employment, where weights reflect the current-price share of each industry.

### 2.1.3.2 Manufacturing productivity growth compared to other sectors

Manufacturing contributes to an economy's productivity growth rate through a combination of its productivity growth rate and its importance to the economy. With its share of the total economy continuously declining, the contribution of manufacturing must increasingly come from superior productivity performance. When looking at the productivity growth rates of manufacturing in different countries, we see for most countries substantial average annual growth rates in the period 1995-2008: from 2.3 percent in the EU15 to 5.1 percent in the US and 7.5 percent in central and eastern European countries (for these countries, the high rate is related to their economic catching-up). This rate was at least twice as high as the market services sector. For central and eastern European countries, it was 3.5 times greater.

On average, although the share of manufacturing in the EU15 economy is larger than in the US, the EU15 performance in terms of manufacturing productivity growth has

been much weaker, with the growth rate declining after 1995, in contrast to the US. This explains the smaller contribution of manufacturing to productivity growth in the EU15 compared to the US.

Although manufacturing contributed less to productivity growth in the EU15 after 1995 compared to the US, most of the EU-US gap in labour productivity growth is not down to the manufacturing sector. This is because of the relatively low weight of the manufacturing sector in the total economy, and because the EU-US productivity growth gap is even bigger in other sectors. In services in particular the US markedly outperforms the EU15. The post-1995 boom in US productivity growth is mostly attributable to the production and use of ICT, primarily by service sectors (see section 2.2.4).

The productivity growth performance of the manufacturing sector is very heterogeneous in the EU15. The weakest performance has been in Italy and Spain, but even in these countries, manufacturing is still doing better than market services, which have had negative productivity growth rates. The strongest performers are Sweden, Finland and Ireland, with annual average growth rates (AAGR) in excess of 6 percent, superior to the AAGRs for their service sectors. In Finland in particular, manufacturing has outperformed services by this measure by a factor of six. In contrast to the EU15 average trend, the productivity growth rate of German manufacturing after 1995 was three times the productivity growth rate for services. In the UK, manufacturing productivity growth is high, but manufacturing has no edge over services.

**Table 1: Labour productivity growth in the manufacturing sector compared to services (services sector = 100)**

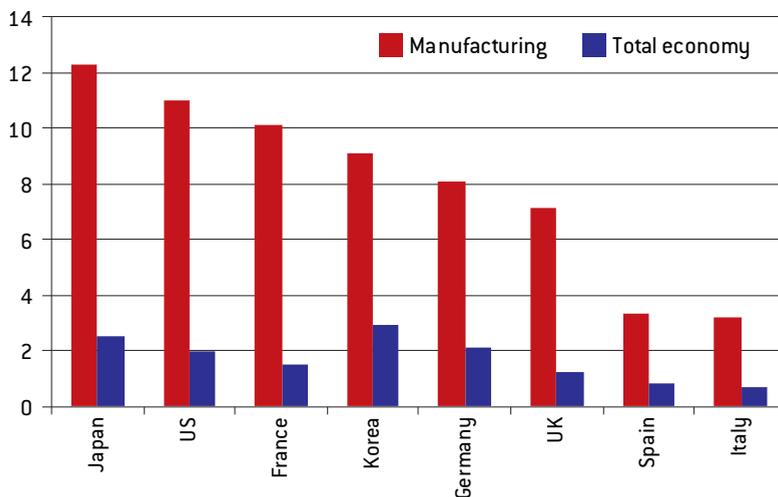
	US		Japan		EU-15		Central and eastern Europe	
80-95	3.8	381	3.1	124	3.1	221	NA	NA
95-08	5.1	213	3.7	336	2.3	230	7.5	357
	UK		France		Germany		Italy	
80-95	4.2	233	2.9	207	2.2	129	3.4	
95-08	3.1	107	2.8	280	2.6	325	0.2	
	Sweden		Finland		Netherlands		Belgium	
80-95	4.4	275	5.1	189	3.0	300	4.1	256
95-08	6.0	400	6.2	620	2.8	138	2.8	311
	Spain		Greece		Portugal		Ireland	
80-95	2.7		NA	NA	2.1	111		
95-08	0.4		3.6	129	2.7	386	6.1	235

Source: Uppenberg (2011). Note: first column gives AAGR, second column gives ratio of labour productivity growth of manufacturing relative to market services (=100); relative ratios only reported for positive productivity growth rates of market services.

### 2.1.4 Manufacturing as the driver of R&D

A major driver of productivity growth is innovation and R&D. Consistent with its superior productivity growth performance, manufacturing pushing forward in this respect. Manufacturing still accounts for most business expenditure on R&D (its share of business R&D is at least four times larger than its share of value added, see Figure 1). Figure 8 shows for a number of countries how much more R&D intensive the manufacturing sector is compared to other sectors. R&D intensity is calculated as the ratio between R&D expenditures and value added. In the US and Japan, manufacturing is about five times more R&D intensive than the total economy. In Europe, manufacturing is also far more R&D intensive than other parts of the economy, but in Italy and Spain manufacturing is far less R&D intensive than in other countries.

**Figure 8: Total economy and manufacturing R&D intensity**

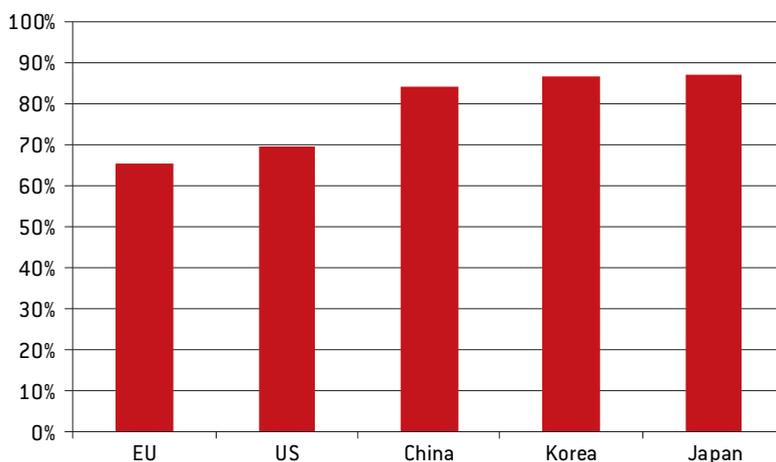


Source: OECD STAN. Note: 2009 or most recent year (US and Germany: 2008, France and UK: 2006). R&D intensity is the ratio of R&D expenditures to value added.

The share of the manufacturing sector in total business R&D has declined somewhat over time for a variety of reasons, such as growing R&D in certain service sectors, and the outsourcing of R&D to specialised R&D labs that are classified as part of the service sector (OECD, 2006). The decline has been most marked in the US, though it has been reversed somewhat more recently, leaving US manufacturing with the lowest share compared to its European and Asian counterparts (about 70 percent of total business R&D). China, Korea and Japan all have shares above 80 percent.

The increase in Chinese and Korean business R&D expenditure has been remarkable, particularly China's. China is now the world's second biggest R&D spender, after the US, and is similar in R&D size to Germany, France and Italy combined<sup>4</sup>.

4. See Veugelers (2013), for an analysis of the increasing importance of China in R&D and innovation.

**Figure 9: Share of manufacturing in total business R&D expenditure, 2009**

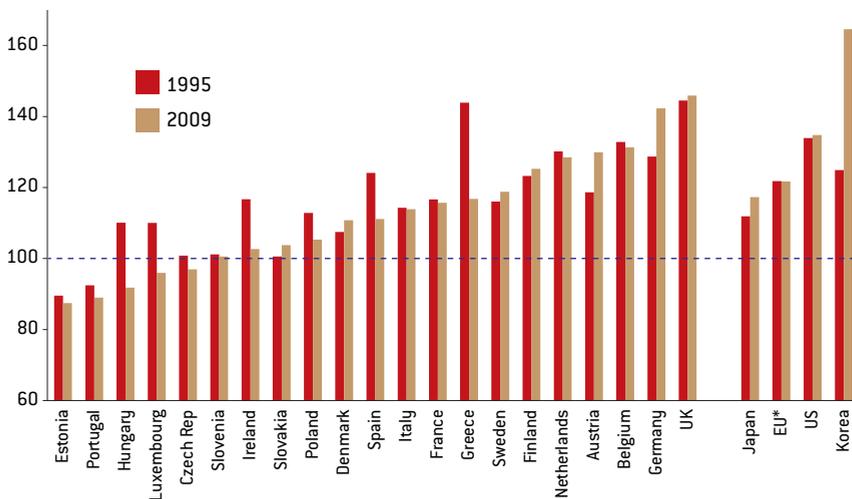
Source: Bruegel based on OECD STAN. Note: EU aggregate (excluding Greece and Luxembourg) from Eurostat.

### *2.1.5 Fewer but better paid jobs?*

High productivity levels building on higher R&D intensities allow the manufacturing sector to sustain higher wages. Average labour compensation per employee in manufacturing is typically higher than in the average economy. In Europe, it is about 20 percent higher. In Korea and the US it is higher still. Within Europe, the highest ratios are in the UK, Austria, Germany and the northern countries. In Portugal and several central and eastern European countries, labour compensation per employee in manufacturing is however lower than in the overall economy. Over time, and in line with the process of relative job shedding, manufacturing pay has increasingly exceeded average compensation in the overall economy in particular in Korea, Japan, the US and most northern European countries, particularly Germany and Austria. This illustrates a shift within manufacturing in these countries towards fewer but higher skilled jobs that are more productive and better paid. France and Italy however do not reflect this pattern, while Spain, Ireland, Hungary and Greece saw a marked decline in manufacturing labour compensation.

Higher productivity levels are especially important for economies with higher labour costs that must compete with locations/countries with lower labour costs. Hourly compensation costs in manufacturing diverge substantially between countries. Even

**Figure 10: Labour compensation in manufacturing relative to the total economy**

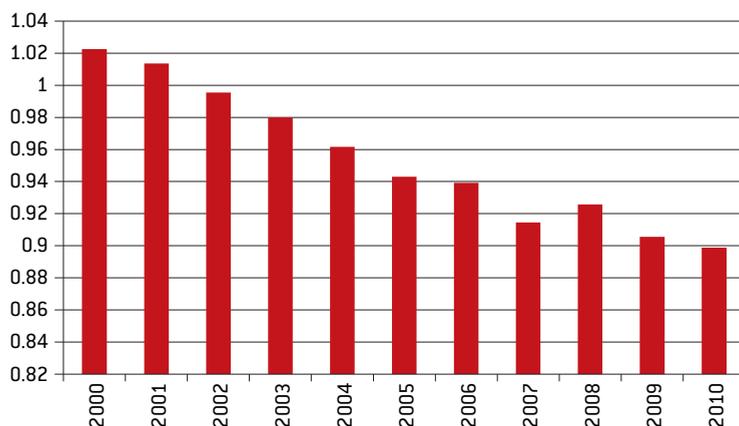


Source: OECD STAN. Note: 2009 or latest available year; Portugal: 2006; France, Poland and UK: 2008. EU\* is the average obtained using as weights the number of employees in the manufacturing sector, excluding Ireland due to data availability. The index represents the ratio of labour compensation for the manufacturing industry to the number engaged divided by the ratio of labour compensation for the total economy to the number of persons engaged for the total economy (total economy = 100) and allows us to look at the development of manufacturing workers' relative wages, compared to the economy as a whole.

though these costs have risen faster in China and India (respectively 17 percent and 10 percent increases between 2006-08) than in the West (for example, US: 2.7 percent, western Europe: 2 percent), the difference remains huge. The difference between China (\$1.07) and India (\$1.17) and western Europe is a ratio of 40 to 1, with southern Europe it is a ratio of 30 to 1, and with eastern Europe it is a ratio of 10 to 1 (source: US Bureau of Labor Statistics). Such huge differences show that hourly wage costs are only one factor determining the attractiveness of locations for manufacturing activities.

### 2.1.6 Declining demand and prices for manufactured goods

Part of the decline in the share of manufacturing in value added is a result of lower demand for manufactured goods. As income levels rise, households spend an increasingly smaller share of their income on goods relative to services (Figure 11).

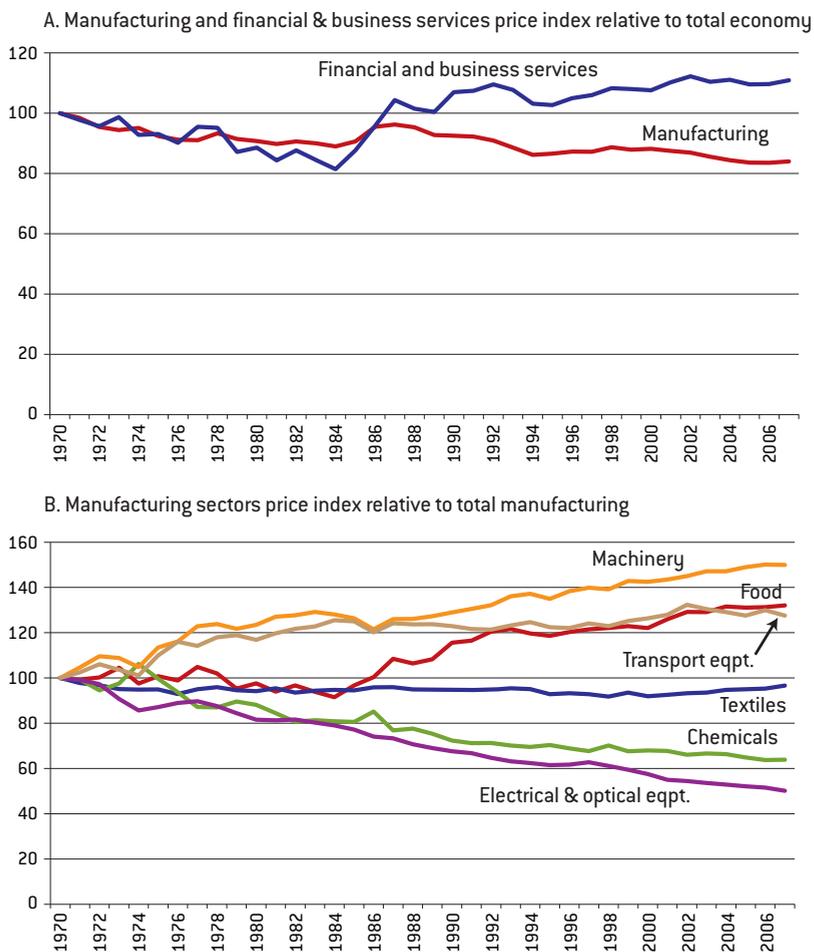
**Figure 11: Ratio of household spending on goods relative to services EU, 2000-10**

Source: Bruegel based on Eurostat

Part of this relative decline in spending on manufactured goods is a result of price effects. In contrast to many services, the prices of which have increased over time, many manufactured products have become relatively cheaper. Lower prices for manufactured goods reduce the contribution of manufacturing to GDP, but they benefit consumers and thus contribute to society's welfare. In addition, a substantial portion of manufactured goods are inputs into other sectors. Lower manufacturing prices thus also contribute to increased performance in other sectors, which are able to use cheaper manufactured goods as inputs.

The price decline for manufactured goods holds particularly for chemicals and ICT equipment. More affordable ICT investments are an important contributor to growth in other sectors, particularly ICT-using manufacturing and services, thereby increasing the indirect contribution of manufacturing to the economy (McKinsey, 2012; see also section 2.2.4).

**Figure 12: Productivity gains are passed on in terms of lower prices**



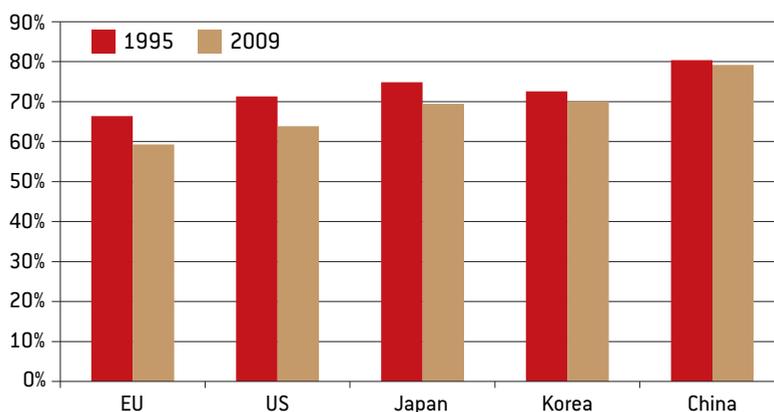
Source: Bruegel based on EU KLEMS.

### 2.1.7 Manufacturing as the driver of trade

Another manufacturing trend is the decline in the share of manufacturing in trade flows. Nevertheless, the contribution of manufacturing to trade and to countries' trade balances remains important. Manufacturing accounts for more than three quarters of total exports from Europe (Figure 1), about five times greater than its weight in value

added. When considering the EU as a bloc, and thus excluding intra-EU trade, the contribution of manufacturing to total EU trade drops somewhat, to slightly below its share in US trade. The share of manufacturing in Asian trade is higher than in the west.

**Figure 13: Share of manufacturing in total trade (gross exports and imports), 1995 and 2009**

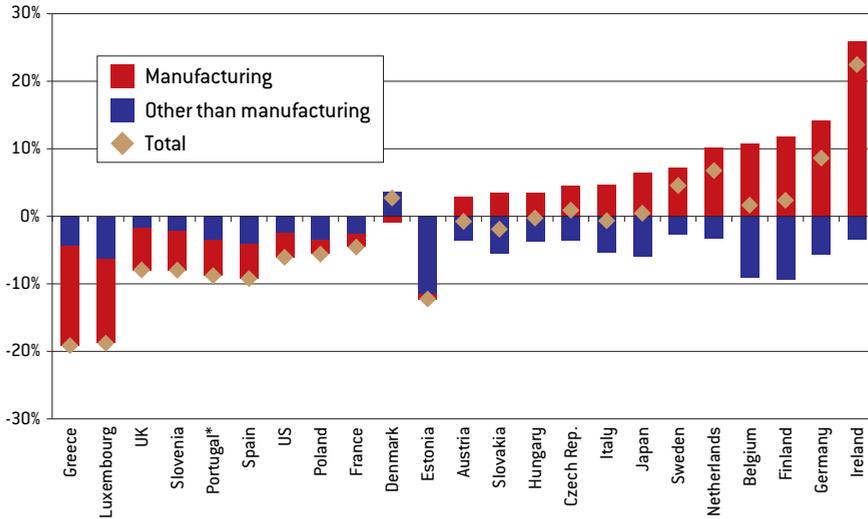


Source: Bruegel based on OECD TiVA database. Note: EU does not include intra-EU trade.

Manufacturing is important both for exports and imports. Increasingly this trade occurs simultaneously, with sectors and firms importing components so that they can manufacture products for export markets. This is a consequence of the growing integration of manufacturing production at the global level, and the increasing spread of global value chains. See chapter 4 for an analysis of manufacturing global value chains.

In most northern European countries (excluding Denmark), the manufacturing trade balance is positive, and compensates for the negative trade balance in other sectors. This is particularly the case for Germany and Ireland, and also for Finland, Belgium and Japan. In the countries in which the manufacturing trade balance is negative, such as the US, the UK and most southern European countries (excluding Italy), the manufacturing deficit is accompanied by a deficit in other sectors.

**Figure 14: Manufacturing and trade balance, 2008**

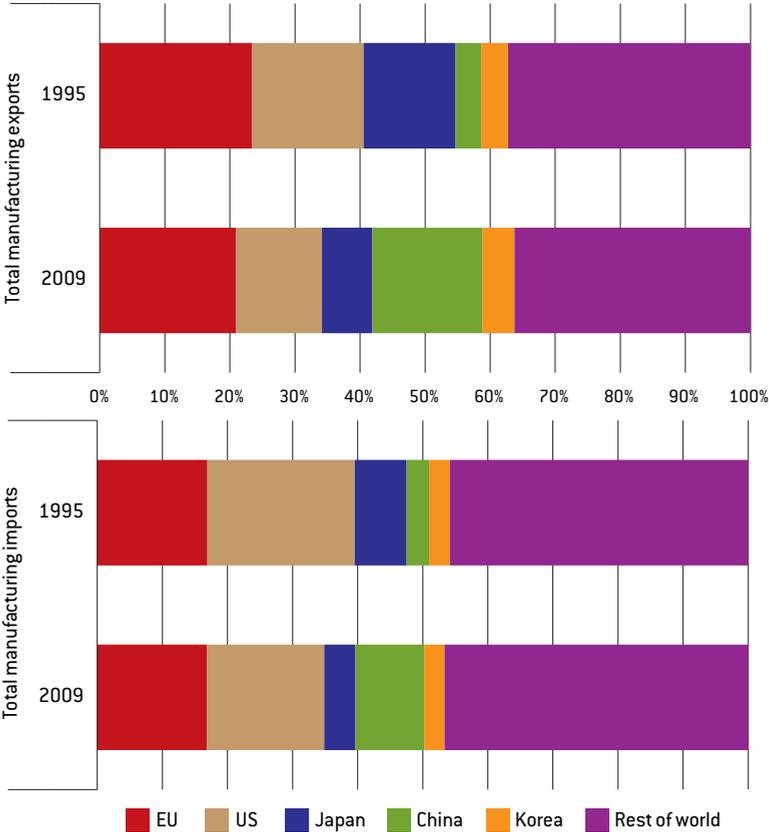


Source: Bruegel based on OECD STAN.

### 2.1.8 The rise of Asian emerging countries in manufacturing trade

Manufacturing export markets have seen a marked geographical shift, with the rise of China as the key country of origin of export flows. This is not a simple shift from west to east, because it is the US and Japan that have seen the strongest decline in their share, while the EU has managed to more or less maintain its position in manufacturing world markets. Asia and particularly China, however, have not just emerged as centres for the production and export of manufactured goods. Asian economies are also increasingly more important as destinations for manufactured goods from the west. Box 1 discusses the role of emerging economies as new centres of gravity for manufacturing.

Figure 15: Country/region's share of manufacturing exports and imports, 1995 and 2009



Source: Bruegel based on OECD TIVA

### BOX 1: EMERGING ECONOMIES AS NEW CENTRES OF GROWTH

There are various reasons for the growing importance of emerging economies in the world economy, included the typically lower costs, especially labour costs, in these countries compared to more developed economies. Another important factor however is the presence of large and growing markets for manufactured goods in these countries: production activities go where the markets are (OECD, 2011).

The attractiveness as locations for investment of Brazil, China, India and South Africa depends greatly on their large and rapidly growing home markets. Branstetter and Foley (2007) show that until 2006, US firms mainly located plants in China to gain access to the Chinese market: almost 75 percent of the sales of these US affiliates were directed to the Chinese market, and less than 10 percent was exported to the United States. The room for growth in emerging markets is substantial; several Asian, Latin American and African countries boast burgeoning middle classes, compared to often-saturated markets in OECD countries.

China and India are the world's most populated countries and have high GDP growth rates. They are quickly becoming important markets for firms in many industries. While global consumer demand has previously been concentrated in rich OECD economies, a new middle class<sup>5</sup> is emerging in China and India. While the middle class worldwide could increase from 1.8 billion to 3.2 billion people by 2020, and to 4.9 billion by 2030, almost 85 percent of this increase is expected to be in Asia. In 2000, Asia (excluding Japan) only accounted for 10 percent of global middle-class spending; this could reach 40 percent by 2040 and almost 60 percent in the long term (Kharas, 2010).

The emergence of new growth centres will significantly shift the world's centre of economic gravity eastwards (Quah, 2011). Kharas (2010) located the global economic centre of gravity in 1965 at the mid-point of Europe, the United States and Japan. Since then, the economic centre has been moving to the south east, close to the axis connecting Washington DC and Beijing. India, China, Indonesia and Vietnam are expected to pull the centre of economic gravity further to the east.

Source: OECD (2013).

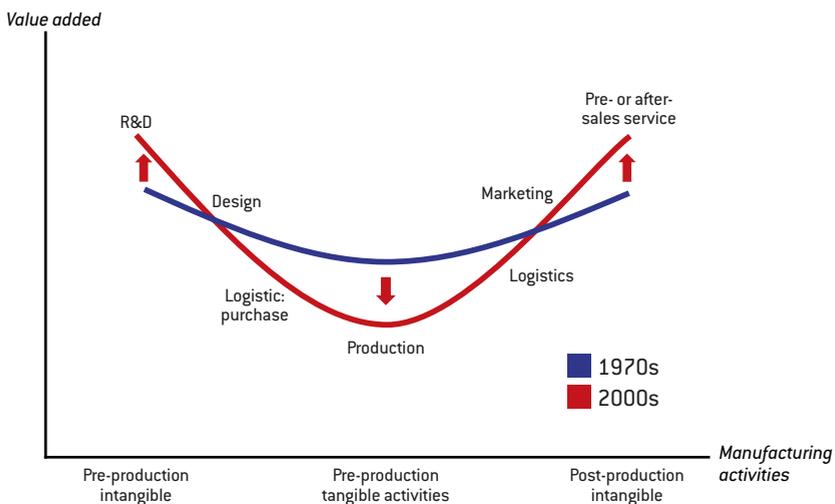
5. The global middle class is defined as all those living in households with daily per capita incomes of between \$10 and \$100 in PPP terms (Kharas, 2010).

**2.1.9 The 'servitisation' of manufacturing and the blurring of the boundary between industry and services**

All too often the correlation between the decline of manufacturing and the rise of services is seen as evidence that the sectors are perfect competitors: the rise in demand for services is seen as leading to less demand for manufactured goods, while greater demand for services jobs drives away employees from jobs in industry. But the relationship between manufacturing and services is much more intricate.

The boundaries between manufacturing and services are blurring. Manufacturing firms do much more than make products. They provide *solutions* to the customers' needs. The services provided can be either explicit, such as pre- and after-sales service of a product, and/or embedded in the solution (such as design activities). The actual production phase in the manufacturing goods value chain may be increasingly the less pivotal part in the creation of value-added from producing goods, as the 'smile curve' illustrates (Figure 16).

**Figure 16: The 'smile curve'**

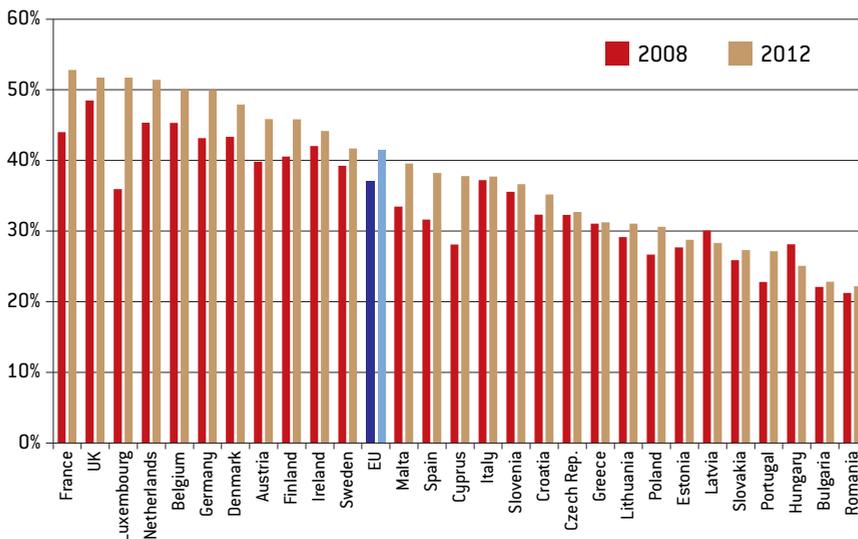


Source: Bruegel based on an OECD presentation at a Bruegel workshop, Brussels, 27 June 2013.

The main trends in the interaction between manufacturing and services are: service activities increasingly performed by manufacturing firms; manufacturing firms outsource activities to services firms, and buy services from independent service providers as an intermediate input.

To illustrate the growing importance of service activities performed by manufacturing firms, Figure 17 looks at service-related jobs in manufacturing. It shows that in Europe about 40 percent of the jobs in the manufacturing sector involve service-related occupations, a share that is continuously increasing in most countries. The share of jobs in manufacturing that can be considered as services-related ranges from about 50 percent in the UK and recently also in France, Belgium, Germany, Austria, the Netherlands and Denmark, to about or below 30 percent in countries such as Greece and Portugal.

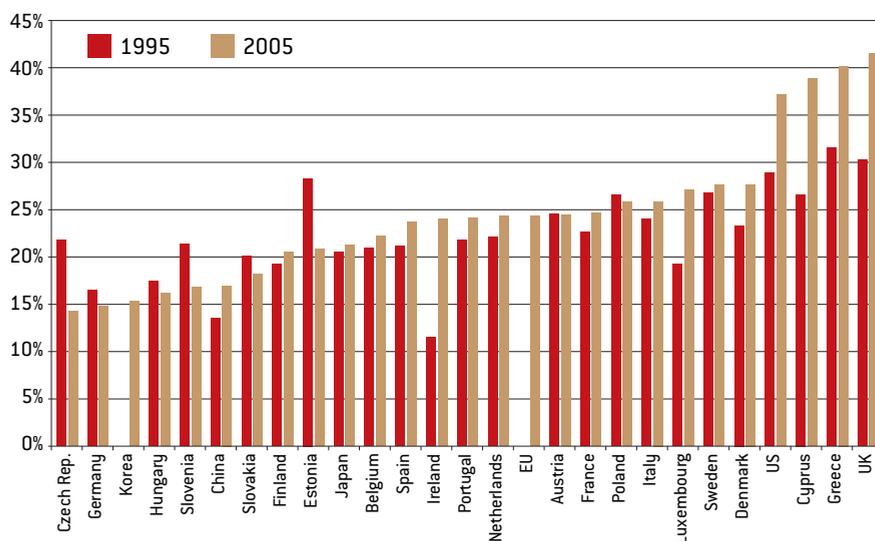
**Figure 17: Share of service-related jobs in the manufacturing sector**



Source: Bruegel based on EU LFS. Note: Services-related occupations cover ISCO classes 100-500, 830, 910, 933. In this figure, we consider services-related activities available from Eurostat extraction of EULFS: managers, professionals, clerical support workers, service and sales workers, technicians and associate professionals. We therefore excluded elementary occupations that are services-related as no breakdown was available from publicly available data. Data for Netherlands is 2011.

On average, services make up about one quarter of all inputs bought by the EU manufacturing sector. This share of services purchases by manufacturing is growing in most countries. It is highest in the UK at more than 40 percent, similar to the US. Greece and Cyprus are outliers on the high end. Germany has a marked lower share of services purchased, about 15 percent, similar to Korea and China. The biggest component of services purchases in the EU is from trade (37 percent) and social services (30 percent), with only one third of services purchases from communication and transport (16 percent), business services (16 percent) and R&D services (4 percent).

**Figure 18: Share of services in total manufacturing intermediate consumption**



Source: Bruegel based on OECD Input-Output Tables (Total).

## 2.2 Trends in manufacturing subsectors

The sectors that compose the aggregate manufacturing sector differ substantially by various measures, as Box 2 details. These different characteristics translates into different trends and challenges faced by each of the sectors. Table 2 shows the different subsectors that we consider in this section, and their relative sizes (in terms of value added). Chemicals, pharmaceuticals and rubber and plastics combined make up the biggest manufacturing sector in the EU (2010 figures), with an increased share of total EU manufacturing value added since 2000. The textiles and Clothing and metals and metal products sectors have lost value added share.

**Table 2: Manufacturing industries' shares of total manufacturing value added, EU, 2000 and 2010**

	2000	2010
Food, drinks, tobacco	13.3%	12.8%
Textiles & Clothing	5.5%	3.7%
Wood, paper, publishing & Furniture	13.2%	11.8%
Chemicals, Pharma, Rubber & Plastics	13.8%	16.9%
Metals and Metal Products	14.6%	13.0%
Machinery & Equipment	9.9%	9.7%
Electr(on)ics	9.7%	11.7%
Transport Equipment	9.8%	10.5%
Other	10.2%	9.9%

Source: Bruegel based on EUROSTAT.

#### **BOX 2: A BIRDS' EYE VIEW OF THE CHARACTERISTICS OF THE DIFFERENT MANUFACTURING SECTORS**

- Chemicals and transport equipment (cars) are typically medium to high technology intensive. Pharmaceuticals and electr(on)ics typically record the highest levels of R&D intensity. Textiles and clothing and food have typically lower technology intensities.
- For chemicals, pharmaceuticals and transport, being close to customers is important, meaning these sectors are medium tradable. Electr(on)ics and textiles and clothing are highly tradable. Food products are typically low tradable.
- Food and textiles are labour intensive, while electr(on)ics, motor vehicles and chemicals have low labour intensities.
- Energy issues are more important for the sectors wood and paper, basic metals, chemicals and rubber and plastics.

Source: On the basis of McKinsey (2012).

The classification of manufacturing subsectors leaves a lot of scope for heterogeneity, especially because some classifications (for example the pooling of chemicals, pharmaceuticals and rubber and plastics into one group) combine a wide range of companies and activities. But even within more homogenous sectors, there might still be substantial heterogeneity of firms. For instance, in lower-tech sectors, such as textiles, food and metals, one can find firms that are strong technology leaders. These

firms are often the stable market leaders in otherwise typically turbulent sectors. To capture this heterogeneity one needs to go the firm level (see chapter V).

### *2.2.1 The specialisation of countries in manufacturing sectors*

An implication of the heterogeneity of manufacturing sectors is that the trends and challenges that individual countries and regions experience can to a great extent be related to the manufacturing subsectors that are most important in the make-up of the economies of those countries and regions.

Figure 26 in the Annex compares EU countries on the basis of the manufacturing sectors in which they specialise. Portugal, Italy, Greece and several central and eastern European countries specialise in textiles. While central and eastern European countries have reduced their specialisation in textiles, Portugal, Italy and Greece have reinforced theirs. Ireland, Hungary and Belgium specialise in chemicals (excluding pharmaceuticals). The large EU countries: France, Germany, UK, Italy and Spain have all lost their specialisation in pharmaceuticals. It is only the smaller countries such as Sweden, Ireland, Belgium, Denmark and Slovenia which continue to specialise in pharmaceuticals. Germany and Finland have strong positions in machinery. Finland, Germany and Ireland specialise in electr(on)ics. Germany and the Czech Republic specialise in transport equipment. Italy, Belgium, Sweden and Spain are abandoning their specialisations in this sector<sup>6</sup>.

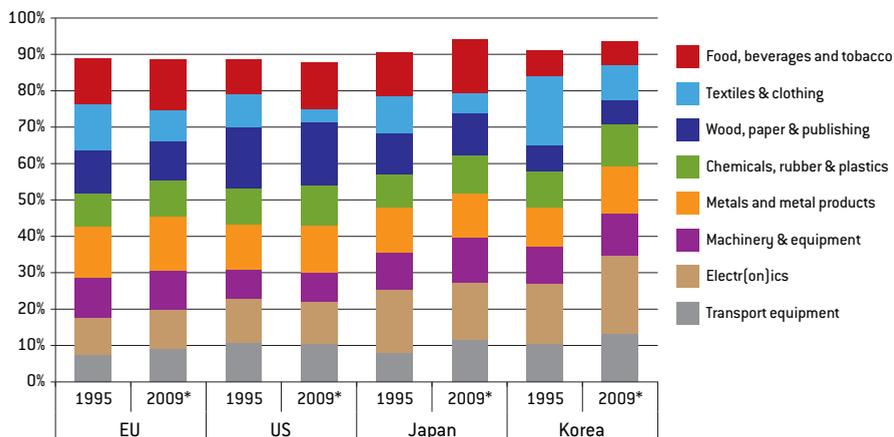
### *2.2.2 Employment trends by sector*

Although all manufacturing sectors have witnessed drops in their shares of total employment, the drop is more notable in some, particularly textiles and clothing, than in others. Electronics has gained employment share in Korea, but has remained stable, or has even lost share, in the west and Japan.

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6. See also European Commission (2011) for an analysis of the industrial structure in EU member states.

**Figure 19: Share of sectors in manufacturing employment, 1995 and 2009**



Source: Bruegel based on EUROSTAT and OECD STAN. Note: not available for China; \* 2009 or most recent year.

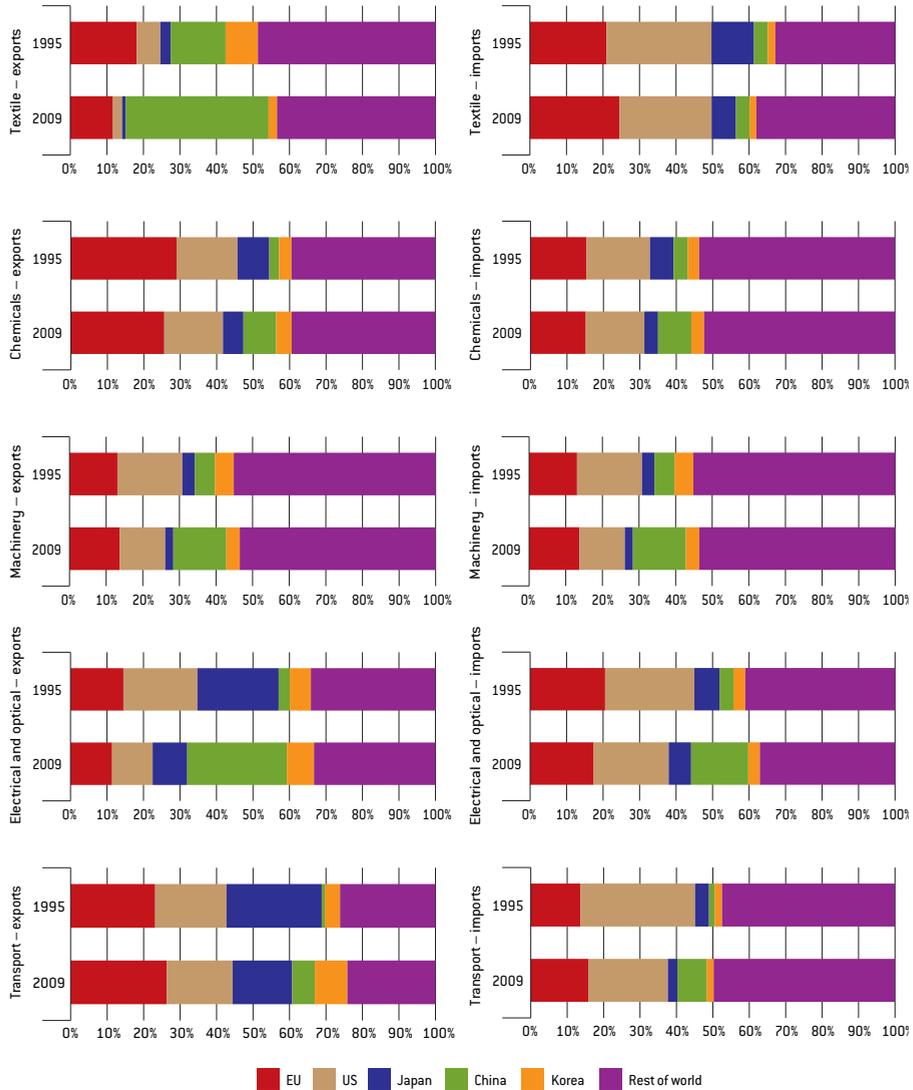
### 2.2.3 Trade effects by sector

The two most tradable manufacturing sectors, textiles and electr(on)ics have also seen the most marked shift from west to east. The rise of China and Korea in electronics has hurt most prominently the US and Japan. The EU27 has been relatively less affected, but mostly because these sectors were already smaller in the EU than in the US and Japan. The chemicals sector has seen much smaller shifts, and in transport, the shifts have also been modest.

