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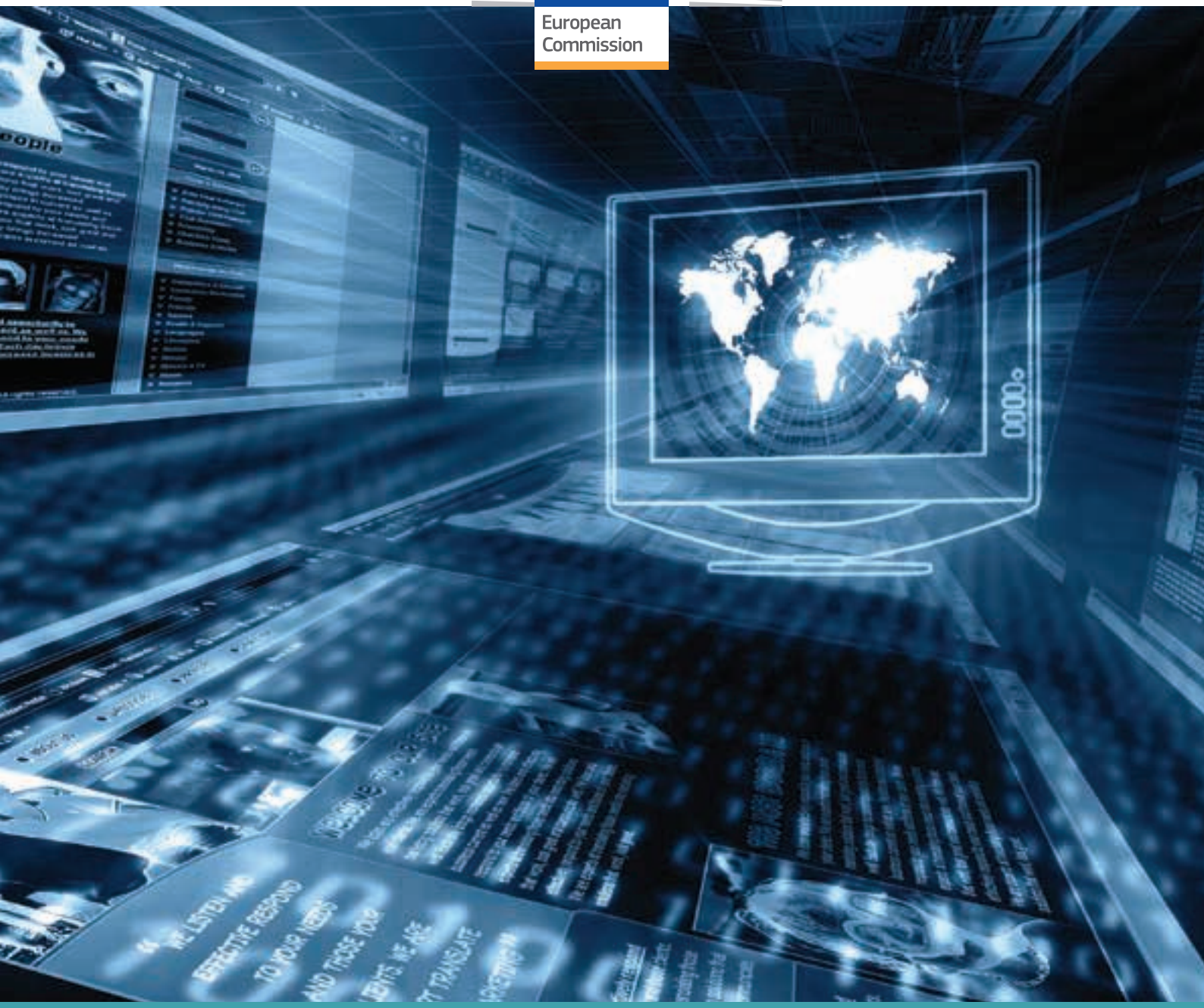

EU STRUCTURAL CHANGE

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Internal Market, Industry, Entrepreneurship and SMEs

EU Structural Change 2015

Konstantin Pashev (ed)
Paolo Casini
Neil Kay
Smaranda Pantea

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Comments would be gratefully received by e-mail to:
konstantin.pashev@ec.europa.eu

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OVERVIEW

The purpose of this report is to identify and explain the changes in the productive structure of the EU economy and its specialisation patterns in the past 15 years and to discuss the implications for economic policy.

The world has undergone radical change in the past two decades, marked in particular by the rise of China and the other emerging industrial powers. The resultant shifts in global trade and capital flows have drastically altered the geography and structure of global value chains. Global competition has also been profoundly transformed by the liberalisation of cross-border trade and capital flows, but most importantly by the internet and the digital society, which have brought the world to its next technological frontier. Last but not least, the past 15 years have seen two recessions; the fallout from the second, 'Great Recession' still dominates the policy agenda in advanced and emerging economies.[1] In this context, a major challenge for policy-makers is to distinguish long-term structural change from changes driven by cyclical demand fluctuations.

The past two decades have also been marked by important milestones in the history of the EU, with the launch of the single currency, the enlargement of the single market from 12 to 28 members, and a new leading role in the search for global solutions to the pressing societal challenges of climate change, population ageing and the unsustainable use of scarce resources.

Changes in the structure of EU output and employment

The report's point of departure is the change in the output and employment structure of the economy since 2000 (Chapter 1). A major long-term trend, revisited here, is **the structural shift of the EU economy from manufacturing to services**. The scale and pace of this trend in the past two decades lead one to question whether and to what extent it is healthy and sustainable. Between 2000 and 2014, the share of manufacturing in total EU output fell by a further 3.5 percentage points (pp) in nominal value-added terms, from 18.8% to 15.3%.

Does this trend pose a threat to EU growth and competitiveness in the long term? Can the EU sustain its social and economic model through services-led growth, even if this is at the expense of further shrinkage in the relative importance of manufacturing?

The erosion of the manufacturing base of the economy is a matter of concern for policy-makers for several reasons:

- services depend on a strong manufacturing base for their equipment and material inputs and, more importantly, in terms of demand for business services. If manufacturing is increasingly offshored to third countries, some of the services in the value chain may follow;

[1] In the EU, the 2000-2001 recession lasted five quarters and the financial crisis in 2008 led to a double-dip recession: five quarters in 2008-2009 and six quarters in 2011-2013.

- services are less tradeable than goods and do not have such strong export potential as manufacturing. Currently, manufacturing accounts for about 15% of gross value added (GVA), but about 40% of EU exports. This is important for growth, as 90% of global growth is expected to be generated outside Europe, a third of it in China alone (IMF 2010); and
- the lion's share of company R&D (about two thirds) takes place in manufacturing.

In brief, the shrinkage of manufacturing undermines the export and innovation potential of the economy, which is the major driver of long-term growth and higher living standards.

A country breakdown of the trend illustrated in Chapter 1 shows that in the past 15 years the largest decline in the share of manufacturing in the economy occurred in Member States in which it was already low, such as Cyprus, Luxembourg, Greece and the United Kingdom. On the other hand, in most of the countries in which manufacturing had a high share at the turn of the century, it registered smaller drops or even increases. Noteworthy exceptions are Finland, Sweden, Italy and Malta, where manufacturing entered the 21st century with high shares, but had largely lost these by 2014. This may indicate that deindustrialisation tends to accelerate or become irreversible beyond a critical threshold. If specialisation follows the 'product space' hypothesis,[2] the reverse may also be true: the crowding-out of manufacturing may have a tendency to accelerate as the related knowledge, skills and technology asset base is eroded, and a growing proportion of the related inputs and finished products needs to be imported.

This is why reversing the trend of deindustrialisation and restoring a sustainable level of manufacturing has been high on the EU policy agenda in recent years.[3] The European Commission's 2014 political priorities called for a stronger industrial base and for manufacturing to make a greater contribution to the economy.

How can the trend of deindustrialisation in the EU be reversed? The answer hinges on our understanding of the drivers of the structural shift towards services. We identify two major factors:

- **growth in incomes** combined with the higher income elasticities of services relative to manufactured goods, leading households to spend proportionally more on education, personal care and leisure-related services;
- enterprises' **growing intermediate consumption** of business services (e.g. communication and information services, finance and insurance, accounting and audit, transportation, marketing and distribution, etc.). In the past two decades, the share of service inputs in manufacturing has grown significantly. This process was driven by the growing importance of knowledge-intensive business services such as information and communication services, finance and insurance, industrial design, marketing, distribution and aftersales maintenance, transport and logistics, etc., but also the service inputs were increasingly procured from the market rather than produced in-house. While research has focused mainly on the intermediate consumption of services by manufacturing, much of it takes place in other service sectors, agriculture, construction, utilities and other industries.

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2 See Hidalgo *et al*. (2007), Hidalgo and Hausmann (2009), Reinstaller *et al*. (2012) and ECR 2013 Chapter 2.

3 The European Commission's 2014 Industrial Policy Communication *For a European industrial renaissance* (COM (2014) 14 final, 22.1.2014)) and the political guidelines for the new Commission, *A new start for Europe: my agenda for jobs, growth, fairness and democratic change* (22.10.2014) called for the weight of industry in GDP to be brought back to 20%.

To some extent, the increase in the share of services as intermediate inputs in other business sectors may also be accounted for by services that companies buy to comply with legislation or reporting and information obligations and testing (e.g. conformity assessments, audits, etc.). The cost of services — including those that companies buy to improve their products and processes, and those that they buy to comply with the rules — tend to be higher per unit of output for micros and small businesses (ECR 2013). Another driver of growing demand for services is government consumption.

Apart from the faster growth of final and intermediate demand for them, the growing share of services in the economy also reflects **different rates of productivity growth** and the **crowding-out** of **certain EU manufactured products** from international markets. Manufactured goods are more exposed to cross-border competition than services, which are less tradeable across borders. This leads to two effects:

- productivity in manufacturing increases faster, which is reflected in the decrease in the relative prices of manufacturing *vis-à-vis* services; and
- where productivity gains are not sufficient to offset lower labour costs in third countries, some manufacturing sectors lose domestic and external market share. Such losses in manufacturing competitiveness (textiles and leather are typical examples) also reduce the share of manufacturing in EU value added.

The fall in relative prices for manufactured goods explains more than 70% of the decline in the nominal share of manufacturing in EU GVA in the past 15 years. While this represented 3.5 pp in current prices, in constant prices it was around 1 pp, which is the real erosion of the industrial base of the EU economy (ECR 2014).

Not all of these drivers of structural change present problems that need to be fixed. If the shrinking share of manufacturing reflects productivity gains and lower prices for goods, this is good news for consumers and policy-makers in terms of competitiveness and real incomes. With the completion of the internal market for services and the opening of services markets in third countries, cross-border trade of services will grow, exposing providers to tougher competition and increasing the productivity of the services sectors. Similarly, the growing demand for services driven by growth in incomes or increased use of knowledge-intensive business services is hardly something that should or could be subject to policy concern. The role of policy would be to single out the drivers of the erosion of the industrial base that can be ascribed to real losses in competitiveness on domestic and foreign markets.

Despite its shrinking share in the economy, manufacturing is not in decline (see Chapter 1). While it declined in terms of share of GVA or GDP and employment, it grew by about 14% in real terms (GVA) in 2000-2014. However, services grew much faster over the same period, driven by information and communication services (69% growth), professional services (30%), real estate services (27.8%) and finance and insurance (23.3%).

While at EU aggregate level, there seems to be no problem if the output of services grows faster than that of goods, the same is not true for some Member States that have lost large parts of their manufacturing output in the past 15 years. In Cyprus, Luxembourg, Greece, Italy, the UK, Portugal and Spain, manufacturing GVA is lower today than in 2000. This is not just a consequence of the crisis: the decline started long before that. In all 'catching-up' Member States, manufacturing GVA grew faster than the EU average between 2000 and 2014. The largest increases were registered by Slovakia (182% increase), Poland (147%), the Czech Republic (111%), Estonia (90%) and Romania (52%). At the same time, these countries registered the highest growth in business and professional, and finance and insurance services, obviously driven by the spectacular growth in manufacturing.

Chapter 1 also provides evidence of an overall upgrading of EU manufacturing to higher technology intensities. The EU as a whole and the majority of Member States increased their high- and medium/high-tech manufacturing output and reduced their output in the low- and medium/low-tech sectors. This structural shift largely reflects the industrial performance of several 'old' Member States (Belgium, Germany, Denmark, Sweden and France), but also the catch-up by the Baltic states, Poland, Hungary, Slovakia, the Czech Republic, Bulgaria and Romania, which have considerably upgraded the technology-intensity of their manufacturing. It is noteworthy that the 'new' Member States from central and eastern Europe have also seen growth in their lower-tech industries, which may reflect a pull effect from the high-tech sectors and relocation of production from the EU-15. There are several Member States, such as Greece, Spain, Italy and the UK, in which manufacturing output is declining regardless of technology-intensity.

Of greater importance for public policy is **the job aspect of the observed changes in output.** The decline in the share of manufacturing in the economy is reflected in a commensurate decline in its share of employment. Shares of both output and employment declined by 3.5 pp between 2000 and 2014. In absolute terms, manufacturing employment declined by 16% in this period, i.e. there are about 6 million fewer jobs in manufacturing today than there were 15 years ago. About two thirds of this decline (loss of 4 million jobs) took place during the recession. At the same time, the proportion of jobs in services has grown by 7.4 pp, from about two thirds to three quarters, adding about 15 million jobs in market and 8 million in non-market services, thus more than offsetting the decline of employment in agriculture, industry and construction.