The importance of trade effects for explaining manufacturing job losses in the west varies strongly in different sectors. Significantly more developed-economy jobs have been lost because of trade in sectors with tradable products, such as electronics and textiles, for which the centre of gravity has shifted towards Asia. European countries that specialise in these sectors, such as Portugal in textiles, have seen more job losses because of trade effects.

Clearly, because tradability differs in different manufacturing sectors, and countries specialise in different types of manufacturing activities, the composition of the manufacturing trade balance differs substantially in different countries. While the contribution of the textiles sector has been negative in most western economies, this is not the case in Greece, Portugal and Italy. Electr(on)ics also contributes negatively

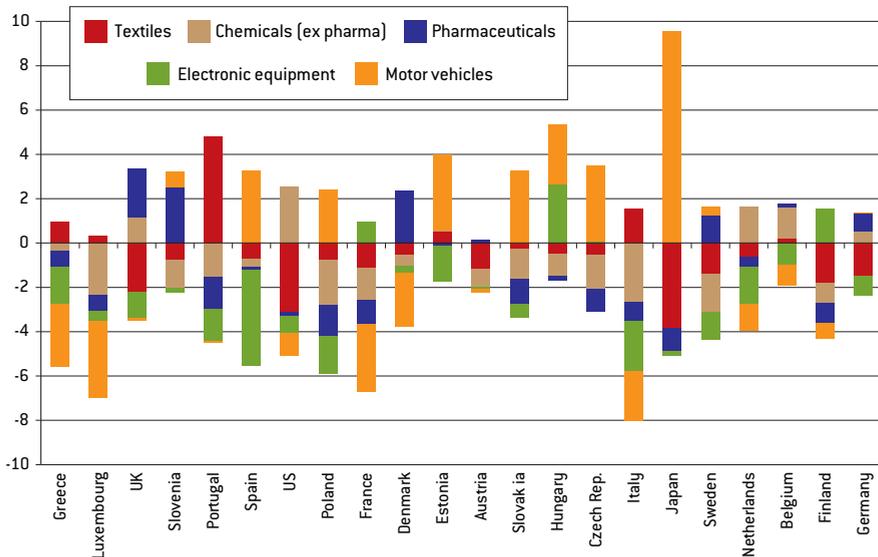
**Figure 20: Manufacturing sectors' shares of total world imports & exports, 1995 and 2009**



Source: Bruegel based on OECD TiVA

to the manufacturing trade balance in most western economies, but not in Finland, Hungary and France. Chemicals (excluding pharmaceuticals) contributes positively to the manufacturing trade balance in the US, the Netherlands, Belgium, Ireland, the UK and Germany. The pharmaceuticals sector contributes positively to the manufacturing trade balance in the UK, Slovenia, Denmark, Sweden, Germany and Ireland. The motor vehicles sector contributes positively to the manufacturing trade balance in Spain, Japan and several central and eastern Europe countries.

**Figure 21: Contribution of selected industries to the manufacturing trade balance, 2008**



Source: OECD STAN. Note: The 'contribution to the trade balance' can be interpreted as an indicator of 'revealed comparative advantage', because it indicates if an industry performs relatively better or worse than the manufacturing total, no matter whether the manufacturing total itself is in deficit or surplus. If there were no comparative advantage or disadvantage for any industry, a country's total trade balance (surplus or deficit) should be distributed across industries according to their share in total trade. The 'contribution to the manufacturing trade balance' is the difference between the actual and this theoretical balance. A positive value for an industry indicates a structural surplus, and a negative value indicates a structural deficit. The indicator is additive and individual industries can be grouped together by totalling their respective values: by construction, the sum across all industries is zero. To allow comparisons between countries, the indicator is generally expressed as a percentage of total trade.

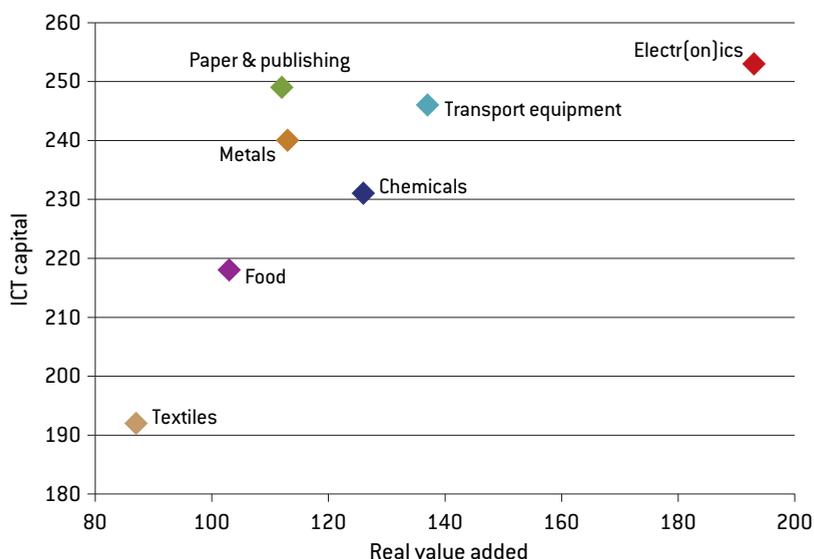
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### 2.2.4 Growth in real value added by sector: ICT production and ICT capital use

Since 1995, the ICT revolution has led to marked differences in productivity growth patterns in different manufacturing sectors. ICT impacts the analysis of manufacturing sectors in two ways: first there are different trends in the ICT producing sectors compared to other sectors, and second, there is the use of ICT capital goods by other sectors.

The ICT manufacturing sector (electr(on)ics, Nace 30-33) has displayed the strongest growth in real value added. It has also been the sector with the strongest growth in ICT capital and total factor productivity (TFP). The growth of real value added in other manufacturing sectors has been much less, with the lowest increase in textiles and food. Textiles and food are also the sectors with the lowest increase in ICT capital (in textile, there has even been a decline). ICT capital growth has also been a substantial contributor to the growth in value added in the car manufacturing sector. All this suggests a strong correlation between ICT production and ICT use and the growth performance of manufacturing sectors<sup>7</sup>.

**Figure 22: Sectoral real value added and ICT capital, average 1995-2007 indices (1995=100)**



Source: Bruegel on the basis of EUKLEMS and EIB (2011).

7. For more on the impact of ICT on productivity growth, see eg Strauss and Samkharadze (2011).

Divergence between the EU15 and the US in manufacturing productivity growth, and the superior performance of some European countries over others, can be linked to their ICT-producing industries. ICT capital formation has been somewhat more important in labour productivity growth in the manufacturing sector in the US than in the EU15, particularly in the 1990s. But the most marked difference is in the performance of the ICT producing sector, electr(on)ics, in which the US massively outperformed the EU15. Within Europe, ICT-producing industries have made a large contribution to productivity growth in Finland, Hungary, Ireland and Sweden (Pilat *et al*, 2006; see Figure 23a).

But perhaps the biggest contribution that ICT durables has made to the growth of value added in other sectors was in the services sector. Investment in ICT capital has been a major contributing factor to labour productivity growth in business and financial services, both in the EU and the US, but more so in the US, thus further reinforcing ICT's contribution to the EU-US productivity growth gap (see Figure 23b).

### 2.2.5 From low-skilled to high-skilled jobs

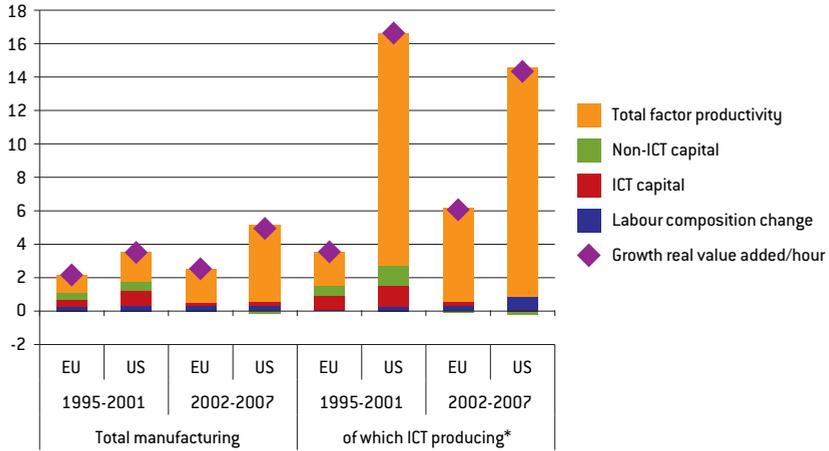
The loss of manufacturing jobs has been mostly the loss of low-skilled jobs while the number of high-skilled jobs in manufacturing is increasing. This holds for all sectors, but is most pronounced in textiles, which has been through the sharpest decline in low-skilled jobs relative to high-skilled jobs. Even in textiles, there has been an expansion in high-skilled jobs, but the increase has been much lower than in other sectors. The food sector has seen the greatest increase in high-skilled labour, and is the sector with the most marked shift from low- to high-skilled jobs.

**Table 3: High versus low-skilled labour shedding in manufacturing, average 1995-2007 indices (1995=100)**

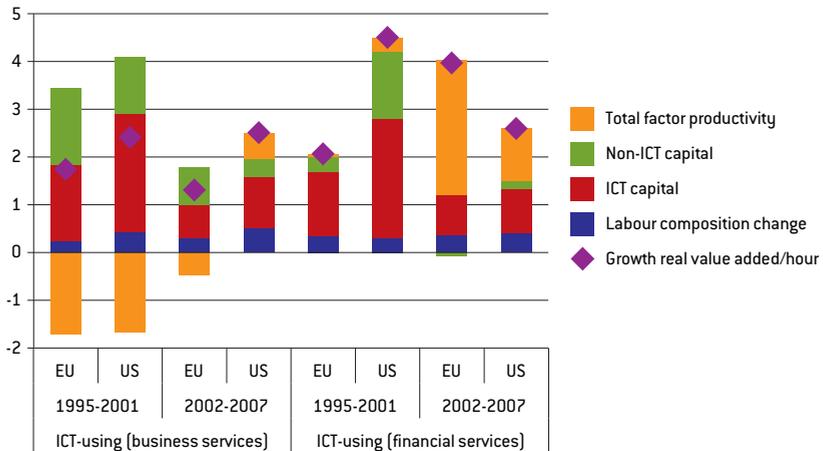
	High-skilled labour	Low-skilled labour	Ratio high/low
Electr(on)ics	122	98	125
Transport Eq	129	97	133
Chemicals	122	94	130
Paper&Publish	120	92	130
Metals	127	100	127
Food	135	94	143
Textiles	111	75	148

Source: Strauss and Samkharadze (2011) on basis of EUKLEMS.

**Figure 23a: Contribution of ICT to labour productivity in total manufacturing and ICT producers (annual average growth rate, %)**



**Figure 23b: Contributions to labour productivity in ICT using services**

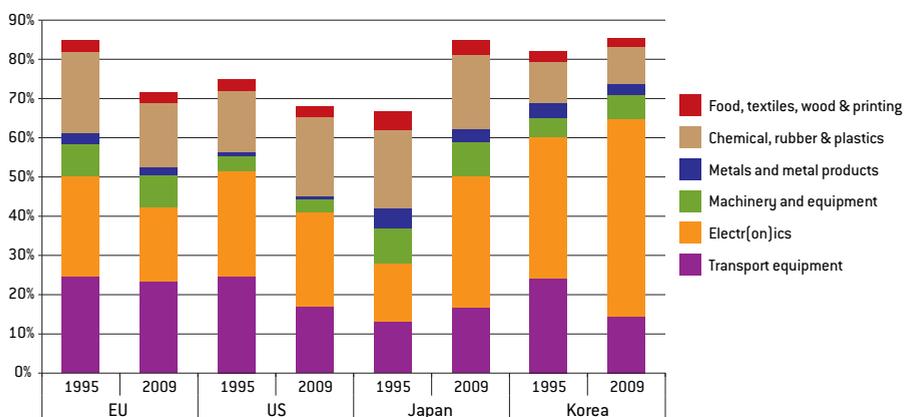


Source: Bruegel based on EU KLEMS. Note: 'EU15' consists of Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain and UK. \* Electrical and optical equipment.

### 2.2.6 Manufacturing sectors as the drivers of R&D

Technology intensity and the scope for technology-driven innovation and productivity and sales growth differs substantially in different sectors. Three sectors account for the bulk of private R&D expenditure: chemicals (including pharmaceuticals and rubber and plastics), motor vehicles and electr(on)ic equipment. The latter has however lost importance in Europe and particularly in the US. These three sectors also have the highest R&D intensity of all manufacturing sectors.

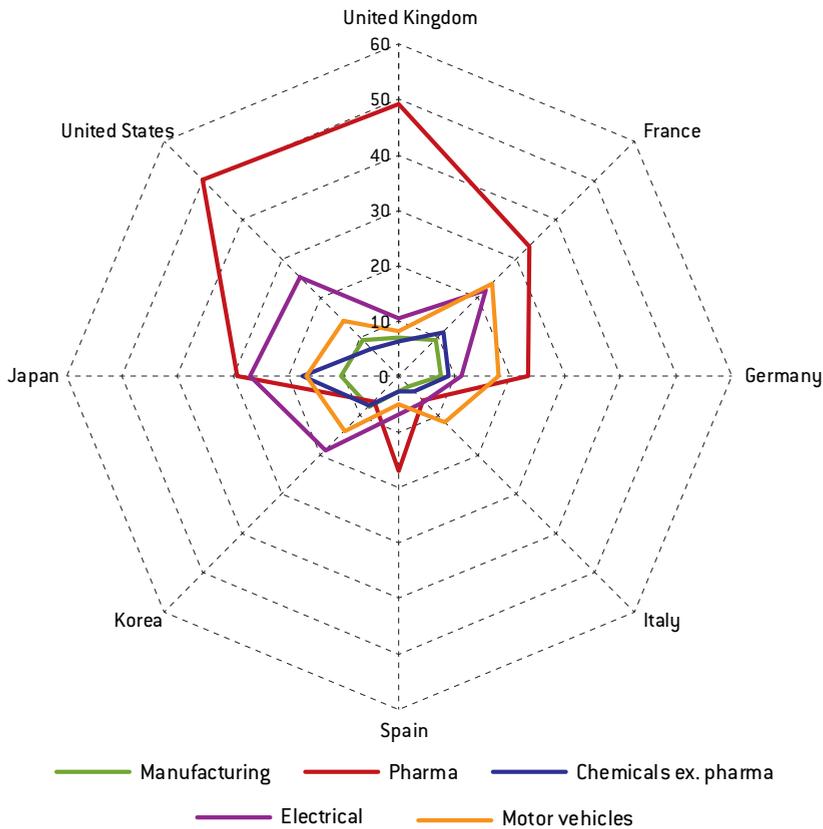
**Figure 24: Manufacturing sectors, share of total business R&D**



Source: Bruegel on the basis of EUROSTAT and OECD, ANBERD. Note: Data for EU does not include Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, Latvia, Lithuania, Luxembourg, Malta or Romania. Data for different manufacturing sectors over time is not available for China. In 2009, 84 percent of China's business R&D was in manufacturing sectors.

Within manufacturing, the sector with the highest R&D intensity is pharmaceuticals. This is the case in all countries, but most notably in the US and UK. Both countries account for a large share of total pharmaceutical sector R&D. Electronics, cars and chemicals have more medium R&D intensity rates. In electronics, US and Japanese manufacturers stand out with the highest R&D intensity, compared to their European counterparts. The car sectors in European countries, especially France and Germany, have higher R&D intensities. For more on which countries have a technology strength in which sectors, see Cincera and Veugelers (2012).

**Figure 25: R&D intensity by sectors and countries**



Source: Bruegel based on OECD STAN.

### 2.3 Challenges for manufacturing in Europe

The global trends and challenges that are influencing and shaping the future of manufacturing globally will also influence and shape the future of European manufacturing<sup>8</sup>. Looking at global opportunities, the first opportunity for manufacturers is the new consumers who will enter the consumer class for manufactured goods.

8. See Future Manufacturing Council of the Australian government (2011) and World Economic Forum (2012) for a more elaborate discussion of future opportunities and challenges for global manufacturing.

These consumers will mostly be supplied by the growing middle class in emerging markets. On the manufacturing supply side, a pipeline of innovations from new technologies provides further opportunities to bring new kinds of manufactured product to the market, to reinvent existing products and to improve the efficiency of manufacturing processes. Examples include manufacturing via 3D-printing, robotics, nanotechnology and IT developments allowing easier management of 'big data'.

The global challenges for manufacturers include:

- The changing patterns of consumer behaviour; consumers in many countries are more urban, affluent, mobile and ageing;
- Rapidly evolving and increasingly more modular technologies, which are much less sensitive to economies of scale and challenge large incumbents;
- A more globally integrated world with diverging growth perspectives and consequential shifts in market demand and competition;
- A lurking scarcity of supply for many natural resources (such as petroleum, rare earths, metals), with a resulting pressure on prices;
- A scarcity of specific skills, especially technical, multidisciplinary and entrepreneurial talent. This scarcity exists even though there is mass unemployment, and is evident particularly in ageing societies and when labour and education markets are inflexible;
- Global warming and subsequent climate change.

These challenges will have to be dealt with in conjunction with a more volatile and uncertain environment for European manufacturing. The euro crisis has created greater uncertainty about macroeconomic and financial-market conditions. There is also more uncertainty about whether and how governments will intervene in markets: if they will be more protective or more liberal, with more/fewer or different regulations<sup>9</sup>. Input prices for some resources (raw material, energy) will continue to be volatile. Climate change will introduce more and bigger shocks, more difficult to handle with normal risk-management practices. Because of global integration, external shocks will diffuse faster and wider. International supply chains further amplify the impact of external shocks. Firms engaged in global manufacturing are more vulnerable to the disruption of their supply chains. A local disruption in the supply chain reverberates through the

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9. A 2008 survey done by EIU for the *European Voice*, polling 337 executives from the manufacturing sector, identified as major challenges for manufacturing in Europe: competition from emerging markets and controlling the costs of material. Of secondary importance were energy and climate change regulations, particularly for respondents from the chemicals sector.

international network because the intermediate goods traded are relationship-specific, meaning it is not easy to shift to another supplier<sup>10</sup>.

Translating the looming opportunities into real strengths for manufacturing in Europe depends on how these challenges are addressed:

- Climate change and the scarcity of some natural resources calls for manufacturing processes and products with greater environmental sustainability.
- Consumers' expectations for sustainable and personalised products will require manufacturers to customise their products to meet individual tastes and preferences. From the design and production perspectives, manufacturers will need to respond quickly to a much wider variety of product specifications.
- Manufacturing technologies are likely to increasingly play a prominent role in enabling mass customisation. Key enabling technologies such as nanotechnology and biotechnology, rapid prototyping and additive manufacturing have the potential to support the development of new, improved, sustainable and higher value-added products and production processes. New manufacturing technological innovations also provide the opportunity for low-volume manufacturing without relatively expensive set-up costs (for example, 3D printing), reducing entry barriers for new players in the global market and reducing the need to offshore production to locations where economies of scale and lower labour costs can be achieved. Computing and the ICT revolution have had a particularly significant impact on manufacturing industries in the past, providing the opportunity for more agile, just-in-time processing, high-performance manufacturing, and accelerated introduction of new products. Continuing developments in hardware and software technologies (such as cloud computing) will continue, if not accelerate, these trends in the future.
- Because many new entrants into the workforce are pursuing careers outside the manufacturing industry, manufacturing faces tough competition in the labour market. Consequently, the ability of companies and the industry as a whole to market manufacturing as a viable and rewarding career path will be vital to recruiting new generations of employees. This will particularly be the case for attracting multidisciplinary creative talents that are needed to research, develop and implement the new manufacturing technology innovations discussed in this chapter. This will require more flexible labour and higher education markets in Europe.

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10. In the automobile industry, for example, it takes six months to a year to change suppliers depending on how complicated the part is to produce. As a French automobile manufacturer realised, the unavailability of only one engine part could shut down whole assembly lines. For more on the amplifying impact of global value chains on shock sensitivity, see for example Escaith and Gonguet (2009).

- The ability of European firms to identify and exploit new and emerging markets will also be critical. The disposable incomes of the middle classes in emerging markets are increasing. This represents a major opportunity for European manufacturers to export their high value-added products. At the same time, these markets remain attractive locations for manufacturing tasks, given their large pool of well trained, still relatively cheap labour, and increasingly also their R&D strengths (Veugelers, 2013).

These global trends shaping the future of manufacturing will also change the set of factors that will be most pivotal for determining the countries and regions in which manufacturers will locate their activities and jobs. The two major location factors, access to markets and access to (cheap) resources, will remain important. But increasingly important will be: access to specific skills and research capabilities; the availability of high-quality support services, and a network of sophisticated lead customers and suppliers.

As an example, the 2012 PWC-CEO survey (PWC, 2012) identified China as the country most frequently noted by respondents as the most important new country for company growth, with the US in second place. Of the motives why these countries are important new growth countries for their companies, the overwhelmingly most important motive mentioned was to grow the firm's customer base. In second tier came being able to access their local talent base, followed by building internal service delivery capacity and building R&D capacity. Of only minor importance were building of manufacturing capability, access to resources & components and access to capital. All this suggests that pre- and post- production activities rather than the assembly-production activities, will be more pivotal for value creation and growth in the manufacturing sector, as the 'smile curve' already suggested page 27.

For the companies that identified an EU country as their most important new growth market (Germany, France, UK), the customer base was the main reason, while the opportunity to build manufacturing capacity was least important. This is reminiscent of the importance of access to the single market as point of attractiveness for locating future manufacturing activities in the EU.

China's attractiveness as the most important new-growth country is a combination of almost all factors, underlining that China is more than just a manufacturing base.

**Table 4: Most important country for growth prospects of your company, % of respondents (N=1258) mentioning country**

China	US	Brazil	India	Germany	Russia	UK	France	Japan	Australia
30	22	15	14	12	8	6	5	5	4

Source: PWC-CEO survey, 2012.

**Table 5: Reasons for importance of countries for growth prospects of your company, % of respondents mentioning reason**

	All location countries (weighted average)	EU countries (Germany, UK, France) (weighted average)	US	China
Grow customer base	78	75	71	79
Access local talent base	51	38	46	55
Build internal service delivery capacity	42	34	30	46
Build R&D capacity	25	21	26	27
Build Manufacturing capacity	24	11	17	30
Access raw material & components	24	10	19	34
Access local sources of capital	15	13	23	14

Source: PWC-CEO survey, 2012.

## 2.4 Main insights

The major trends characterising the recent past of manufacturing in Europe are likely to continue to influence its future prospects. These trends include the continued decline of the share of manufacturing in the total economy in terms of production, employment and value added. The share of the manufacturing sector in total economic activity is not likely to rebound substantially in most European countries. The relative decline of European manufacturing results from relatively slow growth in demand for manufactured products, with demand for services growing more rapidly. The relative and absolute decline in manufacturing employment is due to strong productivity growth, but is also affected by shifting geography, with the growth of manufacturing capacity in Asian countries.

In addition, the character of manufacturing production in Europe is changing. Manufacturing activity increasingly involves intellectual assets and high value added

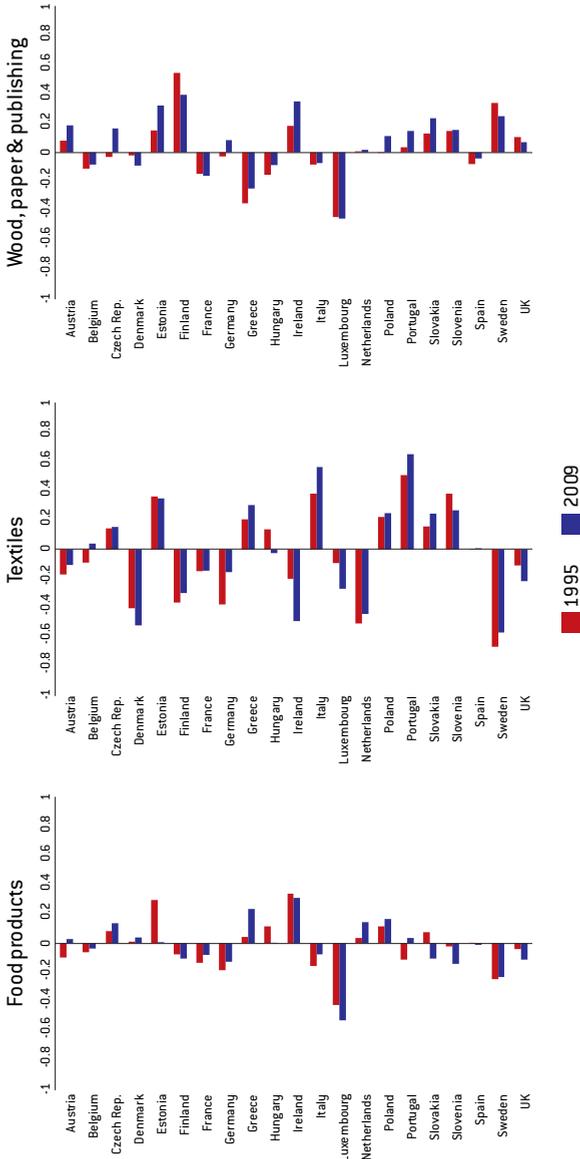
activities, such as research and development, design, financial and aftersales services and logistics. The emphasis on high value added activities translates into a growing servitisation of manufacturing and the greater importance of innovative capacity. The sources of innovative capacity for manufacturing are present and developed worldwide. Aspects of high-technology production are increasingly carried out in Asian countries. Research and development capacity is growing strongly in emerging markets, particularly in China.

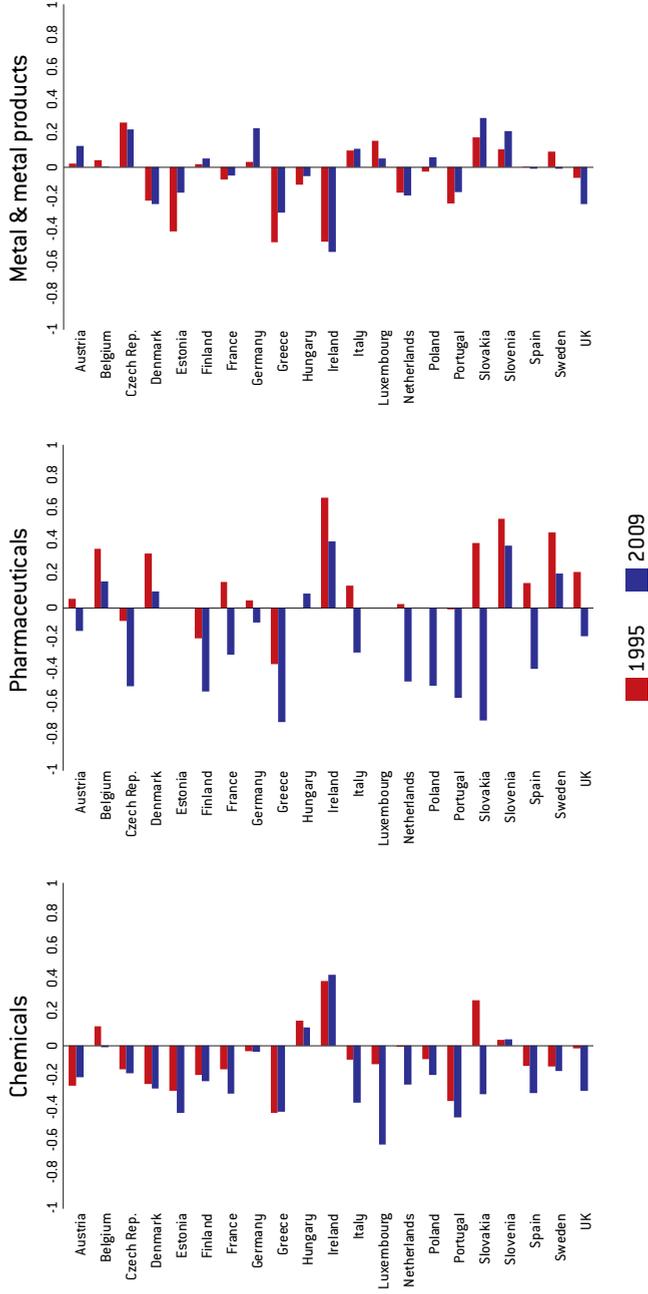
Manufacturing production continues to be more and more integrated at the global level. Manufacturers increasingly explore which aspects of production can be carried out at arms' length, either within their own country or abroad, or by their foreign affiliates. Chapter 4 looks at the impact of global value chains in more detail.

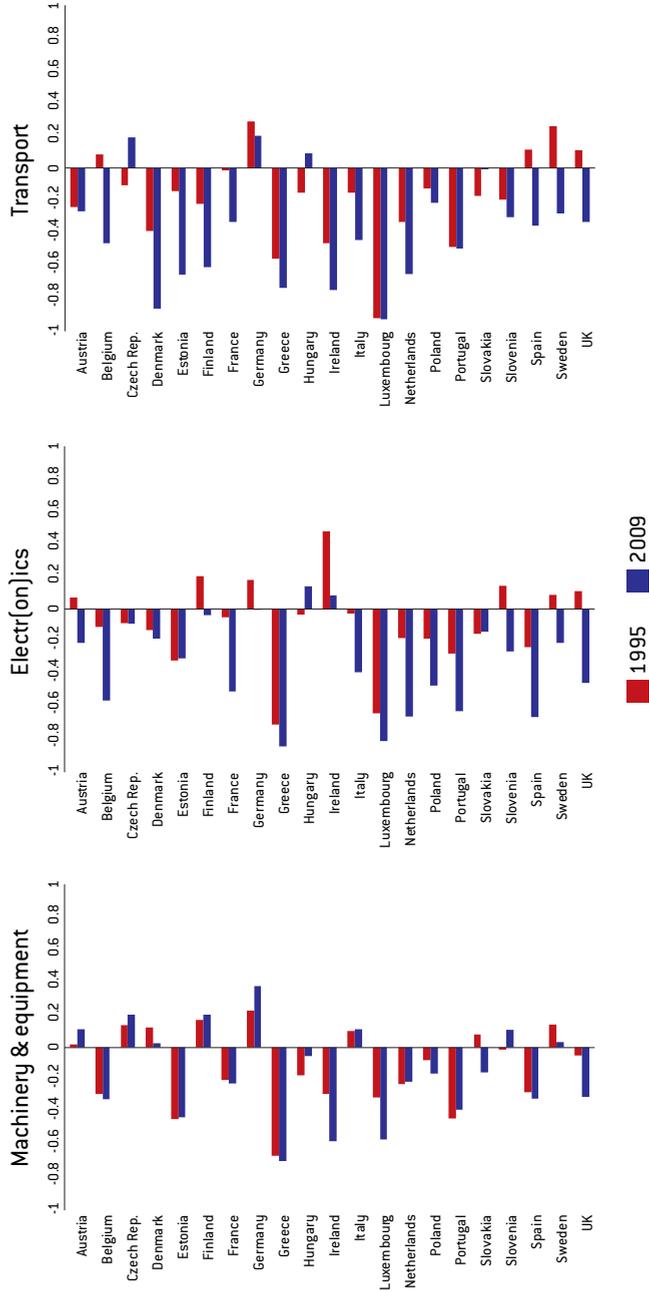
What do all these continuing trends bode for the future of manufacturing in Europe? Despite the declining share of manufacturing employment and value added, manufacturing will continue to matter for European economies, but primarily for its innovation and productivity-growth capacity, directly and indirectly. Even if the decline stops (as the discussion on the rebirth of manufacturing would suggest, a discussion particularly going on in the US, riding on the shale gas windfall, see for example Morgan Stanley, 2013), high levels of manufacturing employment will not return to Europe, because of productivity increases and the forces of global competition. The issue is not so much how many jobs, but which types of manufacturing activities and jobs will ensure Europe's future prosperity. Manufacturing activities and jobs will increasingly be beyond the production stage, providing manufactured solutions with high value creation.

Annex

Figure 26: EU countries and sectors, revealed symmetric comparative advantage based on value added for EU







Source: Bruegel based on OECD STAN. Note: The RSCA index is computed considering EU as the reference total.

# 3 Manufacturing as a source of growth for southern Europe: opportunities and obstacles

BY ERKKI VIHRIÄLÄ AND GUNTRAM B. WOLFF

Growth in southern Europe remains elusive. Private sector deleveraging, the gradual reduction of public deficits, a weak business environment and the comparatively high borrowing costs weigh on economic growth. These factors combined with the need to adjust high external debt levels suggest that growth should come from the external sector, ie from exports of goods and services.

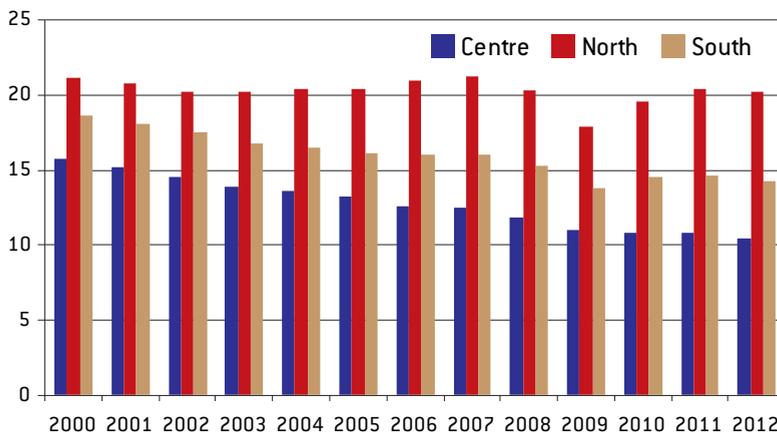
The manufacturing sector is one of the key sectors determining export performance and an important source of growth. In the US, the EU and Japan, productivity growth in the manufacturing sector has significantly outpaced that of the rest of the economy in the last few decades. Yet at the same time, the manufacturing sector has been undergoing a steady relative decline. In the south of Europe in particular, but also in France, the manufacturing sector's weight in the economy has been limited and declining, while in Germany manufacturing has retained its relative importance.

In this chapter, we document the evidence of the decline in manufacturing in southern Europe. We assess to what extent the decline has been different from the decline elsewhere and contrast it in particular with Germany. We then discuss different explanations for the decline in manufacturing in southern Europe. As well as the trend of a natural decline in manufacturing, the rise in unit labour costs and capital costs and structural factors and agglomeration effects play a role in explaining the decline of the sector in the south.

### 3.1 Growth and manufacturing: stylised data

The pre-crisis booms in the south were associated with a decline in manufacturing – its share of total value added dropped from 18.6 percent in 2000 to 13.8 percent in 2009 (Figure 1). The decline in the 2000s has been similar in France and Belgium, even though the level is even more subdued, declining to 11 percent in 2009. In contrast, northern Europe, and Germany in particular, has not experienced such an erosion of its manufacturing base. Since 2009, the decline in the share of the manufacturing sector seems to have stopped in the south and centre of Europe.

**Figure 1: Share of manufacturing in total gross value added for euro-area country groups, 2000-12**



Source: Bruegel based on Eurostat. Note: Centre = Belgium, France; North = Austria, Finland, Germany, the Netherlands; South = Greece, Italy, Portugal, Spain. The aggregates are weighted.

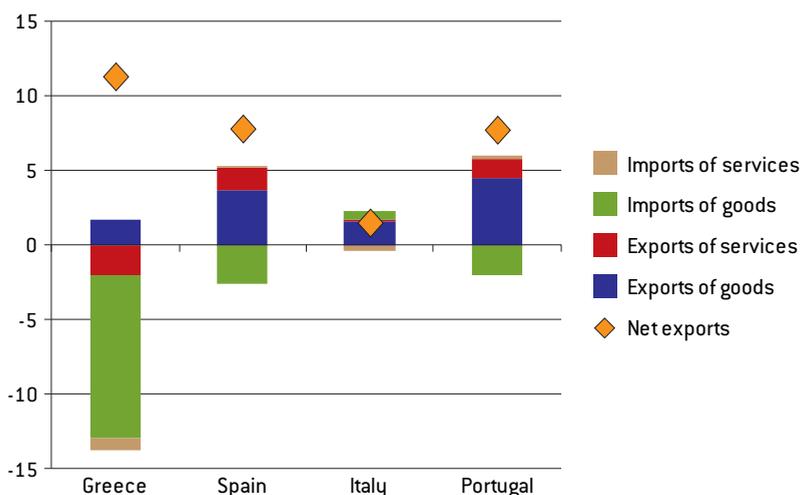
Because domestic demand is expected to remain subdued for the foreseeable future, exports have become a primary source of growth. A significant trade surplus is also necessary to service and reduce the sizeable net foreign liabilities in the region, which ranged from a manageable 24 percent in Italy to a very high 117 percent of GDP in Portugal in 2012.

Traditionally, southern Europe's exports have been more concentrated than the EU as a whole in services, tourism in particular, relative to manufacturing. Additionally, goods other than manufactured goods make up a larger share of exports from the south than from the north of Europe. Specifically, manufactured goods made up about 60 percent of total exports of EU members in 2012, whereas services accounted for approximately

25 percent. In contrast, in the southern European countries, the share of manufacturing was about 55 percent. Nevertheless, the share of service exports was less than 1 percentage-point greater than in the EU as a whole. Consequently, the difference relative to the EU aggregate is explained primarily by the larger share of non-manufactured goods in total exports. There are significant differences between the southern countries. In Italy, the share of manufacturing in exports was 67 percent compared to 20 percent in Greece. Conversely, services accounted for 47 percent of Greek exports, whereas the share for Italy was only 18 percent.

The external balance of southern euro-area countries has adjusted considerably since the beginning of the crisis (Figure 2). In Spain and Portugal, a healthy increase in exports has been the primary driver<sup>1</sup>. Greece has adjusted exclusively through import compression. But the trade balances could improve considerably more should manufacturing regain some of its former weight.

**Figure 2: Change in trade balance 2007-12, selected countries (% of 2012 GDP)**



Source: Bruegel based on AMECO.

1. In Ireland the increase in the current account balance has also been driven by the export sector. We do not cover Ireland in detail, however, because its manufacturing sector is considerably larger than that of southern EU countries and suffers from fewer structural problems. Additionally, Ireland posted a healthy current account surplus of 3.7 percent of GDP in 2012.