Structural change is very much driven by technology and skills. The report looks at changes in employment according to manufacturing sectors' varying degrees of technology-intensity. It shows that loss in output in low-tech sectors is matched by even larger losses in employment. All Member States for which data are available lost employment in low-tech manufacturing, including those that increased output in these sectors. This indicates that low-tech, labour-intensive sectors may not provide the solution to the problem of unemployment. They are much more exposed to competitive pressures from low-cost economies and lose market shares both at home and abroad and related output and employment. Against the backdrop of this long-term trend, other sectors of the economy may have higher potential in terms of job creation. However, most Member States also lost employment in medium/low-, medium/high- and high-tech sectors. Taken together with rising output, this is a sign of labour productivity gains in these sectors. The notable exceptions in terms of employment gains are in the Czech Republic, which saw more jobs being created in the high, medium/high- and medium/low-tech sectors, Poland (medium/low- and high-tech), Denmark (high-tech), Austria and Slovakia (medium/high- and medium/low-tech), Hungary and Slovenia (medium/high-tech) and Latvia (medium/low-tech).

The investment gap

Investment in productive physical capital is an important driver of economic growth and should ideally represent 20-25% of GDP (more in emerging and catching-up economies, less in mature economies dominated by services). On average across the EU, gross fixed capital formation represented 22.1% of GDP in 2000, but only 19.3% in 2014. The decline affected all asset classes, except intellectual property products, and was particularly sharp in ICT equipment and machinery & equipment. Across Member States, gross fixed capital formation

(GFCF) declined as a proportion of GDP in all Member States except Belgium, Bulgaria, France, Romania and Sweden.

In most Member States, investment kept pace with GDP growth from 2000 to 2008, but the onset of the economic and financial crisis and recession caused investment to drop much more than GDP. The worst year was 2009, when EU investment in ICT equipment and machinery & equipment fell by around 17% in real terms, while investment in buildings & structures dropped by almost 10%. 'Intellectual property products' was the only asset class in which investment remained virtually unchanged from 2008 to 2009.

Even though GFCF has since regained some of its lost momentum, it grew more slowly than EU GDP in 2009-2014. This gave rise to a growing investment gap in relation to pre-recession GFCF levels. Last year, the EU investment gap was between EUR 240 and 380 billion; over the whole 2009-2014 period, the cumulative investment shortfall exceeds EUR 1200 billion.

The recession caused similar investment gaps in most Member States. Apart from Germany, Poland and Sweden, where the volume of investment kept growing throughout the recession, in most Member States investment volumes peaked in 2007 or 2008 and in 2014 were up to 65% lower than in the peak year. The largest drops occurred in Greece (-65%), Cyprus (–61%) and Romania (–53%). The resulting investment gaps have led to unsustainably low proportions of GFCF in relation to GDP in many Member States, e.g. Cyprus (10.8%), Greece (11.6%), Portugal (14.6%) and Ireland (16.4%). At the opposite end of the scale, GFCF represents more than 25% of GDP in the Czech Republic and Estonia, and over 23% in Belgium, Latvia and Sweden.

Productivity and structural change

Productivity gains or losses explain much of the development of productive structures. In open competitive markets, productivity developments are the key to understanding the changes in domestic and global value chains and market shares. Chapter 2 studies changes in EU productive structures and specialisation through the underlying changes in productivity and the relative prices of goods and services on international markets.

The crisis had the most severe impact on labour productivity in manufacturing, which in 2007-2009 lost two fifths of the gains registered since 2000. This can be largely explained by the slower adjustment of labour demand to the abrupt slump in demand at the start of the crisis. The lag between cyclical changes in demand and use of labour is not a new phenomenon, but seems traditionally to be more pronounced in Europe than in the United States. This is usually explained by higher labour-market rigidities in Europe due to regulatory or structural constraints on hiring and firing workers. On the one hand, the regulatory cost of firing may be higher than keeping employees when output is falling. Added to this, in the case of skilled labour, is the transaction cost of hiring and training new staff when demand picks up. Therefore, the tendency towards labour-hoarding against the backdrop of slump in demand tends to grow with the extent of labour protection and skill mismatches/excess demand for certain skills.

Sector-wise, the decline in labour productivity was more abrupt in manufacturing (especially sectors producing capital goods), which experienced a deeper plunge in demand relative to

services while at the same time facing a shortage of technical and engineering skills (ECR 2013, p. 20).

Chapter 2 applies decomposition analysis to distinguish productivity gains from technological and organizational change **within the broad sectoral aggregates** (e.g. within manufacturing) from **gains from relocating factors of production across sectors** (e.g. from manufacturing to services)**.** The analysis distinguishes as well two types of structural shift across sectors: from low- to high-productivity sectors ('static shift'); or from sectors with low productivity growth to sectors with high growth ('dynamic shift'). The distinction between the three structural drivers of productivity gains has important policy implications. The sectors with the highest productivity (e.g. mining, tobacco, oil refining, and real-estate services) may also have the lowest productivity growth. This can be partly explained by the level of productivity attained, but the effect may also depend on whether the sector is capital-intensive or knowledge- and technology-intensive (e.g. pharmaceuticals, information and communication services, finance and insurance). Therefore, the productivity gains may be broken down to show to what extent they are driven by relocation of production to capital-intensive sectors and to what extent by a shift to sectors with high knowledge-intensity.[4]

The decomposition analysis shows that structural shift across sectors (e.g. from manufacturing to services) plays limited role. In both in the pre-crisis years (2002-2007) and during the recession (2008-2013), productivity gains are mainly due to capital deepening and technology upgrades **within the sectors**. The sectoral effect accounts for 86% of productivity gains before 2007 and 78% subsequently, even though productivity growth during the crisis fell by almost 60% in aggregate terms. The relative weight of productivity growth due to structural shift grew from 13% to 21%, which is evidence that the recession accelerated the restructuring of the economy away from low-productivity sectors. It is worth noting, however, that productivity gains due to the shift to high-growth sectors are negative (albeit small) in both periods, which is evidence of a negative or limited shift to high-productivity growth sectors (which are usually knowledge-intensive) accompanying the shift of the economy from manufacturing to services.[5] Part of the explanation may be that knowledge-intensive business service sectors may not be able to absorb the entire knowledge and skills capital released from manufacturing, and with the shift to services some of the production factors are relocated to lower-growth service sectors.

The application of the decomposition analysis at the level of the Member States shows that in the past 15 years, all Member States except Poland saw gains in labour productivity. These were highest in certain catching-up economies such as Latvia, Estonia, Slovakia, the Czech Republic, Slovenia and Hungary, but the overall EU score was largely driven by the impressive performance of most of the 'old' Member States, with Portugal, Greece, Finland, Sweden, the UK, Austria, Germany and the Netherlands scoring above the EU average. Most of this growth reflects sectoral productivity gains, but structural shift also played a large role in Lithuania, Slovenia and Bulgaria. The shift of resources to sectors with high productivity growth was weak but positive for some countries, such as Bulgaria before the crisis and Cyprus, Ireland and Finland after it. This may reflect growth in the relative weight of

[4] It should be noted, however, that sectors of high productivity growth are not necessarily knowledge-intensive sectors (such as pharmaceuticals, information and communication services and financial intermediation). Mining, for instance, has high productivity growth because of sustained substitution of labour with capital and outsourcing of labour-intensive phases of production to third countries.

[5] This finding does not contradict the evidence in Chapter 1 of a shift from low- to high-technology intensive sectors in manufacturing. In the decomposition analysis in Chapter 2, manufacturing is presented as one sector, so shifts across manufacturing subsectors would appear as improvements within the sector.

financial services in the 'new' Member States and/or information and communication services in the 'old' Member States.[6]

During the recession, EU productivity growth dropped by about 60% relative to the pre-crisis period. Labour productivity growth slowed for almost all Member States, turning negative for four (Greece, the UK, Finland and Belgium), in addition to Poland. The decline was most pronounced for some of the top performers in the lead-up to the crisis, such as the Czech Republic and Hungary. However, other Member States (Ireland, Lithuania, Spain and Bulgaria) actually improved their labour productivity performance during the recession. Poland stands out as the only Member State not affected by the recession in terms of growth, despite its consistently negative labour productivity growth over the past decade. The decomposition analysis shows that labour productivity gains in Poland came mainly from shifting resources to higher-productivity sectors, but these were not enough to offset the sectoral losses of labour productivity, i.e. output by sector shrank faster than labour inputs employed in its production.[7]

Labour productivity gains may not materialise in competitive gains if labour costs grow faster. Therefore, Chapter 2 looks at unit labour costs (ULCs), which are widely used to translate labour productivity into sectoral cost-competitiveness, especially for homogeneous or labour-intensive products which compete with similar products from low-cost countries. The analysis shows that ULC development closely mirrors labour productivity developments:

- sectors that saw the largest losses in terms of labour productivity (e.g. leather and tobacco) also experience significant increases in terms of ULCs;
- many sectors gained labour productivity in the past decade, but the gains were more than offset by a faster increase in labour costs, which resulted in losses in terms of cost-competitiveness; these included the more or less capital-intensive fabricated metals, refined petroleum, rubber and plastic, food, machinery and equipment, electrical equipment, and other transport equipment sectors;
- in a third group of industries, such as non-metallic minerals, wood, furniture, chemicals, paper, printing, clothes, textiles, computers, and electronic and optical equipment, increases in labour productivity triggered ULC improvements.

There is no clear pattern linking ULC gains to labour, capital or technology intensities at this level of aggregation. For instance, the EU registered its biggest ULC losses in labour-intensive low-tech sectors such as leather and footwear, and food, but also registered its highest gains in similar sectors, such as clothes, textiles, beverages, wood, paper and furniture. Such gains may partly reflect a 'near-shoring' of production to lower-cost central and eastern European (CEE) and 'neighbourhood' countries, but there are also ULC improvements in high-tech sectors such as computers, electronic and optical equipment, and pharmaceuticals. At the same time, in a number of medium/high-tech sectors, the EU seems to have lost cost-competitiveness in the past 10 years: machinery, electrical equipment, other transport equipment, repair and installation.

Labour productivity and related ULC developments are not sufficient to explain growth and changes in the productive structure and competitive advantages of an economy. Labour and

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[6] It is worth noting, however, that apart from the relocation of resources from low- to high-tech sectors, the dynamic effect may also reflect manufacturing shrinking faster than finance and insurance, for instance.

[7] In principle, growth without productivity gains may reflect labour inputs increasing faster than capital inputs in the expansion of output. The additional capital and labour inputs explain growth, but this is accompanied by negative productivity gains. In the case of Poland, however, its spectacular resilience during the crisis is more likely to reflect strong performance in terms of TFP (which measures skill and technology level and the efficiency of combining labour and capital).

capital inputs generate more growth than their simple sum would imply. The difference, which is unaccounted for by the volume of labour and capital inputs employed in production, is captured by total factor productivity (TFP). TFP is important, as it also measures the quality of the labour and capital inputs, the efficiency with which they are combined, the extent to which they are utilised, and the role of technological, process and organisational innovation.

EU TFP was hit severely by the crisis. For comparison, the US saw smaller drop in TFP by 2009 and returned much faster to pre-crisis levels and subsequent growth. Japan – where the damage was similar to that in the EU – also managed to recover faster and to follow a recovery path similar to that of the USA. Member States' TFP performance varies widely, however. Today, more than half have still to recover their pre-crisis TFP levels. Those most heavily affected by the crisis are Greece, Italy, Luxembourg and Cyprus, which are at or below their 2000 level of TFP. For Italy, Luxembourg and Spain, TFP started to decline or stagnated long before the crisis. In the case of Spain, the positive development after the crisis only just offset pre-crisis (i.e. pre-2000) losses in productivity. At the other end of the spectrum are some 'new' Member States (the Baltic states, Poland and Slovakia), but also Ireland and Germany, which scored considerable TFP gains both before and during the crisis. Overall, the crisis did not interrupt their longer-term TFP performance. Romania stands out as making the largest TFP gains relative to 2000, but the crisis seems to have put these on hold.

Further analysis, based on the EU KLEMS dataset, which presents TFP by manufacturing sector, confirms that for certain Member States the problems of declining or stagnating TFP date back to before the crisis. For Italy and Spain, and even France and Belgium, manufacturing TFP started to stagnate long before the crisis, providing strong evidence of structural rather than cyclical problems.

As mentioned above, TFP is affected by the quality of factors of production, as measured, for instance, by skills and technology. Therefore, Chapter 2 also looks at those determinants of productivity. Skills determine the potential of the economy to create and employ new technologies and innovate. Another useful indicator along with skills is the level of investment in R&D by sector.

The chapter shows that the most knowledge-intensive sectors (measured through levels of education of the workforce) are the services sectors: education, professional services, information and communication, finance and insurance. The most knowledge-intensive manufacturing sectors (in descending order) are pharmaceuticals, coke and refined petroleum, computers and electronics, other transport equipment, chemicals, tobacco, beverages, and machinery and equipment. All have workforces with relatively high rates of tertiary and post-secondary or upper secondary education. In the last six crisis years, there was a small but clearly observable shift from low to higher skills in all sectors of the economy. This is consistent with the shift in EU specialisation to high-tech sectors and with the growing knowledge-intensity of the goods and services on the market. On the supply side, this phenomenon also reflects the long-term trend of wider access to all levels of education, which increases education levels across all types of job, even if the jobs themselves do not change much. During the crisis, this trend has accelerated, as low-skill jobs were more affected, while labour-hoarding was more pronounced in relation to high-skill jobs. The largest gains in terms of education are in information and communication, finance and insurance, and the electricity and gas sector. As for manufacturing, the leaders are other transport equipment (which includes aircraft, ships, etc.), tobacco, and coke and refined petroleum, which also show the highest gains in terms of TFP.

A comparison of EU and US business expenditure on R&D in manufacturing shows that overall US companies spend more on innovation. European firms perform better in sectors

such as computers, electronic and optical products, electrical equipment and chemicals, but also in medium/low- and low-tech sectors such as basic metals and textiles. However, overall R&D intensity is higher in the USA. For some sectors, e.g. pharmaceuticals, other transport equipment, and motor vehicles, the difference is very large. A significant gap between the EU and the USA is also observable at Member-State level. While most European countries saw an increase in business R&D expenditure in the past decade, in many the proportion of GDP invested in research is still substantially lower than in the USA and China.

This report examines also the impact of energy costs and climate policies on the structural shift to low-carbon economy. It builds on previous decomposition analysis in the European Competitiveness Report 2014, based on the World Input-Output Database (WIOD), which shows that all world economies improved their energy efficiency (measured in terajoules per value added) in the lead-up to the crisis. The EU-12 and China registered the biggest improvement (starting from a very low base), which reflects both a reduction of energy-intensity within sectors and a structural shift of the economy to less energy-intensive sectors. The energy-saving effect is stronger in Europe and China, while the structural effect is stronger in Japan and the USA. The latter is considerable in the EU-12, but productive structure in the EU-15 has shifted to more energy-intensive sectors. Based on price elasticities of demand for electricity it shows that energy efficiency gains could not offset the impact of higher prices on energy costs. (ECR 2104).

The analysis in Chapter 2 of this report expands and confirms those findings by examining the cost of energy per value added by sector. It shows that, despite the energy efficiency gains the majority of industrial sectors suffered from increased energy cost per euro of value added between 2008 and 2012. Among the most heavily affected sectors are such energy intensive sectors as refined petroleum (where energy rose in average by 10.7% per year), basic metals (7.6%) and metal products (5%), wood (6.1%) minerals (4.3% per year), chemicals, textile and food. Few sectors managed to reduce energy cost per value added: paper, construction, beverages and pharmaceuticals.

The EU in the global supply chains

The past two decades have seen globalisation taking place on a wider scale and at a faster pace. With the growing integration of the EU economy in global supply chains, these become a major driver of structural change. Chapter 3 seeks to establish the link between structural change and competitiveness. The EU economy continues to account for the biggest proportion of world trade, including 37.5% of manufacturing goods exports and 43% of services exports.[8] However its share in global exports has been shrinking. In the past decade, its share in manufacturing exports shrank by 7 pp, while its share in services exports dropped by 5 pp. The EU lost market share in almost all services sectors, except for royalties and licence fees, and communication services, sectors in which it has strong revealed comparative advantages (as it does in personal care services, finance, insurance, and computer and information services).

The decline in exports in goods and services is almost entirely accounted for by the decline of intra-EU exports as a proportion of global exports. Actually, intra-EU manufacturing exports have grown in absolute terms by a factor of almost 1.5 in the past 10 years, while EU manufacturing exports to third countries almost doubled. Nevertheless, the EU has lost

[8] Both shares include intra-EU trade. If intra-regional trade is excluded, Asia leads in exports of goods by a small margin (15.8% of world exports, as compared with the EU's 14.6%), but the EU leads in exports of services, with extra-EU services exports representing 19% of the global total.

positions on global manufacturing markets as the new emerging industrial powers have expanded twice as fast, e.g. China increased its global exports 3.75 times and India 4.35 times. It is worth noting, however, that the strong growth in extra-EU exports reversed after the first quarter of 2013 and these have since fallen by some 7%.[9]

The geography of EU trade flows has also changed significantly in the past decade. Asia has emerged as number one destination for extra-EU exports and origin of extra-EU imports. EU manufacturers have been partly crowded out by Asian manufacturers on North American markets. The rise of Asia in global trade is driven by the spectacular performance of China and, to a lesser extent, India. China initially penetrated global export markets in labour-intensive low-technology sectors, but this has been followed by gains in more capital-intensive and higher-technology industries. Industrial policies to support technological upgrading have underpinned this performance, together with global trade liberalisation and demand from fast-growing middle classes in emerging markets.

These developments raise two important policy implications:

- The fast growth of the emerging industrial powers explains why extra-EU exports grew much faster than intra-EU exports. Global trade has been expanding much faster than intra-EU trade, despite the strong impact on the latter of the introduction of the euro, the deepening of the single market and the unprecedented enlargement which have internalised trade flows with 13 new Member States in the past 10 years. Even though growth in emerging markets is slowing down, it will remain the major source of growth in export demand, 90% of which is expected to occur outside Europe;
- The second important observation is the distinct trend of substitution of EU manufacturing exports with products from emerging industrial powers in the traditional high-income markets of North America and Europe. This trend is likely to determine the structure and dynamics of world trade in the future and the EU's opportunities for export expansion. Together with the deepening of the single market, the EU should attach urgent priority to policies to improve the positioning of EU businesses in global value chains. This may be a stronger driver for growth in the medium and long term along with the deepening of the Single market.

Like the EU's relative weight in world trade, **its share in world capital flows has declined**. The EU continues to be a major destination for foreign direct investment (FDI), but China today attracts an equal share. In terms of outflows, the EU is the second largest source of FDI after the United States.

The crisis had a severe impact on the EU's position in global FDI flows. In 2013, its outbound and inbound FDI were both around 40% of their 2007 levels. Again, the slump was deeper for **intra-EU capital flows, which shrank fivefold**. In comparison, investment in the EU from third countries shrank much less, declining in 2013 to about 75% of its pre-crisis 2007 peak. The collapse of intra-EU FDI contributed substantially to the investment gap studied in Chapter 1. It is not surprising that, in times of weak demand and uncertain prospects, cross-border investment in the EU collapsed more than domestic investment. The steeper decline of intra-EU FDI relative to that from third countries increased the weight of the latter in incoming FDI from 24% in 2004 (40% before the crisis) to 73% in 2013. With the growing weight of emerging industrial powers in global trade, their weight in investment in the EU is also growing fast. This is an opportunity for the EU, given the pressing need to close the post-crisis investment gap, but also a challenge for EU policy-makers, as the proportion of

[9] Short-term Industrial Outlook: http://ec.europa.eu/growth/industry/competitiveness/reports/short-term-industrial-outlook/index_en.htm

strategic assets owned by non-EU investors is growing fast. The share of EU assets hold by third countries grew from 31.5% in 2007 to 37.4% in 2013. It is noteworthy that the slump of intra-EU cross-border investment seems to reflect demand uncertainties and structural constraints more attractive investment opportunities outside the EU rather than liquidity constraints. While intra-EU cross-border investment shrank, EU FDI bound to emerging markets grew from 38.5% in 2004 to 68.5% in 2013.

Finally, the report provides preliminary analysis of back-shoring. Evidence is limited and far from conclusive, but back-shoring seems to remain at low levels. Drivers of back-shoring – such as shrinking wage differentials especially for skilled labour; problems with local inputs; cultural and language obstacles; other political and commercial risks – do not seem to have materialized in empirically observable deceleration of offshoring. The relevant policy message would be that incoming FDI may have higher potential than back-shoring to address the investment gap and to generate jobs and growth.

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CHAPTER 1

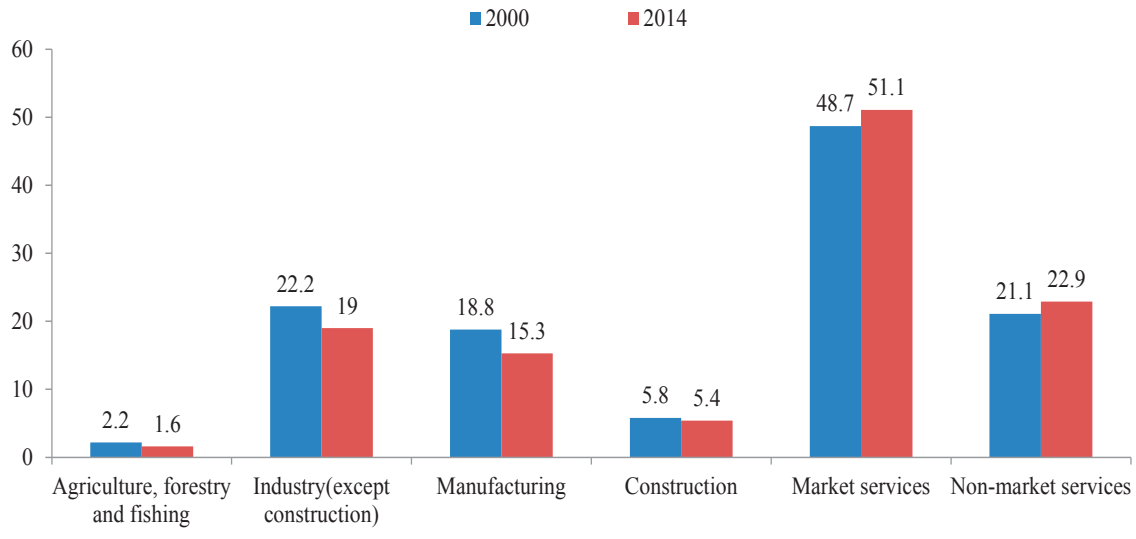
CHANGES IN THE EU'S PRODUCTIVE STRUCTURE

Between 2000 and 2014, the EU experienced significant structural changes driven by events such as: the introduction of the euro, several waves of enlargement, increased globalisation (including China's accession to the WTO), major technology changes driven by automation and digitalisation, and the economic crisis. The impacts of these events varied considerably across Member States and sectors. This chapter documents the structural changes that took place in the EU-28 and the individual EU Member States in terms of output, employment and physical capital, and explores possible explanations.

1.1 CHANGES IN OUTPUT STRUCTURE

This section examines changes in the structure of EU output between 2000 and 2014. Figure 1.1 shows the changes in the shares of the major economic sectors[10] gross value added (GVA).

Figure 1.1: Shares of major sectors in EU-28 GVA in 2000 and 2014 (% of total GVA)



Source: Own calculations based on National Accounts, Eurostat.

[10] The sectors are defined on the basis of Eurostat definitions. Agriculture, forestry and fishing are sector (A). Industry includes: mining and quarrying (B), manufacturing (C), electricity, gas, steam and air conditioning supply (D) and water supply; sewerage, waste management and remediation activities (E). Market services include: wholesale and retail trade, transport, accommodation and food services (G-I), information and communication (J), financial and insurance activities (K), real estate activities (L), and professional, scientific and technical activities; administrative and support service activities (M-N). Non market services include: public administration, defence, education, human health and social work activities (O-Q) and arts, entertainment and recreation; other service activities; activities of household and extra-territorial organisations and bodies (R-U).

The figure shows that the GVA shares of agriculture, industry and construction decreased, while those of service sectors increased. As a result, market and non-market services accounted for 74% of the GVA in 2014. Over the period, the share of manufacturing decreased from 18.8% to 15.3%. These patterns are consistent with a long-term shift in the economic structure from manufacturing to services, a trend previously documented *inter alia* by European Commission (2013a, 2013b).

There are several possible explanations for the increased importance of services in the economy. First, income elasticity of demand[11] for certain services (education, health, leisure related and personal services, etc.) is higher than for most manufactured goods. Together with increases in income in the EU-28, this resulted in an increase in the share of services in the economy. Second, the use of services as intermediate inputs in manufacturing increased during this period, partly due to the externalisation of services previously performed by manufacturing/industrial firms in-house (European Commission, 2013b). Third, productivity increased faster and prices increased more slowly in manufacturing than in service sectors (European Commission, 2013b). Fourth, manufacturing was more exposed to competition from low-cost producers outside the EU, which may have led to a reduction in manufacturing production and reallocation of resources within the EU towards services, which were less exposed to such competition.

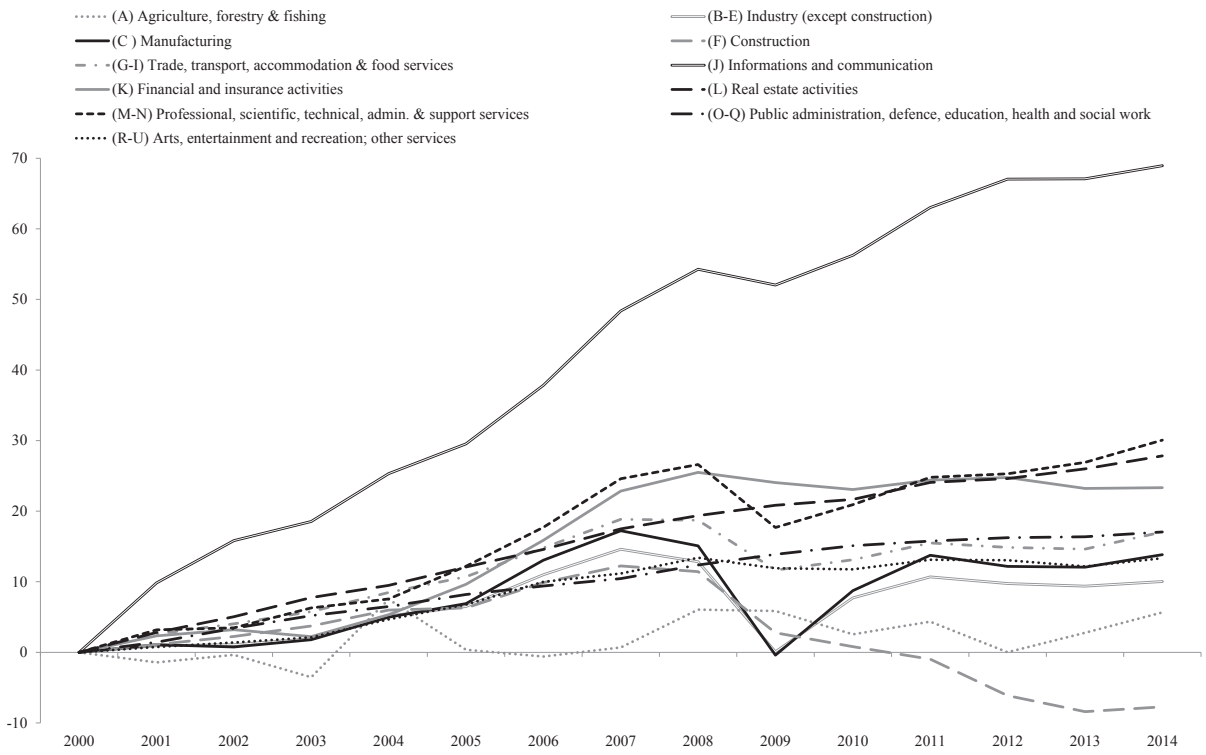
Figure 1.2 shows that, in real terms,[12] value added in manufacturing increased over the period by almost 14%. However, it increased faster in service sectors, with *Information and communication* (68.5%), *Professional, scientific and technical activities; administrative and support service activities* (30.7%) and *Real estate activities* (27.6 %) seeing the biggest rises.