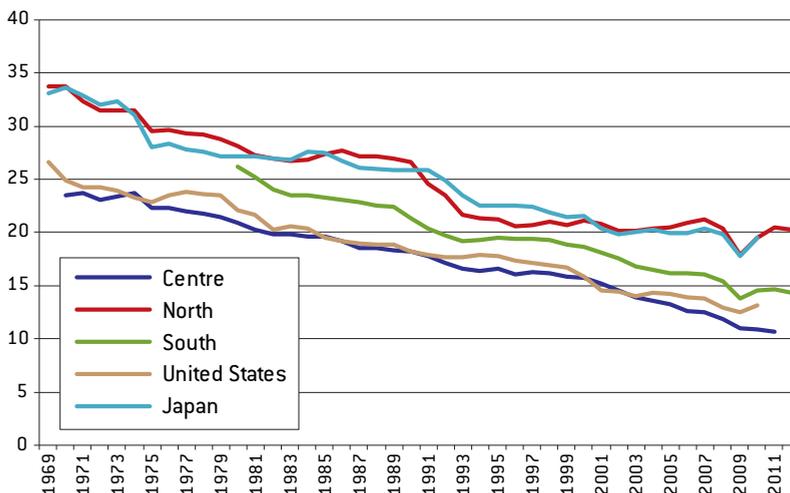
Between 2007 and 2012, manufacturing accounted for 85 percent and services for 16 percent of the increase in net exports, while net exports of non-manufactured goods declined somewhat. However, gross exports of services grew faster (7.1 percent) than exports of manufactured goods (3.5 percent) in southern Europe in relative terms. These were both dwarfed by growth in gross exports of non-manufactured goods (64 percent).

This snapshot shows that a deeper analysis of the manufacturing sector in southern Europe is needed. How different are the long-term trends in the manufacturing sector in the region from those seen elsewhere? In addition, we explore whether the introduction of a common currency or price- and non-price competitiveness factors can explain developments in the 2000s. Finally, we study the financing conditions for potential exporters in southern Europe and assess the potential impact on the manufacturing sector of more restrictive financing conditions.

### 3.2 A historical perspective on the role of manufacturing

Figure 1 showed the decline of manufacturing during the 2000s. The reported relative fall, however, has been steady: across the developed world, the share of manufacturing has been declining for decades. Figure 3 shows the share of manufacturing in total gross value added for selected country groups and individual economies over a longer time span. Clearly, the decline of manufacturing has been widespread, persistent and strikingly linear. It also started before the integration of China and other emerging markets into the world economy. The question is therefore what has driven this downward trend and to what degree it is reasonable to assume a reversal in southern Europe.

**Figure 3: Share of manufacturing in total gross value added for euro-area country groups, Japan and the US (1969-2012)**

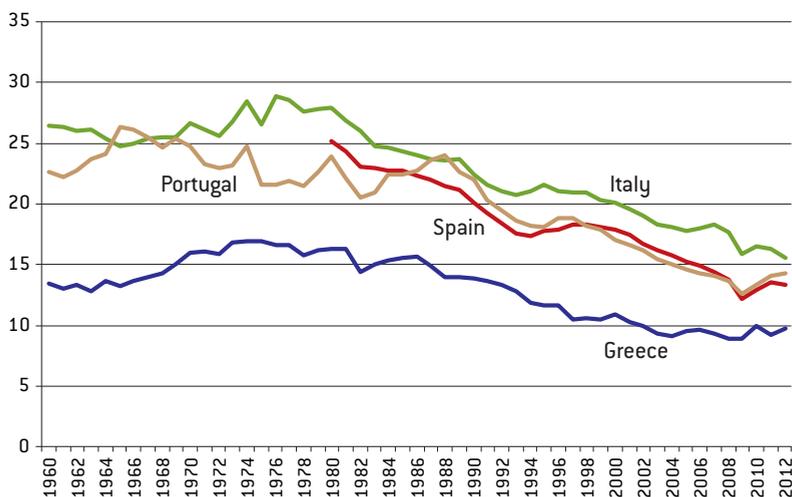


Source: Bruegel based on AMECO. Note: Figure 3 is the long-term counterpart of Figure 1. However, the two use different sources and numbers therefore differ somewhat. AMECO has the advantage of yielding a longer time series. Eurostat has figures for all countries for 2012. Country groups as in Figure 1. Note that Germany = West Germany up to 1990.

The picture is similar if we analyse manufacturing's share of employment (Figure A1 in the Annex). The most significant difference is that the relative share of manufacturing has also continued to decline in Germany when measured by this indicator.

The southern aggregate (Figure 3) masks differences in the significance of manufacturing for each country. The sector has traditionally been quite large in Italy, whereas the Greek manufacturing sector is the smallest as a share of gross value added (Figure 4).

**Figure 4: Share of manufacturing in total gross value added for southern euro-area countries (1960–2012)**

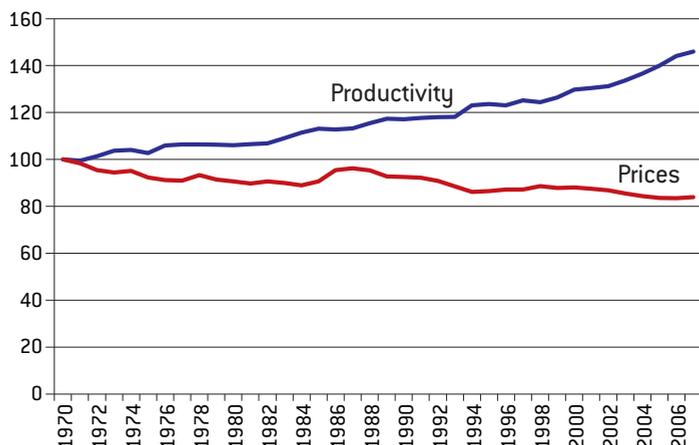


Source: Bruegel based on AMECO.

Edwards and Lawrence (2013) argue that much of the relative decline of manufacturing can be explained by high productivity growth in the sector not being matched by an offsetting increase in demand. Therefore, productivity growth has coincided with lower prices, a lower-value share of total output and lower employment in the sector. In a nutshell, manufacturing is undergoing the same process as the agricultural sector did.

Figure 5 shows the greater increase in manufacturing productivity compared to the economy as a whole (EU15). Between 1970 and 2007, manufacturing productivity more than tripled, whereas productivity in the total economy increased by a factor of less than 2.5. As a result, manufacturing productivity increased 40 percent more than aggregate productivity. However, the relative price of manufactured products declined by almost 20 percent.

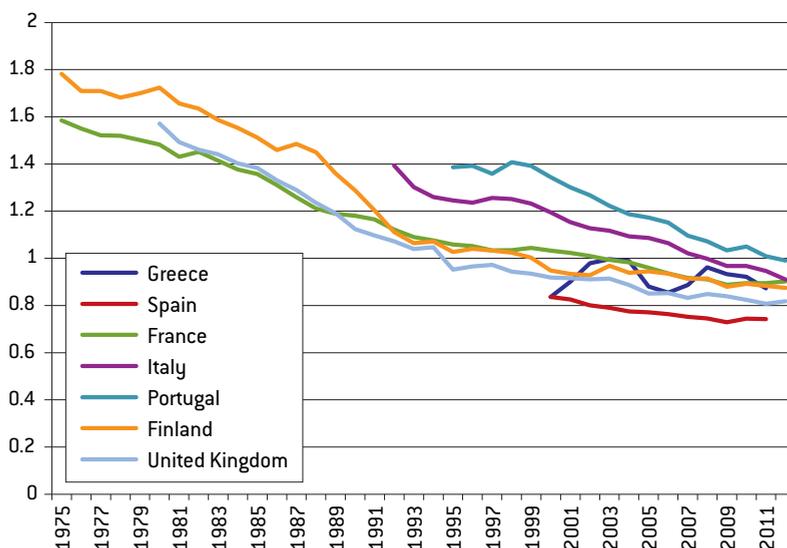
**Figure 5: Manufacturing productivity and prices relative to total economy in the EU15, 1970-2007 (1970=100)**



Source: Bruegel based on EU KLEMS database. Notes: (i) Productivity is measured by gross value added per hour worked. The price index is derived from the difference in nominal gross value added growth and volume growth. (ii) The two measures are calculated by setting productivity and prices indices in total economy and manufacturing equal to 100 in 1970. The lines in Figure 5 plot the evolution of the manufacturing-total economy ratio of these indices. For instance, the value of 146 for productivity in 2007 is equal to  $334/229 \times 100$ , where 334 is the productivity index for manufacturing in 2007 and 229 the corresponding index for total economy. Consequently, the relative productivity of the manufacturing sector increased by 46 percent over the period. Because the total economy includes the manufacturing sector, manufacturing productivity has grown even faster relative to other sectors.

As the decrease in the relative price of manufactured goods has not been matched by a commensurate increase in demand, households spend an increasingly smaller share of their income on goods relative to services (Figure 6).

**Figure 6: Ratio of household spending on goods relative to services, selected countries (1975-2012)**

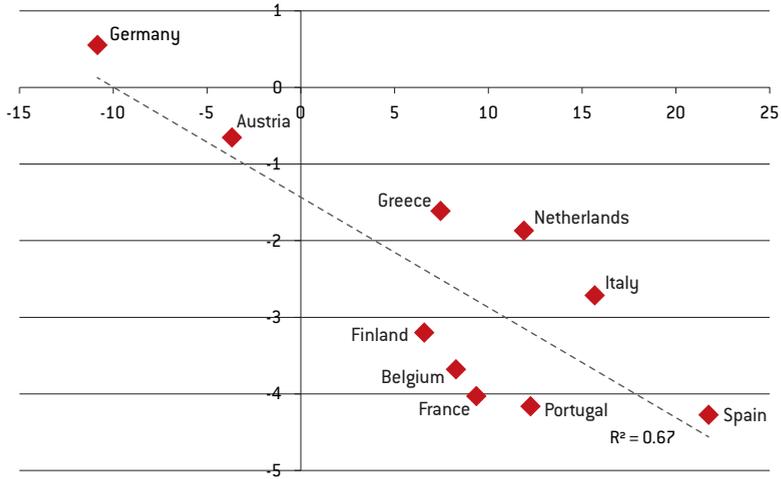


Source: Bruegel based on Eurostat.

### 3.3 Unit labour costs as an explanation for the decline in manufacturing

One hypothesis is that the size of the manufacturing sector is driven by the appreciation of the exchange rate. In particular, since the introduction of the euro, real exchange rates have diverged significantly in the euro area. Figure 7 illustrates the relationship between changes in real exchange rates and the share of manufacturing in gross value added, since the introduction of the euro.

**Figure 7: Change in manufacturing share vs. change in ULC-based REER 1999-2008**

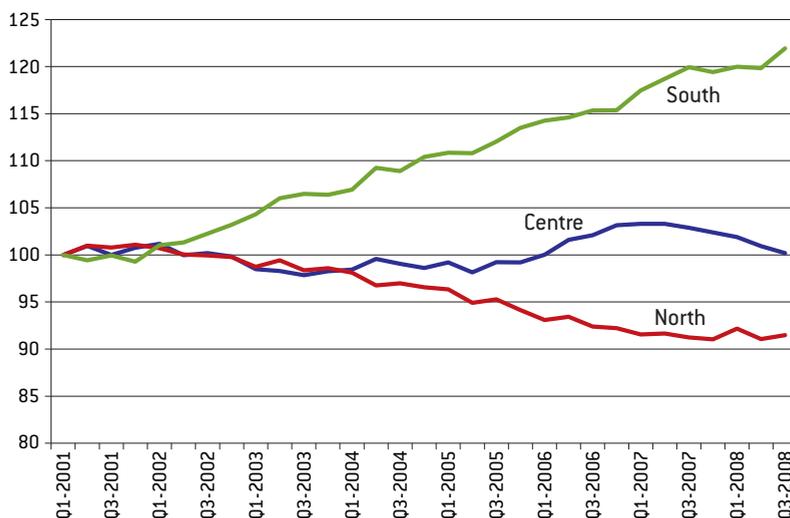


Source: Bruegel based on AMECO. Note: The REER used is relative to 36 industrial countries. ULC change on x-axis, change in manufacturing shares on y-axis.

An appreciating real exchange rate is associated with a decline in the share of manufacturing. The Greek, Italian and Spanish manufacturing sectors contracted by less than expected given the strong exchange rate appreciation after 1999. However, the particularly severe decline in Portugal after the introduction of the euro coincided with relatively muted relative cost increases.

The general decline of manufacturing in the developed world can be attributed to technological and demand effects. However, price competitiveness issues also impact the size of the manufacturing sector in southern Europe. The steep rise in manufacturing unit labour costs in the south before the crisis (Figure 8) corroborates this hypothesis.

**Figure 8: Unit labour cost growth in manufacturing relative to the euro area (2001Q1-2008Q3)**

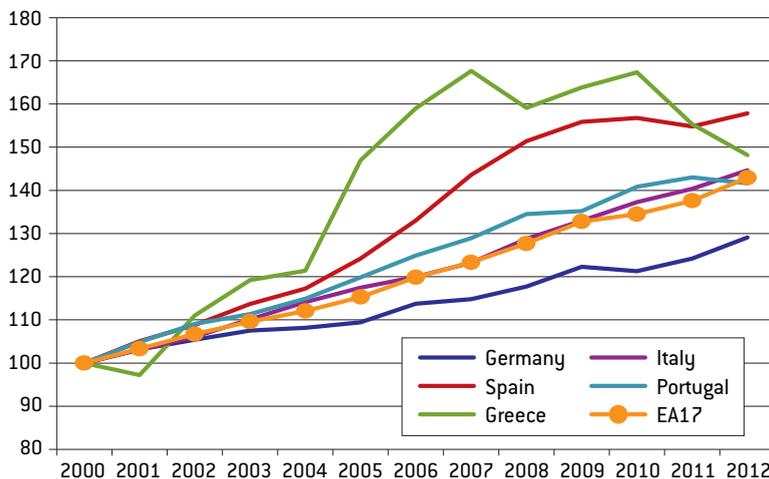


Source: Bruegel based on OECD and AMECO. Note: The index is calculated by setting unit labour cost indices in all countries equal to 100 in 2001Q1. The evolution of the ULC index is then averaged across countries in a given group. The sum of manufacturing gross value added during 2001–2008 is used as a country-specific weight. Finally the group index is divided by the EA-17 index.

Figure 9 shows the evolution of hourly compensation in manufacturing<sup>2</sup>. Hourly compensation in 2012 was 10 percent below its 2009 level in Greece in nominal terms. Furthermore, wages have grown more slowly in Spain and Portugal than in the euro area as a whole since the crisis. In Italy, though, there was no wage devaluation relative to the monetary union aggregate.

2. The OECD unit labour cost data for manufacturing extends only until 2011Q2, so it cannot be used to judge how much adjustment has occurred up to present.

**Figure 9: Evolution of manufacturing nominal hourly compensation 2000-12 (2000=100)**



Source: Bruegel based on ECB.

Wage costs matter for the viability of manufacturing because manufactured goods have to compete on international markets. Consequently, the increase in labour costs during the first ten years of the euro partly explains the decline of manufacturing in the south. Since the onset of the crisis, costs in the south have partly adjusted relative to the euro-area average.

### 3.4 Agglomeration effects

A further explanation for the decline in manufacturing might be the increasing agglomeration of economic activity. Such agglomeration effects can arise from increased economic integration in Europe. The introduction of the euro, in particular, could have influenced firms and industries to locate to certain regions to reap the benefits of economies of scale and decreasing transportation (or more broadly transaction) costs. Box 1 surveys the literature on determinants of industry location and the transformation of the European industrial landscape.

### BOX 1: AGGLOMERATION EFFECTS IN EUROPEAN MANUFACTURING

Classical trade theory (Ohlin, 1933) explains why countries specialise in different industries based on their relative factor abundance. The new trade theory that flourished in the 1980s aimed to explain intra-industry trade based on economies of scale. Related to this, the new economic geography (Krugman, 2009 and 2011, surveys the literature) concentrates on the question of what determines industry location. If transport costs are not prohibitive, economies of scale provide an incentive for industries to concentrate their production in selected geographical areas. Given that economies of scale can be achieved anywhere, industry location is determined by minimising aggregate transportation costs. This is done by locating production in the largest market. This core-periphery model implies that lower transportation costs would lead to the de-industrialisation of remote areas and a concentration of economic activity in the centre. Furthermore, the concentration of industries would be supported by external economies of scale such as labour pooling by similar firms. Closeness of firms would give rise to information sharing and mutually helpful feedback.

Economic integration in Europe and particularly the introduction of the euro ignited debate about the effects on the continent's industrial landscape. The theoretical framework of Krugman and Venables (1996) implied that concentration could be limited if trade costs fell only by little. Drastic reductions in trade costs, though, would favour strong industry concentration.

A crucial question was whether increased integration would favour more inter-industry or intra-industry trade. For instance, Kenen (1969) and Eichengreen (1992) argued that integration would lead to greater specialisation by different countries in different industries. This would mean that industry-specific shocks would become more important, subjecting members of a currency union to more heterogenous business cycles because they could not pursue independent monetary policy. Conversely, Ricci (1997) argued that a monetary union would favour the development of intra-industry trade. He postulated that exchange rate flexibility is conducive to inter-industry specialisation, because relative price fluctuations act as an absorber of industry-specific shocks. Therefore a move to a fixed exchange rate system would favour relatively more intra-industry trade between different regions.

Relatively little empirical research has assessed changes in European industrial landscape in the last decades. Bagoulla and Péridy (2011) stress market and supply

access as determinants of location choice for industries in the Euro-Mediterranean area, which includes EU and some non-European countries. They also found that concentration of high-technology manufacturing increased between 1990 and 2003. Brühlhart and Traeger (2005) summarised the literature by stating that *“this diagnosis of a slowly more concentrated European industrial geography is supported by the majority of analyses, but there are numerous exceptions.”* They empirically estimated the concentration of industry by both the relative employment shares of different industries in different regions, and by examining the geographical dispersion of production. They found that in terms of employment shares, manufacturing is concentrating in Europe. Topographically, however, it is diverging because manufacturing is moving to lower-density regions. The authors argue that this methodological difference explains the conflicting results in previous literature.

Finally, Höhenberger and Schmiedeberg (2008) find that when using a three-sector classification (agriculture, manufacturing, services), there was convergence in employment shares in the EU15 without Luxembourg between 1970 and 2004/05.

The literature surveyed in Box 1 does not provide strong evidence that the unusual pattern of manufacturing in Germany can be explained by the euro. Certainly, Germany with its large market and central location appears to have all the ingredients for a Krugman-type concentration of activity. In particular, the integration of German industry with eastern Europe has been exceptional. Gräf *et al* (2013) show that the global value chains of German companies are a source of competitive edge over rivals. The foreign value added content of German exports has increased faster than in other countries since the mid-1990s. This is because German companies have been especially active in integrating eastern Europe and other emerging markets into their production chains. This in turn, according to Gräf *et al* (2013), increased their competitiveness. Arguably, this effect is not related to the monetary union but rather to the enlargement of the EU to central and eastern Europe. German manufacturing has stabilised since the early 1990s, not only since the introduction of the euro.

Instead of the euro, a more plausible explanation for the current strength of German industry is thus the disappearance of the iron curtain. Germany, more than other countries, was exposed to the resulting increased competition and the opportunity to reorganise its production structure. The competitive pressure forced Germany to engage in labour market reforms that reduced wage growth substantially. A further important factor was the corporate deleveraging that started in 2001 and is documented by Ruscher and Wolff (2012). A combination of high debt, a shock to the

stock market and changes in the cost of finance because of the abolition of the public guarantees for Landesbanks (*Gewährträgerhaftung*) initiated a major corporate deleveraging period (Schumacher, 2006). This deleveraging substantially strengthened the financial position of German industry and further contributed to its current strength.

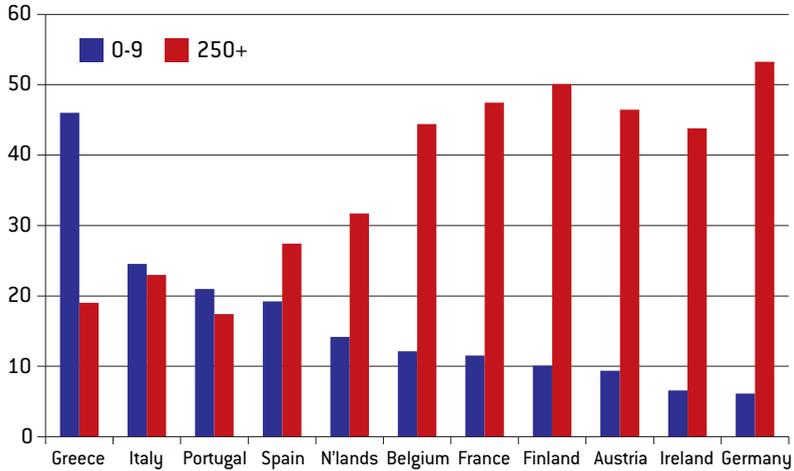
One important question is why French industry did not benefit from similar locational advantages. Transportation costs between France and central and eastern Europe arguably are not so great, and France benefited from lower transportation costs to and from the Iberian Peninsula, which was booming up to the beginning of the crisis. Nevertheless, the French manufacturing sector has declined dramatically and is among the smallest in relative terms in the EU. This question clearly deserves further analysis.

### 3.5 Structural factors

Other factors contribute to the weakness of manufacturing in the south of Europe. Such non-price-competitiveness factors are familiar, multiple and not specific to only manufacturing. However, they are certainly a major part of the weakness of southern European industry. Southern countries rank badly according to many structural indicators relating to labour and product markets and education levels, all of which depress firm productivity (see Darvas & Pisani-Ferry, 2011, for a comparison of structural indicators).

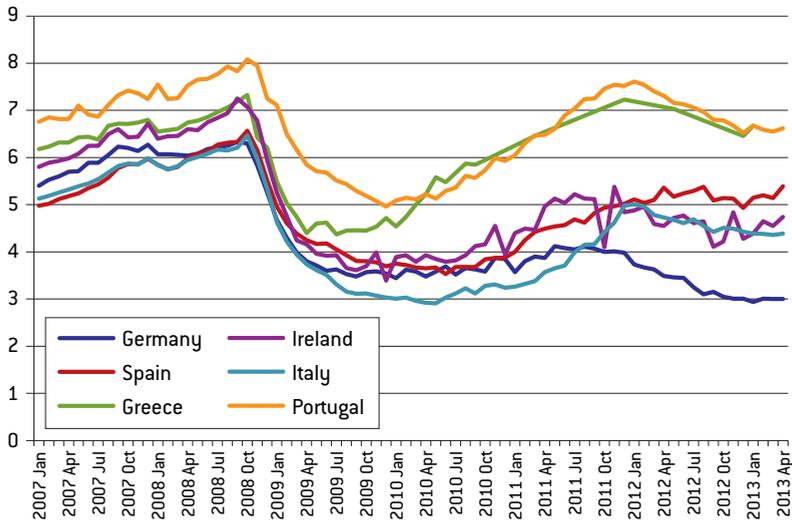
One factor that coincides with low productivity is the small average size of southern European companies (Figure 10). One of the important insights of modern firm-level research is that firm size is one of the most important factors associated with corporate performance (Altomonte *et al*, 2012). In Greece, firms with fewer than 10 employees account for 46 percent of total employment in manufacturing compared to only 6 percent in Germany. Ireland is clearly more northern than southern based on manufacturing firm size, which might partly explain why its export performance since 2007 has been the best of the afflicted countries. Barriers to firm growth in southern Europe involve trade costs, innovation costs and tax distortions (Crespo *et al*, 2012.). The EFIGE study (see chapter 5) singles out innovation costs as the quantitatively

**Figure 10: Micro manufacturers (0-9 employees) and large manufacturers (250+ employees), share of total employment in 2012**



Source: Bruegel based on European Commission's SME performance review.

**Figure 11: Interest rate on new loans to non-financial corporations, loans of up to €1 million (Jan 2007-Apr 2013)**



Source: Bruegel based on ECB.

largest impediment to firm expansion.

### 3.6 The crisis: financing conditions as a drag on manufacturing

Manufacturing is a relatively capital-intensive sector. Therefore its growth relies on adequate credit to finance investment as well as the working capital. As the southern manufacturing sector consists to a great extent of relatively small companies, we assess in particular the financing conditions facing small- and medium sized enterprises (SMEs) in the region.

Interest rates on comparatively small loans remain far higher in the south than in Germany (Figure 11). Greek and Portuguese companies already faced higher borrowing costs before the crisis, but Spanish and Italian borrowing costs deviated from Germany only in 2011.

In addition to the cost of credit, there are quantitative restrictions. Of the German SMEs that applied for credit in the second half of 2012, 85 percent obtained the full amount<sup>3</sup>. The average for the southern European countries was 41.8 percent, with a low of 25 percent for Greece. In addition, whereas only 2 percent of German SMEs did not apply for credit for fear of rejection, the average in the south was 10.6 percent, with a high of 16 percent in Greece.

There are a number of reasons for these differences. To the extent that spreads for corporate borrowing represent the varying risks of businesses in different countries, markets are working efficiently. However, if manufacturing companies that primarily rely on (common) export markets face different borrowing costs in different countries, it can be a sign of financial fragmentation.

Evidence of bank discrimination against SMEs based on their performance or export status is limited. Lawless and McCann (2011) explore this question using Irish survey data for 2010. They tested if firm productivity, sales or export status had an effect on loan outcomes. They found that banks did not discriminate between heterogeneous SMEs, which points to inefficiencies in credit allocation in a crisis.

Holton *et al* (2012) used the SAFE survey<sup>4</sup> to test determinants of SME access to

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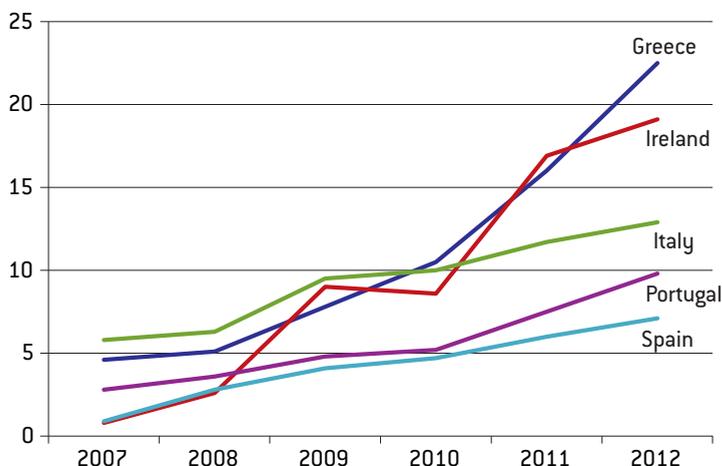
3. According to the European Central Bank's 'Survey on the access to finance of SMEs' (SAFE), available at <http://www.ecb.europa.eu/stats/money/surveys/sme/html/index.en.html>.

4. *Ibid*.

finance at the European level. They found that firms that self-report better performance face fewer constraints when obtaining credit, which would indicate functioning markets. Nevertheless, this result is based on a panel regression of firms from 11 euro-area countries, and does therefore not reveal if the result holds in southern Europe.

A potential cause of fragmentation is the health of the banking system in distressed

**Figure 12: Bank non-performing loans as a % of total loans, selected countries, 2007-12**



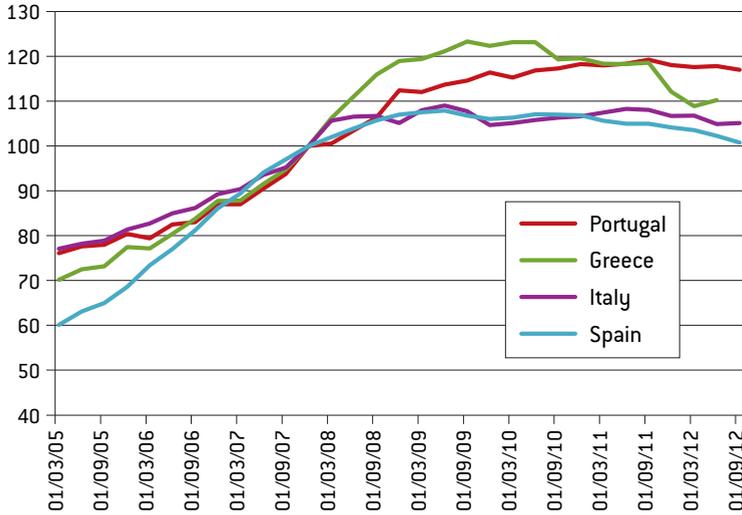
Source: Bruegel based on IMF.

economies. Non-performing loans have not yet peaked in southern Europe (Figure 12) and weak banks often do not extend loans.

Non-performing loans are also a counterpart to high levels of corporate debt. Figure 13 plots the evolution of non-financial corporate debt in southern economies. The rapid growth in outstanding credit stopped around the end of 2008 after which [absolute] debt levels have stayed flat in Italy, Portugal and Spain and decreased somewhat in Greece. As nominal GDP was lower in all four countries in 2012 than in 2008, relative debt levels have actually increased since the crisis.

The corporate deleveraging process in southern Europe has thus not yet been completed and dramatically weighs down on growth. As the external growth environment remains relatively weak and corporate bankruptcy/debt restructuring processes

**Figure 13: Nominal non-financial corporate debt 2005Q1-2012Q3 (2007Q4=100)**



Source: Bruegel based on BIS.

burdensome, the corporate sector as a whole remains structurally weak. Banks are likely to demand a generalised risk premium for all corporations because of the difficulty in clearly and easily distinguishing between good and bad borrowers.

However, the resulting higher cost of capital has dramatic effects on industry and growth. Higher capital costs will – all other things being equal – reduce the optimal size of the capital stock. During the transition phase, investment rates will be

### BOX 2: RELATIONSHIP BETWEEN CAPITAL COST, FACTOR USE AND REQUIRED WAGE ADJUSTMENT

This box presents a simplified model that examines the impact of an increase in capital cost on firms' decisions about how much capital and labour they need. The simulations we include also illustrate the wage adjustment need arising from a shock to the cost of capital.

Assume a profit-maximising firm with decreasing returns to scale employing capital (K) and labour (L) to produce output (y). The assumption of decreasing returns to scale represents constraints in how flexibly a firm can reorganise its production in the short run.

$$\pi = L^\alpha K^\beta; \alpha, \beta > 0, \alpha + \beta < 1$$

For a small firm the price of the output (p), wage level (w) and capital cost (r) are given. It chooses the optimal level of labour and capital given these prices in order to maximise profits ( $\pi$ ).

$$\pi(K, L) = pL^\alpha K^\beta - wL - rK$$

The first order conditions (i)–(iii) are that the marginal product of capital and labour equal their marginal cost.

$$(i) \frac{\partial \pi}{\partial L} = \alpha p L^{\alpha-1} K^\beta - w = 0$$

$$(ii) \frac{\partial \pi}{\partial K} = \beta p L^\alpha K^{\beta-1} - r = 0$$

The two equations can be solved for the two unknowns, the amount of labour and capital employed.

Next, we use the model to roughly illustrate the effects of an increase in capital costs, which represents the tight financing conditions that southern European companies have experienced since the crisis (Table 1).

**Table 1: The effects of an increase in the cost of capital**

Increase in capital cost	Change in K employed	Change in L employed	Change in K/L	Required wage adjustment to keep L at original level
5%	-11%	-6%	-5%	-2%
10%	-20%	-12%	-9%	-3%
25%	-41%	-26%	-20%	-8%

Source: Bruegel. Notes: (i) The figure for the increase in capital cost reflects a relative increase, not a %-point increase in the interest rate. It is therefore invariant to the original cost of capital. (ii) The parameter values we use are  $\alpha$  and  $\beta$ , where  $\alpha$  represents the labour and capital income shares and  $\beta$  is a scalar characterizing the intensity of decreasing returns to scale.

Table 1 shows the effects of different increases in capital cost. An increase of 10 percent, representing for instance an increase in the interest rate from 5 percent to 5.5 percent, would reduce the amount of capital employed by 20 percent, employment by 12 percent and the capital-labour ratio by 9 percent. The exact figures have limited substance but illustrate the fact that a rise in capital costs leads to lower employment because the marginal productivity of labour decreases. The amount of capital decreases even more in relative terms, which causes a drop in the capital-labour ratio.

The model also illustrates that the wage level would need to decrease after the shock to the capital cost in order to keep employment constant. This can be considered as an indication of the need for southern manufacturing companies to cut labour costs to reverse part of the jump in unemployment caused by the increase in capital cost. We assume here that the firm in question sells its output exclusively abroad so that demand for its goods is not affected by a reduction in domestic wages. In our simulations, a 10 percent increase in capital cost would need to be offset by a 3 percent fall in wages to keep employment constant.

dramatically reduced. But lower capital levels also change the optimal amount of labour employed by firms (Box 2). Therefore wages need to adjust by even more than they otherwise would in order to limit the rise in unemployment. Higher capital costs are thus a further burden holding back adjustment.

### 3.7 Implications for policy

Growth in southern Europe remains weak. The most important contribution to growth comes from the external sector and in particular from manufacturers. Because domestic demand is likely to remain weak, further improvement in the competitiveness of the manufacturing sector would be required to increase growth through exports.

However, a number of significant factors are holding back manufacturing. First, manufacturing has experienced a decades-long natural decline across the developed world, and southern Europe is no exception. By contrast, the constant share of manufacturing in Germany stands out as exceptional and can likely be ascribed to successful integration of German industry into the European and global value chain. In particular, the fall of the Iron Curtain triggered a number of important policy changes and business decisions, which led to the vertical and cost efficient integration of German manufacturing with central and eastern Europe.

The currently low levels of manufacturing production in southern Europe could be raised by further cost adjustment. In particular, the adjustment of unit labour costs is one relevant factor.

It may be more important, however, to enhance productivity so that southern manufacturers produce innovative goods that the rest of the world wants. This would require a host of structural reforms related to promoting firm growth. Reductions in trade and innovation costs, and in tax distortions as emphasised by Crespo *et al* (2012), are needed. Also firm size is far below the European average in the south, and small firm size is identified as one of the factors associated with low levels of innovation and limited export performance.

Finally, the currently tight financing conditions for SMEs in the south are a major hindrance to the resumption of growth. They reduce optimal investment levels and increase the need for relative wage adjustment. A thorough review of the state of the banking system, followed by an adequate recapitalisation, is required to resume a healthy flow of credit to viable firms in southern Europe. The establishment of a fully-

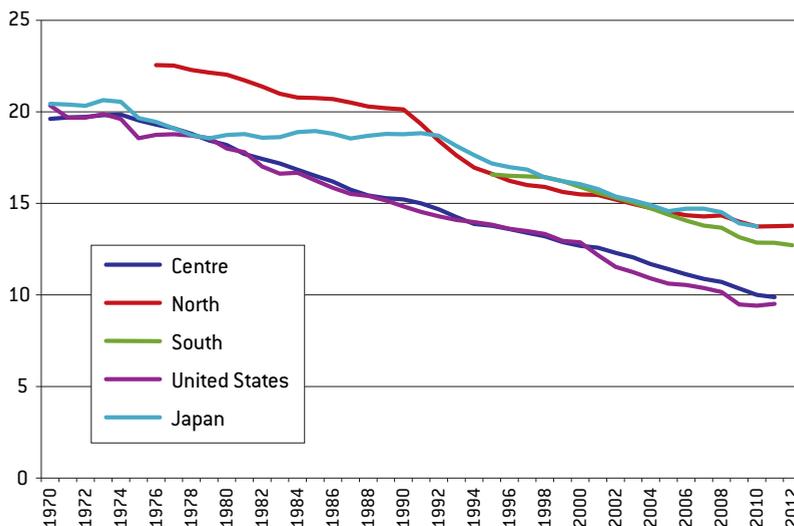
fledged banking union would also greatly contribute to improved financing conditions. Other innovative measures (see Darvas, 2013) can also be considered to help ease financing conditions in the short run. Nevertheless, eventually credit allocation should remain the job of a healthy private financial system.

The strong export growth in parts of southern Europe since the crisis is an indication of the potential of the firms in the region. But they face an uneven playing field compared to competitors in the north because of the south's structural shortcomings and because of current tight financing conditions. Action by policymakers is required to overcome these obstacles.

ANNEX

The share of employment in manufacturing has declined.

**Figure A1: Share of manufacturing in total employment for euro-area country groups, Japan and the US (1970-2012)**



Source: Bruegel based on AMECO.

Among EU countries, only the group of northern European countries has had a broadly stable share of manufacturing in terms of value added since the mid-1990s. Germany in particular stands out. It is the only country that increased the share of manufacturing in value added during both the pre- and post-crisis period (Table A1). But even in Germany manufacturing accounts for a declining share of employment. Among the other northern countries, the decline in manufacturing's share of value added and employment in Finland since it became part of the euro area has been striking. This was influenced for instance by the structural decline of the forestry industry and, more recently, the poor performance of Nokia.

The most drastic declines in manufacturing employment and value added pre-crisis were in Portugal and Spain, with reductions of over four percentage points. Greece's manufacturing sector contracted relatively little pre-2008, although this was probably related to it being the smallest to begin with. From 2008-12, the fall in manufacturing employment was fairly similar in all 'Centre' and 'South' countries. However, whereas

manufacturing's share in gross value added declined by more than 2 percent in Italy, it actually increased in Greece and Portugal. However, this was because other sectors were shrinking even faster.