Figure 1.2 also shows that, while all sectors have been affected by the crisis, the declines in value added in the manufacturing and construction sectors were more severe than in most services sectors. Moreover, while the value added in manufacturing recovered partially, by 2014, it had still not reached its 2008 level. In construction sector, the recovery has been very limited and in 2014, value added was below the 2000 level. In contrast, value added in service sectors recovered faster, with most exceeding the 2008 levels.

[11] Income elasticity of demand measures the responsiveness of the quantity demanded of a good or service to a change in income.

[12] In order to focus on changes in real terms (in volumes), we use chain-linked volumes. An explanation of the Eurostat methodology is available at http://ec.europa.eu/eurostat/cache/metadata/EN/nama_esms.htm

Figure 1.2: Change in EU-28 GVA by sector between 2000 and 2014 (%)

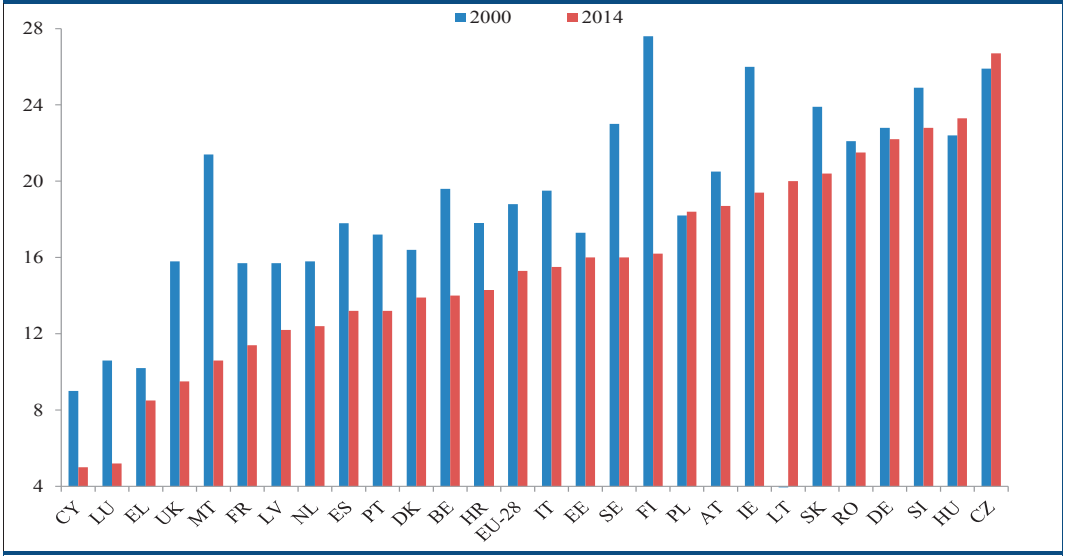


Source: Own calculations based on National Accounts, Eurostat
Note: GVA is measured in chain linked volumes (reference year 2010).

The increases in the real value added in both manufacturing and service sectors suggest that the decrease of the share of manufacturing in the economy in nominal terms is likely due to faster growth in service sectors and a decline in the relative prices in manufacturing relative to those in services (see section 2.3), rather than a decrease in value added in manufacturing. The real-terms increase in value added in manufacturing suggests that the EU as a whole has maintained its competitiveness in this sector, despite increased competition from low-cost producers elsewhere. However, this does not apply to all EU Member States and sectors (see below).

Figure 1.3 shows the proportion of value added in manufacturing in the EU Member States in 2000 and in 2014. In 2014, the share of manufacturing in value added ranged from 5% to almost 27%. It was lowest in Cyprus, Luxembourg, Greece and the UK. In contrast, it was over 20% in seven EU countries: the Czech Republic, Hungary, Slovenia, Germany, Romania, Slovakia and Lithuania. These countries have large manufacturing bases and are highly integrated in intra-European and global value chains, mainly through FDI and the offshoring of production activities from the EU-15 and in particular from Germany (Damijan *et al.*, 2013; van Ark *et al.*, 2013;).

Figure 1.3: Manufacturing GVA shares in EU Member States in 2000 and 2014 (%)

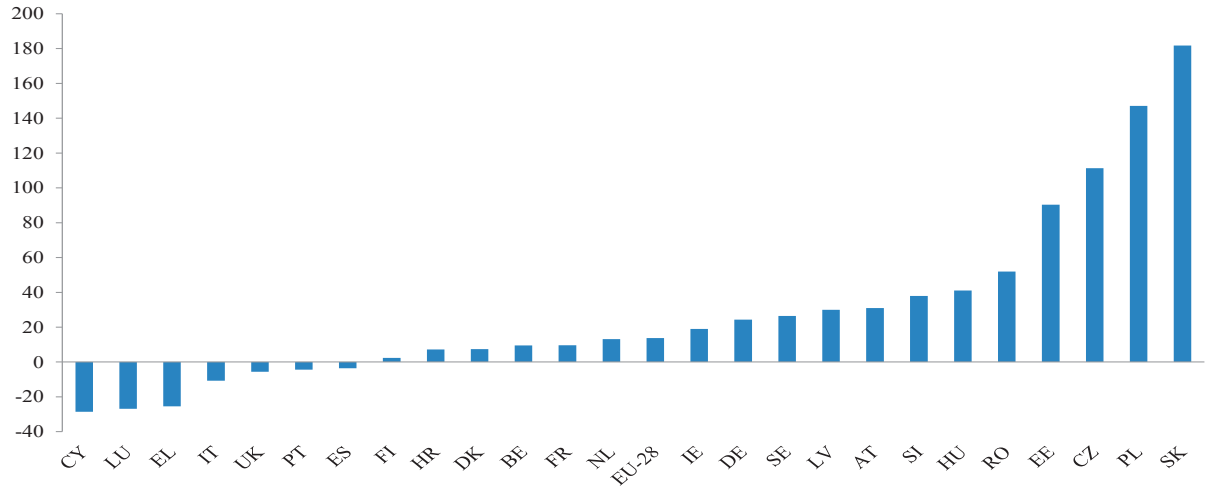


Source: National Accounts, Eurostat.
Note: No data available for BG and for LT for 2000. For LU the latest available data are for 2013 and for RO for 2012.

Despite this heterogeneity, a common trend that emerges from Figure 1.3 is the decrease in the share of manufacturing in value added. Only three countries (the Czech Republic, Hungary and Poland) saw increases. The largest decreases took place in Cyprus, Luxembourg, and the United Kingdom, where manufacturing already had a low share of the economy in 2000. However, large decreases were also recorded in Sweden, Finland and Malta, where manufacturing accounted for more than 20% in 2000. With the exception of Sweden and Finland, countries with large shares of manufacturing in 2000 registered lower decreases, or even increases. This pattern could indicate competitive and resilient manufacturing sectors in countries with a strong industrial orientation in 2000 and de-industrialisation in others. It could also indicate increased specialisation within the EU according to Member States' comparative advantages.

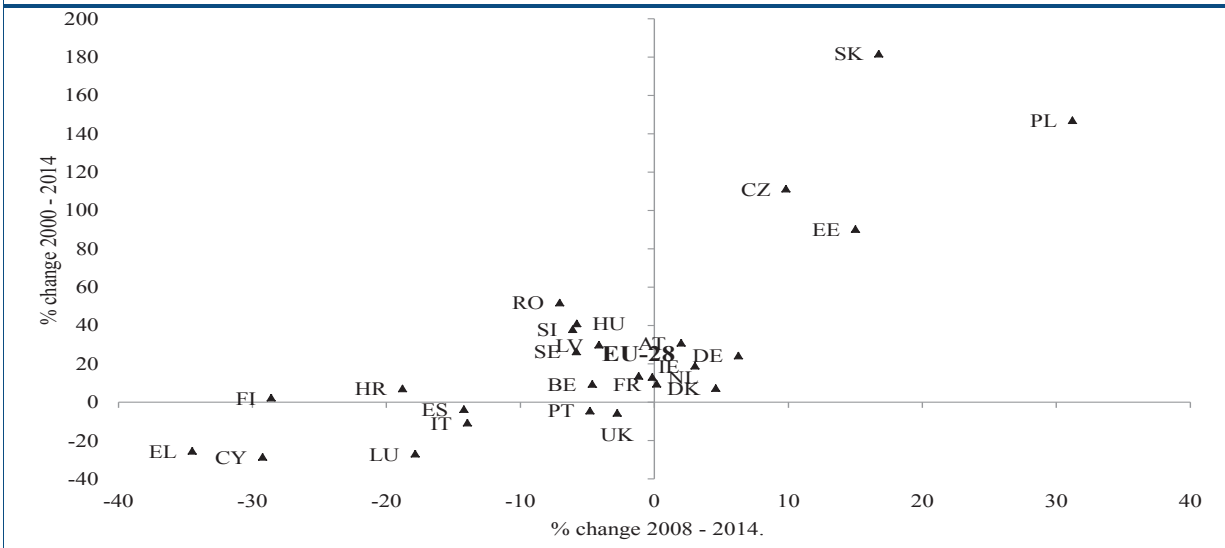
Figure 1.4 suggests that the increase in value added in manufacturing at EU level conceals wide variation at Member State level. In seven Member States (Cyprus, Luxembourg, Greece, Italy, the UK, Portugal and Spain), value added in manufacturing was lower in real terms in 2014 (2013 in the case of Luxembourg) than in 2000, with largest decreases in Cyprus (-28.6%), Luxembourg (-26.9%) and Greece (-25.4%). The largest increases in real terms took place in Slovakia (181.8%), Poland (147.0%), the Czech Republic (111.3%) and Estonia (90.3%). In all CEE countries except Croatia valued added in manufacturing grew faster than the EU average.

Figure 1.4: Change in manufacturing GVA in EU Member States between 2000 and 2014 (% change since 2000)



Source: Own calculations based on National Accounts, Eurostat
Note: GVA is measured in chain-linked volumes (reference year 2010). No data available for BG, LT and MT. The change in GVA for LU for 2000-2013 and for RO is for 2000-2012.

Figure 1.5: The crisis and changes in GVA in the EU Member States



Source: Own calculations based on National Accounts, Eurostat
Note: GVA is measured in chain-linked volumes (reference year 2010). No data available for BG, LT and MT. The change in GVA for LU is for 2000-2013 and 2008-2013 for RO for 2000-2012 and 2008-2012.

Figure 1.5 examines in greater detail the effect of the crisis on the evolution of value added in manufacturing in the Member States. It shows changes in GVA in the long run (2000-2014) on the vertical axis and changes since the beginning of the economic crisis (2008-2014) on the horizontal axis. It reveals that in the EU-28 as a whole and in most Member States, GVA was higher in 2014 than in 2000, but below the 2008 level (top left quadrant). In seven Member States, GVA in 2014 was below the 2008 and 2000 levels (bottom left quadrant). This group includes the southern European countries, which were most affected by the crisis (Greece, Cyprus, Spain, Portugal and Italy), but also two countries that performed relatively well in service sectors, but registered large decreases in manufacturing (the UK and Luxembourg). Finally, the top right quadrant shows that nine Member States increased GVA not only compared with 2000, but also as compared with the beginning of the crisis. The

largest increases as compared with 2008 were recorded in Poland (31.2%), Slovakia (16.8%) and Estonia (15.0%).

Table A 1.3 (see Annex) shows that countries that experienced the largest increases in manufacturing in 2000–2014 also experienced the largest increases in value added in several business-related service sectors, such as *Information and communications* and *Professional, scientific and technical activities; administrative and support service activities, Wholesale and retail trade, Transport, Accommodation and food service activities* and *Financial and insurance activities*. These increases could reflect general high economic growth in these countries. Given their strong linkages with manufacturing, large increases in these sectors could be linked to growth in manufacturing. This underlines the importance of manufacturing as a major market and hub for many service sectors.

Manufacturing comprises sectors that differ considerably, especially with regard to their technology-intensity. To examine changes in manufacturing output in *low-, medium/low-, medium/high-* and *high-tech sectors,* we use the Eurostat classification of sectors according to technology intensity (see Table A 1.1).

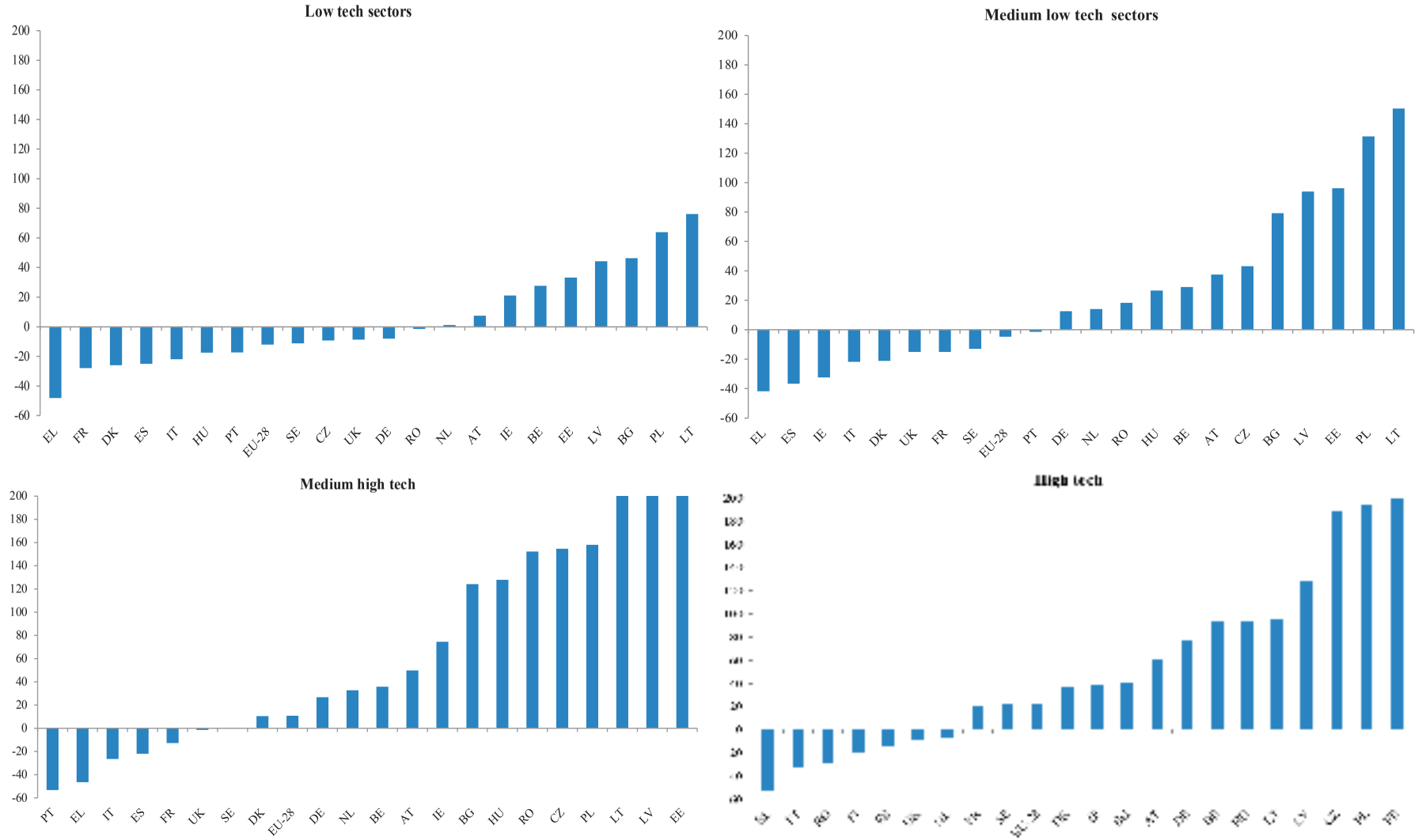
Figure 1.6 shows changes in the volume of production between 2000 and 2012 in the four groups of sectors in the EU-28 and in the 21 individual Member States, for which data were available[13].

Figure 1.6 shows that production in low-tech sectors fell for the EU-28 as a whole and for most Member States. The largest decreases were in Greece, France and Spain. However, production in these sectors increased in nine Member States, with the largest increases recorded in Lithuania and Poland. Production in these sectors increased mainly in CEE countries, but also in Belgium, Ireland and Austria. Production in medium/low-tech sectors shows a similar evolution, but it increased in a larger number of countries and growth tended to be higher.

In medium/high-tech and high/tech sectors the production increased in the EU-28 and many Member States. This growth reflects conditions more conducive to growth in these sectors, such as, higher demand expectations due to previous faster growth, faster technological change and less competition from low-wage producers outside the EU (European Commission, 2014a). However, even in these sectors, production evolved very differently across Member States. Production in medium/high-tech sectors decreased mainly in southern Member States (Portugal, Greece, Italy and Spain). The largest increases were recorded in the three Baltic States. The figure indicates a similar pattern for production in high-tech sectors, with most Member States seeing increases and several (Estonia, Czech Republic, Poland, Lithuania, Latvia and Belgium) more than doubling their output in these sectors. Growth in high-tech sectors was particularly impressive in the Czech Republic and Estonia, in the latter mainly due to large increases in the manufacture of computer, electronic and optical products, from a very low base in 2000.

[13] The analysis focuses on 2000–2012 to facilitate comparison with the similar analysis for employment.

Figure 1.6: Change in production in sectors with different technology intensity between 2000 and 2012 (%)



Source: Own calculations based on Short-Term Statistics, Eurostat
Note: Change in volume index of production with base year 2010. Eurostat estimates. Data not available for CY, FI, HR, LU, MT, SI and SK.

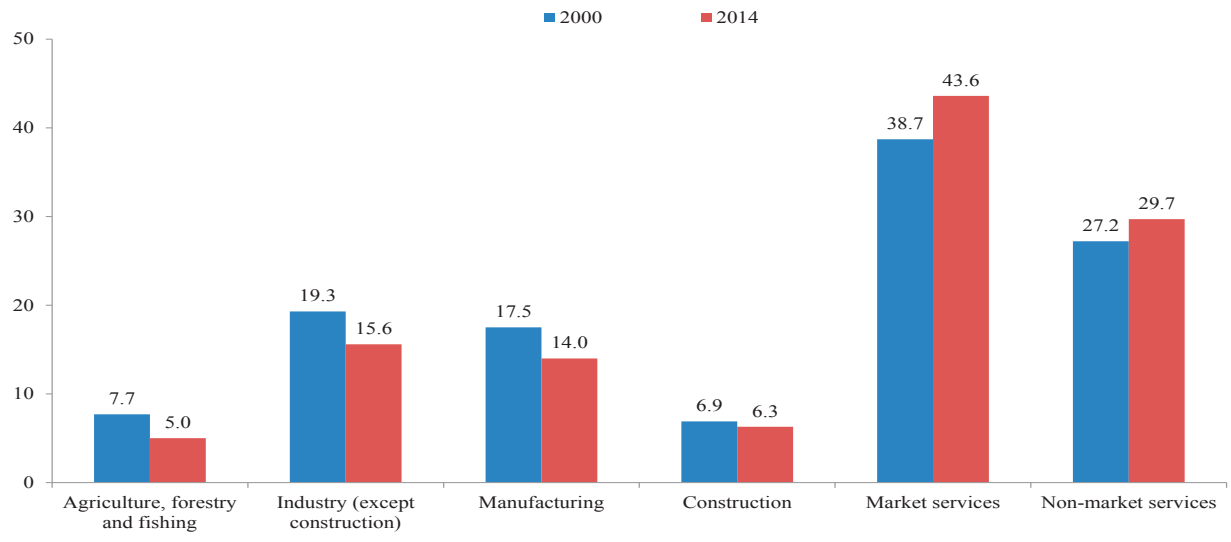
Overall, the most striking aspect highlighted by Figure 1.6 is the wide dispersion in changes in production among the Member States. Large decreases in low-, medium- and high-tech sectors took place in Greece, Italy, Portugal and Spain. While these became particularly severe during the economic crisis, they started beforehand, which suggests pre-existing competitiveness weaknesses. This is consistent with the negative (Greece, Spain, Italy) or stagnant (Portugal) productivity growth in 2002-2008 found by Dall'Olio *et al.* (2014),[14] who ascribe it mainly to restrictive regulation and less firm internationalisation which limited international technology transfers and economies of scale. In contrast, large increases in production were recorded in low-, medium- and high- tech sectors in most CEE countries, but also several EU-15 countries, such as Belgium, Ireland, Austria and Germany.

To summarise, value added in EU manufacturing increased in real terms between 2000 and 2014, but at a slower rate than in service sectors. Nevertheless, sectors and Member States experienced divergent structural changes. Growth in manufacturing was concentrated in medium/low-, medium/high- and high-tech sectors and mostly in CEE Member States and several EU-15 Member States. In contrast, several southern European Member States experienced decreases in sectors with varying technology intensities. These contrasting evolutions suggest that country-specific characteristics are driving these trends. These findings and previous research on this topic highlight the importance of improving business environment and regulations and supporting firm internationalisation.

1.2 CHANGES IN THE EMPLOYMENT STRUCTURE

This section examines changes in the structure of employment in the EU-28 and in the Member States between 2000 and 2014. Figure 1.7 shows changes in the share of major sectors in total employment in the EU-28.The shares of agriculture, industry and construction in total employment decreased between 2000 and 2014, while those of market and non-market services increased.

Figure 1.7: Employment shares by sector in the EU-28 in 2000 and 2014 (% of total employment)



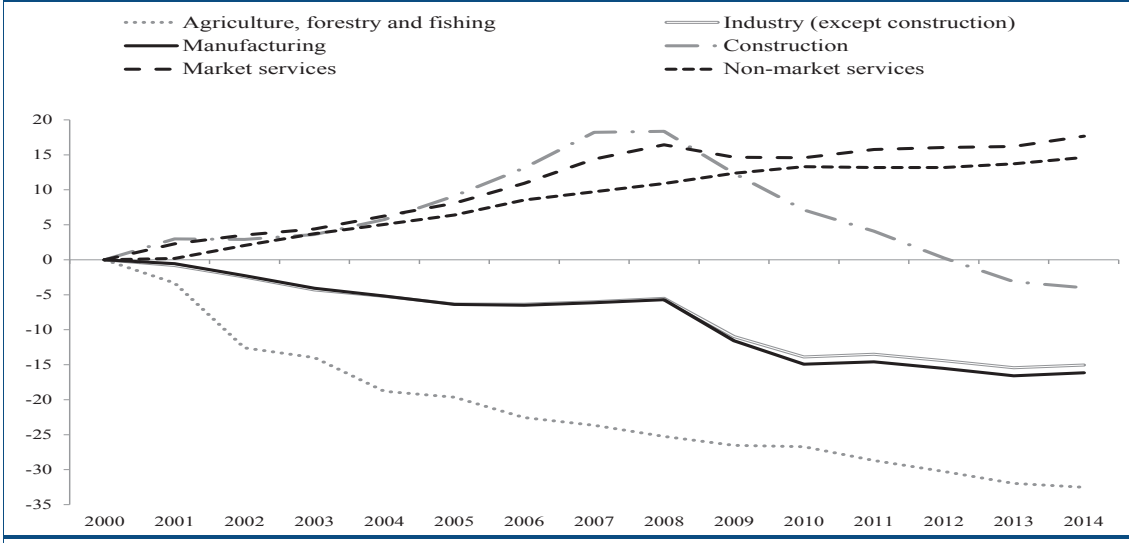
Source: Own calculations based on National Accounts, Eurostat

[14] The results in Dall'Olio *et al.* (2014) are not incompatible with the calculation showed in Section 2.1.1. The different figures are explained by the different periods used in the analysis and by the inclusion of different sectors.

Compared to 2000, the share of manufacturing decreased by 3.5 percentage points from 17.5% to 14.0%, while the share of services (market and non-market) increased by 7.4 percentage points from 65.9% to 73.3%.

Figure 1.8 shows the percentage changes in employment in major sectors.

Figure 1.8: Change in employment by sector in the EU-28 (% change since 2000)



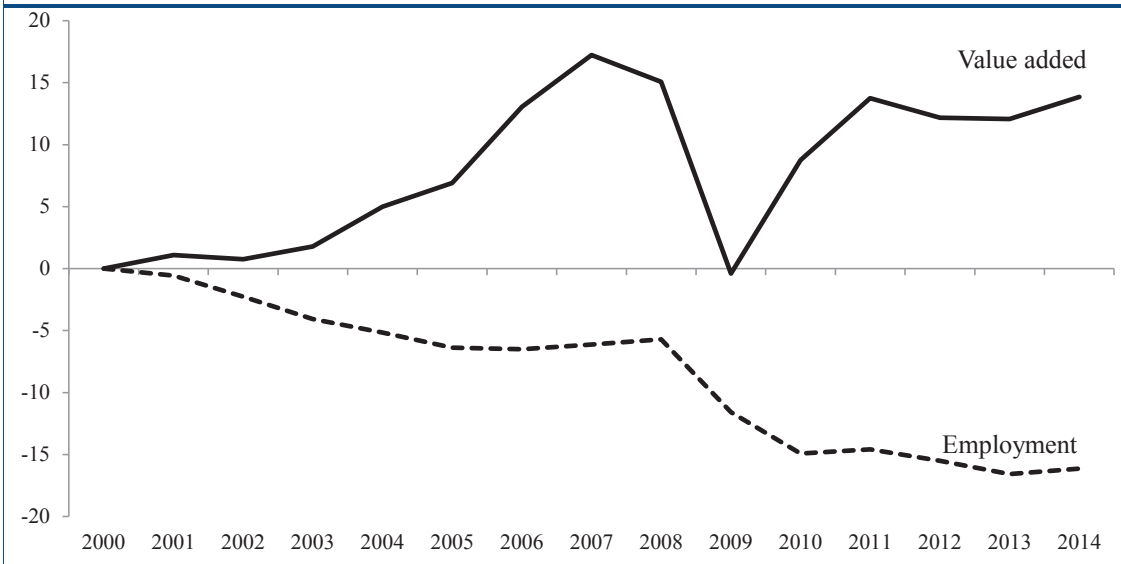
Source: Own calculations based on National Accounts, Eurostat

Since 2000, employment has fallen considerably in agriculture (-32.5%), manufacturing (-16.1%) and construction (-4.0%). Over six million jobs were lost in this sector, as employment decreased from 37.7 million persons employed in 2000 to 31.6 million in 2014. Figure 1.8 suggests that these losses were the result of a combination of a pre-existing historic trend of decline and a large negative effect of the economic crisis. Employment in manufacturing fell steadily since 2000 until the onset of the crisis, suggesting a historic trend of decline. The crisis had a particularly severe effect on this sector and, unlike output, employment continued to decline after the crisis (almost four million jobs were lost in 2008-2014).

There were employment increases as compared with 2000 only in service sectors, where they were substantial. In 2014, there were 15 million more persons employed in market services and 8 million more in non-market services than in 2000. Employment growth in service sectors more than offset the losses in agriculture, industry and construction, leading to an overall positive growth over the period 2000-2014 period[15]. Additionally, Figure 1.8 shows that employment in service sectors was more resilient during the crisis, increasing in both market and non-market services in 2008-2014. Looking at the whole period 2000-2014, the highest growth took place in *Professional, scientific and technical activities and administrative and support services activities* (more than 40%), in *Real estate activities* (22.7%), which largely reflects the real estate boom before the crisis, *and in arts, entertainment and recreation and other services, activities of households and extra-territorial organisations and bodies and information and communications* (18.8%) (for details, see Table A 1.5 in annexes).