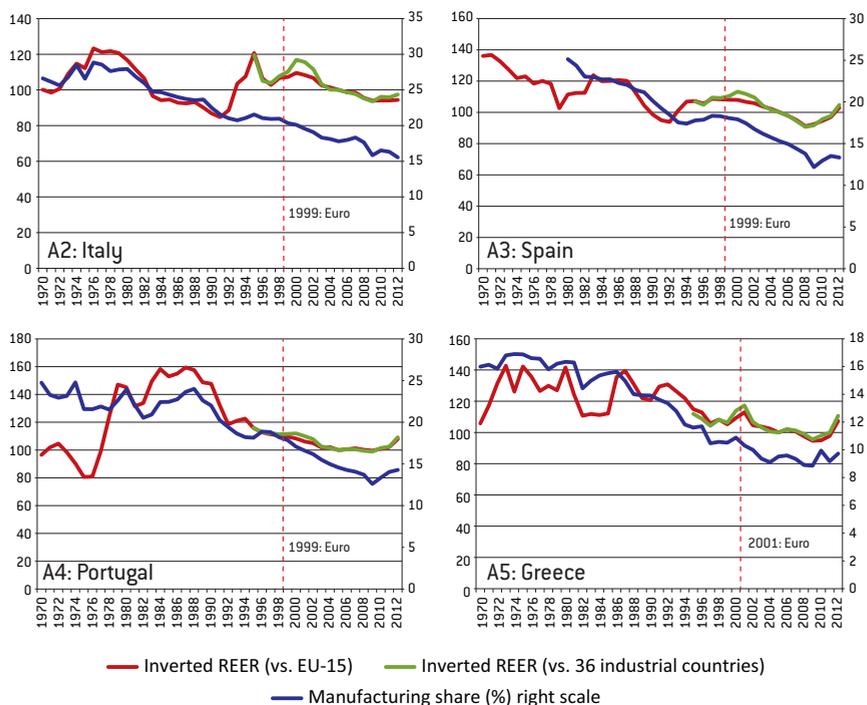
**Table A1: Changes in the %-share of manufacturing in total economy.**

	Change 1999-2008 employment	Change 2008-12 employment	Change 1999-2008 value added	Change 2008-12 value added
<b>North</b>	-1.8	-0.7	-0.3	-0.1
Austria	-1.6	-0.9	-0.7	-0.3
Finland	-2.4	-1.8	-3.2	-4.6
Germany	-1.6	-0.8	0.6	0.1
Netherlands	-2.1	-0.6	-1.9	0.1
<b>Centre</b>	-2.8	-1.2	-4.0	-1.2
Belgium	-2.8	-1.5	-3.7	-1.6
France	-2.8	-1.2	-4.0	-1.2
<b>South</b>	-3.1	-1.3	-3.5	-1.1
Greece	-0.5	-1.5	-1.6	0.8
Italy	-2.4	-1.6	-2.7	-2.1
Portugal	-4.0	-1.2	-4.2	0.6
Spain	-4.8	-1.4	-4.3	-0.5

Source: Bruegel based on Eurostat (employment data in persons) and AMECO (value added). Note: Initial employment share change for 'South', Greece and Spain is measured during 2000-08 due to missing data. Change in value added share for 'Centre' and France in the latter period is measured during 2008-11 for the same reason.

Figures A2–A5 take an even longer-term view by plotting the manufacturing share against the change in the real exchange rate based on unit labour costs, and highlighting the year of euro accession. The downward trend in the share of manufacturing in Italy did not change when it joined the euro. In Greece, the share of manufacturing if anything stabilised after its euro membership, albeit at a very low level. In Portugal and Spain, however, the manufacturing share stabilised to some degree in the mid-1990s, but resumed its decline after the adoption of the euro.

**Figures A2–A5: Evolution of manufacturing share in total gross value added and ULC-based real exchange rate, Greece, Italy, Portugal and Spain (1970-2012)**



Source: Bruegel based on AMECO.

# 4 Manufacturing in global value chains<sup>1</sup>

BY KOEN DE BACKER, SÉBASTIEN MIROUDOT AND ALEXANDROS RAGOUSSIS

## 4.1 New competitive dynamics in global manufacturing

### 4.1.1 *The rise of global value chains*

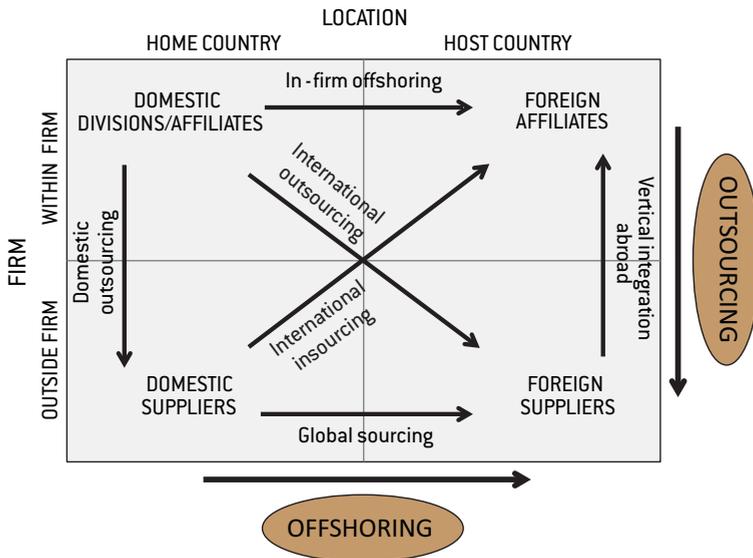
As a consequence of the dispersion of value chain activities around the world, manufacturing has become increasingly organised within so-called global value chains (GVCs). A value chain includes the full range of activities that firms engage in to bring a product to the market, from conception to final use; such activities range from design, production, marketing and distribution to support to the final customer (Porter, 1986; Gereffi *et al*, 2001). The activities in a manufacturing value chain might be performed by a single company or divided between several (supplier) firms; they cover goods and services and can be concentrated in one location or spread out over different locations. Many companies have broken up their value chains by outsourcing parts of their value chains to external partners and offshoring production stages to different countries, hence the term global value chain (GVC, Figure 1).

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1. This chapter is based on OECD (2013) *Interconnected economies: benefiting from global value chains*, which sets out the main evidence and policy implications from the OECD work on global value chains. Note on data on Israel: statistical data on Israel is supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law. Note on data on Cyprus by Turkey: the information in this document with reference to 'Cyprus' relates to the southern part of the island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus. Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the 'Cyprus issue'. Note on data by all the European Union member states of the OECD and the European Union: the Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

This international fragmentation of production in GVCs is driven by technological progress, costs, access to resources and markets, and trade policy reforms. Rapid advances in information and communication technologies (ICT) have resulted in cheaper and more reliable telecommunications, information management software and increasingly powerful personal computers, leading to a marked reduction in the cost of co-ordinating complex activities within and between companies over long distances. Technological progress in transportation through containerised shipping, standardisation, automation and greater intermodality of freight has brought down transportation costs. Trade liberalisation has resulted in reduced trade barriers. These developments have enabled companies to look at relative costs and factor endowments and build efficient value chains incorporating many firms and locations.

**Figure 1: Firms' outsourcing and offshoring strategies**



Source: based on Van Welsum and Vickery (2006), OECD (2007), and Miroudot *et al* (2009).

While GVCs may not be an entirely new phenomenon (Gereffi and Lee, 2012), they are a defining feature of modern globalisation. Baldwin (2009) describes the end of the need to perform manufacturing stages near each other as the 'second unbundling', as opposed to the 'first unbundling' that allowed production to be done far from the point of consumption. Particularly new are the speed, scale and complexity that have been added to the process of economic globalisation. GVCs have deepened the process of

globalisation geographically (by including more countries, including emerging economies), sectorally (by affecting manufacturing but also increasingly services) and functionally (by including not only production and distribution but also R&D and innovation).

Empirical evidence demonstrates the growing importance of outsourcing (ie the purchase of intermediate goods and services from specialist external suppliers) and offshoring (ie purchases of intermediate goods and services from foreign providers)<sup>2</sup>. Going back to the work of Feenstra and Hanson (1996) and De Backer and Yamano (2012), aggregate indicators based on input-output tables show that the share of externally sourced intermediates in production (ie outsourcing) and the share of imported intermediates in total intermediates (ie offshoring) increased in the European Union and in most EU member states between 1995 and 2009<sup>3</sup>.

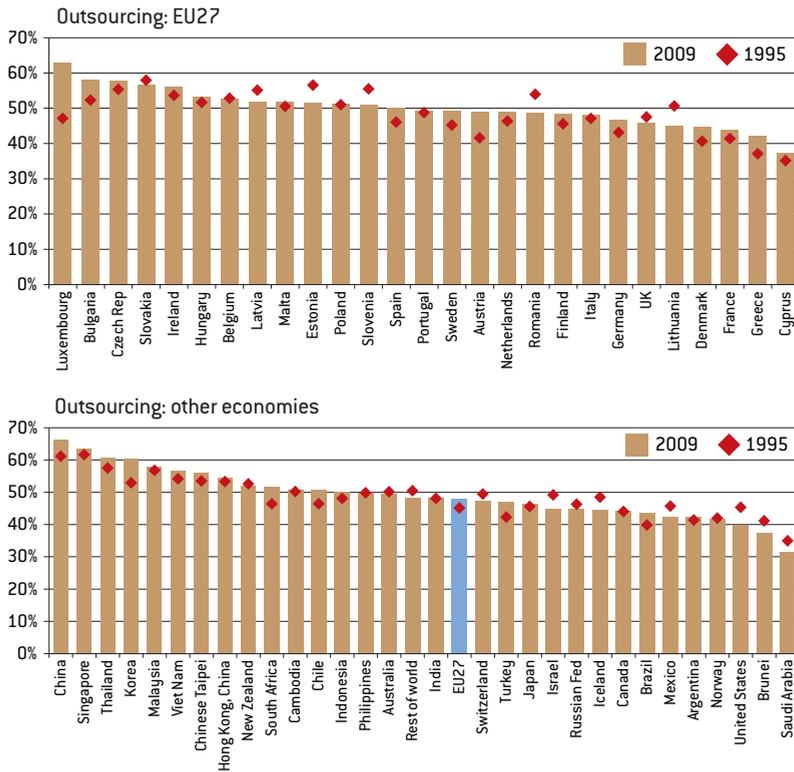
Unsurprisingly, multinational enterprises (MNEs) are leading actors in GVCs because of their extensive international activities through their foreign affiliates. So-called 'buyer-driven' chains have developed around large retailers such as Walmart and highly successful brand merchandisers such as Nike. Their products are often relatively simple, eg apparel, housewares and toys. The manufacturing of such products require relatively little capital and few skilled workers. Lead firms in these GVCs focus almost exclusively on marketing and sales. They have few factories of their own but source products (often via intermediaries such as trading companies) from a large network of independent supplier firms.

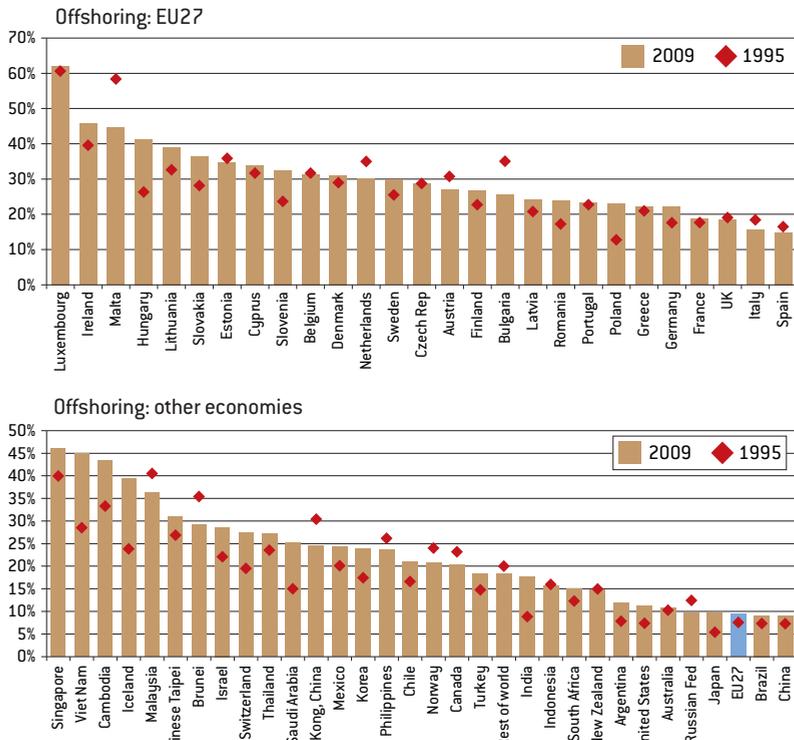
By contrast, producer-driven GVCs are typically found in high-technology sectors, such as the semiconductor, electronics, automotive and pharmaceuticals industries. Because these industries rely on technology and R&D, large firms such as GM, Sony and Apple control the design of products as well as most of the assembly, which takes place in a number of countries. Technology (including design) and production expertise are core competencies that are largely developed in-house in the lead firms or in affiliates and captive suppliers that can be prevented from sharing technology with competitors.

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2. Offshoring includes both international outsourcing (where activities are contracted out to independent suppliers abroad) and international in-sourcing (the transfer of particular tasks within the firm to a foreign affiliate) – see Figure 1.
  3. Evidence on GVCs at the aggregate level has been limited and until recently there was little internationally comparable data on the importance of GVCs for different economies, in contrast to the growing number of case studies on individual product GVCs (eg Apple's iPod and iPhone). However the OECD has addressed the measurement of GVCs during the past years using (international) Input-Output Tables; the OECD/WTO database on Trade in Value Added provides new data and indicators on GVCs for a 57 economies.

The participation of small and medium sized enterprises (SMEs) in GVCs is more limited. Smaller firms often supply intermediates to exporting firms in their country and are as such relatively more integrated in domestic value chains. Slaughter (2013) calculated that the typical US MNE buys more than \$3 billion in inputs from more than 6000 US SMEs – or almost 25 percent of the total input purchased by these firms. Overall, SMEs face serious challenges in terms of finding the financial and managerial resources that will enable them to integrate into GVCs. Their small scale is often insufficient to support the costs of adequate R&D, the training of personnel, and the fulfilment of strict requirements in terms of product standards and quality. However, SMEs may see new opportunities to expand their business abroad in GVCs (OECD, 2006). The supply base of the automotive industry, for example, has globalised, resulting in the rapid internationalisation of smaller companies that have become key suppliers (ie second- or even first-tier suppliers). Often, as car assemblers set up final

Figure 2: Outsourcing and offshoring, 1995 and 2009





Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database). Note: outsourcing is calculated as the purchase of intermediate goods and services from specialist external suppliers as percentage of production, while offshoring is calculated as the purchases of intermediate goods and services from foreign providers as percentage of intermediate inputs.

assembly plants in new locations, they have helped/urged their suppliers to move abroad with them (Van Biesebroeck and Sturgeon, 2010).

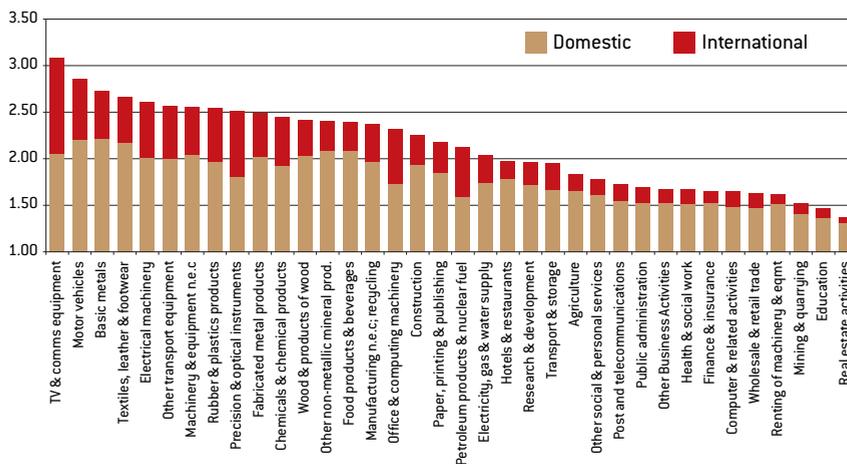
#### 4.1.2 'Made in the world'

As production stages and technologies have become more mobile, a single final manufactured good is nowadays often processed in many countries with sequential stages in the value chain being performed in the location most suited to the activity. Complexity has risen in parallel with mobility: Miroudot and De Backer (2013) showed that the number of production stages that a good or service goes through before it reaches the final customer has increased over the past two decades and that most of this increase is explained by the international part of the value chain. Figure 3 presents

empirical evidence on the length of GVCs in individual industries. Using an index that takes the value of 1 when there is a single stage of production in a single economy, the indicator shows that value chains in some industries are long and that a significant share of this unbundling of production is international.

Differences between industries are to a great extent linked to the technical characteristics of products. International fragmentation of production in GVCs is far more developed in manufacturing than in services, because services are less likely to be sliced up than the manufacturing of products, particularly when services require face-to-face contact between the provider and the consumer. International fragmentation is especially important for modular<sup>4</sup> products in high-technology industries. Parts and components are often produced in one country and exported to another in which they are assembled. This international division of labour is found in electrical machinery, radio/television and communication equipment, office, accounting and computing machinery, and motor vehicles.

**Figure 3: Index of the relative length of GVCs by industry, world average, 2008**



Source: Miroudot and De Backer (2013).

National economies have become more interconnected because GVCs involve extensive flows of intermediate goods and services. The pattern of trade accordingly

4. Modular products consist of multiple components that interact through codified standards and allow companies to slice up the value chain into separable production stages.

shows that a good produced in one economy and exported to its market of final consumption includes inputs supplied by producers in other economies (first tier suppliers) who themselves source their inputs from third economies (second tier suppliers). Many products are 'made in the world' and countries just like firms become increasingly specialised in specific functions within GVCs (see below for a discussion on China's role in assembly activities).

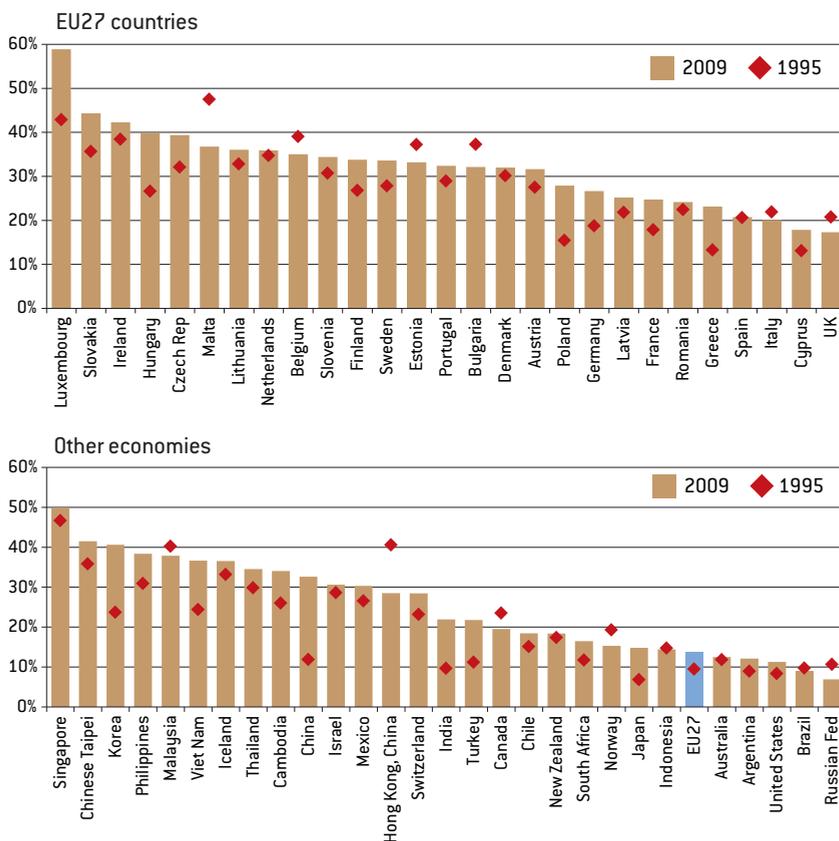
Within GVCs, value is added in different countries throughout the production process, and countries' exports therefore increasingly include foreign value added. The foreign content of exports has generally increased during the past two decades<sup>5</sup>, but economies differ significantly in this respect (Figure 4). In general, foreign value added depends on the size and patterns of specialisation of an economy. Smaller economies tend to have higher shares of foreign value added embodied in their exports. Larger economies have a wider variety of domestically sourced intermediate goods available and are therefore less reliant on foreign imports of intermediates. Meanwhile, countries with substantial natural resources, such as Australia, have lower ratios of foreign value added in exports because mining requires fewer intermediate goods in the production process.

The EU as a whole had a foreign value added share in its exports of 14 percent in 2009, which is similar to other large economies such as the United States and Japan. Size and industrial structure explain to a great extent the heterogeneity in that proportion within the EU. Smaller EU member states have on average greater shares of foreign value added: for example, 60 percent of Luxembourg's exports in 2009 represented value added created abroad and then imported into Luxembourg. The United Kingdom had the lowest foreign value added share within the EU in 2009, which is to some extent explained by its strong orientation towards services. Foreign direct investment (FDI) is another factor behind the heterogeneity within the EU: countries that have witnessed large inflows of FDI following their accession to the EU, and have attracted sizeable manufacturing activities, such as the Czech Republic, Hungary and Slovakia, have higher shares of foreign value added. The same is true for countries such as Belgium, Ireland and the Netherlands, which are also characterised by a high (foreign) MNE presence.

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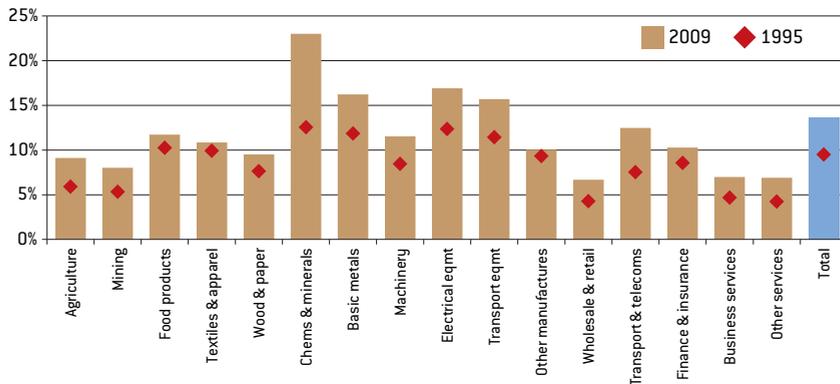
5. A decrease in foreign value added content of exports was observed in 2009 suggesting some consolidation in GVCs took place during the financial/economic crisis, most likely as a direct result of the huge and simultaneous drop in international trade during the economic crisis.

**Figure 4: Foreign value added content of exports by country, 1995 and 2009**



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database).

The foreign content of the EU’s exports rose by 4 percentage points between 1995 and 2009, reflecting the EU’s growing integration within GVCs. The highest share of foreign value added is observed in chemicals and minerals, for which nearly one quarter of the overall export value reflects foreign content, double the 1995 figure (Figure 5). Other industries with relatively high foreign value added content are electrical equipment, transport equipment and basic metals. EU services have, as expected, relatively lower foreign value added.

**Figure 5: Foreign value added content of exports, EU27, 1995 and 2009**

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database).

#### 4.1.3 Increasing competition from emerging economies in manufacturing GVCs

Manufacturing has increasingly globalised over the past decade, as emerging economies have become important partners in GVCs especially in manufacturing industries<sup>6</sup>. Products often conceived and designed in developed countries are manufactured and assembled in countries such as China, with intermediate inputs sourced from other countries. See Box 1 in Chapter 2 for a discussion of the rise of emerging economies in global manufacturing.

Emerging countries are attractive locations particularly for labour-intensive activities, as their labour costs are lower than those of more developed economies (Pilat *et al*, 2006)<sup>7</sup>. Although labour costs account for only a fraction of total production costs (with considerable differences between different industries), it is an important factor in the choice of locations for some firms<sup>8</sup>. Emerging regions have indeed increased their share in value added, especially in traditional industries such as food and beverages,

6. However, India has become an important exporter of services, as companies have outsourced a range of knowledge processes, business processes and information technology operations to India (Fernandez-Stark *et al*, 2011).

7. Cost savings and cheap labour are important drivers of the growth of offshoring to emerging markets, but they are not the only, nor the most important factors behind investment in these countries. (OECD, 2011). The attractiveness of emerging economies for MNEs is to a large extent explained by their large and growing (home) markets.

8. Labour costs should be considered relative to a country's level of productivity. Countries accept high labour costs if they coincide with high levels of labour productivity; countries with low labour costs typically have low levels of labour productivity.

textiles and apparel, leather and footwear, and paper (Hepburn, 2011). As labour-intensive, low-value-added activities have been relocated, manufacturing jobs in emerging countries have expanded strongly (Figure 6).

Manufacturing activities in emerging economies often take place in areas with special administrative and regulatory status, ie so-called 'export processing zones' (EPZs) (WTO and IDE/JETRO, 2011). Foreign investors are attracted to EPZs because of the low costs and the ease of importing and exporting. Low or zero tariff barriers and minimum administrative requirements allow companies to source intermediates from abroad efficiently for assembly into final products, which are then exported. According to WTO and IDE/JETRO, about one-fifth of exports from emerging and developing economies originate from EPZs; China accounts for almost 70 percent of world exports from EPZs.

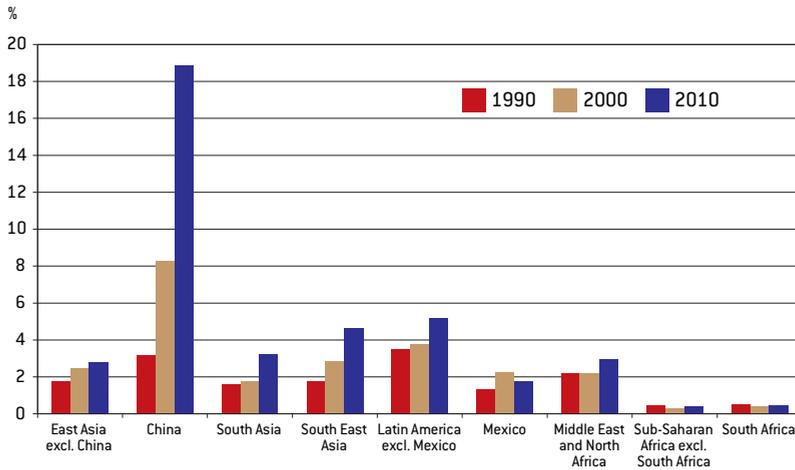
The central importance of Asia as a manufacturing hub in GVCs is largely linked to EPZs: almost half of Chinese exports are estimated to originate with foreign MNEs in EPZs. Consequently, China (but this is also true for Mexico) has become specialised in (pure) assembly activities in manufacturing GVCs. Case study evidence eg relating to Apple's iPod and iPhone, shows that China does not necessarily capture a lot of value through assembly. Overall, EPZs have clearly stimulated exports and created employment but their performance is overall less strong in terms of value added, because of the high import content of the exports of assembled goods.

#### *4.1.4 Backshoring on the horizon?*

Recently, a number of companies (especially US companies) have considered repatriating activities they previously offshored to China. The cost structure of production is changing in emerging countries: in China, for example, average hourly wage increases of 15-20 percent a year have eroded the country's cost advantage in labour-intensive activities. India, Indonesia, the Philippines and others have also experienced strong wage increases as the middle classes have grown. The average hourly wage in emerging economies was estimated at about 2 percent of the US average in 2000 and is expected to reach 9 percent in 2015 (World Economic Forum, 2012). As productivity differences narrow and the share of labour in total production costs shrink, savings from offshoring become smaller. Companies respond to these rising labour costs by increasingly automating factories in emerging countries, relocating production to other emerging countries where labour costs are still low, and/or eventually backshoring, or repatriating, specific activities.

Risk diversification is another motive for backshoring and explains why firms

**Figure 6: Share of major emerging regions in world manufacturing employment (in percentage of world manufacturing)**



Source: United Nations Statistics Division. Note: East Asia excluding China includes China - Hong Kong Special Administrative Region, China - Macao Special Administrative Region, Mongolia, Republic of Korea and Chinese Taipei; South Asia includes India, Iran (Islamic Republic of), Nepal, Pakistan, and Sri Lanka; South-East Asia includes Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam; Latin America excluding Mexico includes Argentina, Bolivia (Plurinational State of), Brazil, Chile, Colombia, Ecuador, Peru, Suriname, Uruguay, Venezuela (Bolivarian Republic of), Costa Rica, Guatemala, Honduras and Panama; Middle East and North Africa includes Algeria, Egypt, Morocco, Tunisia, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Syrian Arab Republic and Turkey; Sub-Saharan Africa excluding South Africa includes Botswana, Cameroon, Eritrea, Ethiopia, Gabon, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Niger, Senegal, Swaziland, Uganda, United Rep of Tanzania and Zimbabwe.

increasingly set-up (often shorter) GVCs in higher-cost countries close to their major markets, in addition to GVCs in low-cost countries. Supply chains have become more complex and extensive, which often means extra risk which is not always visible and hence less easy for firms to control. Just-in-time models, lean structures and the absence of redundancy mean that a breakdown in one part of the chain may result in global disruptions, as demonstrated in the aftermath of natural disasters such as the Japanese earthquake/tsunami in 2011 and floods in Thailand in 2012. Complete GVCs in the electronics and automotive industries broke down as important intermediates were sourced from the affected regions.

Technological advances are expected to support the backshoring trend: digital manufacturing that relies on clever software combined with novel materials and new

production techniques (eg nanotechnology) is expected to reshape production processes in manufacturing. Digital technology will cut the cost of producing smaller batches of a wider variety of product; as scale economies decrease, 'manufacturing on demand' is expected to become (more) economically feasible. Additive manufacturing such as 3D printing, for example, builds products from successive layers of material and enables products to be tailored to individual customers' needs.

In spite of backshoring's growing appeal, there is no consensus on how big this has or will become. Analysis by the Boston Consulting Group (2011) suggests that backshoring (also called on-shoring or re-shoring) could lead to a manufacturing renaissance in the United States<sup>9</sup>. However, it is expected that offshoring to emerging countries will remain an important strategy, though costs are rising in these countries. In addition, emerging countries offer large and rapidly growing markets for manufactured products given their growing middle classes. Nevertheless, GVCs are very dynamic and will continue to evolve as costs increase, technologies continue to change and firms reconsider their operations. Backshoring to developed economies might become more prevalent for technological and quality products characterised by fast product cycles and for which market feedback is important. The mass production of labour-intensive, commoditised products will most likely remain concentrated in emerging economies where production costs, including labour, are lower.

#### 4.1.5 The participation of EU manufacturers in GVCs

Economies participate in GVCs both as users of foreign inputs and as suppliers of intermediate goods and services used in other economies' exports (Koopman *et al*, 2011). One indicator of the participation of countries in GVCs is the percentage of a country's exports that are part of GVCs: either because of upstream links – that is looking back along the value chain and measuring foreign inputs/value added included in a country's exports – or downstream links – ie measuring the domestic inputs/value added of the country contained in the exports of other countries by looking forward along the value chain.

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9. The Boston Consulting Group estimates that in areas such as transport, computers, fabricated metals and machinery, 10-30 percent of the goods that the United States now imports from China could be made at home by 2020, boosting American output by \$20-55 billion a year.

This participation indicator provides an insight into the position of countries in GVCs; economies can be positioned upstream or downstream in GVCs<sup>10</sup>. Upstream economies produce the raw materials or knowledge assets at the beginning of the production process (eg research, design), while downstream economies assemble processed products or specialise in customer services. The position of a country in the value chain can affect the degree to which it benefits from a GVC. Activities such as R&D and design, and also certain services, tend to create more value added than assembly (OECD, 2013).

Smaller economies typically show higher backward participation rates as they source relatively more inputs from abroad, while larger economies have higher forward participation rates. For example, the foreign content of US exports (ie backward participation) is about 15 percent, but US participation in GVCs rises to almost 40 percent when the use of US intermediates in other economies' exports is taken into account (Figure 7). Industrial structure also matters. Resource-intensive countries like Australia, Brazil and Norway, for example, have higher forward participation rates, because their natural resources are included in other countries' exports down the value chain. Also the GVC participation of China is partially characterised by the use of Chinese intermediates in the exports of other countries (ie forward participation); nevertheless backward participation is relatively more important for China given the extensive use of foreign intermediates in China's important assembly activities.

The EU27 as a whole has the lowest GVC participation rate (ie 30 percent) of all 57 economies for which data is available, driven both by upstream and downstream links. As expected for a large integrated economic area, the use of EU intermediates in other (non-EU) countries' exports is greater than the use of non-EU intermediates in EU exports. The participation of individual EU member states in GVCs, however, is significantly greater, with smaller member states displaying greater (backward) participation, as expected, and larger member states such as Germany, France and the United Kingdom showing relatively higher forward participation.

The significant difference between the EU27 as whole (ie EU27 treated as one economy, only taking into account extra-EU exports/imports) and individual member states<sup>11</sup> suggests the existence of important GVC linkages between EU member states. Distinguishing between geographic zones (EU15, other EU and non-EU) indeed shows

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10. Miroudot and De Backer (2013) discuss the position of OECD and non-OECD economies in individual industries in more detail.

11. The participation of individual EU member states in GVCs includes intra- and extra-EU trade flows.

that the participation of individual EU27 member states in GVCs is strongly EU driven. About half of the inputs for most EU member states come from other European countries, with the EU15 member states being especially important sources for intermediates. The same observation is even more valid for downstream linkages: EU27 member states export intermediates to other EU15 countries in particular for use in those countries' exports.

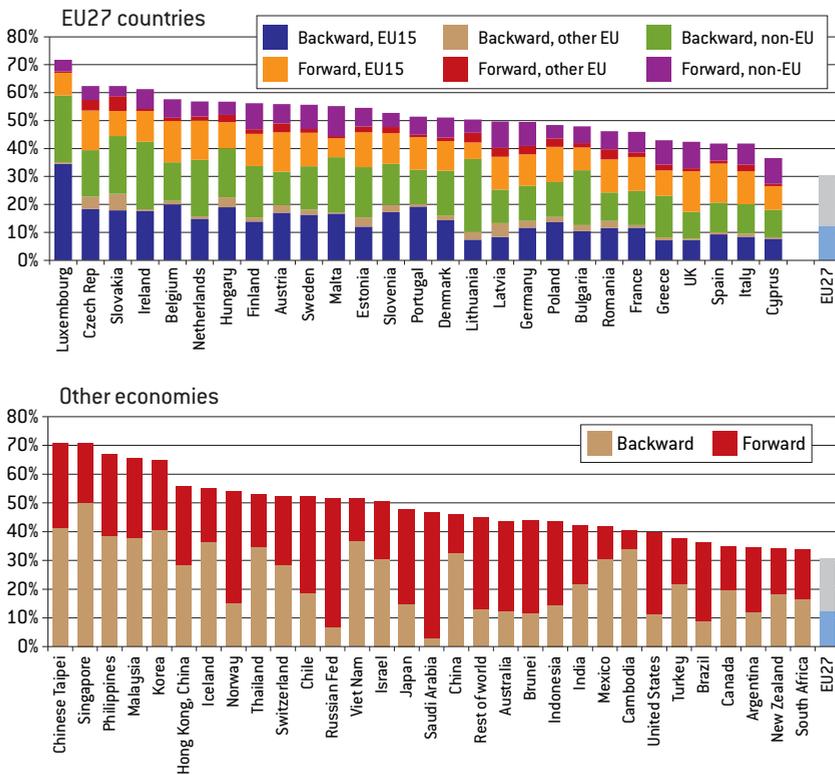
Overall, EU member states are strongly integrated into European value chains, concentrated around the EU15 (with Germany as a central player). The extra-EU linkages of individual member states within GVCs seem to be more important when it comes to the sourcing of intermediates, in particular from member states at the borders of the EU27. These results are in line with other analyses. A recent survey in France showed that most offshoring by French firms went to other EU member states, primarily to the EU15 (Fontagné and D'Isanto, 2013). Amador *et al* (2013) discussed the regional integration of production within the EU and the euro area between 2000 and 2011, and demonstrated the dominant EU origin of foreign value added in EU countries. Likewise, Di Mauro *et al* (2013) argued that the internationalisation of production has fostered an industrial restructuring in different EU economies and between the EU and the rest of the world, allowing EU firms to vertically specialise in European and global value chains.

The strong regional character of GVCs is also observed in other parts of the world. Within the NAFTA region, Canada and Mexico are heavily oriented towards the other NAFTA countries, in particular the United States: almost half of the imported intermediates embodied in their exports comes from the NAFTA zone. In Asia also, the majority of the intermediates embodied in exports are sourced from within the region, reflecting the importance of 'Factory Asia' where advanced parts and components are often produced in developed economies such as Japan and Korea and then exported to emerging economies such as China and increasingly Vietnam and Cambodia where the intermediates are assembled into finished products. In spite of their increasingly global character, GVCs still display a strong regional focus for much the same reasons that trade overall is still highly regional. The foreign value added of economies' exports originates largely in neighbouring economies.

This strong regional concentration is related to the role of distance and trade costs in vertical trade because inputs are often shipped multiple times. Although transport costs have consistently fallen, they still matter, particularly for products characterised by a large weight-to-value ratio (Harrigan, 2010; Van Assche, 2012). Hummels (2007) estimated that for the median individual shipment US exporters paid \$9 in transport

costs for every \$1 they paid in tariff duties. Furthermore, timely deliveries of intermediates are crucial for the smooth functioning of GVCs (Hummels and Schaur, 2012), and Harrigan and Venables (2006) showed that the adoption of just-in-time techniques pushes firms to locate production of time-sensitive components closer to home.

**Figure 7: GVC participation, 2009 (% of total exports)**



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database).

Figure 8 shows the GVC participation of the EU27 (in comparison with China, Japan and the United States) and individual member states for total manufacturing, electronics, automotive and chemicals. The results underline the strong EU orientation of European manufacturing, notwithstanding important differences between industries. The EU27's manufacturing GVCs seems to be less integrated overall than

those of other large economies such as China, Japan and the United States. This is explained by the lower foreign sourcing of intermediates (ie backward participation) and by the lower use of EU intermediates in the exports of non-EU countries. More research is needed to disentangle the relationship between EU and global linkages – if they are mutually exclusive or interdependent, and under which conditions – as this can be expected to impact the long-term competitiveness of EU manufacturing<sup>12</sup>.

Participation in chemical GVCs is roughly equal for the EU27, China, Japan and the United States, although the results on forward participation show that Japanese and US intermediates are included in global exports of chemicals more than EU intermediates. Within the EU27, a number of smaller countries show especially high participation rates mainly driven by the imports of intermediates. In Ireland this is related to the investments of large, especially American, pharmaceutical companies, while Belgium and the Netherlands are important ports that serve as gateways for basic chemicals. The participation of other countries, such as Germany, France and the United Kingdom, in GVCs is more closely linked to the use of their intermediates by other countries' chemical industries.

The gap in GVC participation between the EU27 and the other large economies is greatest in the electronics industry. China's strong integration into electronics GVCs, mainly through assembly activities further down in the value chain, is clearly reflected in the high backward participation of China in this industry. In contrast, the participation of Japan and particularly the United States in electronics GVCs is strongly driven by the use of their advanced intermediates in the electronics exports of other countries. Sourcing of intermediates from outside the EU is of major importance for the EU electronics industry and explains, more than intra-EU sourcing, the participation in GVCs of smaller EU member states such as Hungary, Malta, Finland, Slovakia and the Czech Republic. Major electronics-producing countries, such as Germany, France and Italy, export intermediates for further production/final assembly within and outside the EU.

In contrast to the global linkages in electronics, the EU automotive industry has a much more regional character despite the importance of GVCs in this industry (see Figure 3). Auto manufacturers in EU member states source the majority of their intermediates from other EU countries, while sourcing from outside the EU27 is significantly lower.

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12. The participation of China, Japan and the United States in GVCs is however not only due to 'global' linkages; as discussed above, linkages with neighbouring countries within NAFTA and Factory Asia explain the results to some extent.