[15] Total employment in the EU, increased from 215 million persons employed in 2000 to 226 million in 2014. However, the number of persons unemployed has also increased over this period from 20 million to almost 25 million. This suggests that the increase in employment does not reflect only the reallocation of workers from industry, construction agriculture towards service sectors, but also increases in the active population (from 222 to 241 million) in the EU-28 over this period.

Figure 1.9: Evolution of output and employment in manufacturing in the EU-28 (% change since 2000)



Source: Own calculations based on National Accounts, Eurostat
Note: Evolution is shown as change as compared with year 2000. GVA is measured in chain-linked volumes (reference year 2010).

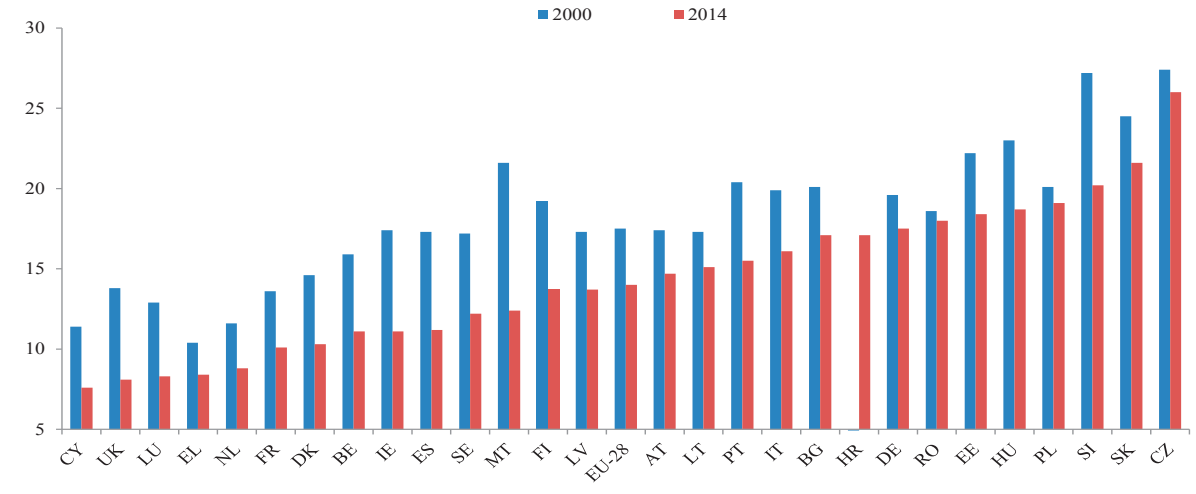
Figure 1.9 shows the contrasting evolution of employment and value added in manufacturing between 2000 and 2014.

The figure suggests impressive growth in value added between 2000 and 2007, followed by large declines in 2008 and 2009 and a fast recovery afterwards. The evolution of employment suggests a negative trend with large declines in 2008 and 2009, although less severe than for value added[16], followed by moderate declines afterwards.

These diverging developments suggest that factors increasing labour productivity (output per unit of labour) played an important role in the decline in manufacturing employment. In fact, section 2.1 shows large labour productivity increases in manufacturing over this period. The economic literature suggests that the most important factors behind these trends are technology change driven by automation and digitalisation (Brynjolfsson and McAfee, 2011, 2014; Chennells and Van Reenen, 1999; Vivarelli, 2012) and offshoring and trade with countries with lower labour costs (Crino, 2009, Autor *et al.* 2013a; Eberstein *et al.*, 2014). These factors either directly substitute workers within the EU or increase productivity, so that less labour is needed per unit of output. Several studies document similar declines in manufacturing employment in the United States and provide evidence that they were driven mainly by technological change and offshoring and trade with emerging economies with lower labour costs (Pierce and Schott, 2012; Autor *et al.*, 2013a; Autor *et al.*, 2013b; Eberstein *et al.*, 2014). Labour productivity and offshoring/trade are analysed in greater detail in Chapter 2 and Chapter 3, respectively.

[16] The smaller decline in employment than in value added during the crisis has been largely attributed to labour-hoarding by firms.

Figure 1.10: Share of manufacturing in employment in the EU Member States (% of total employment)



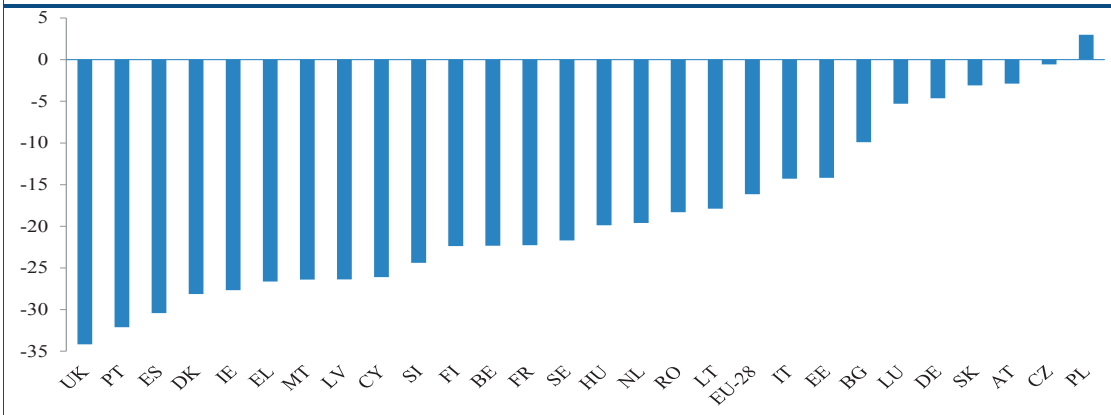
Source: National Accounts, Eurostat,
Note: No data available for HR for 2000. Latest available data for ES, FR and LU are for 2013. Due to breaks in series, 2011 data are used for RO.

Figure 1.10 shows the shares of manufacturing in total employment in the EU Member States.

In 2014, the share of manufacturing in total employment varied from 7.6 % to 26%. It was lowest in Cyprus, Luxembourg and the UK, and the highest in Czech Republic, Slovakia and Slovenia. All CEE countries except Latvia, Germany, Italy, Austria and Portugal had shares above the EU average. The figure also shows that these large differences already existed in 2000. One common pattern that emerges from Figure 1.10 is a decrease in the share of employment in manufacturing in all Member States, for which data were available.

Moreover, Figure 1.11 suggests that employment in manufacturing decreased in absolute terms in all Member States, for which data were available, except Poland, which registered modest growth. Moreover, for many Member States, these losses were large. In 14, employment in manufacturing fell by more than 20%. The largest losses took place in the UK (-34.2%), Portugal (-32.1%) and Spain (-30.4%).

Figure 1.11: Change in manufacturing employment in the EU Member State (% change 2000-2014)

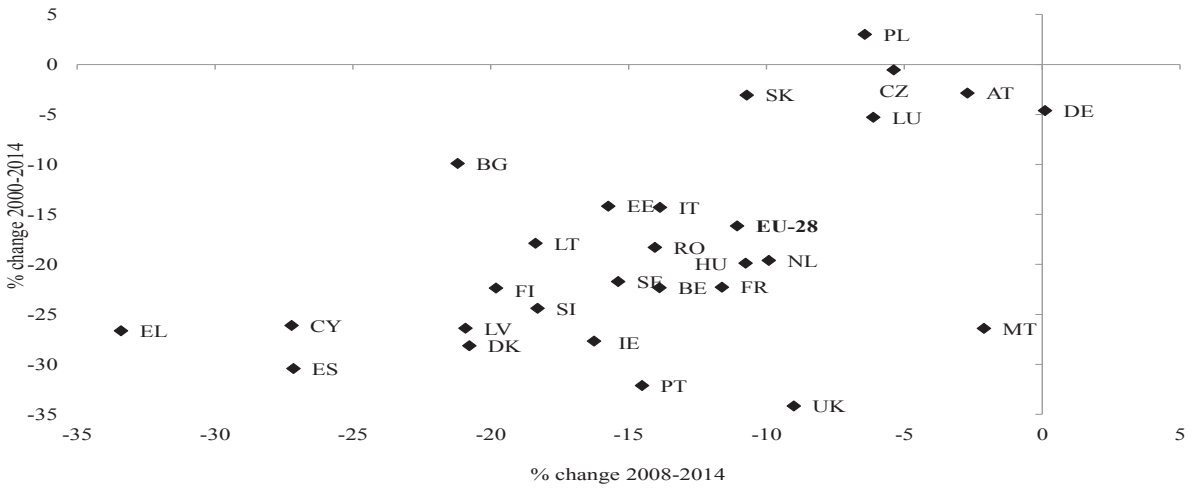


Source: Own calculations based on National Accounts, Eurostat.
Note: No data available for HR for 2000. The latest available data for ES, FR and LU are for 2013. Due to breaks in series, 2011 data are used for RO.

The losses were also large in absolute terms. The largest were recorded in the UK (over 1.2 million jobs), France (779 thousand jobs), Italy (653 thousand jobs) and Romania (over 432 thousand jobs). These employment losses in manufacturing, in almost all Member States, contrast with the increases in value added in 18 Member State and for the EU-28 as a whole (see Figure 1.4). Employment in manufacturing decreased even in countries that registered increases of over 50% in value added, such as Slovakia, the Czech Republic, Estonia and Romania. These contrasting developments in employment and value added are consistent with large increases in labour productivity in manufacturing in these countries documented in section 2.1.

Figure 1.12 shows the changes in employment in manufacturing in the long term (since 2000) and since the beginning of the crisis (2008-2014).

Figure 1.12: The crisis and changes in employment in the EU Member States



Source: Own calculations based on National Accounts, Eurostat
Note: No data available for HR for 2000. Latest available data for ES, FR and LU are for 2013. Due to breaks in series, the percentage changes for RO are calculated for 2000-2011 and 2008-2011

In most of the EU Member States and in the EU as a whole employment in manufacturing remains below the levels achieved in 2000 and in 2008, at the beginning of the crisis. In contrast with the partial recovery in value added in manufacturing in many Member States, Figure 1.12 suggests an absence of recovery in employment in all Member States except Germany. However, five (Poland, the Czech Republic, Austria, Luxembourg and Malta) appear close to pre-crisis employment levels.

The differences between sectors with different technology intensities (see previous section) are likely to lead to differences in employment growth. Table A 1.6 shows shares of sectors with different technology intensity in total manufacturing employment in 2000 and in 2012 and changes in these shares.

Employment in manufacturing remained concentrated in labour intensive low-tech and medium/low-tech sectors, with these sectors accounting for between 54.4% (in Germany) and 89.6% (in Cyprus) in 2012. Looking at changes over time, the share of low-tech sector decreased in almost all Member States, while the share of the medium/low-tech increased in all of them. The most striking aspect of the structure of manufacturing employment across Member States is the large variation in the share of medium/high-tech sectors, which ranged

from 6.2% (in Cyprus) and 39.4% (in Germany) in 2012. The share of these sectors increased in 12 out of 20 Member States analysed. In all Members States, high-tech sectors accounted for a small share of manufacturing employment: between 2.3% (in Portugal) to 13.5% (in Hungary) in 2012. However, compared to 2000, the share increased in eleven Member States. Overall, the table suggest that, while employment in manufacturing remains concentrated in low-tech sectors, more than half of the Member States examined experienced increases in the shares of medium/high-tech and high-tech sectors.

Figure 1.13 presents percentage changes in the employment in sectors with different levels of technology intensity for the Member States for which data were available for all manufacturing sectors[17].

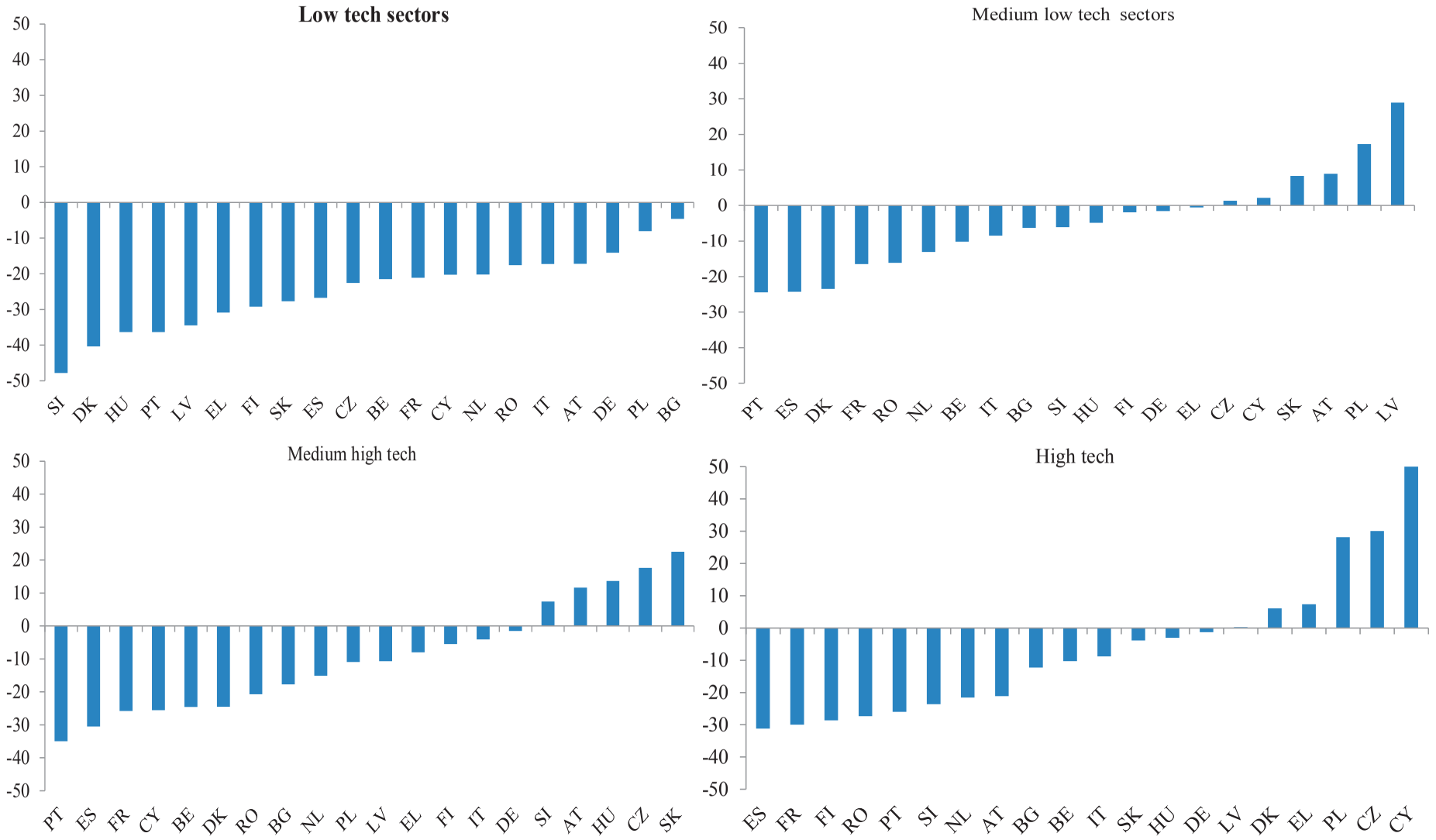
Employment in low-tech sectors, which account for between 26.4% and 62.7% of manufacturing employment (see Table A 1.6), decreased in all Member States for which data were available. Taken together, Figure 1.13 and Figure 1.6 suggest losses in competitiveness in low-tech sectors, which tend to be more exposed to competition from low cost producers from outside EU, as a likely explanation for these employment losses in many Member States. However, they also show that the increases in production in several Member States (Figure 1.6) did not lead to increases in employment. This could be indicative of the presence of important increases in labour productivity, which enabled these Member States to remain competitive in these sectors, but at the same time decreased labour demand leading to employment losses.

In medium/low tech, medium high-tech and high-tech sectors, employment developments varied more across Members States. Employment decreased in most, but by less than in low-tech sectors. Employment in medium/low-tech and in medium/high-tech sectors increased in five Members States and in high-tech sectors it increased in six[18]. Figure 1.13 suggests that the changes in the shares of sectors with different technology intensities in Table A 1.6 are due mainly to the differences in the magnitude of the employment losses across these sectors.

[17] Data on employment at NACE rev. 2 two-digit level are not available for the EU-28 aggregate and for several EU Members States. Therefore, our analysis is limited to the countries for which these data are available.

[18] The largest increase in employment in high-tech sectors was recorded in Cyprus, albeit from a very low base, of less than 1.000 employed in high-tech sectors in 2000.

Figure 1.13: Change in employment in sectors with different technology intensity between 2000 and 2012 (%)



Source: Own calculations based on National Accounts, Eurostat.
Note: No data available for HR, IE, LU, LT, MT, SE and UK. Due to breaks in series, the percentage change for RO is calculated for 2000-2011.

The economic literature suggests that different occupations within sectors are affected differently by technology change and by offshoring/trade and both these factors represented major trends during the period studied. Both factors are more likely to affect negatively occupations characterised by routine tasks, which can be easily outsource or automatised (Blinder, 2009;Crino, 2009; Brynjolfsson and McAfee, 2011, 2014; Vivarelli, 2012)[19].

Figure A 1.1 in the annexes shows changes in the occupational structure of employment in manufacturing in the EU-28 and in the Member States. It shows large declines in employment in blue-collar occupations in most Member States during the period 2008-2013. These were most pronounced during the crisis, but continued in many Member States during the recovery. After 2011, employment in these occupations grew only in Poland, Romania and the UK, among the countries examined, and these increases were modest. Moreover, for many Member States the declines preceded the crisis, which suggests that they reflect already-ongoing structural changes. In contrast, employment in white-collar occupations decreased less during the crisis than that of blue-collar workers and recovered faster and in a larger number of Member States. The recovery was particularly strong for white-collar high-skilled occupations, which include managers, professionals and technicians.

These changes in employment in different occupations are consistent with the evidence in Chapter 2 on the increase in skill intensity in different manufacturing sectors and with the hypothesis that blue-collar workers are more likely to be displaced by technology change and offshoring/trade. Similar declines in routine occupations during recessions were documented by Jaimovich and Jiu (2012) in the United States. The authors attributed these changes mainly to technological change.

Overall, this section shows that, between 2000 and 2014, employment in manufacturing has followed a downward trend in most Member States, despite the increase in the value added in the same sector. The employment losses in manufacturing were particularly large during the crisis, but the negative trend preceded the crisis. These losses were concentrated in low-tech manufacturing and blue-collar occupations. However, even in sectors with higher technology intensity, employment increased in a few Member States only. Overall, these losses appear to be driven to a large extent by workers being displaced by technology and/or by production outside the EU in the countries where value added in manufacturing increased. In the countries were value added in manufacturing decreased, losses in competitiveness may have played an important role.

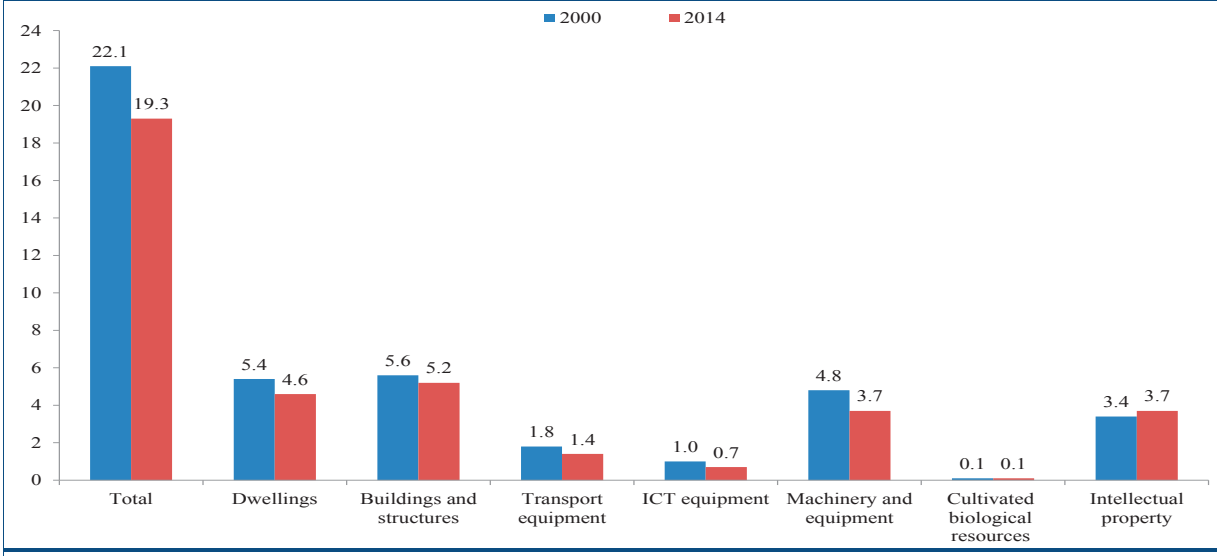
These large employment losses in manufacturing are a matter of policy concern. There is evidence that jobs lost in manufacturing tend to be replaced by lower wage and less skilled jobs in service sectors (Goos *et al.*, 2009, Eurofound, 2013, 2014). Employment losses in manufacturing may lead to losses of sector and occupation specific skills, which would affect future production capacity in manufacturing. Manufacturing is a major hub for other sectors, such as business services, logistics, and utilities. Jobs in these sectors in the EU-28 may also decline without a strong manufacturing base. This highlights important challenges for policy makers, in particular in areas relating to strengthening the EU's industrial base, but also areas relating to lifelong learning and increasing labour mobility.

[19] Autor *et al.* (2013b) argue that trade and technology have different effects on employment in different occupations.

1.3 CHANGES IN INVESTMENT IN FIXED CAPITAL

This section examines changes in investment in fixed capital, measured as gross fixed capital formation (GFCF). Figure 1.14 shows the share of different types of assets in GFCF in 2000 and 2014 for the EU-28.

Figure 1.14: Shares of GFCF in GDP in the EU-28 in 2000 and in 2014, by type of assets

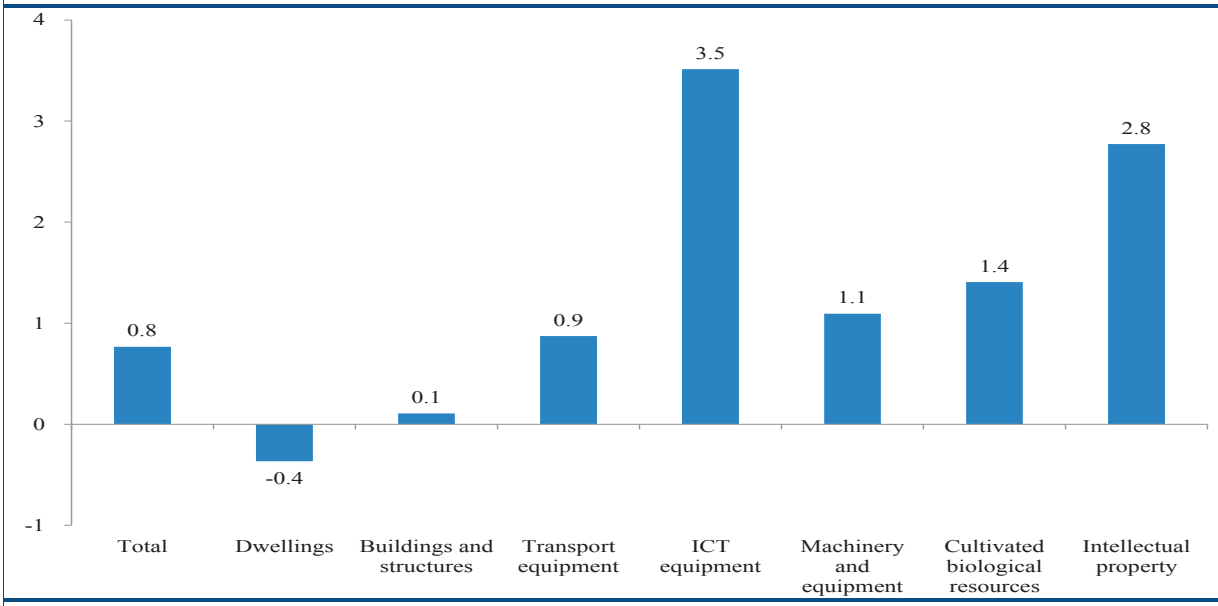


Source: National Accounts, Eurostat.

Figure 1.14 shows that the share of GFCF in GDP was *lower* in 2014 (19.3%), than in 2000 (22.1%). This applies to all assets except intellectual property products, whose share was higher in 2014, suggesting the growing importance of these assets for the EU economy. The share of GFCF in GDP in 2014 was also lower (by 2 percentage points) than its long term average. This suggests that the current level of GFCF is below the level necessary to sustain growth and competitiveness in the long run (European Commission, 2014b). Moreover, the European Commission (2014c) provided evidence that the current investment level in the EU compares unfavourably with that of its main competitors, in particular China and the United States.

Figure 1.15 shows the average growth of GFCF in different types of assets. On average, GFCF increased by 0.7% per year between 2000 and 2014. The largest increases were recorded in ICT equipment (3.5%), followed by intellectual property products (2.8%), which is indicative of the increased economic importance of these two types assets. Dwellings is the only asset with negative average growth of GFCF in the period studied, driven by large decreases in GFCF in 2008 and 2009 and moderate decreases afterwards. However, apart from its positive effect on upstream industries, this type of investment has little effect on the productive capacity of the economy.

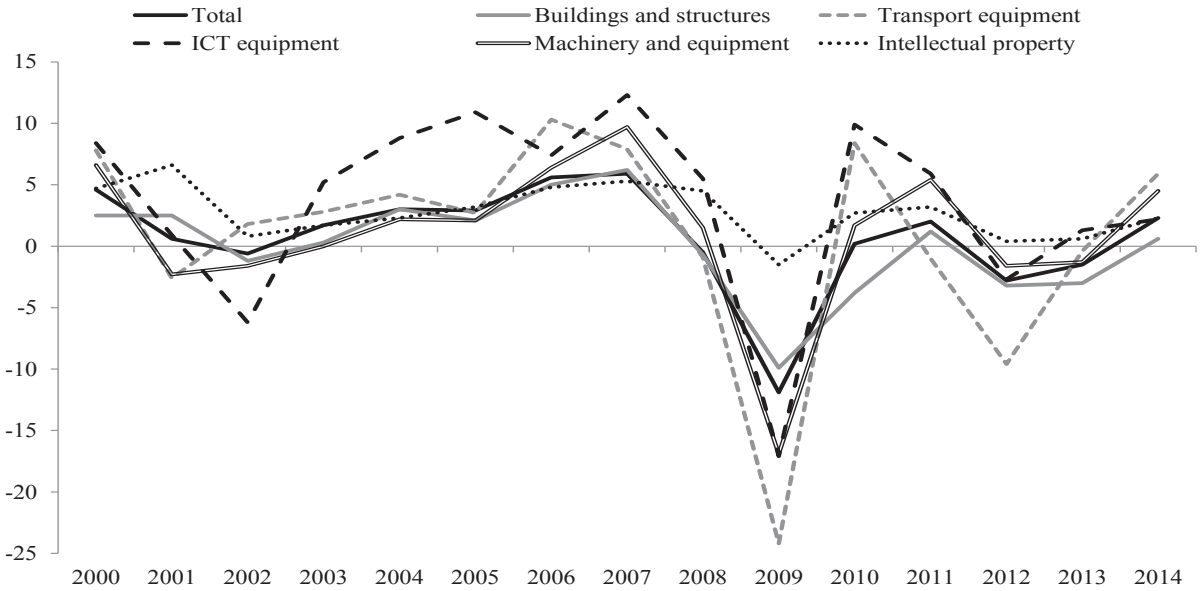
Figure 1.15: Average annual change in the GFCF in EU-28 between 2000 and 2014, by type of asset