High transportation costs make intercontinental shipping very costly especially for downstream activities, eg complete cars or subsystems. In addition, political pressure might also motivate leading firms in the automotive industry to locate production close to end markets<sup>13</sup>. The large (backward) participation rates in GVCs of countries like Slovakia, the Czech Republic, Hungary and Poland, illustrate the shift eastwards of assembly activities in this industry.

Network analysis of vertical trade between countries in the electronics and automotive industries largely confirms these insights and provides further insights on the central position of Germany within European value chains (Asian Development Bank, 2011)<sup>14</sup>. The analysis of the electronics industry clearly shows the existence of three hubs in the global production of electronics: south-east Asia, NAFTA and Europe centred on Germany. The Asian hub is globally dominant and is built around Japan as lead manufacturer/producer of parts and components, and China as the contract manufacturer. The dominance of the Asian hub is not only because of strong intra-Asia linkages, but also because of the strong relationships between Asia and the NAFTA hub (especially the United States and in second order Canada and Mexico), and Asia and Europe (Germany, the Czech Republic, Slovakia and Hungary), though the Asia-Europe links seem less strong.

The automotive industry also has a strong regional concentration in the same hubs (Asia, NAFTA and Europe), but the links between these hubs are much more limited compared to the electronics industry. Japan clearly occupies the central position within the Asian production hub, while there is strong integration between the United States, Canada and Mexico within NAFTA. The European hub is centred on Germany for which, in particular, the links with central and eastern European countries such as the Czech Republic, Slovakia, Poland and Hungary have become increasingly important since the accession of these countries to the EU (IMF, 2013).

The involvement of Germany in European and global value chains in manufacturing has increased in the past two decades as a consequence of decreasing trade costs

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13. The high cost and visibility of automotive products can create the risk of a political backlash if imported vehicles make up too large a share of total vehicles sold. This in turn creates pressure for supplier co-location within regional production systems for operational reasons, such as just-in-time production, design collaboration and the support of globally produced vehicle platforms (Van Biesebroeck and Sturgeon, 2010).

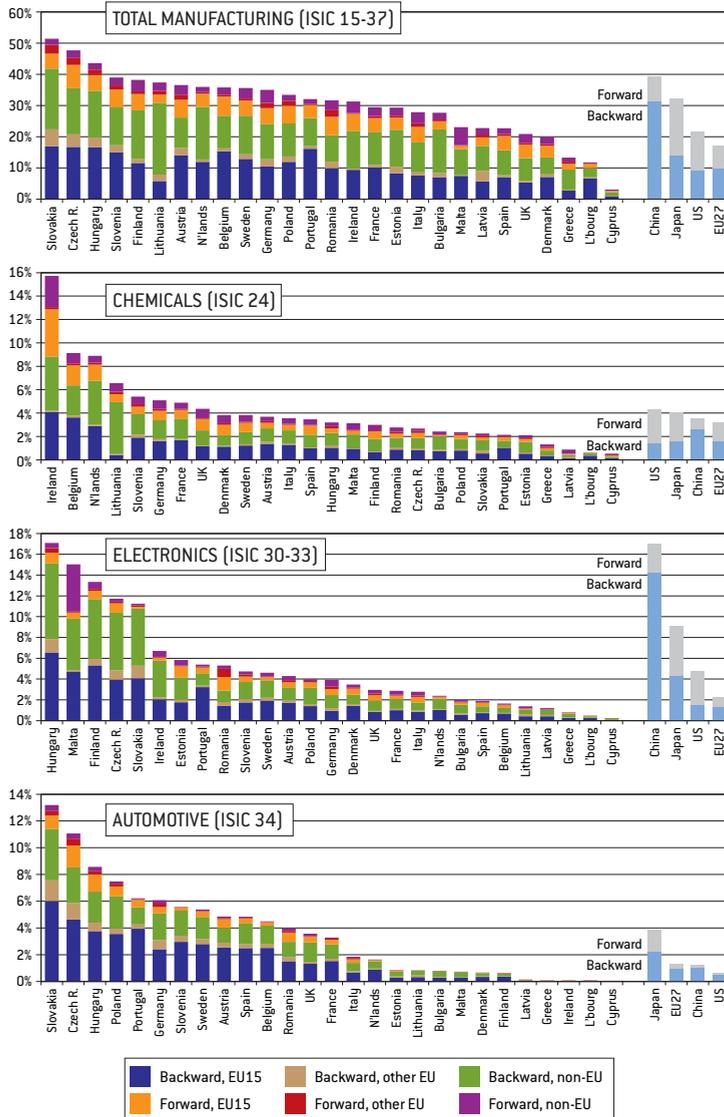
14. Based on bilateral trade data for 75 countries, vertical trade relationships for each country pair are calculated on the basis of a supplier's country share in parts and components by an industry in the hosting country, weighted by that industry's share of total final goods exports. Network analysis is then used to visualise a world map of vertical trade relationships based on the dyadic network relations between countries on the industry level.

within the EU and new opportunities for firms to offshore part of their production process. This is reflected in the rising foreign content of German exports: while in 1995, 81 percent of German exports represented domestic value-added, this share had fallen to 73 percent by 2009 (Figure 4). The foreign content of German exports is particularly high in industries such as basic metals, chemicals and minerals and transport equipment (35 percent): when a car is exported from Germany, typically one third of the value comes from other countries.

The increased supply links of the German economy through the offshoring of production to lower-cost countries in eastern Europe has resulted in claims that Germany has become a 'bazaar' economy (Sinn, 2006). The preceding analysis qualifies this to some extent. Figure 7 clearly shows that most of Germany's foreign inputs are sourced from other EU countries, but that the share of these inputs contributed by EU15 member states is greater than the share contributed by the countries that joined the EU in 2004 and 2007. In the transport equipment industry, for example, about half of the inputs are sourced from France, Italy and the United Kingdom; on average, less than 3 percent of inputs used in Germany are imported from eastern European countries. Second, the data shows that Germany is also a major exporter of intermediates that are used in third-country exports. This forward participation represented 25 percent of German exports in 2009.

Summarising, the results overall show the regional organisation of global manufacturing with production concentrated around hubs in Europe, NAFTA and Asia. Participation in GVCs within Europe is strongly EU oriented with a central position for the EU15, and in particular Germany, in EU manufacturing. The internationalisation of production has resulted in the deeper integration of EU manufacturing, with member states specialising in industries/activities according to their comparative advantage. This has resulted in the rising foreign, primarily EU, content of EU countries' exports, and has significantly benefitted the competitiveness of the EU27 and individual member states in a global perspective.

**Figure 8: GVC participation in manufacturing industries, EU27, 2009 (% of total exports)**



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database). Note: The indicator at the industry level is expressed relative to country exports (instead of industry exports) in order to take into account the importance of the industry in the total export composition of a country, which explains the lower participation rates of countries in individual industries.

## 4.2 Global value chains and manufacturing competitiveness

### 4.2.1 Growing interdependencies between economies

With companies and countries now embedded in international networks of production, GVCs increasingly challenge policy thinking about competitiveness. Today's economies no longer rely exclusively on domestic resources to produce and export goods and services. Instead, their exports increasingly embody the technology, labour and capital of the countries from which they import intermediate goods. As a result, the competitiveness of national economies increasingly depends on the competitiveness of their partners. Policymakers need to understand these patterns and know how concentrated or diversified this international sourcing is.

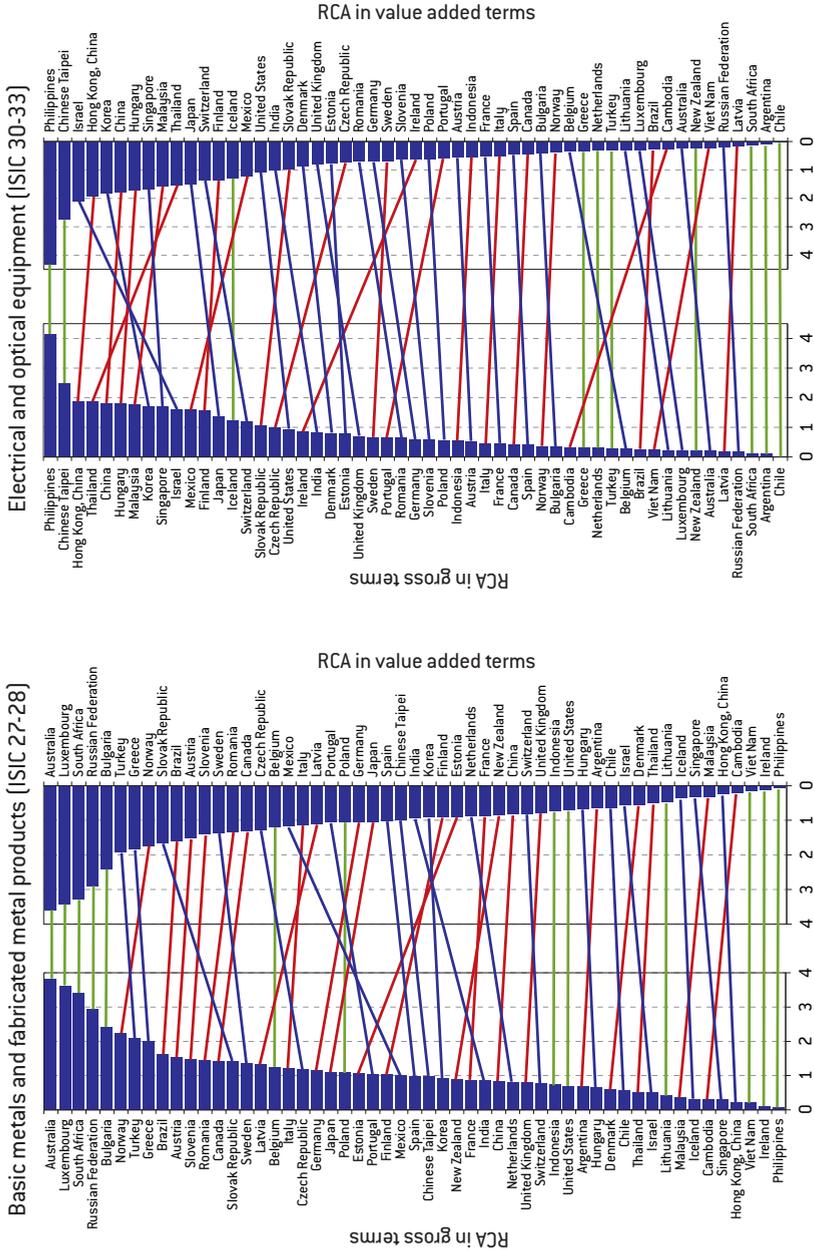
The international competitiveness of economies is typically assessed on the basis of export market shares and indicators of revealed comparative advantage (RCA)<sup>15</sup>. But indicators based solely on export data (in gross terms) may misrepresent the real specialisation of countries in GVCs: for example, they may simply reflect the fact that a country is specialised in the final assembly of a good, imports all the necessary intermediate inputs and adds little value to the good itself. Competitiveness should no longer be assessed (solely) at the level of industries or products, but also in terms of activities (*“What you do matters more than what you sell”*, The Conference Board, 2012). In a world of GVCs, comparative advantage increasingly reflects strengths at the level of activities, tasks and production stages.

Using export flows expressed in value-added terms allows countries' capacities to add and capture value across activities in GVCs to be better captured. Economies heavily engaged in GVCs, such as China, tend to have significantly lower shares of total exports based on domestic value added than they have in terms of gross exports. Because of the strong growth in processing, trade and assembly activities, China rapidly became the largest exporter in output (ie gross) terms, but on the basis of the domestic value added embodied in exports, the United States was still the largest exporting economy in 2009.

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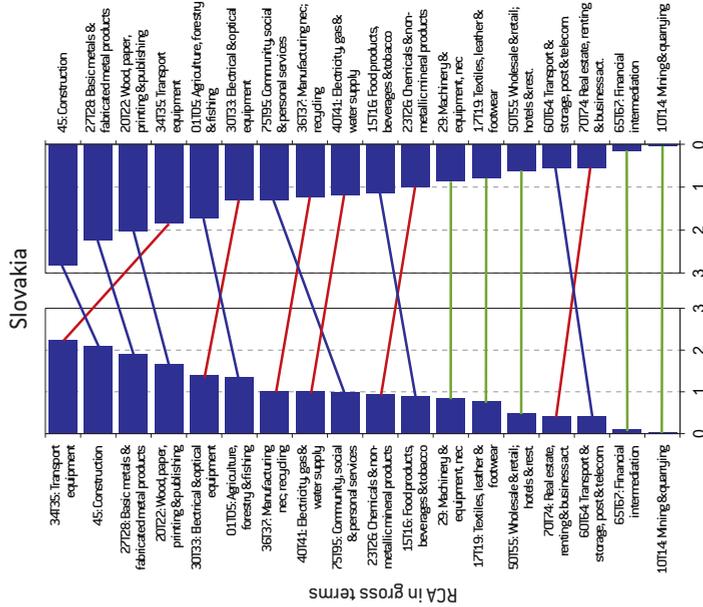
15. Empirical measures of comparative advantage go back to the seminal work of Balassa (1965). The shares of a given sector in a country's exports are compared to that sector's share in world exports. A value greater than 1 is said to show that a country possesses a comparative advantage and is specialised in that industry, while a value less than 1 points to a comparative disadvantage. Measures of comparative advantage suffer from a number of shortcomings, however (for an overview, see Sanidas and Shin, 2010).

Figure 9: RCA based on gross exports and value added exports, two industries and two countries, 2009

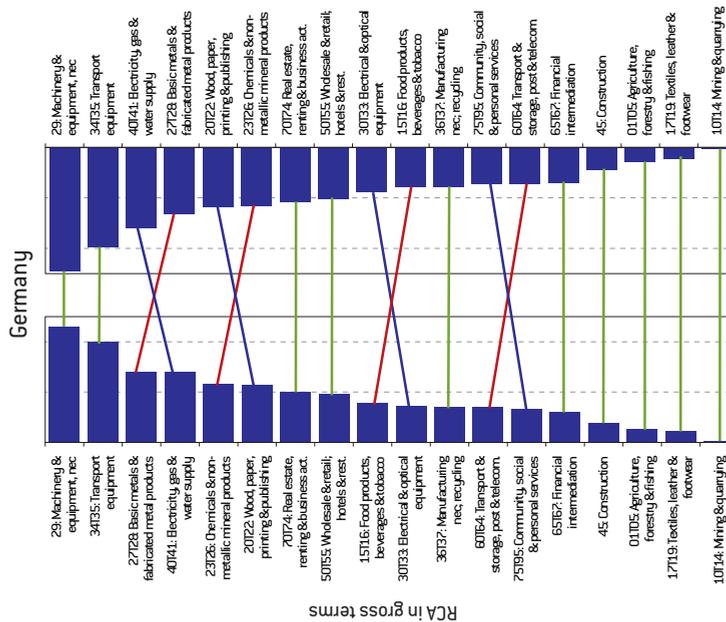


MANUFACTURING IN GLOBAL VALUE CHAINS

RCA in value added terms



RCA in value added terms



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database)

Figure 9 shows RCA measures in gross and value-added terms for ‘basic metals and fabricated metal products’ and for ‘electrical and optical equipment’. It also gives a more detailed breakdown by industry level for Germany and Slovakia. The figure shows significant variations in both the ranking and size of RCA measures across and within countries (see also Koopman *et al*, 2011). Though positions in the rankings change, the rankings show a relatively high degree of stability<sup>16</sup>. Unsurprisingly, industries that involve a high level of international sourcing exhibit on average greater dissimilarities between the two RCA measures. RCA measures based on value added also provide new insight into the international specialisation of countries. In general, larger countries show smaller dissimilarities between the two RCA measures, because they are less dependent overall on international sourcing.

#### *4.2.2 International sourcing enhances export specialisation and competitiveness*

Outsourcing and offshoring within GVCs typically have negative connotations and are associated with firm closures and job losses at home. The strong manufacturing growth of emerging economies is sometimes perceived to have come at the expense of significant losses of jobs in developed economies. It is argued that companies from developed economies move manufacturing to China and other emerging economies only to take advantage of the low labour costs, thereby hollowing out their national manufacturing industries.

But offshoring benefits the home country significantly in terms of productivity, innovation and competitiveness. Companies that offshore labour-intensive jobs to low-cost countries can even help save domestic jobs when offshoring strengthens their international competitiveness; the tasks that are moved offshore increase the productivity of activities that are not relocated if inputs sourced from abroad are cheaper and of higher quality. The importing of intermediates also increases countries’ ability to export; the international sourcing of intermediates in GVCs helps firms to reduce costs, acquire higher-quality inputs and improve productivity and export competitiveness. Policy interventions intended to limit such competitive effects, often aimed at protecting individual firms or industries, may then have the opposite effect and thus reduce competitiveness.

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16. This is to some extent explained by the relatively high level of industry aggregation in the OECD-WTO TiVA Database; more disaggregated industries will typically show greater dissimilarities between RCA measures in gross and value-added terms.

Analysis by the OECD (Box 1) shows that outsourcing and offshoring in the context of GVCs helps to make countries more competitive and to improve their export specialisation. GVCs positively affect the international specialisation of countries by expanding their sourcing possibilities both within the domestic economy and abroad. This greater use of intermediates helps countries to increase their value added in export activities. Basically, the use of cheaper, more differentiated and better-quality intermediates allows firms and countries to specialise in industries and activities according to their comparative advantage, ie where they are more efficient than other firms and countries. In today's global economy, success in international markets depends as much on the capacity to import high quality inputs as on the capacity to export.

#### **BOX 1: ECONOMETRIC RESULTS ON INTERNATIONAL SOURCING AND EXPORT COMPETITIVENESS**

The empirical model described in this box adds interconnectedness through outsourcing and offshoring to the existing framework of determinants of export specialisation. The analysis includes external economies of scale, the country's capital endowment (dependent on capital intensity at the industry level; Romalis, 2004) and high-skilled labour endowments (dependent on high-skill intensity at the industry level) as variables to capture the more traditional explanations of international trade.

Increased sourcing of intermediates is captured through outsourcing and offshoring on the industry level to reflect the choices companies face when sourcing inputs for their production processes. As discussed previously (see Figure 2), outsourcing is captured in the variable 'intermediates use intensity' at the industry level (ie the cost of intermediate inputs as a share of total output), while offshoring is proxied by the variable 'intermediates import intensity' (ie the share of imported intermediates in total intermediates used by that industry). Both variables are expressed relative to world averages for the same industry and therefore point to intensities that deviate from technological norms of production for either of the two activities.

The export specialisation or competitiveness of countries are measured in revealed comparative advantage (RCA) in gross and value-added terms, taking into account the limitations of traditional RCA measures in the presence of GVCs (see above). Deardorff (2012) describes how RCA measures can be used, together with other data, as a guide to what causes actual patterns of trade between countries and

whether these are driven by the traditional explanations of comparative advantage or by other factors. Most studies however have used export flows to study determinants of international competitiveness; only a few have used RCAs in econometric models (Dalum *et al*, 1998; Sleuwaegen and De Backer, 2001).

Rather than test the traditional explanations of international specialisation, the results confirm the core determinants of specialisation formalised in international trade theory: physical and human capital endowment favour export specialisation in industries that use these factors of production intensively. Large market size is also found to drive export competitiveness and points to the importance of (external) economies of scale across industries.

The positive relationship between offshoring and RCAs in gross terms partly reflects the fact that exports expressed in gross terms increasingly include imported intermediates. The positive effect on RCAs in value-added terms, however, clearly signals the significant impact of increased sourcing on the export specialisation and competitiveness of countries. The impact of sourcing is also positive when outsourcing and offshoring are restricted to the sourcing of intermediates within the industry ('narrow definition') instead of from any source ('broad definition').

**Table 1: The effects of outsourcing and offshoring on the export competitiveness of countries**

Variables	RCA in value added (symmetric)						
	I	II	III	IV	V	VI	VII
Domestic demand index	0.079*** (0.004)	0.077*** (0.004)	0.081*** (0.004)	0.081*** (0.004)	0.072*** (0.004)	0.079*** (0.004)	0.074*** (0.004)
Physical capital endowment x physical capital intensity	0.001*** (0.000)	0.001*** (0.000)	0.002*** (0.000)	0.001*** (0.000)	0.002*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
High-skill endowment x high-skill intensity	1.828*** (0.253)	1.849*** (0.251)	2.057*** (0.251)	2.104*** (0.249)	1.724*** (0.247)	1.866*** (0.254)	1.807*** (0.249)
Outsourcing index (broad definition – intermediate use intensity)		0.165*** (0.020)		0.154*** (0.019)			
Offshoring index (broad definition – imported intermediates intensity)			0.097*** (0.006)	0.097*** (0.006)			
Outsourcing index (narrow definition – intermediate use intensity)					0.058*** (0.004)		0.065*** (0.004)
Offshoring index (narrow definition – imported intermediates intensity)						0.006*** (0.001)	0.008*** (0.001)
Observations	18639	18612	18603	18603	18612	18603	18603
R-square	0.192	0.197	0.209	0.212	0.205	0.197	0.211

Variables	RCA in value added (symmetric)						
	I	II	III	IV	V	VI	VII
Domestic demand index	0.077*** (0.004)	0.075*** (0.004)	0.079*** (0.004)	0.078*** (0.004)	0.071*** (0.004)	0.077*** (0.004)	0.072*** (0.004)
Physical capital endowment x physical capital intensity	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
High-skill endowment x high-skill intensity	1.963*** (0.255)	1.961*** (0.254)	2.124*** (0.254)	2.151*** (0.254)	1.858*** (0.250)	1.992*** (0.257)	1.935*** (0.252)
Outsourcing index (broad definition – intermediate use intensity)		0.098*** (0.020)		0.088*** (0.019)			
Offshoring index (broad definition – imported intermediates intensity)			0.075*** (0.007)	0.074*** (0.006)			
Outsourcing index (narrow definition – intermediate use intensity)					0.057*** (0.004)		0.063*** (0.004)
Offshoring index (narrow definition – imported intermediates intensity)						0.006*** (0.001)	0.008*** (0.001)
Observations	18639	18612	18603	18603	18612	18603	18603
R-square	0.191	0.193	0.2	0.202	0.203	0.195	0.208

Source: OECD calculations. Note: Robust standard errors are reported in parentheses. Significance levels are indicated by: \*\*\* at 1%, \*\* at 5%, and \* at 10% level.

### 4.2.3 The importance of innovation and knowledge-based capital in GVCs

Because of greater competition from emerging countries, innovation has become crucial for the long-term competitiveness of OECD manufacturing. Innovation and knowledge increasingly determine the creation and growth of value added and employment in manufacturing, and multi-factor productivity growth is also closely linked to innovation and improvements in efficiency (OECD, 2010).

Innovation is closely related to the broad accumulation of so-called intangible or knowledge-based assets, which involve tacit, non-codified knowledge in areas such as R&D, branding, design and the complex integration of software with organisational structures<sup>17</sup>. Investment in knowledge-based capital has been rising since the 1980s

17. There are three main categories of knowledge-based capital: computerised information, innovative property and economic competencies (Corrado et al, 2005).

in developed economies: in the United States and the United Kingdom, investment in knowledge-based capital now exceeds investment in physical capital such as equipment, material and buildings.

Knowledge-based capital is at the heart of the manufacturing competitiveness of more mature economies: it is the source of the advanced knowledge and capabilities needed to develop sophisticated and complex products<sup>18</sup>. Investment in brand equity, design, organisational capital and business models allows developed-economy manufacturers to compete on aspects other than cost. Developed economies are typically specialised in higher-value, more technology-intensive products, and in higher value-added activities in manufacturing. Emerging economies are generally specialised in more labour-intensive and low-cost assembly activities that create less value added.

Most of the value creation in a GVC is often found in upstream activities, such as the development of a new concept, R&D or the manufacturing of key parts and components, or in downstream activities, such as marketing, branding or customer service. Final assembly, which is often offshored to emerging economies, represents only a small part of value generation. In general, activities that can be offshored tend to be commoditised and create relatively less value added. Position in the value chain is thus an issue of interest to many policymakers. Emerging economies for example find that they do not create/capture much value from their extensive manufacturing activities. GVCs have changed the nature of global competition because companies and countries no longer only compete for market share in high value-added industries but increasingly also for high value-added activities within GVCs.

Knowledge-based capital is also increasingly important in the governance of GVCs because firms can use their specific capabilities to shape the industry architecture and to capture a larger share of value. Superior capabilities allow firms to innovate and compete in their own market segment, but also to change the competitive conditions of the whole value chain. Firms are often able to manage linkages with other firms within a GVC to make themselves less replaceable, while making other firms more dependent on them. Because the latter has to co-operate with them to create value, such firms can leverage their position in GVCs and capture more value. As industries and products become more fragmented and decentralised, competencies in terms of system integration skills can leverage companies' innovation activities in GVCs. The lead firm manages the different stages of the value chain and makes the different elements work together. The example of Apple shows that its strong design capabilities

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18. Sutton (2012) explains in detail how firm capabilities act as the central channel for economic growth of countries.

enabled it closely manage the integration the different components and services into its different products.

Econometric analysis (Box 2) shows that investment in knowledge-based capital is an important source of competitiveness for economies engaged in GVCs. Countries with knowledge-based assets are likely to benefit more from their integration in GVCs through offshoring within higher-skill and higher-technology industries. Knowledge-based assets at the firm level allow companies to innovate faster and better, to position themselves in higher value-added activities in GVCs and to govern the architecture of their GVCs.

#### **BOX 2: ECONOMETRIC RESULTS ON INTERNATIONAL SOURCING, KNOWLEDGE-BASED CAPITAL AND EXPORT COMPETITIVENESS**

The analysis described in this box extends the model discussed in Box 1 (which demonstrated the importance of outsourcing and offshoring on countries' competitiveness) by including knowledge-based assets as a factor of production that may contribute to the specialisation patterns of countries. Like other production factors, knowledge-based capital measured at the country level is included dependent on the intensity with which knowledge-based capital is used at the industry level in order to capture differential effects across industries. While data on physical capital has long been available, data on knowledge-based capital at the economy level has only recently become available (Corrado *et al*, 2012). This data is largely limited to developed economies, and this should be kept in mind when interpreting the results of the econometric work described below.

The results show first that knowledge-based capital enhances the export competitiveness of skill-intensive industries. The more a country invests in knowledge-based capital, the more likely it is to develop a comparative advantage in international trade in such industries (Table 2, column II)<sup>19</sup>. This finding is in line with the positive effects of factors of production such as physical and especially human capital (Table 2 column I) and underlines the importance of knowledge-based capital as a productive resource.

19. Column I of the OLS results reproduces results for the subsample of 14 countries (for which data on knowledge-based capital are available) used in this experiment. Column II replaces high-skilled labour endowment with intangible capital endowment, dependent on high skill intensity at the industry level. Column III introduces two interaction variables to measure separately the impact of knowledge-based capital endowment on specialisation in industries that are both high-skill- and offshoring-intensive.

Second, the positive effect of knowledge-based capital is greater in industries that are high-skill- and offshoring-intensive (Table 2, column III), suggesting a strong complementarity between knowledge-based capital and integration in GVCs. Offshoring magnifies the positive effects of knowledge-based capital in terms of export specialisation.

**Table 2. The effect of knowledge-based capital on the export competitiveness of countries**

Variable	RCA in gross exports (symmetric)			RCA in value added (symmetric)		
	I	II	III	I	II	III
Domestic demand index	0.024*** (0.009)	0.020** (0.009)	0.019** (0.009)	0.023** (0.009)	0.019** (0.009)	0.018* (0.009)
Physical capital endowment x physical capital intensity	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.004*** (0.000)	0.003*** (0.000)	0.003*** (0.000)
High-skill endowment x high-skill intensity	3.077*** (0.475)			3.064*** (0.483)		
Outsourcing index (broad definition – intermediate use intensity)	0.111*** (0.010)	0.127*** (0.010)	0.125*** (0.010)	0.081*** (0.010)	0.097*** (0.010)	0.095*** (0.010)
Offshoring index (broad definition – intermediates import intensity)	0.159*** (0.036)	0.172*** (0.035)	0.161*** (0.035)	0.094*** (0.035)	0.107*** (0.035)	0.096*** (0.035)
Knowledge-based capital endowment x high-skill intensity		0.040*** (0.005)	-0.01 (0.009)		0.041*** (0.005)	-0.007 (0.010)
Knowledge-based capital endowment x high-skill intensity x intermediates import intensity			0.685*** (0.097)			0.665*** (0.097)
Knowledge-based capital endowment x intermediates import intensity			-0.286*** (0.042)			-0.278*** (0.042)
Observations	6585	6585	6585	6585	6585	6585
R-square	0.316	0.317	0.323	0.308	0.31	0.315

Source: OECD calculations. Note: Robust standard errors are reported in parentheses. Significance levels are indicated by: \*\*\* at 1%, \*\* at 5%, and \* at 10% level.

#### 4.2.4 The growing importance of services in manufacturing GVCs

Costs along the value chain are influenced by the quality of services involved in the logistics chain as manufacturing firms increasingly use and produce services as inputs

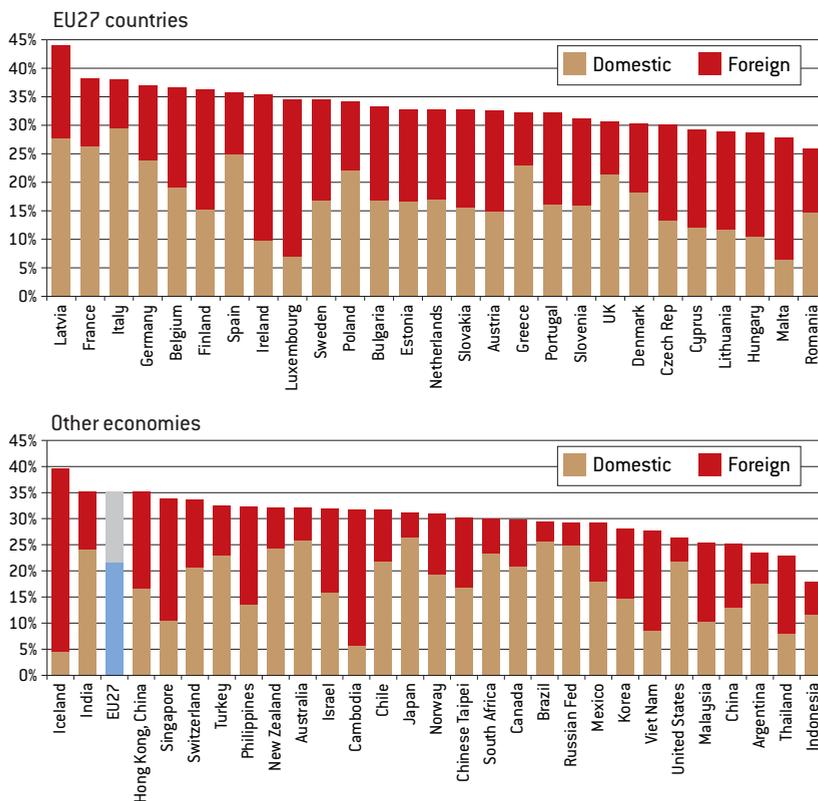
into their products (Nordås, 2010). Consequently, services have taken on greater importance for manufacturing competitiveness; manufacturing exports include significant value added in service industries (Figure 10). On average, the value created directly and indirectly by services as intermediates represent more than 30 percent of the total value added in manufactured-goods exports. OECD and non-OECD countries show significant shares of service inputs in their manufacturing exports, with smaller countries sourcing relatively more service inputs from abroad.

The value of manufactured products increasingly reflects service inputs because services play a crucial role as ‘enablers’ of GVCs. Logistics, communication services, business services and so on facilitate the efficient functioning of GVCs because they help to transfer goods, data, technology and know-how across borders and to coordinate dispersed activities quickly and smoothly. Transport and communications networks are the backbone of GVCs and services provided to these networks, often by specialised suppliers domestically or internationally, directly benefit manufacturing activities.

Services are not only embodied in manufactured products, but are increasingly sold together with goods as embedded services. Since GVCs increasingly allow for the unbundling of business functions, and because pure production activities are increasingly located in emerging economies, manufacturers in developed countries rely more on complementary non-production functions to create value. Manufacturing firms increasingly use services to gain a competitive advantage. Services help not only to increase productivity but also to differentiate, customise and upgrade products and develop closer, more longstanding relationships with customers (Kommerskollegium, 2012).

It should be noted however that the increasing use of services in manufacturing is to some extent a statistical artefact. Many services activities were previously done in-house but are now increasingly outsourced and offshored by manufacturing companies (Pilat *et al*, 2006; Rowthorn and Ramaswamy, 1998; *The Economist*, 2011). The services content of manufacturing exports shown in Figure 10 constitutes a lower bound for the contribution of services to manufacturing output because it only counts traded services; services such as R&D are often performed in-house.

**Figure 10: Services content of gross manufacturing exports, 2009**



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database).

### 4.3 What policies are needed, and which are not?

The international fragmentation of production in global value chains challenges the way policymakers should look at the global economy. It is essential to understand how GVCs work, how they affect economic performance, and how policy can help countries derive benefits from their participation in global value chains. The growing interconnectedness between economies as a result of GVCs directly changes the rationale of government policies in areas related to globalisation, such as trade policy, investment policy, competitiveness, innovation and upgrading. The negative effects of trade protection for example are particularly important for GVCs in which parts and

components cross borders many times. As imports are essential for exports, tariffs and non-tariff barriers in GVCs are effectively a tax on exports. Export restrictions can also affect the efficient functioning of GVCs and increase costs. OECD (2013) discusses the policy challenges for different domains in detail.

However, because the drivers of manufacturing competitiveness in GVCs increasingly include factors that are outside the scope of national policies, the direct influence of policy on growth and job creation within national borders is limited. There is a growing tension in competitiveness policies between the global character of individual firm strategies that include international activities in GVCs, and government policies that target local jobs and value added. In an era when some MNEs' operations are larger than some national economies, the contribution of domestically-owned firms to the national economy is no longer easy to pinpoint. Likewise, the returns on investment by domestic firms in the national economy – and the support that governments provide to that investment – may partly leak to other countries through linkages to GVCs. This leakage may be compounded by the tax planning strategies of MNEs.

One response to the loss of manufacturing and the growing fragmentation of production has been a call for industrial policies, often with a strong focus on manufacturing. Such policies capture a range of initiatives. In some cases, they discourage manufacturers from relocating activities abroad. In others, they give implicit support to the manufacturing sector. Many of the defensive policies aimed at supporting manufacturing ignore the realities of today's global economy. In a world of GVCs, firms require imports from abroad and will need to offshore some of their activities in order to remain competitive at home. Old-style industrial policies characterised by industry-specific support policies or national champions have no role to play in a world characterised by GVCs. They distort international competition and the efficient operation of value chains, and run the risk of an international subsidy war, with taxpayers as the main losers. More fundamentally, subsidies are not the way to encourage long-term investment and the building of capabilities.

GVCs are also at the heart of the discussion on 'making things instead of making ideas', which relates to the debate on the future of manufacturing in developed economies. The fragmentation of production has so far led to a division of labour in which OECD countries have specialised in upstream activities such as R&D, design and innovation, while emerging countries have specialised in manufacturing and assembly activities. The result of this global restructuring process is that, while OECD countries still create a large part of the value generated by GVCs, they are often no longer able to maintain large numbers of manufacturing jobs. Policies that focus exclusively on manufacturing

may ignore the growing importance of services for value creation in GVCs, including for the production of manufactured goods.

This is not to say that governments cannot play a useful role in maintaining manufacturing capabilities. Clearly, manufacturing continues to matter in a world of GVCs. Tangible goods continue to dominate global trade, even if much of the value embodied in goods now derives from inputs of services. Recent technological advances, such as the emergence of 3D printing, may enable manufacturing firms to engage in tailored production – but with the efficiencies of mass production – close to their markets. This could reduce the need for offshoring. Strategies and policies that support the building of such new capabilities, including the necessary skills, infrastructure and research, therefore provide a new way forward to ensure the future of manufacturing in advanced economies. Existing innovation policies remain important for the creation and capturing of value within GVCs, but may need to be reoriented to take better account of the organisation of the global economy in terms of activities and tasks instead of industries or products. To remain competitive, developed economies will need to focus on tasks with high value added to compensate to some extent for their typically higher costs.

# 5 Meeting the manufacturing firms involved in GVCs

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## Introduction and motivation

Recent empirical international trade literature has shown the importance of better understanding the heterogeneity of firms within sectors and countries. In particular, using the unique, large and rich EFIGE survey database on firms' internationalisation strategies, Altomonte *et al* (2012) in *Triggers of competitiveness*, characterise the types of firms that are more likely to be internationally active, and how their profiles interact with the productivity effects of internationalisation. Mayer and Ottaviano (2007) in *The Happy Few* show how the trade performance of countries and sectors depends on a few firms.

This firm-level literature has focused mostly on single internationalisation strategies: exports, imports, offshoring or outsourcing, and the choice between these strategies as substitutes. What these firm-level studies only marginally touch on is the impact of global value chains (GVCs) and the consequent development of more complex combinations of internationalisation strategies and more complex connections between firms in global value chains: simultaneously carrying out certain tasks abroad and others at home, for which components are imported and the output of which is exported to other markets, possibly for further processing.

In this chapter, we use the EFIGE database to study the prevalence and impact of GVCs at the firm level. The EFIGE database provides unique detailed information on firms' internationalisation strategies, allowing us to look at combinations of international strategies typically associated with involvement in GVCs: the importing of components, offshoring or internationally outsourcing certain parts of the value chain, exporting finished goods or semi-finished goods for further processing and trade. EFIGE also allows us to position firms within the value chain. The analysis shows great hetero-

generality among firms involved in GVCs, and that only a few firms are intensively involved. The firms that are involved, however, matter for Europe's knowledge-based growth and competitiveness performance, because they are large, trade-intensive, more innovative and more productive.

We start by presenting the data and our approach to identifying the extent of firms' involvement in global value chains. In section 5.1, we look at the complexity of firms' international strategies, as reflected in how many international activities they are simultaneously involved in. GVC-involved firms are 'multiple-mode firms', of which those with the greatest level of involvement simultaneously organise production abroad, import components for local production and export their produced goods. We also identify the firm's position in the value chain – whether or not the firm is producing to order for other firms. To check the validity of our construct for GVC involvement of firms, we look at how these firms measure up against other indicators typically used in the literature on GVCs, most notably the extent to which they import components rather than buy locally, and the import content of their exports. This is set out in section 5.2. Section 5.3 details how concentrated country and sector value added, employment and particularly trade are in the few 'multiple mode' firms. Multiple-mode firms are not only important for total employment and trade, they are also likely to matter for competitiveness because of their productivity profile. Section 5.4 looks at the performance profile of multiple-mode firms, analysing if greater levels of GVC involvement are associated with higher productivity. Section 5.4 also looks at innovation and human capital investment in particular as drivers of productivity. Section 5.5 assesses whether GVC involvement has helped to shield firms from the crisis or if, *on the contrary*, has made them more vulnerable to the crisis. Section 5.6 identifies the type of European firm that focuses its international value chain deployment on the European Union, and looks at the impact this might have on the performance of such firms.

## 5.1 The EFIGE data and GVC variables

### 5.1.1 The EFIGE data

We use the EFIGE dataset, a representative and cross-country comparable sample of firms with manufacturing activities in Europe<sup>1</sup>. For this set of firms, EFIGE provides detailed survey evidence on their international activities: what they import and from where, what they export and to where, and what and where they produce abroad, either

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1. For more detailed information on the EFIGE database, see: <http://www.bruegel.org/datasets/efigedataset/>.

through offshoring (ie through foreign manufacturing affiliates) or through outsourcing (contracting with other manufacturing firms abroad). The database also provides information on other firm characteristics, such as performance, ownership, skill level of workers and innovative performance.

The EFIGE dataset covers 14,759 firms, including about 3000 from each of Germany, France, Italy and Spain, 2200 from the United Kingdom and 500 from each of Austria and Hungary. The survey excludes firms with fewer than 10 employees, thus slightly oversampling large firms to ensure their representativeness because of their critical role for competitiveness<sup>2</sup>. About 600 firms belong to a foreign group, of which 350 are from another European country as the reporting unit. As there is only one EFIGE wave, covering the period 2007-2009, no comparisons over time can be made with the current dataset. Table 1 provides an overview of the main manufacturing sectors covered by EFIGE.

**Table 1 EFIGE main sectors**

NACE 1.1	Sector	Number of firms
15-16	Food, drink and tobacco	1504
17-19	Textiles and clothing	1020
20-22, 36	Wood, paper, printing, furniture	2714
24	Chemicals and pharmaceuticals <sup>3</sup>	555
25-26	Rubber, plastic and other non-metallic	1600
27-29	Metal, metal products	5118
30-33	Electrical and optical equipment	1422
34-35	Transport equipment	412

Source: Bruegel.

### *5.1.2 GVC involvement: multiple-mode internationalisers*

To identify the firms, sectors and countries that are most involved in GVCs, we look at those firms that use multiple modes when operating internationally, especially those that combine production abroad with the importing of components and the exporting of their goods.

2. See Altomonte and Aquilante (2012).

3. Because of the low number of observations in the EFIGE sample from the pharmaceutical sector, this sector could not be separated from chemicals.

First we classify firms as internationally active only if their trade turnover (either turnover from imports of intermediate goods and services for domestic production, exports of domestic production or international production activities) is above the twenty-fifth percentile in their sector, or if their share of international activity (import, export or international production) over total turnover is above the twenty-fifth percentile. We use both criteria combined to identify those firms that are substantially internationally active (in terms of turnover and shares)<sup>4</sup>.

For the firms that are substantially internationally active, we identify GVC involvement through the number of international activities the firms are substantially engaged in. Starting from three types of activity – exporting, importing and foreign production (both inter-firm, international outsourcing, and/or intra-firm offshoring, foreign direct investment), we can construct seven mutually exclusive categories, listed in Table 2.

Firms with high levels of GVC involvement are those that import a substantial proportion of their components and export a substantial proportion of their goods, and also offshore or (internationally) outsource substantial parts of their activities (triple-mode firms). Firms with a medium level of involvement are those that are substantially involved in two modes of international activity (dual-mode firms): mostly, these are firms that import substantial amounts of components/services and export their products. Less common among the dual-mode firms are those that simultaneously produce abroad and also import or export. Firms with low levels of involvement are only engaged in one mode of international activity: only exporting, or only importing (single-mode firms). Foreign production is typically combined with exporting or importing. Firms that are solely international producers but that do not import or export are rare<sup>5</sup>.

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4. Combining shares and volumes as criterion, we want to avoid excluding those firms that for instance have a relatively low trade turnover but a considerably high share of trade over total turnover (ie small firms with small turnover but high share, and larger firms with small share but high turnover).

5. This is consistent with studies that show FDI to be a more advanced internationalisation mode compared to simple exporting, which is often seen as the first mode for firms that expand internationally, requiring less in the way of fixed set-up costs.

**Table 2: Categories of GVC-involved firms**

	Number of firms	Detailed categories	Number of firms
NO Zero mode	4232	Firms without substantial imports, exports, international production	4232
LOW Single mode	4742	Pure importers of components/services Pure exporters Pure international producers (through FDI or international outsourcing)	1630 3072 40
MEDIUM Dual mode	4999	Importers and exporters Importers and international producers Exporters and international producers	4738 96 165
HIGH Triple mode	786	Importers, exporters and international producers (through FDI or international outsourcing)	786

Source: Bruegel.

In the total EFIGE sample, 29 percent of the firms are not substantially involved in international activities. While 32 percent are only substantially involved in one mode of international activity, 34 percent combine two modes. Only 5 percent of the sample firms are triple-mode firms, illustrating the skewed distribution of GVC-involved firms. Of these triple-mode firms, 60 percent are engaged in offshoring/FDI 90 percent are engaged in international outsourcing. About half of the triple-mode firms (47 percent) indicate that the main destination for their foreign production (outsourced or offshored) is their home country, from where it is re-exported to third countries, further illustrating the complexity and interrelatedness of their international activities<sup>6</sup>. Firms that use multiple modes when internationalising, especially those that combine production abroad with the importing of components and exporting of their goods (triple-mode firms), are identified as the firms most involved in GVCs compared to those that use only one or even no internationalisation mode substantially.

Triple-mode firms are much more prevalent in the textiles and electr(on)ics sectors – in which they make up 12 percent and 10 percent of the firms respectively. They are also more prevalent in the transport equipment (8.7 percent) and chemicals/

6. Unfortunately, given the small number of triple-mode firms, further splitting this category into different subcategories runs the risk of arriving at too small numbers for a representative analysis.

pharmaceuticals (7.6 percent) sectors. By contrast, in the wood and paper sector, only 3 percent of the firms are triple-mode firms. For the food, drinks and tobacco sector, the figure is 2 percent – the lowest prevalence of triple-mode firms in the sectors we consider. This sector also has the highest proportion of zero-mode firms: 42 percent. These sectoral patterns are very much in line with findings from the existing GVC evidence (see eg, OECD, 2013).

**Table 3: Multiple mode internationalisation by sector**

	Zero	Single	Dual	Triple
Total	28.7%	32.1%	33.9%	5.3%
Food and tobacco	42.4%	32.5%	23.0%	2.1%
Textile	19.8%	27.9%	40.7%	11.6%
Wood, paper, printing, furniture	34.4%	35.4%	26.8%	3.4%
Chemical and pharmaceuticals	10.1%	31.7%	50.6%	7.6%
Rubber and plastic	26.9%	32.9%	35.5%	4.7%
Metal, machinery and equipment	29.3%	32.2%	34.1%	4.4%
Electrical and optical equipment	18.7%	29.7%	42.0%	9.6%
Transport equipment	22.8%	25.0%	43.4%	8.7%

Source: Bruegel on the basis of EFIGE.

Among the countries in the sample, Spain and Germany have the lowest prevalence of triple-mode firms. But Germany has more dual-mode firms, while Spain has more firms that are not substantially engaged in any international activity (34 percent). The two smallest countries in the EFIGE sample, Austria and Hungary, have higher shares of triple-mode firms. Of the large EFIGE countries, France has the highest prevalence of triple-mode firms.

Tables 3 and 4 make clear that even within sectors and countries that are typically identified in the GVC literature as being more GVC-involved (for example, Hungary and France, and sectors such as electronics and textiles), there is still substantial heterogeneity in terms of how intensively firms within these sectors and within these countries are GVC-involved.

**Table 4: Multiple mode internationalisation by country**

	Zero	Single	Dual	Triple
Total	28.7%	32.1%	33.9%	5.3%
Austria	17.6%	30.5%	42.7%	9.3%
Hungary	27.1%	30.7%	35.3%	6.9%
France	31.9%	31.6%	29.4%	7.1%
Germany	23.2%	32.2%	42.6%	2.0%
Italy	28.0%	34.4%	33.1%	4.6%
Spain	33.9%	32.7%	30.6%	2.7%
UK	23.9%	31.2%	39.8%	5.1%

Source: Bruegel on the basis of EFIGE

Which types of firms within sectors and countries are more likely to be triple-mode firms, involved in importing, exporting and international production? Box 1 details our analysis. We find that older, incumbent firms, larger firms and firms that are part of an international group are more likely to be substantially internationally active, as typically found in the international trade literature. But these firms are also significantly more likely to deploy more complex internationalisation strategies involving GVCs, being dual or triple-mode internationalisers.

The sectoral profile (Table 3) remains robust in the econometric results. Compared to the food and tobacco sector, firms from the textiles, chemicals and rubber and plastics, metal products, electronics and transport equipment sectors are significantly more likely to be dual and triple-mode firms, all other firm characteristics being equal. The country results in Table 4, however, no longer hold, suggesting that other firm characteristics, particularly firm size, largely account for differences between countries. For France, Germany, Italy, Spain and the UK, none of the differences in the prevalence of triple-mode firms remain significant, all other things being equal, while Hungarian companies are less likely to be triple-mode firms.

**BOX 1: ECONOMETRIC RESULTS**

We estimate the probability that a firm belongs to the group of zero, single, dual or triple-mode internationalisers as a function of a set of firm characteristics. These characteristics include country and industry affiliation<sup>7</sup>, size, firm age, whether the firm is part of a foreign group and whether the firm faces competition from abroad. The econometric technique used is a multinomial logit<sup>8</sup>.

**Table 5: Multinomial logit, single, dual and triple mode with zero mode as base case**

	Single vs zero	Dual vs zero	Triple vs zero
Age of the firm	0.176*** (0.05)	0.305*** (0.05)	0.474*** (0.09)
Facing foreign competition	0.941*** (0.05)	1.707*** (0.05)	2.069*** (0.11)
Being part of Foreign group	1.010*** (0.15)	1.536*** (0.15)	1.631*** (0.18)
Small firms	0.253*** (0.05)	0.588*** (0.06)	0.665*** (0.14)
Medium-sized firms	0.730*** (0.07)	1.534*** (0.08)	2.323*** (0.15)
Large firms	0.524*** (0.15)	2.016*** (0.14)	3.736*** (0.17)
Country and sector affiliation fixed effects are included, but not reported			
Obs=14443; Pseudo R-square=0.136; Chi-square= 5019.813			

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Source: Bruegel. Note: Small firms: 20-49 employees; Medium-sized firms: 50-249 employees; Large firms: 250 employees or more.

Firm age, competition from abroad, foreign ownership and firm size are significantly positively associated with international activities, be they single, dual or triple-mode. But the association is stronger for dual-mode firms and even more so for triple-mode firms. This indicates that older, larger firms and firms that are part of an international

7. For the country affiliation, the reference country is the UK, for the industry affiliation, the reference sector is food and drink and tobacco;

8. Although our group of internationalised firms includes only firms that have *substantial* international activities from at least one mode, the results are nevertheless very consistent with previous analysis of the EFIGE data, which looked at the probability of international activities, without any restriction on the minimum size of international activities (see Mayer and Ottaviano, 2007; and Altomonte *et al.*, 2012).

group are not only more likely to be involved in international activities, but are also more likely to be involved in more complex international strategies associated with GVC-involvement, combining the importing of components, exporting and foreign production.

Compared to UK firms, German and French firms are significantly less likely to be single and dual-mode firms, but there is no significant difference between these countries for triple-mode firms. Spanish firms are less likely to be dual and triple-mode firms. Austrian firms are confirmed to be significantly more likely to be triple-mode firms. Hungarian firms are however significantly less likely to be triple-mode firms.

In terms of sector, firms from the chemicals and electr(on)ics sectors, and car manufacturers, are significantly more likely to be involved in international activities, especially at dual-mode, and particularly triple-mode, level.

### *5.1.3 Positioning in national and international value chains*

The EFIGE survey provides some information that allows us to identify where firms are positioned in the value chain for their goods. More concretely we can draw out some details about each firm's main clients: whether they are private or public customers, or are other firms (both intra-group and external). We also know the 'nationality' of these other, destination, firms, ie if they are firms operating in the same region/country or operating abroad<sup>9</sup>. Using this information, we define firms whose total turnover is fully determined by producing to order for other firms as intermediate firms<sup>10</sup>. These intermediate firms are positioned in global value chains when they produce to order for other firms located abroad<sup>11</sup>.

Of the total EFIGE sample, 32 percent of firms produce to order for other firms. Of the firms that are substantially internationally active, about one in five (22 percent) produce to order for other firms located abroad. Controlling for other firm characteristics, intermediate firms are significantly more likely to be single mode in terms of their international activities, and significantly less likely to be triple-mode firms.

9. For intra-group customer firms we know whether the group firms are national or international.

10. This definition is similar to that given in Accetturo (2012).

11. Unfortunately, we do not know whether the destination firm would itself be producing for other firms or selling to final customers (private or public), limiting the identification of the positioning of the pivotal firm within the value chain. We also do not know whether the destination firm will be selling directly for further exports or for the local market.

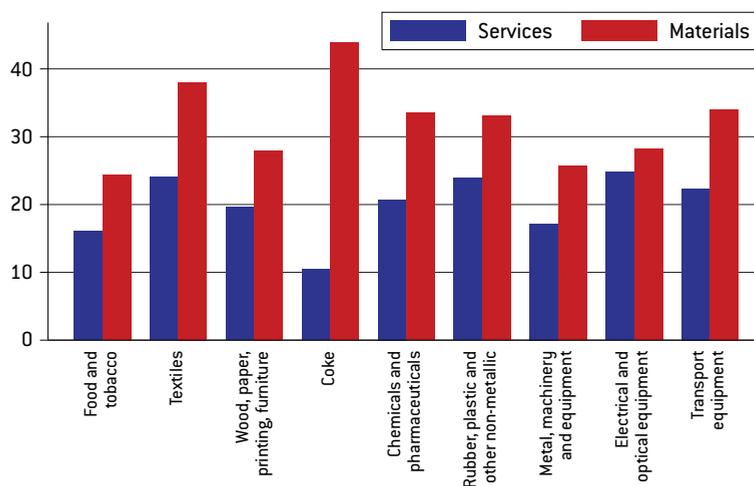
## 5.2 Multiple mode firms and GVC involvement

Before we analyse the multiple mode firms in more detail, we first look at whether firms with multiple international activities can indeed be expected to be more involved in GVCs. To this end, we check how triple and dual-mode firms, compared to zero and single-mode firms, score against two indicators that have typically been used in the existing GVC literature as proxies for GVC involvement: intermediate import ratio (section 5.2.1) and import content of exports (section 5.2.2).

### 5.2.1 *Intermediate import ratio*

The intermediate import ratio (IIR) (Feenstra and Hanson, 1996) is the share of imported intermediates in total intermediates used by a sector. Sectors and countries that are heavily import-dependent for their intermediates are assumed to be more involved in global value chains. The EFIGE dataset allows us to compute a micro-equivalent of the IIR: a firm's purchased intermediates (materials and services) from abroad as a share of its total purchases of intermediates. On (weighted) average, EFIGE firms have an IIR for materials of 28 percent (the median ratio being 20 percent). Not unexpectedly, the IIR for services is lower at 20 percent (the median ratio being 10 percent) reflecting the stronger proximity preference of services purchases compared to materials purchases.

We find, in line with the existing GVC evidence, that firms in the textiles and clothing sector have the highest IIR for materials. The chemicals and rubber and plastics sectors also have relatively high IIRs for materials. Food firms have the lowest, and metals and metal products firms have a relatively low IIR. The IIR is higher for materials than for services for all sectors, though the difference is smallest for firms in electr(oni)c{s}.

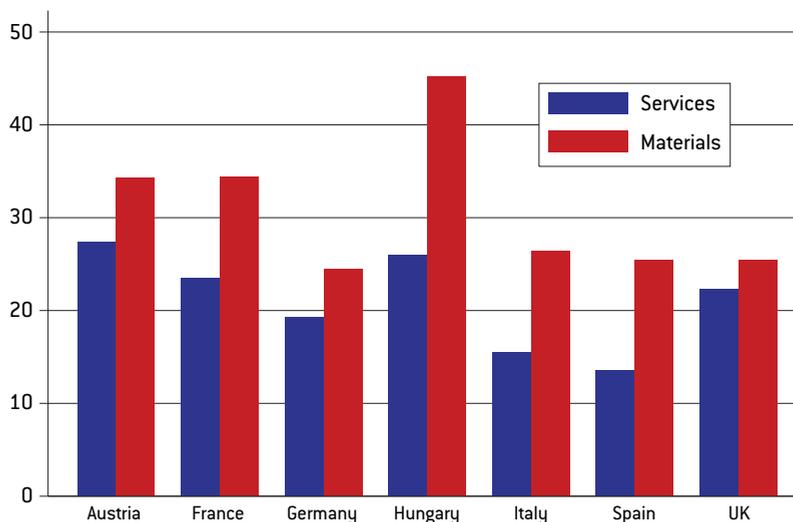
**Figure 1: IIR by sector, 2008**

Source: Bruegel on the basis of EFIGE.

When looking at countries, firms from Hungary have the highest IIR, particularly for materials. This is indicative of the extensive assembly activities in Hungary. In general, smaller countries are more likely to have a higher IIR (see also Austria). Compared to other large countries (Germany, Spain, the UK), French firms have the highest IIR for materials, confirming greater involvement in global value chains<sup>12</sup>.

Table 6 indicates if firms with multiple international activities have a higher IIR. There is a clear positive association: triple-mode firms have significantly higher IIRs than dual-mode firms, which in turn have significantly higher IIRs than single-mode firms. This is the case for both materials and services. This evidence is consistent with multiple-mode firms being more likely to have designed their value chains globally. A multivariate analysis of which types of firm have a higher IIR ratio confirms these

12. All the sector and country effects are robust when simultaneously controlling for other firm characteristics (age, size, foreign ownership, competition) in econometric analysis (not reported).

**Figure 2: IIR by country, 2008**

Source: Bruegel on the basis of EFIGE.

country, sector and multiple-mode patterns<sup>13</sup>. In line with the results reported in Table 6, the multivariate analysis confirms that dual-mode, and especially triple-mode firms, have significantly higher IIR ratios for materials. Triple mode firms also have higher IIR ratios for services. These results confirm that internationally outsourcing or offshoring production will lead to an increase in imports of intermediates, both of materials and services. In line with this, the effect of foreign ownership is very positive and significant. However, larger firms tend to source a smaller share of their intermediates from abroad. This is consistent with the notion that larger firms might be more vertically integrated, or have their own local cluster of component suppliers. These results only hold for materials, not for services, as the footnote makes clear.

13. The multivariate analysis controls for firm age, competition, foreign ownership, firm size and sector and country affiliation. The sector results confirm the results from Figure 1, with firms from textiles and from chemicals and rubber and plastics having higher IIRs, while firms in food and metal products have significantly lower IIRs. The country dummies confirm the results of Figure 2, with firms from Austria, France, and especially from Hungary having higher IIRs. Also, Italy has a significantly higher, although more modestly higher, IIR. For the imports of services, only triple-mode firms are significantly more likely to buy their services from abroad, but dual-mode firms are not. There are no significant differences in terms of firm size, ownership, country and sector of affiliation for importing services. But interestingly, young firms are significantly more likely to import services from abroad.

**Table 6: IIR and multiple mode internationalisation**

		Single	Dual	Triple
Intermediate import ratio materials	Average	21%	32%	38%
	Median	10%	20%	30%
	Observations	1407	3027	548
Intermediate import ratio services	Average	14%	22%	27%
	Median	5%	10%	20%
	Observations	271	797	260

Source: Bruegel on the basis of EFIGE.

### 5.2.2 The import content of exports

Section 5.2.1 described how imported intermediate inputs are important for most sectors. But how much of these imported imports contribute to exports? This is a further specific characteristic of global value chains, involving more complex forms of internationalisation than simple exporting or importing. The GVC literature has often referred to the concept of import content of exports (ICE), for which several indicators have been constructed (eg OECD, 2013). While the GVC literature needs to use a combination of information from input-output tables and (bilateral) trade data to construct ICE ratios at the country or sector level, the EFIGE data provides information on import and export activities at the firm level that can be used to construct these indicators.

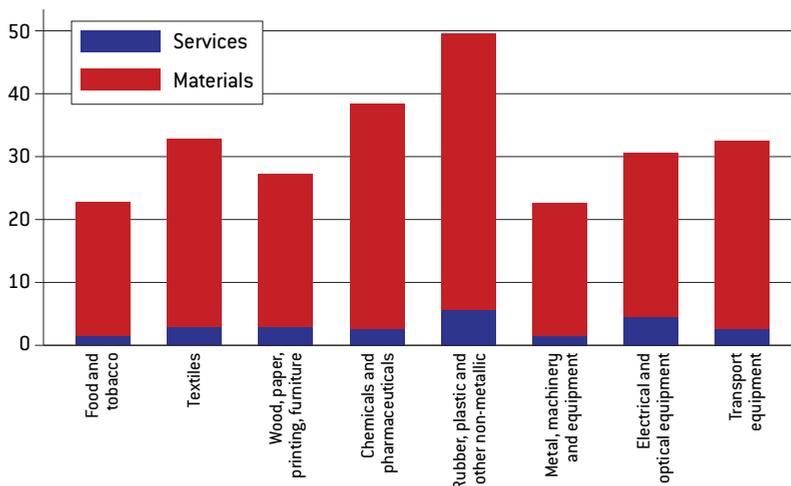
Using EFIGE firm-level data, the ICE of a sector/country is computed as the total reported value of imports in terms of turnover as a share of the total value of exports in terms of turnover, where the totals have been obtained by summing up all sample firms' shares in the sector or country<sup>14</sup>.

For the total EFIGE sample, about one third of all reported exports are made up from imported intermediates (32 percent). Figure 3 shows how the sectoral pattern for ICE is somewhat different to the IIR pattern. Like for the IIR, food and tobacco sector firms score low on the import content of their exports, further confirming their lower level of involvement in global value chains. Firms with the highest ICE scores are from the chemicals and rubber and plastics sectors. In line with their higher IIR, this further confirms the high level of involvement in global value chains of these sectors. Textiles

14. To construct this indicator we assume that both parts of production that are sold at home versus abroad share the same structure of imported intermediates, an assumption typically made in this literature.

firms, which have a high IIR, only have an average ICE ratio. Metals and machinery sector firms have higher IIRs, but low ICE scores.

**Figure 3: Import content of exports by sector, 2008**



Source: Bruegel calculations on the basis of EFIGE.

The evidence from EFIGE therefore suggests that although there is a correlation between the GVC indicators most commonly used in the GVC literature – IIR and ICE – there is still substantial heterogeneity, with a number of sectors scoring high for one indicator, but not necessarily for the other. This makes the analysis of GVC involvement sensitive to which indicator is used.

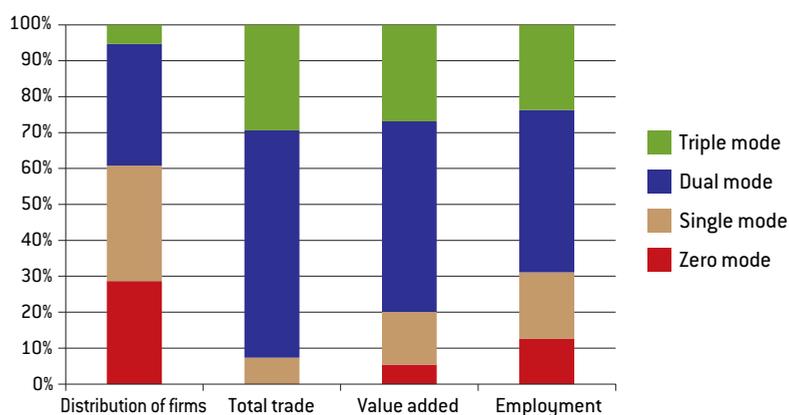
The ICE indicator suggests a strong correlation between imports and exports, at least at the sector level where the ICE indicator was calculated. However, for individual firms within sectors, there is only a weak correlation between imports and exports. This low correlation is because of a substantial number of firms that are either exclusively importing (but not exporting) or exclusively exporting (but not importing). Even among those firms that both import and export simultaneously (dual and triple mode firms), there is a strong tendency towards one or the other: firms that are major importers are not major exporters and vice versa. More typically, firms are either mainly importing or mainly exporting. This somewhat surprising result from the firm-level analysis suggests that the link between imports and exports at the sector/country level not only occurs within firms, but also, and perhaps even more importantly, between firms,

with some firms in the sector doing most of the importing, while others do most of the exporting. This suggests that importers cluster with the exporters in a country/sector, rather than that most firms are themselves combining importing and exporting activities in a substantive fashion. Unfortunately, EFIGE, being focused on internationalisation patterns, has no information on the local links between firms that are importing and those that are exporting. Because the ICE ratio does not work well at the firm level, we will not use it further in the analysis.

### 5.3 GVCs, multiple-mode internationalisers and their importance for value added, employment and trade

Although few in number, firms that combine foreign production with the importing of components and exporting of their produced goods matter substantially for employment and value added. The 5 percent of firms that are triple-mode firms account for about 27 percent of total sample value added and 24 percent of total sample employment. The group of dual-mode firms, which makes up 34 percent of firms in the sample, accounts for 53 percent of total sample value added and 45 percent of total sample employment. Firms with multiple international activities are therefore the bigger firms that are likely to matter substantially for the aggregate performance of sectors and countries.

**Figure 4: Share by category of firm of total trade, value added and employment, 2008**



Source: Bruegel on the basis of EFIGE.

Figure 4 summarises the average firm values for employment and value added by type of international involvement, illustrating that multiple mode firms are indeed the larger firms, both in terms of employment and value added, though more in terms of the latter than the former. Thus, there is a substantial labour productivity premium for multiple-mode firms, especially triple-mode firms. This translates into triple-mode firms being able to sustain higher unit labour costs. However, within the triple-mode firm group, the divergence between average and median values indicates that the average is skewed because of the exceptional performance of a small number of firms.

**Table 7: Employment, value added and multiple-mode internationalisation**

		Zero	Single	Dual	Triple
Total number		4232	4742	4999	786
Employment	Average	33	44	97	276
	Median	20	25	34	60
Value added (thousands of euros)	Average	1246	2377	7930	20005
	Median	833	1123	1783	3699
Labour productivity	Average	734	1042	2467	5471
	Median	589	699	911	1449
Unit labour cost	Average	0.79	0.73	0.73	0.93
	Median	0.78	0.75	0.74	0.71

Source: Bruegel on the basis of EFIGE.

Multiple-mode firms are even more likely to matter for trade flows and the external competitiveness of nations, because they are also more trade intensive compared to single mode firms, with both a higher import intensity and a higher export intensity, with especially the latter difference most pronounced, as Table 8 shows.

**Table 8: Import intensity, export intensity and multiple-mode internationalisation**

		Single	Dual	Triple
Import intensity	Average	8%	14%	16%
	Median	2%	8%	10%
Export intensity	Average	29%	42%	43%
	Median	20%	32%	36%

Source: Bruegel on the basis of EFIGE.

In general, total trade flows are likely to be concentrated in a small number of firms (see Mayer and Ottaviano, 2007). Ten percent of EFIGE firms account for about 87 percent of total trade in the EFIGE sample (91 percent of imports; 85 percent of exports). These top 10 percent trading firms are much more likely to be triple-mode firms: 24 percent of the top 10 percent are triple-mode firms, compared to 5 percent for the sample overall. They are also more likely than average to be dual-mode firms: 64 percent of the top 10 percent firms are dual-mode firms, compared to 34 percent for the sample overall.

As a consequence of their large size and higher trade intensity it is not surprising, as Figure 4 shows, that the triple-mode firms, which make up 5 percent of the total sample, account for almost 30 percent of total sample trade. The 34 percent of sample firms that are dual-mode account for 63 percent of total trade. Firms that only import or only export, which are the firms one typically has in mind when discussing internationalisation, only account for 7 percent of total sample trade. Multiple-mode firms therefore substantially drive the total trade flows of countries and sectors.

Table 9 shows the sectors in which multiple-mode firms are particularly dominant in terms of trade flows. This is particularly evident for electr(on)ics and transport equipment: triple-mode internationalisers account for more than 40 percent of electr(on)ics sector exports and almost half of transport equipment exports. Simple exporters account for less than 1 percent of total transport sector exports and less than 5 percent of electr(on)ics sector exports. Triple-mode firms account for more than 40 percent of textile sector imports, and more than half of rubber and plastics sector exports. In the chemicals and pharmaceuticals sector, simple importers account for less than 1 percent of total imports.

#### 5.4 GVCs, multiple-mode internationalisers, productivity and innovation

Multiple-mode firms matter not only because they are the bigger producers, employers and traders. They are likely to matter for countries' competitiveness because of their outstanding productivity profile.

##### 5.4.1 Multiple-mode internationalisers and productivity

Are firms that are simultaneously importing components, producing abroad and exporting their goods the best performing firms? We know from the empirical trade literature that more productive firms are more likely to become internationally active because they can more easily absorb the fixed costs associated with inter-

**Table 9: Share of import and export turnover by sector and level of firms' international activities**

	Import turnover			Export turnover		
	Single	Dual	Triple	Single	Dual	Triple
Total	4%	75%	21%	9%	58%	33%
Food and tobacco	18%	64%	18%	18%	45%	37%
Textile	4%	55%	42%	13%	55%	32%
Wood, paper, printing, furniture	7%	71%	22%	19%	62%	19%
Chemical and pharmaceuticals	1%	76%	23%	11%	62%	28%
Rubber and plastic	4%	42%	54%	13%	56%	31%
Metal, machinery and equipment	9%	68%	23%	9%	53%	37%
Electrical and optical equipment	9%	55%	37%	5%	54%	41%
Transport equipment	6%	61%	33%	1%	51%	48%

Source: Bruegel on the basis of EFIGE.

nationalisation. Melitz (2003) introduced this argument for exporting firms; Helpman, Melitz and Yeaple (2004) for offshoring firms. One can expect this to hold a fortiori for multiple-mode firms that are simultaneously involved in exports, imports and location of activities abroad. Only the best-performing firms will be able to take on the fixed costs associated with multiple-mode internationalisation. At the same time, GVC involvement can be expected to improve firm performance, if only because it gives access to more efficient sourcing and larger markets. It does however also make GVC-involved firms more vulnerable to external shocks.

Table 7 identified the superior labour productivity performance of multiple-mode firms, and especially triple-mode firms. Our measure for productivity in this section is Total Factor Productivity (TFP), in line with previous EFIGE analyses (Mayer and Ottaviano, 2007; and Altomonte *et al*, 2012)<sup>15</sup>. Because in the EFIGE dataset, TFP is measured simultaneously with the identification of the internationalisation strategy, we cannot identify any causal relationship (ie whether multiple-mode internationalisation strategies make firms more productive rather than whether more productive firms move into multiple-mode internationalisation).

15. Total Factor Productivity refers to the estimated productivity of all inputs taken together and it is a measure of the overall efficiency of a firm. There are several procedures in the literature for TFP estimation based on firm-level production functions. In line with previous EFIGE analyses, we use the Levinsohn-Petrin method (see Altomonte *et al*, 2012, for a more detailed discussion of the various methods).

Table 10 provides some first descriptive evidence that multiple-mode firms indeed have higher TFP scores. Compared to firms that have no substantial international activities, single-mode firms (typically engaged in exporting or, though less so, in importing) already have higher TFP scores. Dual-mode firms score even higher, and triple-mode firms have the highest TFP scores.

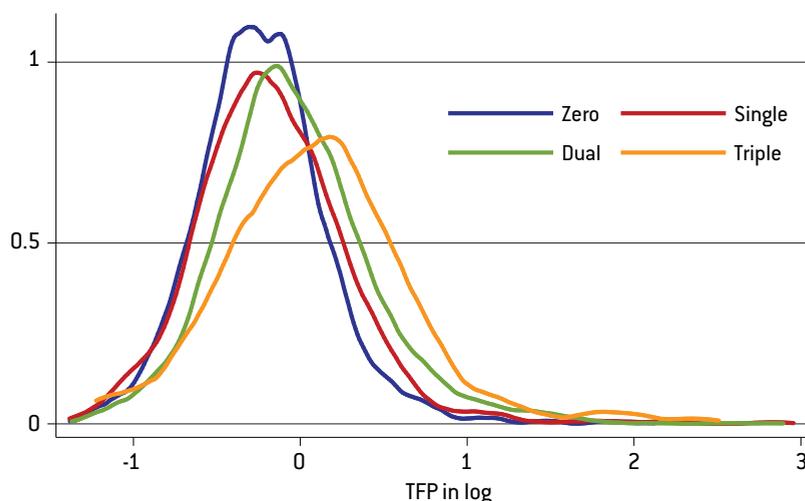
**Table 10: Productivity and multiple-mode internationalisers**

		Zero	Single	Dual	Triple
TFP	Average	0.86	0.96	1.09	1.32
	Median	0.78	0.81	0.92	1.09
	Observations	2018	2403	2593	421

Source: Bruegel on the basis of EFIGE.

Because the TFP distribution of firms is highly skewed, it makes more sense to look at the full distribution of productivity levels, rather than averages (see also Altomonte *et al.*, 2012). Figure 5 shows the kernel-density functions for our four categories of internationalising company<sup>16</sup>.

**Figure 5: TFP density and multiple-mode internationalisers, 2008**



Source: Bruegel calculations on the basis of EFIGE.

16. A kernel density shows the shares of firms (density) that reach each productivity level. It shows the probability of picking a firm with a certain productivity level when the firm is randomly drawn from each category of activities.

Figure 5 confirms that firms, particularly triple-mode firms, with greater GVC involvement are on average characterised by higher TFP scores. The figure shows that the superior performance of these triple-mode firms holds especially in the upper tail of the distribution, ie triple-mode firms are not just more likely to have on average a higher TFP score, they are especially more likely to be the best performers.

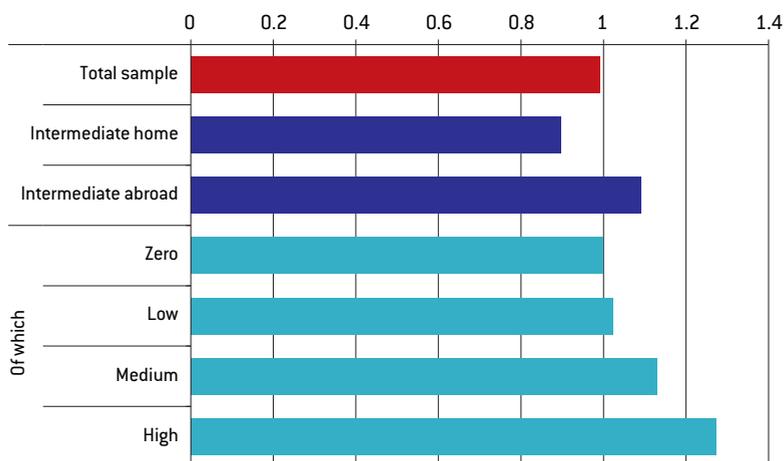
The intermediate import ratio (IIR) which is associated with GVC involvement also shows a positive correlation with TFP, especially for the upper part of the distribution. Table 11 looks at the weighted average TFP at different quantiles of the IIR distribution. While TFP performance increases for firms with higher quantiles of IIR, better TFP performance is especially evident at the high end of the IIR, ie for firms that import at least 75 percent of their components from abroad. This is consistent with a positive association between substantial sourcing of components from abroad and higher overall efficiency.

**Table 11: TFP and IIR**

IIR_mat	First quantile	Second quantile	Third quantile	Fourth quantile
Average TFP	1.03	1.05	1.07	1.18
Observations	693	893	573	786

Source: Bruegel on the basis of EFIGE.

The TFP profile for firms that are positioned as intermediate firms in value chains is more complicated. In general, firms that are producing to order for other firms are associated with lower productivity levels. But this is particularly the case for those intermediate firms that only supply to other firms in their home country. Intermediate firms that are involved in global value chains, ie that produce for other firms abroad, have increasingly higher productivity performance scores, the more complex the internationalisation strategies they deploy.

**Figure 6: (Weighted) average TFP for intermediate producers, 2008**

Source: Bruegel on the basis of EFIGE.

The multivariate analysis reported in Box 2 confirms a positive but insignificant productivity premium for single-mode internationalisers. More importantly, it confirms a significant and sizeable productivity premium for dual-mode and particularly for triple-mode internationalisers. This shows that these firms are more productive not only because they are typically larger and older, but because their productivity premium is intrinsically connected to their more complex international involvement, combining several internationalisation modes at the same time. In addition, the multivariate analysis confirms that firms that produce to order for firms abroad are significantly more productive than their domestic counterparts. The most efficient intermediate producers are more likely to participate in global, rather than domestic, value chains. Based on their unique capacities, intermediate producers can be pivotal firms in global value chains, resulting in better productivity performance.

### BOX 2: ECONOMETRIC ANALYSIS OF MULTIPLE-MODE INTERNATIONALISATION AND PRODUCTIVITY

We look at firm characteristics that significantly correlate with higher TFP levels in a multivariate fashion, using OLS (ordinary least square) as the estimation method. Our main focus is on the impact of the internationalisation choices of firms: ie if a single, dual or triple internationalisation mode is adopted, the base comparison being firms that have no substantial international activities (Model 1). We also check (in Model 2) if intermediate firms have different TFP profiles. We control for other firm characteristics (size, age, foreign ownership, foreign competition), and sector and country affiliation. Table 12 shows the relevant results.

**Table 12: OLS estimates of multiple-mode international firms on TFP**

Dep. Variable: TFP	Model 1	Model 2
Single Mode	0.012 (0.01)	0.01 (0.01)
Dual Mode	0.056*** (0.02)	0.053*** (0.02)
Triple Mode	0.071** (0.03)	0.071** (0.03)
Intermediate home		0.016 (0.02)
Intermediate abroad		0.035** (0.02)
Firm age, fixed firm size effects, country and sector dummies, foreign group and foreign competition included; Dependent variable is log(TFP)		
Obs	7312	7312
R-square	0.283	0.284

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Source: Bruegel.

According to the results, there is a small and insignificant productivity premium for single-mode internationalisers, but a significant productivity premium for dual-mode internationalisers (mostly importers and exporters). Nevertheless, the highest productivity premium is for the triple-mode firms which import components, carry

out foreign production and export their produced goods. Although the productivity premium is significant for triple-mode firms, there is more heterogeneity in terms of productivity in this group, as was already clear from the descriptive analysis. When disaggregating the triple-mode firms into those that use intra-firm FDI versus inter-firm outsourcing for their international production, the results (not reported) confirm a strong positive and significant productivity premium for triple-mode firms engaged in inter-firm outsourcing, while there is too much heterogeneity in the TFP performance of triple-mode firms that engage in FDI.

With respect to the positions of firms within value chains, we find that firms that produce to order for other domestic firms have no specific productivity advantage, all things being equal. The negative productivity profile in the descriptive statistics for local intermediate producers is therefore due to other firm characteristics, such as their smaller size. Firms that produce to order for firms abroad, however, have a significant productivity premium, all other things being equal.

These results take into account the effects of other firm characteristics. Larger and older firms and foreign-owned firms are more productive. The country-affiliation results show that firms in all countries in the EFIGE sample, except for Austria, have higher TFP levels than UK manufacturing firms. The sector affiliation results show that all sectors except for textiles and clothing have higher TFP levels than food and tobacco.

#### *5.4.2 Multiple-mode internationalisers, innovation and human capital*

Although TFP captures all growth-contributing factors that are not labour and capital, the 'residual' is usually interpreted in the literature as capturing 'innovativeness'. Can we interpret the TFP premium for GVC-involved firms and for the firms that are producing to order for firms abroad as evidence of greater levels of innovation being the driver for the superior productivity of these firms? The EFIGE dataset contains direct information about the innovation profile of sample firms, ie whether they introduced any new product and/or process innovations in the time period considered. This allows us to test more directly if multiple-mode firms are more innovative, and if this drives their greater productivity performance.

**Table 13: Innovation and multiple-mode internationalisers**

	No innovation	Product	Process	Both
Zero	50%	15%	18%	16%
Single	36%	21%	16%	26%
Dual	24%	24%	14%	37%
Triple	17%	31%	9%	43%

Source: Bruegel on the basis of EFIGE. Note: the table shows the proportion of firms that have introduced product or process innovations, both or none.

Firms that import components and export their goods, and particularly those that also produce abroad, are more likely to introduce product innovations (either on their own but particularly in combination with process innovations). Multiple-mode firms, especially triple-mode firms, are much less likely to only introduce process innovations, often associated with cost cutting or the introduction of labour-saving technologies. This is consistent with greater levels of GVC involvement being associated with better innovation performance. It does not support the common view that GVC firms are cost-cutting process innovators.

Multivariate analysis confirms the positive association between multiple-mode internationalisation and innovation, particularly for the combination of product and process innovations and for triple-mode internationalisers<sup>17</sup>. It also confirms that, compared to internationally inactive firms, single- and dual-mode firms are more likely to introduce only process innovations. But this does not hold for triple-mode firms.

Firms producing to order for other firms at home are less likely to be involved in innovation strategies, and if they innovate they are most likely to be process innovators only. This is consistent with the importance for intermediate firms of specialising in process innovation to improve efficiency. In contrast, firms producing to order for firms abroad are more likely to be innovative, and those that are innovative are also more likely to be involved in process innovation, most often in combination with product innovation: not only improving the efficiency of production processes

17. Using a multinomial logit specification, we look at which firm characteristics determine the likelihood of firms introducing product innovation, process innovations or the combination of product and process innovations. Our main focus is on the use of single, dual or triple internationalisation modes, the base comparison being firms that have no substantial international activities. We also check for any extra effect applying to intermediate firms. We control for other firm characteristics (size, age, foreign ownership, foreign competition), and for sector and country affiliation. We also control for R&D investments, human capital and ICT investments as inputs into the innovative process. Results are not reported.

but also improving the quality of the components they deliver. Opening up to international value chains is thus associated with more complex innovation strategies<sup>18</sup>.

**Table 14: Innovation and intermediate producers**

	No innovation	Product	Process	Both
Intermediate home	45%	14%	20%	20%
Intermediate abroad	30%	21%	17%	32%

Source: Bruegel on the basis of EFIGE.

Developing complex innovation strategies requires R&D resources, ICT infrastructure and a highly-skilled human capital base. A graduate-level workforce is particularly important for supporting innovation strategies that are aimed at introducing new products<sup>19</sup>. In line with and in support of their more complex innovation profile, multiple-mode firms are also more likely to recruit university graduates. This is the case particularly for triple mode firms, which are more directed towards product rather than process innovation.

**Table 15: Human capital and multiple-mode internationalisers**

Average % of university graduates in workforce	
Zero	7%
Single	9%
Dual	11%
Triple	15%
Intermediate home	6%
Intermediate abroad	9%

Source: Bruegel on the basis of EFIGE. Note: Average = weighted average.

18. The multivariate analysis, controlling for other firm characteristics, confirms that firms that produce to order for other firms are significantly less likely to be involved in only product innovation, and are more likely to be involved in only in process innovation. In addition, firms that produce to order for other local firms are significantly less likely to have complex innovation strategies, combining process and product innovation, which does not hold for firms producing to order for foreign firms.

19. The multivariate analysis of innovative performance controls for several inputs into the innovation process. It finds that R&D investments increase the probability of innovative performance, for product and process innovations. While ICT investments are significant drivers for process innovations, human capital is most associated with product innovations.

Firms that produce to order for other firms, particularly those which supply other domestic firms, are less likely to hire university graduates. Firms that supply foreign firms are somewhat more likely than local intermediate firms to recruit university graduates, but not substantially more likely<sup>20</sup>.

### 5.5 GVCs, Multiple Mode Internationalisation and crisis sensitivity

Recent research shows that the impact of the crisis on firms' performance differs according to the organisational mode of global transactions that the firm is involved in (Altomonte di Mauro *et al*, 2012), and by firms' positioning in GVCs (Békés *et al*, 2011). With the positive association between greater GVC involvement and productivity and innovation, one could expect that firms with greater GVC involvement would be shielded from the crisis by their greater productivity, making them less sensitive to the crisis and consequently less likely to shed their high-skilled workforces. However, there is also evidence that GVCs act as a channel for the rapid transmission of real and financial shocks, amplifying national fluctuations in demand for final goods, making GVC-involved firms more crisis-sensitive (OECD, 2013).

Using the EFIGE survey, it is possible to investigate whether or not firms experienced a reduction in turnover between 2008 and 2009, and by how much. Tables 16 and 17 break this down according to firms' level of GVC involvement. The descriptive analysis shows that GVC-involved firms are somewhat more likely to have experienced reductions in turnover, but the differences between them and non-GVC involved firms are small.

Firms that produce to order for other firms are more likely to have been affected by the crisis: four out of five such firms report reductions in turnover. This holds for firms servicing other national firms, and for those servicing firms abroad.

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20. A multivariate analysis for human capital (results not reported) confirms that investment in human capital increases with higher levels of international involvement: dual and particularly triple-mode firms are more ambitious in terms of human capital accumulation strategies, hiring relatively more workers with university degrees. The multivariate analysis also confirms the significantly lower ratio of graduate hiring by firms who produce to order, both home and abroad.

**Table 16: Multiple-mode firms and turnover reduction during the crisis**

	Reduction in turnover in 2009			
	No reduction	<10%	10%-30%	>30%
Zero	31%	20%	31%	18%
Single	28%	19%	35%	18%
Dual	27%	18%	36%	19%
Triple	28%	19%	39%	14%

Source: Bruegel on the basis of EFIGE.

**Table 17: Intermediate producers and turnover reduction during the crisis**

	Reduction in turnover in 2009			
	No reduction	<10%	10%-30%	>30%
Intermediate home	23%	16%	37%	25%
Intermediate abroad	21%	16%	39%	24%

Source: Bruegel on the basis of EFIGE.

The multivariate analysis confirms these figures<sup>21</sup>. While GVC involvement does not significantly correlate with crisis sensitivity, positioning in supply chains does: intermediate firms are more likely to have experienced a reduction in turnover, particularly severe cuts (>30%). This holds irrespective of whether they supply firms at home or abroad. At the same time and all else being equal, the results show that firms that invest in innovation strategies are less likely to have seen cuts in turnover, or have experienced smaller cuts in turnover. This evidence corroborates the assertion that more developed innovation profiles are important for firm resilience in the face of external shocks.

## 5.6 European versus global value chains

The furthering of the integration of European Union member states offers European firms the possibility to organise their value chains at EU level, thus avoiding higher coordination and transportation costs compared to global value chains. At the same time such a regional focus might limit the benefits from value chains, restricting the

21. We analyse the firm characteristics that are conducive to a higher crisis sensitivity in a multivariate fashion using an ordered probit with the categories being: no change in turnover, <10%, 10-30%, > 30% loss in turnover. The use of multiple internationalisation modes and the intermediate producer status variables are our key firm characteristics of interest. Simultaneously we correct for firm size, age, foreign ownership, competition from abroad, the presence of inputs for innovation (R&D, human capital, ICT) and sector and country affiliation. Results are not reported, only discussed in the text.

scope for access to markets and resources to nearby geographical areas, thus foregoing global opportunities.

We can identify in the EFIGE dataset if European based firms remain mostly within Europe when they internationalise, or if they are internationalising globally. For exports and foreign production, we can identify the share which remains within Europe. For imports we can only identify whether or not the firm is importing from in- or outside Europe.

**Table 18. Intra-EU internationalisation and multiple-mode firms**

		Single	Dual	Triple
Intra-EU exports as share of total exports	Average	71%	69%	64%
	Median	80%	80%	70%
	Observations	2653	3971	658
Intra-EU FDI as share of total FDI	Average	59%	51%	50%
	Median	98%	50%	50%
	Observations	43	190	504
Intra-EU outsourcing as share of total outsourcing	Average	51%	46%	46%
	Median	40%	60%	40%
	Observations	50	181	367

Source: Bruegel on the basis of EFIGE.

The majority of exports from EFIGE firms goes to other EU countries. While the share of exports from single- and dual-mode firms that remains within the EU is not significantly different, firms that combine exports, imports and foreign production (triple-mode firms) send a lower share of their exports to other EU countries, although on average it is still almost two-thirds. In terms of foreign production, the EU is less dominant, with about 50 percent of FDI remaining within the EU; for outsourcing, the figure is somewhat less than 50 percent. There is little difference between dual- and triple-mode firms in this respect (but note that only a few single- and dual-mode firms are engaged in FDI or active outsourcing).

We use this information to identify the firms with international activities concentrated in the EU. We label these firms European Value Chain firms (EVCs). We categorise single-mode firms as EVCs if the international activities in which they are engaged are predominantly (>50 percent) within the EU. For dual-mode firms, an EU focus implies that both of their modes (typically imports and exports) remain mostly (>50 percent)

in the EU. Triple-mode EVC firms are those for which all of their modes (exports, imports, foreign location of activities) are mostly (>50 percent) within the EU.

About one out of two single-mode internationalising firms (49 percent) can be labelled as EVC firms, using our definition. About one out of three dual- and triple-mode internationalising firms can be labelled as EVC firms (respectively 37 percent and 36 percent). Among firms that produce to order for other firms abroad, almost one out of two has an EU focus (47 percent).

Multivariate analysis (results not reported) confirms that there is no significant difference between triple- and dual-mode firms in terms of their EU focus: triple-mode firms are not significantly more likely to be extra-EU oriented compared to dual-mode firms. But single-mode firms are significantly more EU-focused. This is consistent with a simple internationalisation strategy that confines its geographic scope to nearby markets. Firms that are intermediate producers in international value chains are significantly more likely to be EU-focused in their international scope. For these types of firms, geographic closeness to their value-chain partners seems to be more important than it is for non-intermediate internationalisers. The multivariate analysis, controlling for other firm characteristics, also shows somewhat surprisingly that large firms are more likely to be EU-focused. Firms that belong to another EU group are unsurprisingly more likely to be EU-oriented in their international scope. French and German firms are less likely to be EU-focused in their internationalisation, as are firms from the metals and metal equipment, electr(on)ics and transport equipment sectors.

To examine whether an EU focus for international activities has an impact on firm performance, we look at the TFP profile of EVC firms.

**Table 19: Multiple-mode firms, EU focus and TFP**

		Single		Dual		Triple	
		Non-EVC	EVC	Non-EVC	EVC	Non-EVC	EVC
TFP	Average	0.98	0.96	1.08	1.12	1.34	1.29
	Median	0.82	0.81	0.90	0.95	1.08	1.11
	Observations	756	748	1649	944	256	165

Source: Bruegel on the basis of EFIGE.

Table 19 reports the (weighted) average and median TFP values for the different cases. For single-mode firms, an EU focus makes little difference to TFP. For dual- and triple-mode firms there is also only a small difference between EVC firms and non-EVC firms. All of these differences are small and are furthermore sensitive to other firm characteristics. None of the differences show up significantly in multivariate analysis (not reported). Also there are no significant productivity differences between firms that produce to order for other firms abroad, whether they have an EU focus or not. Overall, the evidence therefore suggests neither a productivity premium nor a discount for European firms that concentrate their international value chain configuration on Europe.

## 5.7 Main findings

The sectoral and country prevalence of multiple-mode internationalisers is very consistent with the sectoral and country patterns of GVC sensitivity in the macro-economic GVC analysis, as reported in chapter 4. But even within sectors and countries that are typically identified in the GVC literature as being more GVC-involved (countries such as Hungary and France, and sectors such as electronics, textiles and clothing and chemicals), there is still substantial heterogeneity in terms of how intensively firms within these sectors and within these countries are GVC involved, warranting an analysis of GVC involvement at the firm level, to better understand which firms are more heavily involved in GVCs.

We find that older, larger firms and those that are part of an international group are not only more likely to be substantially internationally active, as typically found in the empirical firm-level trade literature, but are also significantly more likely to be multiple-mode internationalisers, deploying complex internationalisation strategies typically associated with GVC involvement: combining imports of components, exports and foreign production of parts of their value chain.

The firm-level analysis also shows that the performance of sectors and economies is skewed towards GVC-involved firms. There are relatively few multiple-mode firms, combining different international activities; in particular, few firms combine the importing of components and exporting of produced goods with the organisation of part of their production activities abroad. But these few firms, given that they are larger and more trade intensive, substantially drive the creation of total value added, employment and, particularly, trade flows in most sectors and economies. Getting to know them therefore matters.

Multiple-mode firms, particularly the triple-mode firms, also have the highest productivity premia, are significantly more likely to introduce new product innovations, have a more sophisticated human capital base, hire relatively more workers with a university degree and consequently are more able to support higher unit labour costs. Despite their greater vulnerability to external shocks, multiple-mode firms are not more likely to be crisis sensitive, thanks to their superior productivity performance.

Our analysis also shows that firms that are producing intermediate goods for global value chains also have a significant productivity premium compared to intermediates producing for local value chains. These international intermediate producers also develop more complex innovation strategies, combining improved production processes with newly developed components. Based on their unique capabilities, intermediate producers can be pivotal to global value chains, creating and capturing substantial value. By contrast, firms with an intermediate position who supply only domestic value chains do not realise any productivity premium and are less likely to introduce product innovations.

While GVC involvement does not significantly correlate with crisis sensitivity, positioning in the value chain does: intermediate firms are more likely to experience a reduction in turnover, irrespective of whether they supply customers at home or abroad. At the same time, and all else being equal, the results show that firms that invest in innovation strategies and human capital are less likely to have seen cuts in turnover, or have had smaller cuts in turnover, during the crisis. This evidence corroborates the assertion that innovation strategies are important for firm resilience in the face of external shocks.

Although for most European manufacturing firms the EU is the major arena for their international activities, multiple-mode firms are less likely to be solely focused on EU markets. However, firms with international activities which constrain their scope to the EU do not experience any productivity discount nor premium, suggesting that for

European value chain firms, the foregone opportunities of global sourcing are cancelled out by the higher coordination costs of global value chain organisation.

Overall, our analysis of global value chain involvement and its impact on performance at the firm level provides consistent evidence that the firms that take on the opportunities of global market access, and which source resources globally, are well placed to be the engines of Europe's innovation-based growth and to drive its external competitiveness on the basis of globally sustainable comparative advantage. Given their highly specific characteristics, it matters for policy makers to better understand who they are, what they do and what challenges they face. The final chapter of this Blueprint delves deeper into the implications for EU policy.

In any case, more firm-level analysis is needed, particularly to trace the performance of GVC-involved firms over time in order to better identify the causal relationship between internationalisation strategy and performance: do firms need to be strong before they can benefit from the opportunities offered by engagement in global value chains, or does engagement in global value chains make firms stronger, and able to weather the gales of fierce global competition?

# 6 Energy competitiveness

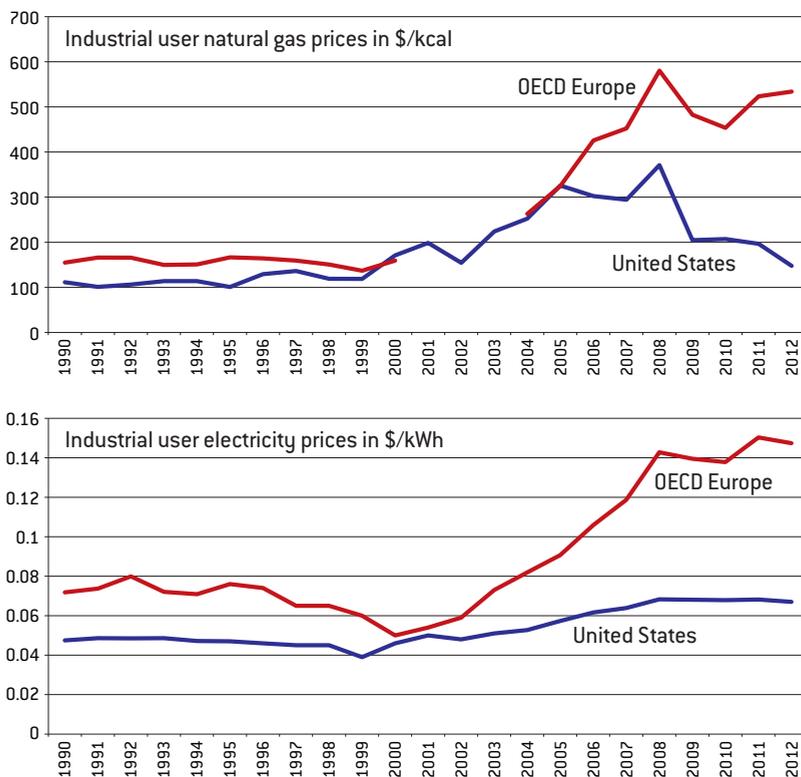
BY GEORG ZACHMANN AND VALERIA CIPOLLONE

High energy prices have raised concerns that the competitiveness of European manufacturing will suffer. In this chapter, we describe the recent development of energy prices and qualitatively explore what is driving them. We then provide an empirical assessment of which sectors are likely to be most negatively affected by high international energy prices, and the implication of this for overall competitiveness. We conclude with recommendations to policymakers.

## 6.1 Energy is becoming relatively expensive in Europe

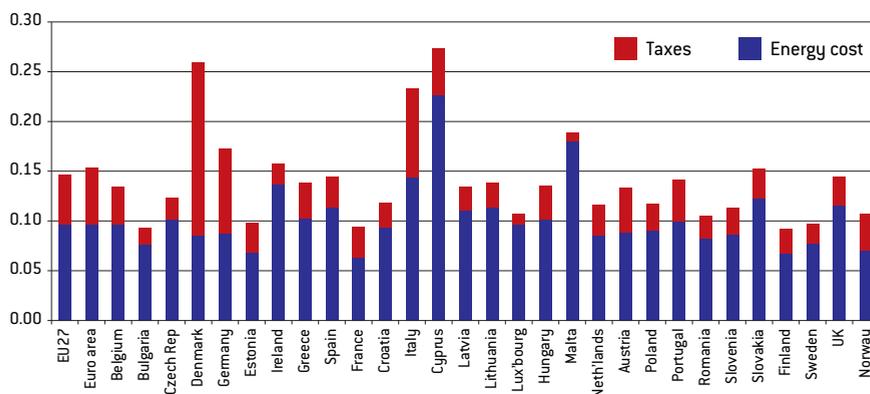
In Europe, natural gas prices for industrial users quadrupled and electricity prices for industrial users more than doubled in nominal terms between 1990 and 2012, according to the International Energy Agency. The European electricity price increase has hugely outstripped the modest price increase in the United States (Figure 1). European industrial-user electricity prices, which were 35 percent above US prices in 1990, were 120 percent above US prices in 2012. For natural gas, the development has been even more striking. US prices returned to their 1990 level in 2012. Consequently, the price divergence that started after 2005 resulted in European natural gas prices exceeding the corresponding US prices by almost a factor of four.

**Figure 1: Natural gas and electricity price paid by industrial users, 1990-2012**



Source: IEA.

These aggregate numbers, however, should be treated with caution. Energy prices for different groups of industrial user vary significantly and prices are different in different US states and in different European countries or even regions. For example, a Deloitte (2013) report on Belgian electricity prices found that industrial consumers pay €6.5 to €10 /MWh more for electricity in Flanders and €7 to €25 /MWh more in the Walloon region, compared to the average price similar consumers pay in surrounding countries. In different countries, electricity prices for industrial users are driven by different combinations of wholesale electricity prices, network tariffs and taxes and levies. In France, for example, consumers benefit from comparatively lower taxes and partly regulated wholesale prices, and in Germany consumers benefit from low wholesale prices as a result of subsidised renewables, and partial exemption from the cost of the network and the feed-in tariffs.

**Figure 2: Industrial user electricity prices in €/kWh in Europe, second half 2012**

Source: Eurostat. Note: 500 MWh < Consumption p.a. < 2 000 MWh.

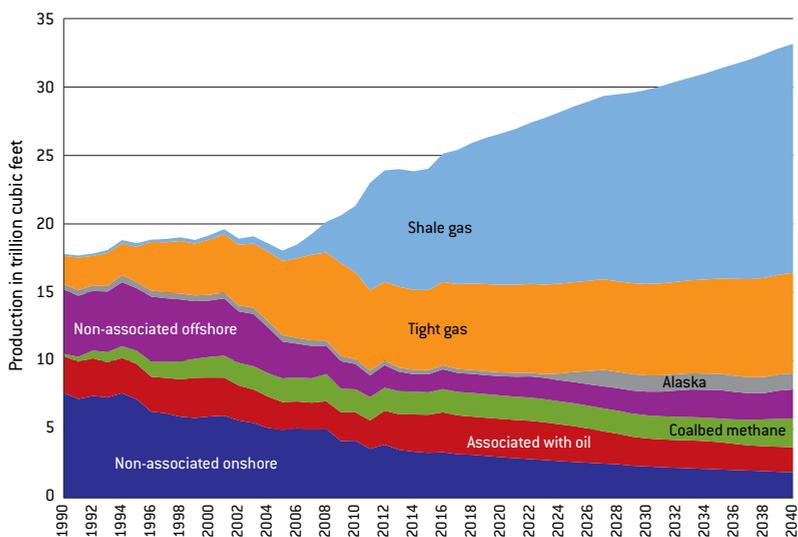
Nevertheless, the general trend of increasingly higher European energy prices compared to the US is uncontested and is a cause for serious concern on the part of European Union energy-intensive industry, which is reflected in EU policy. For example the *Action Plan for a competitive and sustainable steel industry in Europe*, adopted by the European Commission in June 2013, states that “*European industry is faced with higher energy prices than most of its international competitors, a trend which has been amplified by price development dynamics of recent years*”.

There are five main reasons for the absolute and relative increase in European energy prices:

First, global commodity prices have increased in the past two decades. The price of Brent oil increased from about \$40 /barrel in 1990 to more than \$100 in the first half of 2013. The price of Australian coal – a proxy for internationally traded coal – increased from about \$65/tonne in 1990 to almost \$100/tonne in the first half of 2013. And the price of US natural gas increased from about \$2.30/million British thermal units (mmbtu) to \$3.75/mmbtu in the first half of 2013 (all prices expressed in 2013 values). Increasing consumption in emerging economies is one of the main reasons for this development. China’s energy consumption alone increased from 26 billion gigajoules in 1990 to 110 billion gigajoules in 2011, surpassing that of the US in 2010.

Second, US natural gas and electricity prices have increased less than global energy prices because the US has been able to develop huge cheap US hydrocarbon resources. Since 2008, the production of tight and shale gas has exceeded the reduction in conventional gas sources, leading to an increase in US production from 21 trillion cubic feet (tcf) in 2008 to 25 tcf in 2012<sup>1</sup>. Because of a lack of natural-gas exporting infrastructure in North America, increased supply has led to a surplus that has caused regional prices to drop from around \$9/mmbtu to less than \$4/mmbtu<sup>2</sup>. Despite the economic crisis, US natural gas consumption has not decreased because low prices made it attractive – especially in power generation. Between 2007 and 2012, natural gas consumption in the US power generation increased by 34 percent, while coal consumption dropped by 21 percent. This switch to natural gas led to a stabilisation of the electricity production cost, and industrial-user electricity prices marginally decreased after 2008.

**Figure 3: US natural gas production in trillion cubic feet**



Source: US Energy Information Administration, *Annual Energy Outlook 2013 Early Release*.

Third, European natural gas and electricity prices have increased faster than global energy prices. While the supply situation for natural gas in the US has been very

1. US natural gas marketed production (millions of cubic feet) according to [www.eia.gov/dnav/ng/hist/n9050us2A.htm](http://www.eia.gov/dnav/ng/hist/n9050us2A.htm).
2. North America was a net importer of natural gas until 2011. In 2008 it consumed about 2 percent more natural gas than it produced. In 2012, production in North America exceeded consumption by 1 percent for the first time.

favourable, domestic production in the EU has declined faster than consumption. The dependency rate<sup>3</sup> increased from 49 percent in 2000 to 66 percent in 2012. At the same time, declining natural consumption [-15 percent between 2005 and 2012] because of the economic crisis and an increased share of coal in power production (the US switch from coal to natural gas put pressure on global coal prices) has been unable to bring natural gas prices in Europe down. The reason is that natural gas prices in Europe are largely determined by long-term contracts – many of them including take-or-pay provisions. A large proportion of imported natural gas is still purchased at oil-indexed prices that do not reflect current market conditions.

A fourth reason for Europe's above-average increase in energy prices is its energy policy. Europe is pursuing a comparatively ambitious decarbonisation agenda. For some years, carbon prices of €15-20 resulted in higher electricity prices – since 2011, this effect has withered with the collapse of the carbon price. Several EU countries have invested heavily in electricity generation from renewable energy sources. This policy is motivated by an aim to reduce the cost of these new technologies, which can replace imported fuels and reduce carbon emissions. Such deployment-driven reduction in the cost of new technologies brings about reductions in the cost of energy in the long-term. Between 2000 and 2012, 93 gigawatts of wind turbines and 53 gigawatts of solar panels were deployed in the EU. The cost of electricity produced by these facilities was higher than that of conventional units. Furthermore, the large-scale deployment of solar panels and wind turbines in some regions required network extensions and greater levels of system services. The increased cost of the electricity system was mainly borne by electricity consumers.

Finally, European energy prices are comparatively high because market structure (number and ownership of energy-sector assets), market design (the way prices are set) and policy do not incentivise the most economic investment, production and consumption choices (see Zachmann, 2013). Significant regulatory uncertainty biases investment decisions towards high-variable and low-capital cost intensive technologies (eg extensions to the lifetime of low-efficiency plants instead of new high-efficiency units). Regulated prices are a disincentive for energy efficiency investment. National renewable support schemes cause substantial inefficiencies (solar PV in Germany instead of Greece). And incompatible national rules for ensuring national supply security create expensive over-redundancies and prevent effective competition between energy companies in different countries.

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3. The share of imports in total energy consumption.

**BOX 1: SOURCES OF LONG-TERM CONVERGENCE**

In the long-term there are numerous drivers that cause the energy price in different countries to converge:

Direct trade in energy between the low-cost and the high-cost country is the most obvious channel for price convergence. If the US decides to allow exports of natural gas to Europe and both sides invest in the necessary infrastructure – LNG liquefaction plants in the US, LNG regasification plants in the EU, and the necessary vessels and pipeline network extensions – the price differential between the two sides of the Atlantic will converge towards the transport cost. If the US decides to not export to Europe directly, because European natural gas prices are lower than Asian prices, prices might still converge. Asian imports of US gas might replace imports from other parts of the world – such as the Middle East. The capacities in these exporting countries might be rerouted to Europe.

A second source of convergence is the relocation of energy consumption<sup>4</sup>. Just five energy consuming industries – chemicals and petrochemicals, non-metallic minerals, food and tobacco, iron and steel and paper, pulp and print – are responsible for more than 25 percent of European natural gas consumption. If some of those industries were to relocate, natural gas demand would shift. The resulting lower demand in Europe would put downward pressure on prices, while the higher demand in the US would put upward pressure on prices.

A third source of convergence arises from the effect of the US fuel switch. As a result of low gas prices, other fossil fuels such as oil and coal will be less in demand in the US. This will drive down the prices of these globally traded commodities – eventually reducing the cost of energy in Europe.

A fourth source of convergence stems from increased investment in alternative energy sources and energy efficiency in Europe. Higher energy prices in Europe will incentivise more investment in replacements for natural gas. In the longer-term, these investments will reduce the demand for natural gas and its price in Europe.

Finally, forward-looking natural-gas suppliers with market power in Europe might have an incentive to reduce prices in anticipation of the above-mentioned effects. In our view, the future development of natural gas prices in Europe will be driven by

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4. Energy behaves like other production factors in the Samuelson factor-price equalisation theory. See Samuelson (1948).

Russian exporters, and whether they start to aggressively price gas in order to stabilise/increase their European market volume. There is a strong rationale for such a strategy in the medium term, because otherwise Europe has strong incentives to invest in (i) diversifying natural gas production and imports, (ii) offshoring energy-intensive activities to low-energy cost regions, (iii) invest in energy efficiency, and (iv) invest in replacements for natural gas.

## 6.2 Electricity prices and the competitiveness of manufacturing

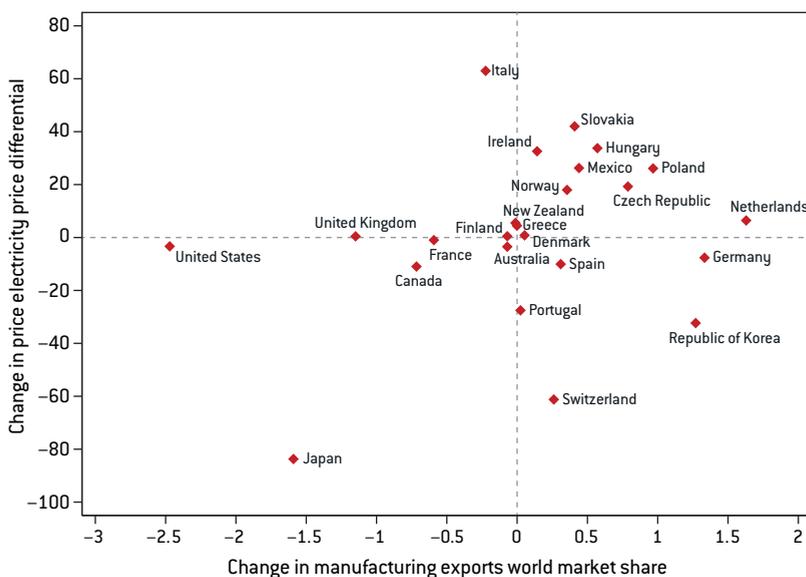
Electricity is a major production factor in many sectors. Therefore, policymakers are concerned that above-average electricity prices make domestic products uncompetitive on international markets. One would expect countries that experience increasing electricity prices compared to their competitors to see a fall in their export market share. This effect cannot be easily confirmed by trade data. In fact, an increase in the electricity price relative to other countries in most cases during the 1990s and 2000s has coincided with an increase in manufacturing export market share (Figure 4). As the effect is not significant<sup>5</sup> and many major factors<sup>6</sup> are ignored we cautiously conclude that electricity price movements are unlikely to be significantly responsible for changes in export shares during the 1990s and the 2000s.

But even if energy prices are not major drivers of countries' total exports, they certainly affect the competitiveness of individual sectors. Sectoral competitiveness is a multidimensional concept that involves supply side, demand side and institutional determinants. On the *supply side*, cost, quality and availability of sector-specific production factors are key drivers. For example, many textile products require cheap plentiful labour, while low capital costs allow specialisation in exporting chemical products produced in capital-intensive refineries. On the *demand side*, the size of, and distance to, the market is an important determinant of sectoral competitiveness. A large domestic market might, for example, allow producers of aircraft to reach a size that is competitive globally. On the institutional level, the legal, regulatory and tax system of a country co-determine whether a country is likely to specialise in a certain sector. For example, environmental regulations could drive dirty production offshore. Finally, there is no simple cause-and-effect relationship between determinants and

5. A regression with the 'change in export market share' as dependent and the 'change in relative electricity price' as independent variable, results in a beta of 0.010. But, even if the model were well specified we could only be 90.6 percent sure that beta is indeed larger than zero.

6. For example, in some countries electricity prices might increase because of high electricity demand caused by a booming export economy.

**Figure 4: Effect of a change in relative electricity price on a change in average manufacturing export market share between 1996-2000 and 2001-2008 for OECD countries**



Source: Bruegel.

sectoral specialisation. Sectoral specialisations within countries interact through knowledge spillovers, shared supply-chains and other effects that result in agglomerations of sectors not explained by the previous factors. For example, countries that export cars are likely to be good at exporting motorcycles as well. The development of the individual drivers of specialisation is itself affected by the current specialisation. For example, countries that have a strong chemical industry are likely to invest in the education of chemical engineers and the infrastructure for importing raw materials and exporting final products, reinforcing the sector. Because of this complexity, it is difficult to reliably model how external shocks on an individual determinant affect a country's export specialisation pattern.

In order to explore how high European energy prices might affect sectoral competitiveness, we analyse how energy prices interacted with sectoral specialisation in the past. We use electricity prices as a proxy for country-specific energy costs because electricity – because of its network-dependence – is not a globally traded commodity, and in fact is significantly heterogeneous in different countries. To evaluate the role of

energy costs for sector specialisation we consider 27 OECD countries between 1996 and 2011. This allows us to compute the revealed comparative advantage, which captures a country's level of specialisation in certain exports, and to see how this is affected by country-level differences in energy prices. So, for each sector, we estimate whether countries with above-average electricity prices are more likely to specialise in it, or not.

As discussed, other factors are likely to play an important role for specialisation patterns. Countries with above average unit labour costs tend not to specialise in labour-intensive products such as textiles, and countries with above-average capital costs tend not to specialise in capital-intensive products such as chemicals and metals<sup>7</sup>. Consequently, some of the specialisation patterns we might have attributed to energy price differentials previously might actually be driven by other factors. To reduce the risk of overstating the importance of energy prices for sectoral specialisation because of such omitted variables, we control for four other important factors: cost of capital, cost of labour, size of the home market and level of development of the country<sup>8</sup>. In the analysis, cost of labour is represented by average hourly compensation, cost of capital is proxied by the 10 year interest rate for each country's sovereign bond, size of the home market is represented by the nominal GDP and level of development is represented by *per-capita* GDP.

The results confirm that larger countries are more likely to specialise in many products<sup>9</sup>. This effect appears to be more because of the population size of the country than its wealth<sup>10</sup>. In terms of capital and labour cost, some products behave as expected: 'cotton sacks/bags' is more likely to be found in countries with low wages and high interest rates; and 'electric and electronic keyboard instruments' in countries with low interest rates and high wages. Others behave contrary to expectation: according to our results, 'ball bearings' are more likely to be found in countries with high wages and low interest rates. Hence, we cannot exclude that we seriously under-represent the complexity of the drivers of sectoral specialisation in our model<sup>11</sup>.

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7. According to the Heckscher-Ohlin theorem, trade flows are driven by factor abundance: a country will export products that require factors relatively abundant on its territory and import the others.

8. Introducing more factors and more complex interactions between factors would be desirable but is limited by the number of available observations.

9. The probability that a country specialises in about 1300 of the 2800 product categories covered by the analysis is positively related to the country's GDP. The reverse is only true for about 400 product categories.

10. We find that in product categories for which specialisation is positively related to GDI, it is typically negatively related to GDP per capita.

According to our analysis, about 600 product types are more likely to be produced in low electricity-price countries than in high-price countries (those products have a negative coefficient in the 'electricity price' columns in Table 1). Some of them are quite intuitive – such as sodium chlorate (used for bleaching paper) or ammonium nitrate fertiliser<sup>12</sup> – because energy costs represent a high share of the production cost. We also count about 1000 products that are more likely to be exported by countries with high electricity prices (those products have a positive coefficient in the 'electricity price' columns in Table 1). These products come from rather diverse sectors that are typically less energy intensive.

We have so far focused on whether countries with above or below average energy prices export more or less of a certain product. But export specialisation in manufactured products can only to a limited extent react to the current energy price. Past investment patterns are strong drivers of export specialisation – an existing aluminium smelter might continue producing even if the electricity price rises comparatively high, while even if the electricity price is very low, the absence of a fertiliser plant prevents exports of ammonium nitrate. In the long-term however, investment also reacts to energy prices. Anecdotal evidence suggests that investment in energy-intensive sectors drops when energy prices rise. Germany had rising energy prices and saw investment increase more than in the US in the less energy-intensive 'machinery and equipment' sector. At the same time, the US increased investment in the energy-intensive basic metals sector by more than twice as much as Germany (Figure 5).

To somewhat capture these investment effects, we look at the differences in the revealed comparative advantage in 2011, 2006 and 2001, and the price differential over the respective preceding five-year periods. Country production specialisation appears to be influenced by energy prices also over the medium-term<sup>13</sup>. We find more than 100 products that countries with low energy prices tend to specialise in. Again, ammonium nitrate and sodium chlorate feature in this group of energy-intensive products that are more likely to be exported by low-energy cost countries. But we also find more than 500 products that are more likely to be exported by high-energy cost countries. These tend again to be of a rather diverse nature.

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11. Our model explains about 15 percent of the variation of specialisation in the analysed products. Only for 2 percent of the products we explain more than half of the specialisation. It is difficult to do better, as the limited sample size constrains the degrees of freedom and hence the number of control variables we could sensibly include in the estimation.

12. About 3-5 percent of the world's natural gas production is consumed in the production of ammonium nitrate.

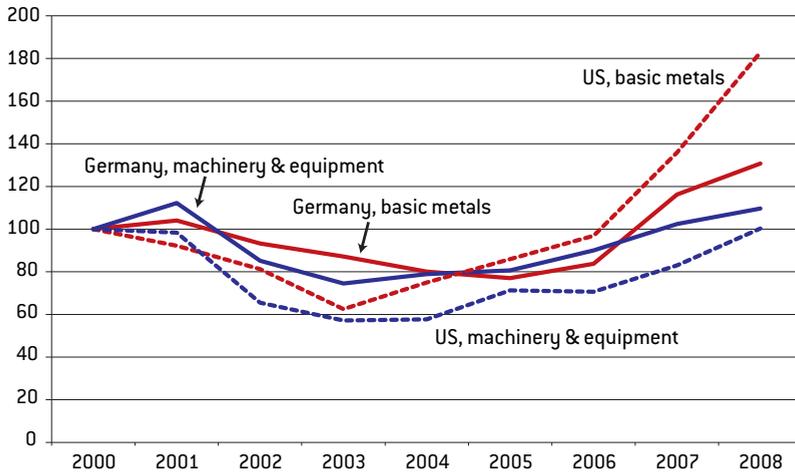
13. We consider 3-10 years as medium-term.

**Table 1: Selected results for a logistic regression of product-level competitiveness on electricity prices (short-term)**

Product name	Electricity price coefficient	Extent of fit (R <sup>2</sup> )*	Product name	Electricity price coefficient	Extent of fit (R <sup>2</sup> )*
Sports gloves etc.	10.3	72%	Goat meat, fresh/chld/frz	-9.3	45%
Cellulose acetate plasd	6.1	70%	Sodium chlorate	-8.3	36%
Shotgun barrels	6.0	61%	Newsprint rolls/sheets	-8.0	42%
Wig making materials	6.0	45%	Conif wood pulp semi-blc	-6.8	39%
Indust driers non-electr	5.9	48%	Cotton seeds	-6.2	41%
Ammonium chloride	5.7	51%	Flax tow/waste	-5.9	24%
Silk yarn non waste, bulk	5.5	45%	Meat, equine, frsh/chl/frz	-5.8	26%
Cellulose acetate non-pl	5.4	66%	Chem wood pulp dissolving	-5.6	45%
Raw silk not thrown	5.1	45%	Mixed alkylbenzenes nes	-5.5	27%
Cotton sacks/bags	5.1	46%	Semi-chemical wood pulp	-5.4	22%
Honing/lapping machines	5.0	61%	Ammonium nitrate fert.	-5.1	20%
Elec keyboard instrumnts	5.0	58%	Silicon dioxide	-5.1	57%
Vulc rubber thread/cord	4.9	66%	Potassium sulphate fert.	-5.0	24%
Sawing machs,metalworkng	4.9	38%	Tall oil	-5.0	32%
Shotgun/rifle parts nes	4.8	34%	Wooden shingles/shakes	-5.0	33%
Dry-cleaning machines	4.8	46%	Potatoes, presvd/frozen	-4.9	29%
Tetracyclines and derivs	4.7	36%	Zirconium wrt/artics nes	-4.9	42%
Parts for fans/gas pumps	4.6	43%	Radiation detectors etc	-4.8	44%
Safety/relief valves	4.3	34%	Urea (fertilizer)	-4.8	31%
Motorcycles etc >800cc	4.1	56%	Cotton garnetted stock	-4.8	26%
Leather sandals	4.1	33%	Nickel unwrought	-4.5	46%

Source: Bruegel. Note: We report here the 21 largest and 21 smallest coefficients. All coefficients are significant at the 0.1% level. The regression controls for country differences in labour compensation, interest rate, GDP and GDP per capita. \* R<sup>2</sup> is the McFadden pseudo R<sup>2</sup> for the logit estimate, and indicates how much of the differences between countries in export competitiveness is actually explained by the factors under consideration.

**Figure 5: Gross fixed capital formation in two sectors in two countries at current prices (index = 2000)**



Source: OECD STAN.

**Table 2: Selected results for a logistic regression of product-level competitiveness on electricity prices (medium-term)**

Product name	Electricity price coefficient	Extent of fit (R <sup>2</sup> )*	Product name	Electricity price coefficient	Extent of fit (R <sup>2</sup> )*
Metal non-rmvl tools nes	10.4	72%	War munition / parts	-18.6	73%
Printing machinery	8.5	59%	Plywood-standard	-9.9	35%
Indust driers non-electr	8.4	53%	Fish fillets/ meat.frs/ch	-8.6	55%
Wig making materials	7.9	52%	Flax tow/waste	-8.5	37%
Theophylline etc/derivs	7.9	38%	Aircraft undercarriage	-7.7	30%
Footw all rub/plast nes	7.3	45%	Brandies/ marcs etc.	-7.3	26%
Sports gloves etc.	7.1	53%	Radiation detectors etc	-7.2	55%
Shotgun/rifle parts nes	6.9	43%	Newsprint rolls/sheets	-7.1	33%
Bookbinding machinery	6.5	46%	Semi-chem wood pulp	-6.9	34%
Laser/photon mach tools	6.4	60%	Wood chips - non-conifer	-6.5	40%
Silk yarn non waste, bulk	6.4	47%	Semi-chem fluting paper	-6.4	30%
Unit construct machines	6.3	51%	Ammonium nitrate fert.	-6.4	29%
Mink skins unassembled	6.1	46%	Chem wood pulp disolvin	-6.3	37%
Ski-boots leather uppers	6.0	39%	Goat meat. fresh/ chld/frz	-6.2	29%
Cutlery sets nes	5.7	43%	Silicon dioxide	-6.1	58%
Iron, simple stl shapes nes	5.6	51%	Sodium chlorate	-5.8	29%
Punching etc machines nes	5.4	45%	Quicklime	-5.7	29%
Camera parts/ accessories	5.4	48%	Tapioca/sago/etc	-5.5	21%
Tetracyclines and derivs	5.3	36%	Hydrogen peroxide	-5.2	23%
Metal mch-tl work holder	5.3	52%	Conif wood pulp semi-blc	-5.2	28%
Dry-cleaning machines	5.3	46%	Iron/steel dross/scale	-5.1	21%

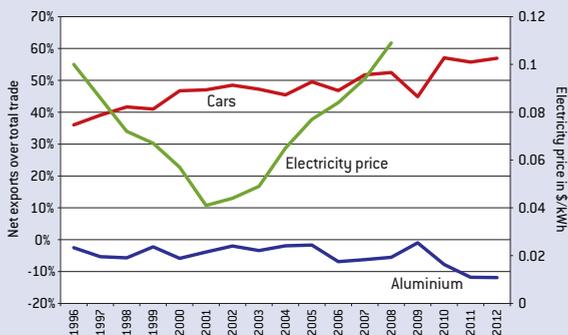
Source: Bruegel. Note: We report here the 21 largest and 21 smallest coefficients. All coefficients are significant at the 0.1% level. The regression controls for country differences in labour compensation, interest rate, GDP and GDP per capita. \* R<sup>2</sup> is the McFadden pseudo R<sup>2</sup> for the logit estimate, and indicates how much of the differences between countries in export competitiveness is actually explained by the factors under consideration.

**BOX 2: A GLOBAL VALUE CHAIN CASE STUDY: ALUMINIUM, ELECTRICITY PRICES AND THE CAR INDUSTRY**

The aluminium sector is very energy intensive. Electricity accounts for about 30 percent of the production cost. Our analytical results confirm that aluminium is exported mainly by countries with low electricity prices<sup>14</sup>. Aluminium is increasingly used to replace steel in car manufacturing. Currently, the aluminium content of a European car is 140 kg, three times the 1990 amount. Consequently, it is interesting to consider if car exports are indirectly affected by electricity prices. Our results indicate that they are not.

The case of Germany is illustrative. Between 2001 and 2008, energy prices increased by 166 percent. This coincided with a substantial increase in German net imports of aluminium of 242 percent. At the same time, car exports continued to rise. Net exports increased by 142 percent independently from the variation in the domestic production of one of the most important inputs. So the competitiveness of the German car industry has not suffered from the increase in energy prices. To what degree this is because other favourable production factors (eg comparatively low unit labour costs) have compensated for higher aluminium prices, and to what degree the increasing cost of aluminium production in Germany was not passed-through to the German car industry because of international competition in the aluminium market, cannot be analysed here.

**Figure 6: German net exports of cars and aluminium versus industrial-user electricity price**



Source: Bruegel based on UN Comtrade and IEA.

14. The regression coefficient for the electricity price on the revealed comparative advantage for not alloyed unwrought aluminium is -3.7. It is significant at the 95 percent confidence level ( $R^2=38\%$ ).

### 6.3 What drives sectoral specialisation?

To widen the scope of the analysis, we aggregate products into their respective sectors. Going from more than 2800 products categories to fewer than 100 sectors allows us to see the bigger picture. Sectoral aggregation<sup>15</sup> confirms the findings of the product category analysis. Countries with high energy prices are likely to specialise in 19 rather diverse sectors. Countries with low energy prices exhibit significant specialisation in nine, typically energy intensive, sectors such as ‘pulp, paper and paperboard’, ‘refined petroleum’, and ‘basic precious and non-ferrous metals’. There is no greater or lower likelihood of occurrence in low or high energy price countries for 67 sectors. For some of these, the reason is that they include both products that are primarily exported by high-price countries and products that are primarily exported by low-price countries. For example, ‘basic chemicals’ is not significant on the sectoral level even though ammonium nitrate is typically exported by low-price countries and sulphites are typically exported by high-price countries.

Table 3 identifies the sectors in which according to our analysis either low electricity price countries reveal a competitive advantage (negative electricity price coefficient) or high electricity price countries reveal a competitive advantage (positive electricity price coefficient). We will use this as the basis for further analysis of how electricity prices shape countries’ manufacturing sectors.

We have, however, to add a note of caution. On the sectoral level, the variables we have chosen (electricity cost, labour cost, capital cost, GDP, GDP per capita) can on average explain only slightly more than 30 percent of which countries specialise exporting in this sector (see the  $R^2$  in Table 3). In addition, there can be a number of reasons for the observed coincidences:

1. Causality: the most straightforward reason is that high energy prices discourage specialisation in energy-intensive products;
2. Joint cause: high energy prices in a country might be the effect of a certain economic factors (such as economic policy, level of economic development or factor availability), which also encourage certain sectors. For example, strong preferences for environmental protection might increase energy prices and

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15. We aggregate the product categories (that are classified according to HS) into sectors (classified according to NACE) using concordance tables provided by United Nations Statistics Division. For each year, between 4409 and 4131 HS products have been linked to 2808-2623 SITC products and to 95 NACE sectors.

**Table 3: Selected results for a logistic regression of sector level competitiveness on electricity prices (medium-term)**

Product	Electricity price coefficient	Extent of fit (R <sup>2</sup> )*
Miscellaneous manufacturing n. e. c.	11.1	61%
Glass and glass products	8.2	62%
Ceramic goods	7.3	59%
Games and toys	6.2	37%
Paints, coatings, printing ink	6.2	71%
Machinery for production, use of mech. power	6.2	61%
Textile weaving	5.0	46%
Electric motors, generators and transformers	4.6	51%
Cutlery, tools and general hardware	4.6	48%
Optical instruments and photographic equipment	4.0	46%
Accumulators, primary cells and primary batteries	3.8	50%
Electricity distribution and control apparatus	3.5	35%
Watches and clocks	3.4	52%
Other wearing apparel and accessories	2.7	39%
Ceramic tiles and flags	2.7	48%
Bricks, tiles and construction products	2.6	26%
Motorcycles and bicycles	2.6	22%
Footwear	2.4	31%
Beverages	2.2	15%
Other transport equipment n. e. c.	-1.9	23%
Refined petroleum	-1.9	17%
Sawmilling, planing and impregnation of wood	-2.2	16%
TV, and radio transmitters, apparatus for line telephony	-2.3	24%
Nuclear fuel	-2.6	22%
Pulp, paper and paperboard	-3.7	21%
Fish and fish products	-3.9	35%
Aircraft and spacecraft	-4.8	46%
Basic precious and non-ferrous metals	-6.7	45%

Source: Bruegel. Note: We report here the betas for all sectors with coefficients significant at the 5% level. The regression controls for country differences in labour compensation, interest rate, GDP and GDP per capita. \* R<sup>2</sup> is the McFadden pseudo R<sup>2</sup> for the logit estimate, and indicates how much of the differences between countries in export competitiveness is actually explained by the factors under consideration.

- encourage environmental technologies, or high cost of capital make both energy production and production of capital-intensive products expensive;
3. Reverse causality: a historic strength in energy-intensive products might support the development of a very competitive energy industry;
  4. Statistical effects: because of the high number of products (2800), some observed coincidences might be random.

Even though we do not see an obvious reason why our methodology might over/under-represent certain sectors, the results entail a high degree of uncertainty.

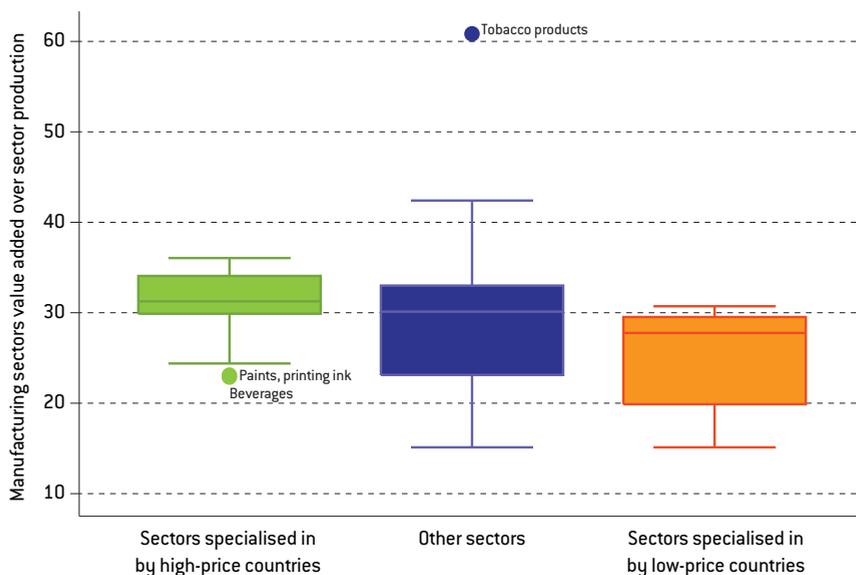
#### 6.4 Value-added and employment in energy-price sensitive sectors

We evaluate whether the sectors that appear to be negatively affected by high energy prices are of particular economic importance. We check if these sectors typically have a higher value added share than sectors that are not or are positively affected by the energy price. Figure 7 shows that sectors in which countries with high energy prices are more likely to specialise are characterised by higher value added than sectors in which countries with low energy prices specialise. Consequently, low energy prices do not help a country to focus its exports on manufacturing sectors that promise high value added. There are several reasons for this:

1. Low energy prices seem to encourage specialisation in a few energy-intensive products. Those are often rather homogeneous and face stiff international competition and are consequently low value added. By contrast, high energy prices coincide with specialisation in many heterogeneous products.
2. Low energy prices often coincide with energy exports while high energy prices coincide with energy imports. Energy-importing countries need to earn a higher value added in their manufacturing exports in order to be able to afford the imports.
3. High energy prices might be a result of specialisation in successful sectors. High export productivity might make investments in energy generation more expensive, thus increasing energy prices.

Consequently, we refrain from the incorrect interpretation that “*high energy prices encourage specialisation in more productive sectors*”. We, however, assert that there is no evidence that energy prices above the global average undermine in the long-term the productivity of export sectors.

**Figure 7: Box plots for value added of all sectors whose specialization is (1) significantly negative, (2) not significant and (3) significantly positively correlated with the energy price**

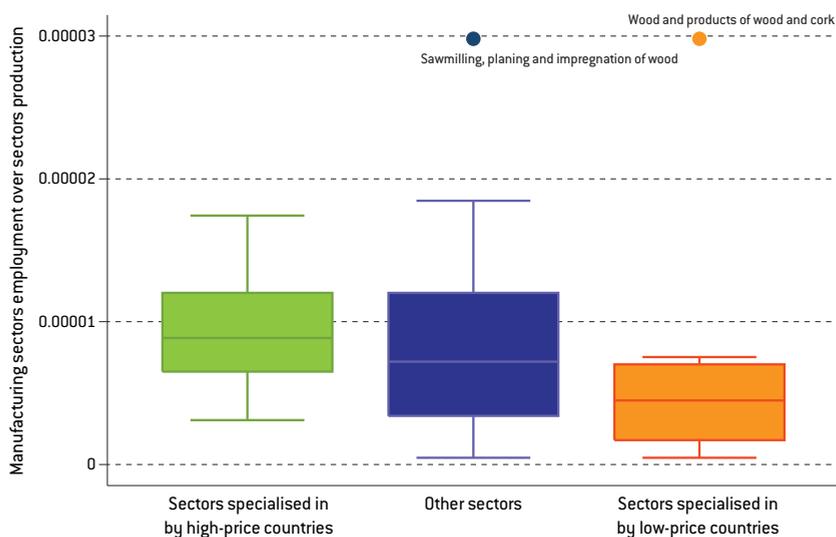


Source: Bruegel. Note: The coloured boxes contain 50 percent of the sectors in each category, the band inside the box represents the median of each category, 90 percent of all sectors in each category have a value-added over production value that lies between the upper and the lower bars.

Figure 8 shows that sectors in which countries with high energy prices are more likely to specialise have significantly higher employment relative to their production value than sectors in which countries with low energy prices specialise. This indicates that countries with high energy prices tend to specialise in sectors with higher employment per production value than countries with low energy prices. Again, causality is difficult to establish but we find no evidence that high energy prices lead to lower employment in the manufacturing export sector.

The effect of relative energy prices on manufacturing value added and employment depends on the sectoral composition in each country. Figure 9 shows that in European countries, value added is highest in those manufacturing sectors that neither significantly coincide with high nor low energy prices. Only Greece, Norway, Sweden and the UK have a higher share of manufacturing value added in sectors that coincide

**Figure 8: Box plots for *employment* of all sectors whose specialisation is (1) significantly negative, (2) not significant and (3) significantly positively correlated with the energy price**



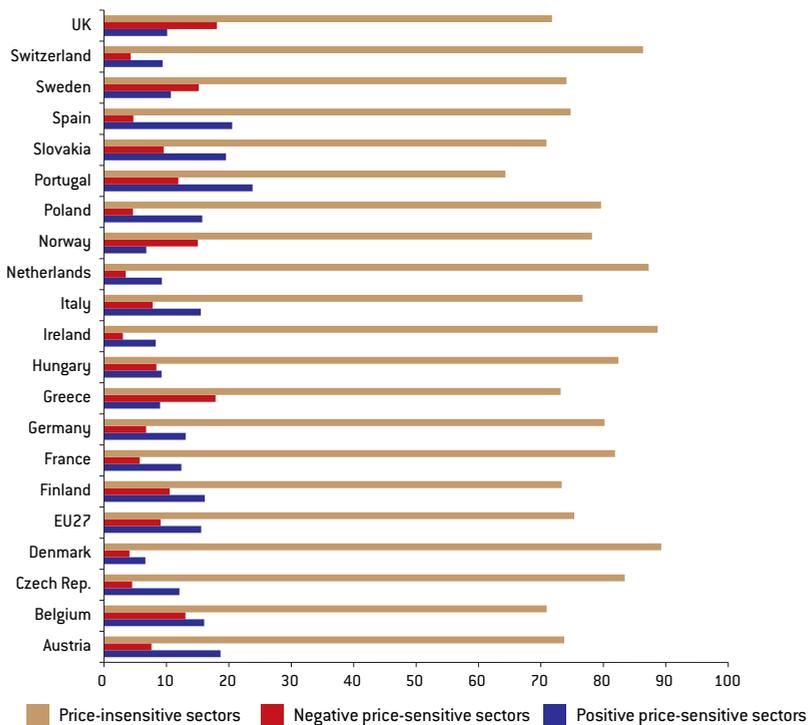
Source: Bruegel. Note: The coloured boxes contain 50 percent of the sectors in each category, the band inside the box represents the median of each category, 90 percent of all sectors in each category have a value-added over production value that lies between the upper and the lower bars.

with low energy prices. All other countries already specialise in sectors that are above-proportionally present in high-energy price countries<sup>16</sup>.

For employment (Figure 10) the picture is similar. In all countries, the highest employment share is in sectors that do not coincide with low or high energy prices. Belgium, Finland, Hungary, Norway and Sweden have the highest employment shares in sectors that coincide with low energy prices. All other countries have higher employment shares in sectors that coincide with high energy prices. But overall in the countries covered, more people (130,000) are employed in sectors that coincide with low energy prices than in sectors that coincide with high energy prices (90,000).

16. To clarify, we note that this argumentation is not circular. We identify products that are above-proportionally exported by countries with low energy prices and aggregate those into sectors. In Figure 6 we do not, however, check which countries export most of these products (the answer would be the countries with the lowest energy prices), but we check which share of value added in a country is produced by the sectors that we find to coincide with low energy prices.

**Figure 9: Share of value added within a country, grouped according to the energy-sensitivity of the sectors**



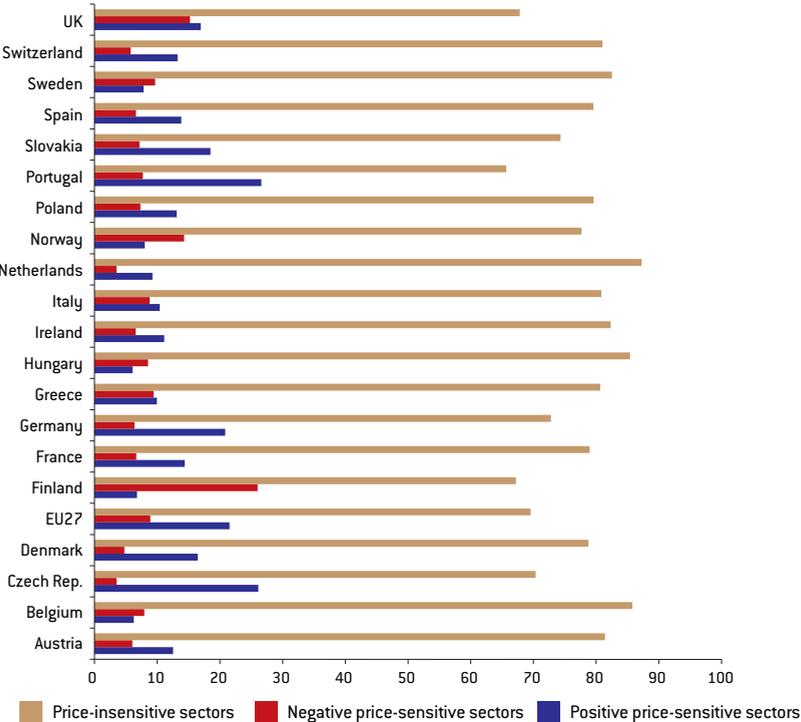
Source: Bruegel. Note: Based on the sectoral value added data by country from Eurostat.

## 6.5 Conclusion

We have shown that whether a country has low or high energy prices does not determine whether it is a competitive exporter of manufactured products, but it does influence in which sectors a country becomes competitive.

Obviously, a country can neither specialise in all manufacturing sectors nor can it have a relative competitive advantage in all production factors. Nevertheless, subsidising individual production factors through direct state aid, favourable regulations or tax exemptions for certain sectors is commonplace in global competition. The costs of these subsidies are borne by other parts of the economy. If they are levied by putting higher taxes on capital or labour, the competitiveness gain of the energy-intensive

**Figure 10: Share of employment within a country, grouped according to the energy-sensitivity of the sectors**



Source: Bruegel. Note: Based on the sectoral employment data by country from Eurostat.

sector might not be enough to compensate for the competitiveness loss of the ‘naturally’ competitive sectors, because the energy-intensive sectors contribute relatively less to employment and value added.

With our analysis we also challenge the view that certain energy-intensive sectors are central to the competitiveness of other sectors. One might think, for example, that the competitiveness of the car industry – one of the largest manufacturing sectors in terms of employment and value added in Europe – depends on the competitiveness of the steel and aluminium industry. We, however, find that while the aluminium industry is indeed concentrating in countries with below-average energy prices, the car industry is not.

There are at least three more reasons to refrain from subsidising energy prices:

First, government intervention in energy pricing (eg regulations) does not create the necessary stable investment framework for energy consumers, and can destroy incentives for energy producers. Investment in energy efficiency and domestic energy supply will be reduced, causing the price disadvantage to increase.

Second, volatile energy prices attract very specific industries that tend to leave as soon as energy prices are lower elsewhere. Other sectors, which invest in human-capital formation, knowledge and complex supply chains form a more sustainable basis for competitiveness.

And third, short-term political intervention might actually prevent structural convergence of energy prices. If large (and potentially even inefficient) consumers are given an incentive to stay by subsidised energy prices, energy consumption cannot react to the differences in resource availability. Other consumers will have to pay more and suppliers will be under no pressure to price energy more competitively.

Europe will be better able to maintain its competitiveness in manufacturing sectors by refraining from unsustainable measures such as subsidies to energy consumers. That said, structural measures for reducing the cost of energy to the economy are of course a sensible economic policy. Most prominently, making the European internal market for energy work could significantly reduce the cost of energy.

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# 7 Policies for manufacturing EU growth

BY REINHILDE VEUGELERS AND ANDRÉ SAPIR

## 7.1 EU policies for manufacturing

The policy debate on the future of manufacturing in the EU is entrenched in a heated and repeated discussion on what kind of industrial policy Europe should pursue. The concept of 'industrial policy' has many facets and is often the source of confusion. The interpretation can range from policies that set out to protect particular firms (champions), policies to safeguard manufacturing, sector-based policies in favour of strategic sectors, policies supporting 'competitiveness', enterprise policies or policies to improve the broad framework conditions for business.

Broadly however, at risk of over-simplification, participants in industrial policy discussions can be classified as proponents of a 'horizontal' approach or as proponents of a 'vertical' approach. The 'horizontal' group wants industrial policy to set the right framework within which economic processes can take place, but does not believe in intervening in the processes. Examples of horizontal intervention include competition policy, regulatory simplification, aid in setting up businesses, development of small and medium-sized enterprises, tax incentives for innovation, and promotion of education and training. The 'vertical' group encourages a more proactive industrial policy, with more direct, targeted intervention.

In practice however both strands tend to converge substantially at the implementation stage. The 'new industrial policy' perspective builds on both perspectives, calling for a more targeted approach that is compatible with a horizontal perspective.

While EU industrial policy in its early phase in the 1970s and 1980s could be branded as quite targeted, a more horizontal approach has been followed since the 1990s. Box

1 outlines a brief history of the swings in EU industrial policy, and the corresponding instruments that have been deployed.

A communication published in 2012 by the European Commission represents its current position on industrial policy<sup>1</sup>. The communication was published during a period of continuing economic crisis in Europe, with manufacturing production and industrial jobs under pressure, and with a lack of confidence, market uncertainty and financing problems reigning. The communication starts from the premise that “*Europe needs industry*”. To quote: “*Europe needs to reverse the declining role of industry in Europe for the 21<sup>st</sup> century. This is the only way to deliver sustainable growth, create high-value jobs and solve the societal challenges that we face*”.

The Communication sets out a roadmap for reindustrialising Europe, with the aim to ‘*raising the share of industry in GDP from the current level of around 16% to as much as 20% in 2020. This should be driven by substantial recovery in investment levels (gross capital formation and investment in equipment), an expansion of the trade in goods in the Internal Market (to reach 25% of GDP in 2020) and a significant increase in the number of SMEs exporting to third countries*’.

Although the Communication stressed, following the horizontal tradition, the need for a comprehensive vision “*mobilising all the levers available at EU level, notably the single market, trade policy, SME policy, competition policy, environmental and research policy in favour of European companies’ competitiveness*”, it brought back a more explicit targeted approach: “*After an extensive public consultation, the Commission proposes to jointly focus investment and innovation on **six priority action lines**: advanced manufacturing technologies, key enabling technologies, bio-based products, sustainable industrial and construction policy and raw materials, clean vehicles, smart grids*”. Reinforcing its targeted approach, the communication was followed up with action plans for specific sectors, such as steel<sup>2</sup>.

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1. European Commission, *A stronger European industry for growth and economic recovery*, COM (2012) 582.

2. See the Action Plan for a competitive and sustainable steel industry in Europe (2013)

**BOX 1: A BRIEF HISTORY OF INDUSTRIAL POLICY IN THE EU**

Although the term of 'industrial policy' did not appear in the Treaty of Rome, Europe was built around a sectoral policy – the European Coal and Steel Community (ECSC), which set out to reduce overcapacity in coal production, while improving the overall production system. This first industrial policy was a success, both in terms of outcome (modernisation and reduction of production capacities of companies) and in terms of coordination between member states. The ECSC provided an interventionist framework within which companies had to modernise themselves.

During the 1970s and 1980s, many European countries developed industrial policy programmes. Although there was a clear intention to collaborate and coordinate national policies, the development of a European industrial policy, with the community interest put ahead of the national interest, proved hard to implement, given the lack of resources and tools at the community level.

From the mid-1980s, the inefficiency of uncoordinated national industrial policies became clear. This led to the development of two important horizontal instruments at EU level: the internal market and competition policy, including state aid. At the same time, the Single European Act (1986) laid the legal basis for the affirmative action of the state in the area of research and development.

During the 1990s, there was a move towards a consensus at EU level to pursue a more holistic, integrated, horizontal approach to industrial policy. The role of EU industrial policy was to ensure the right framework conditions, through internal market and competition instruments and by stimulating R&D and innovation. This 1990s view corresponded with the perception that the main challenge for European industry was to adapt to a global economic context characterised by fast-growing world markets, rapid technological change and the emergence of new competitors. After catching up with the United States in the first few decades after the second world war, European industry had to succeed at the frontier of technological change, requiring innovation-based growth.

EU policy communications on horizontal industrial policy published in 1994 and 2004, and included in the Lisbon programme and its successors up to the EU2020 communication (COM (2010) 2020) all reflect this horizontal integrated approach towards industrial policy. This did not mean that sectoral policies were absent at the EU level. In fact, the EU 'New Industrial Policy' includes both horizontal and vertical measures. Horizontal initiatives include the work on intellectual property rights

(including the EU patent), measures to improve the regulatory environment including simplification and funding for EU (R&D) projects through the multi-annual Framework Programmes. Sectoral initiatives included an ICT focus motivated by the EU missing out on the productivity growth from ICT production and use that the US benefitted from in the second half of the 1990s.

## 7.2 The evidence base underpinning EU industrial policy

An assessment of the adequacy of the current EU industrial policy approach needs to be embedded in a evidence-based understanding of the changing role of manufacturing for Europe's growth. We first briefly recap the main insights from the evidence presented in this Blueprint, which will support our assessment and recommendations for EU industrial policy.

The relative decline in production, value added and employment characterising manufacturing in Europe during the past few decades is not likely to be radically reversed soon, because the forces driving the relative decline are likely to continue to operate in the near future. The decline is taking place across almost all manufacturing sectors, although to different degrees and with different combinations of causes: demand effects, productivity effects and/or trade effects. It is important to note that the decline cuts across the high-tech/low-tech sector divide. The decline in the manufacturing of electronics in Europe, for example, is a reminder that high-tech is not necessarily a shield against the loss of jobs. Nevertheless, across all sectors, the loss of jobs is concentrated in the low-skill segment, with remaining and new jobs being more skill intensive, even in the low-tech sectors of textiles and food.

The shift towards high value added activities correlates with the growing servitisation of manufacturing, together with the greater importance of innovative capacity. This innovative capacity requires a high-quality human capital base with a well-educated and trained workforce. Innovative capacity is important for all manufacturing sectors, not only for the high-tech sectors.

An innovative high-skill capacity helps to make firms more resilient to shocks and helps to build sustainable competitive positions in world markets. Participation in global value chains (GVCs) enables firms and countries to build sustainable competitive positions, even more so if accompanied with innovative capacity. Only a few firms are intensively involved in GVCs, but these few firms matter for Europe's knowledge based growth and competitiveness performance, because these firms are large,

trade-intensive and more innovative, and have highly skilled workforces and higher productivity. They substantially drive the creation of total value added, employment, innovation and, particularly, trade flows in most sectors and economies. Firms that take an intermediate position in global value chains, producing specific components for other firms in the chain, also command higher productivity premiums, particularly when they can exploit unique innovative capacities.

The participation of European firms in GVCs is strongly EU-oriented. These European Value Chains (EVC) have resulted in a deeper integration of EU manufacturing and have significantly benefitted the competitiveness of the EU and its member states in a global perspective. Firms involved in EVCs are not disadvantaged relative to firms that develop more global value chains. This evidence suggests that the European single market provides a significant opportunity to firms to build European value chains that help them to compete on global markets.

### 7.3 Policies to support the contribution of manufacturing to EU growth

Manufacturing global value chains challenge prevailing policy thinking about competitiveness. The growing upstream and downstream interconnections within GVCs make countries more interdependent: one country's exports increasingly embody the technology, labour and capital of other countries from which intermediate goods are imported; imports increasingly reflect tasks which complement, rather than substitute for, domestic production; the offshoring of a production stage which can be performed more efficiently abroad makes domestic activities more competitive.

This growing interconnectedness limits the effectiveness of national policies, requiring more international coordination of policies. For European countries this means first and foremost deeper coordination at EU level, in view of the regional focus of European firms' GVC involvement. European integration has proved to be an opportunity for developing European value chains, and these EVCs are not disadvantaged relative to GVCs. The EU focus should not however translate into an inward focus, because European internationalisation goes hand in hand with openness to the rest of the world and EVCs have helped to improve Europe's competitive position in world markets. The Commission's 2012 industrial policy communication targeting an *'expansion of the trade in goods in the Internal Market to reach 25 percent of GDP in 2020'* runs the risk of a diverting attention away from global markets and external openness.

Internal and external openness are necessary conditions for integration into international production networks. Import tariffs and anti-dumping duties on intermediates

may directly hurt the competitiveness of those domestic firms that import these components. In view of the magnification effect of tariffs and non-tariff barriers along the value chain, openness and the elimination of tariff and non-tariff barriers should be pursued at multilateral level. Barriers between third countries up or down the value chain matter as much as the barriers put in place by direct trade partners. More uniform product standards will make participation in GVCs easier for components suppliers.

Global production networks rely on logistics and communication chains. They require efficient international network infrastructures and competitive complementary services. To reap the full benefits of GVCs, efficient supporting-services markets are needed. This calls for the removal of barriers in sectors such as transport, communications and telecommunications, energy, finance and business services. Within Europe, this is a call to further the single market in these areas, because substantial progress still needs to be made, particularly in the energy and services markets. Exploiting global value chains also requires having in place interconnecting infrastructure, most notably for transport, telecommunications and energy. Trans-European network projects for building this cross-border infrastructure should be given a higher profile in policy terms, and larger budgets.

Secondly, for countries to benefit from GVCs, international flows of capital, labour, human capital and knowledge within GVCs must become effectively linked to domestic productive capabilities in certain tasks. Here a host of national and European economic policies largely determine which position countries occupy in GVCs: which jobs and what value they are able to create. Several aspects need to be considered.

#### 7.4 Horizontal framework conditions

To ensure the continued presence of a viable manufacturing sector in European countries, what matters most is the manufacturing activities that are needed to support Europe's growth, rather than a blunt GDP percentage target for manufacturing. The activities to focus on are the higher value-added activities that build on unique and innovative capabilities. The presence of these activities in Europe will secure productivity growth and external competitiveness, and retaining them will require having in place the framework conditions that are most pivotal for these higher value-added, growth contributing, manufacturing activities. These activities may be in the manufacturing sector, but they entail significant service characteristics.

Because access to large, open and interconnected product markets remains a major location factor for manufacturing, including for the high-end manufacturing activities,

internal market and competition policy will and should remain priority EU levers. Completing the single market for products is perhaps the most important objective to enable manufacturing to contribute to Europe's future growth.

In addition, other framework conditions matter if new high-end activities are to be brought to Europe and retained. These include access to a network of sophisticated lead customers and suppliers, and access to specific skills and research capabilities. The building and reinforcing of innovation networks requires that the integration of the European Research and Innovation Area be furthered, eliminating barriers to the cross-border transfer of skills, knowledge and ideas, and stimulating the mobility of high-end skills across borders and across sectors. This includes between the industrial and services sectors, including the public research sector. The requirement for access to the necessary skills makes education and on-the-job training a policy priority, primarily at national level. A single market for graduate and post-graduate education would however be a highly relevant European project to pursue.

Access to (cheap) energy is regularly claimed to be important to attract activities, particularly in specific energy-intensive manufacturing segments. Effective implementation of a fully efficient internal market for energy is the key policy at EU level that would ensure a level playing field and lower energy prices.

Furthermore, access to finance, although less important for established large manufacturing entities, is a major issue for SMEs, particularly for the small and new firms that want to develop on world markets their ideas for new innovative products. For these firms, addressing the fragility and the fragmentation of the financial sector in Europe, especially the risk-capital segments, will be important.

### 7.5 A targeted approach?

Although sectoral idiosyncrasies exist, the challenges and opportunities identified here apply to most if not all manufacturing sectors. The shift towards high-end activities is not confined to high-tech sectors. The offshoring of manufacturing activities is not confined to low-tech sectors. And manufacturing and service sectors are increasingly intertwined. As a consequence, any type of government intervention to support manufacturing should be sufficiently generic, and avoid picking particular industries to support. What matters most is providing the framework conditions for viable activities to continue to prosper, and for new activities to develop and grow into leading world market status, irrespective of in which sector they are classified.

Increasing the number of SMEs that export to third countries would be a wrong target to aim at. The evidence presented in this Blueprint shows how small and simple exporters are typically only responsible for a very small share of trade, in some sectors less than 1 percent. Neither improving the extensive nor intensive margin will result in significant improvements to competitiveness. What matters more is to provide the framework conditions to support a GVC innovation-based growth path for enterprises, whatever their size or age. The target should be productive firms with unique innovative capabilities, which are able to develop an internationalisation strategy that involves more complex strategies than simply exporting.

## 7.6 The jobs agenda

The offshoring of routine jobs and the structural shift from classic routine production jobs towards higher value-added types of jobs that have some of the characteristics of services jobs, has major implications for employment policy. Adjustment difficulties are likely to result, because the skill requirements for the newly created jobs tend to be higher than and different to those for the jobs lost. In addition, negative impacts are often heavily concentrated in certain regions or sectors. Effective domestic policies are therefore needed to reduce the adjustment costs borne by displaced workers.

Governments will need to facilitate this structural shift and help displaced workers to find alternative employment and to acquire the necessary skills for Europe's future manufacturing activities. This is a challenge familiar from adjustments in the face of globalisation. Policies to pursue, primarily at EU member-state level, include improving the functioning of labour markets and strengthening education and training. At EU level, adjustment programmes, such as the European Globalisation Fund could be upgraded and made GVC-compatible.

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## Manufacturing Europe's future

Edited by Reinhilde Veugelers

The financial crisis has brought back to the fore the importance of a stable manufacturing base as a reviver of economic growth. But Europe continues to lose manufacturing jobs, and to see a decline in the share of value added contributed by manufacturing. These trends present major challenges to European and national policymakers, who have often reacted with measures to stop or reverse the decline.

But the trends in manufacturing cannot simply be viewed in terms of a decline that needs to be reversed. Manufacturing still contributes significantly to the EU economy. But the nature of its contribution is changing: despite the decline in employment, manufacturing's contribution now matters more for Europe's innovation and productivity growth capacity. Moreover, the manufacturing contribution is increasingly channelled through international value chains, and starts to overlap with the services sector. Policymakers must therefore find ways of attracting those high-value manufacturing activities that will underpin Europe's sustainable growth and competitiveness.

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