Source: Own calculations based on National Accounts, Eurostat

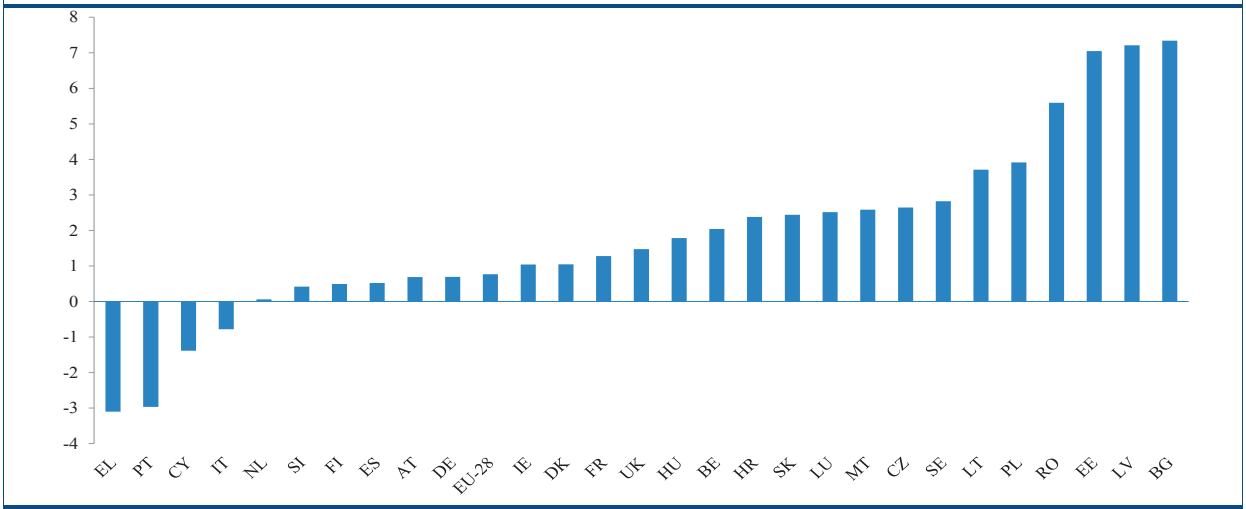
The average growth rates conceal important dynamics. Figure 1.16 shows the evolution of GFCF in selected asset types between 2000 and 2014. For presentational reasons, this figure focuses on the investment types most relevant for the production capacity: building and structures, transport equipment, machinery and equipment, ICT equipment and intellectual property products. It shows that investment was severely affected by the economic crisis and its growth remained weak during the recovery. All types of assets were affected, but investment in transport and ICT equipment and machinery and equipment was affected most. Least affected was investment in intellectual property, which decreased by only 1.5%.

Figure 1.16: Evolution of GFCF in EU-28, by type of asset (% change over the previous period)



Source: Own calculations based on National Accounts, Eurostat.
Note: Annual change in the GFCF measured in chain-linked volume (reference year 2010).

Figure 1.17: Average annual change in GFCF between 2000 and 2014, by Member State (%)



Source : Own calculations based on National Accounts, Eurostat

Figure 1.17 shows the average GFCF growth across the Member States, which varied considerably. In Greece, Portugal, Cyprus and Italy, average GFCF growth in 2000-2014 was negative. To a large extent this is the result of the economic crisis, which led to large decreases in investment from 2009 onwards. In contrast, GFCF growth in Bulgaria, Estonia and Latvia was above 7%. Overall, growth in investment was highest in several CEE countries, partly reflecting low initial levels of fixed capital at the countries' catching up process. Large FDI inflows between 2000 and 2014 also contributed considerably to that process (Damijan *et al*, 2013).

Table 1.1 provides more details on the effects of the crisis on investment. Except for Germany, Poland and Sweden, where investment is increasing year-on-year, in most Member States volumes peaked in 2007 or 2008. In 2014, they were between 1% and 64.7% below peak investment volumes. The largest drops from the peak occurred in Greece (–64.7%), Cyprus (–60.5%) and Romania (–53.2%). Meanwhile investment in Germany, Poland and Sweden did not drop markedly after 2007-2008; in fact, in Poland, it was 16% higher in 2014 than in 2008 (used here as a reference year).

Table 1.1 also gives the investment ratio by Member State, for the peak year identified in the first column and in 2014. For the EU as a whole, investment represented 22.6% of GDP at its peak in 2007, but only 19.3% in 2014. Similar falls in GFCF as a proportion of GDP occurred in the Netherlands, Hungary and Finland. The investment ratio fell much more in several CEE countries such as Bulgaria (from 33.5% to 21.0%), Estonia (36.6% to 25.8%), Latvia (36.5% to 23.0%) and Romania (38.4% to 22.0%), and also in crisis-stricken economies such as Greece (25.7% to 11.6%), Spain (31.0% to 18.9%) and Cyprus (27.3% to 10.8%).

Table 1.1: Changes in GFCF relative to the peak year

	Volume peak year	Change in volumes of GFCF from peak (%)	GFCF/GDP in peak year (%)	GFCF/GDP in 2014 (%)
AT	2008	-4.0	23.4	22.1
BE	2008	-0.7	24.3	23.1
BG	2008	-32.6	33.5	21.0
CY	2008	-60.5	27.3	10.8
CZ	2008	-10.7	29.0	25.3
DK	2007	-15.8	23.7	18.7
EE	2007	-21.7	36.6	25.8
EL	2007	-64.7	25.7	11.6
ES	2007	-34.9	31.0	18.9
FI	2008	-19.1	24.4	20.0
FR	2008	-6.7	23.6	21.7
HR	2008	-35.1	28.1	18.6
HU	2008	-8.6	23.3	21.3
IE	2007	-34.8	27.6	16.4
IT	2007	-29.7	21.6	16.8
LT	2012	-19.2	28.6	19.2
LU	2012	-4.5	18.4	17.1
LV	2007	-33.8	36.5	23.0
MT	2010	-4.8	21.4	18.8
NL	2008	-15.6	22.1	18.5
PT	2008	-36.2	22.8	14.6
RO	2008	-53.2	38.4	22.0
SI	2008	-37.5	29.6	20.1
SK	2008	-8.4	25.7	21.1
UK	2007	-0.7	18.5	17.2
EU-28	**2007**	**-12.4**	**22.6**	**19.3**
		Change from 2008	% of GDP in 2008	% of GDP in 2014
DE		3.5	20.3	20.0
PL		16.1	22.6	19.5
SE		3.6	24.3	23.3

Source: Own calculations based on National Accounts, Eurostat
Note: GFCF is measured in chai-n linked volumes (reference year 2010).

Table A 1.7 shows average GFCF growth by assets and Member State for 2000-2014. Investment in buildings and structures increased most in Romania and Bulgaria. The largest growth in investment in ICT equipment was recorded in Estonia and Ireland and in machinery and equipment in Estonia and Romania. The largest increases in intellectual property products took place in Cyprus and Malta. Overall, the table shows that the increases in GFCF in the Members States were at least partly due to significant GFCF increases in productive assets.

To summarise, this section has shown that, although EU GFCF grew over the period studied, the current level is below its long-term trend, which suggests that it cannot sustain growth in the long run. There is large heterogeneity in the investment in different types of assets and across Member States. GFCF growth took place mainly in ICT equipment and in intellectual

property products and among Member States, mainly in CEE countries. The large declines in share of GDP invested in fixed assets experienced by several Member States since the beginning of the crisis pose important policy challenges because they raise concerns about future growth and competitiveness.

1.4 CONCLUSIONS

In this chapter, we have analysed structural changes between 2000 and 2014 in the EU and individual Member States. We have found that, despite the long-term structural shift to services, EU manufacturing is not in decline. In real terms, value added in manufacturing increased in the EU between 2000 and 2014 by almost 14%. Growth in manufacturing was uneven and it concentrated mostly in in medium- and high-tech sectors and mostly in CEE Member States and several EU-15 Member States, while several southern European Member States experienced large decreases.

In contrast, employment in manufacturing declined by 16% in the EU. At the same time, employment increased in the services sectors, resulting in positive overall employment between 2000 and 2014. Decreases in employment in manufacturing affected all Member States, except Poland, and in many Member States they were large (in excess of 20%). They were concentrated in low-tech sectors and blue-collar occupations. These losses pose important policy challenges. The relative strength of the EU services sector could provide a basis for job creation, but due to the linkages between the two sectors, in the long term, the decline in manufacturing can also have a negative effect on jobs in services.

Trends in investment, measured as GFCF, indicate that while GFCF in the EU grew on average over the period studied, the ratio of GFCF to GDP is currently lower than it was in 2000. The current level cannot sustain growth and competitiveness in the long run. Mainly a result of the economic crisis and the fragile recovery that followed, this is a matter of policy concern as investment plays an important role in long-term growth and competitiveness.

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ANNEXES

Table A 1.1: Classification of manufacturing industries by technology intensity

Manufacturing industries	NACE rev.2	Definition
High technology	21	Manufacture of basic pharmaceutical product and pharmaceutical preparations
	26	Manufacture of computer, electronic and optical products
Medium/high technology	20	Manufacture of chemicals and chemical products
	27	Manufacture of electrical equipment
	28	Manufacture of machinery and equipment n.e.c.
	29	Manufacture of motor vehicles, trailers and semi-trailers
	30	Manufacture of other transport equipment
Medium/low technology	19	Manufacture of coke and refined petroleum products
	22	Manufacture of rubber and plastic products
	23	Manufacture of other non-metallic mineral products
	24	Manufacture of basic metals
	25	Manufacture of fabricated metal products, except machinery and equipment
	33	Repair and installation of machinery and equipment
Low technology	10	Manufacture of food products
	11	Manufacture of beverages
	12	Manufacture of tobacco products
	13	Manufacture of textiles
	14	Manufacture of wearing apparel
	15	Manufacture of leather and related products
	16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
	17	Manufacture of paper and paper products
	18	Printing and reproduction of recorded media
	31	Manufacture of furniture
	32	Other manufacturing

Source: Eurostat

Table A 1.2: Share of the major sectors in GVA in 2014 (%)

	(A) Agriculture, forestry & fishing	(B-E) Industry (except construction)	(C) Manufacturing	(F) Construction	(G-I) Trade, transport, accommodation & food services	(J) Informations and communication	(K) Financial and insurance activities	(L) Real estate activities	(M-N) Professional, scientific, technical, admin. & support services	(O-Q) Public administration, defence, education, health and social work	(R-U) Arts, entertainment and recreation; other services
AT	1.3	22.1	18.7	6.3	22.8	3.1	4.5	10.0	9.3	17.7	2.9
BE	0.7	16.8	14.0	5.7	19.8	4.0	5.8	8.7	13.5	22.8	2.2
BG	5.3	23.5	n.a	4.8	21.3	5.6	7.7	10.6	5.5	13.2	2.5
CY	2.4	7.7	5.0	2.8	28.6	4.4	8.9	11.5	8.9	20.7	4.2
CZ	2.6	32.6	26.7	5.3	17.9	4.8	4.6	8.4	6.5	14.9	2.2
DE	0.8	25.9	22.2	4.8	15.5	4.7	4.0	11.1	10.9	18.2	4.1
DK	1.3	18.1	13.9	4.4	19.5	4.3	6.1	10.2	9.1	23.4	3.6
EE	3.7	21.1	16.0	7.1	22.5	4.9	3.5	10.5	9.0	15.4	2.4
EL	3.8	11.6	8.5	1.8	26.3	3.7	4.4	18.5	4.6	20.8	4.5
ES	2.5	17.5	13.2	5.6	24.1	4.0	3.9	12.2	7.4	18.6	4.3
FI	2.8	19.8	16.2	6.2	16.5	5.6	2.9	12.4	8.5	22.2	3.1
FR	1.6	13.8	11.4	5.7	17.7	4.6	4.7	12.9	12.7	23.2	3.0
HR	4.1	21.1	14.3	5.0	21.2	4.6	6.9	10.3	8.3	15.4	3.1
HU	4.4	26.4	23.3	4.3	18.5	5.0	3.8	8.3	8.9	17.5	2.8
IE	1.6	22.4	19.4	1.7	15.5	12.3	9.7	6.9	10.3	17.5	2.2
IT	2.2	18.5	15.5	4.9	20.1	3.8	5.9	14.2	9.3	17.2	4.0
LT	3.5	23.6	20.0	7.4	32.7	3.0	2.1	6.1	5.8	14.0	1.9
LU	0.3	6.8	5.2	5.4	17.4	5.1	26.9	8.2	11.7	16.1	2.2
LV	3.4	16.4	12.2	6.7	25.3	4.7	4.3	12.9	8.0	15.1	3.4
MT	1.3	12.3	10.6	4.1	22.3	6.9	7.2	5.6	11.0	19.4	9.8
NL	2.0	16.9	12.4	4.5	19.8	4.7	7.8	5.7	13.6	22.4	2.7
PL	3.4	25.1	18.4	7.5	27.1	3.5	4.1	5.1	7.4	14.3	2.6
PT	2.3	17.0	13.2	4.2	25.1	3.4	5.2	12.6	6.7	20.5	2.9
RO	5.4	27.3	21.5	7.1	17.9	6.6	3.3	10.7	8.1	10.3	3.4
SE	1.4	19.7	16.0	5.9	17.4	5.6	4.6	8.4	9.5	24.5	3.0
SI	2.2	27.1	22.8	5.7	20.4	4.1	4.4	6.9	9.5	17.0	2.7
SK	3.7	24.7	20.4	8.3	22.4	4.6	3.9	7.1	7.4	14.5	3.3
UK	0.6	13.5	9.5	6.4	18.4	6.1	8.4	11.5	12.7	18.3	4.1
EU-28	1.6	19.0	15.3	5.4	19.0	4.8	5.5	11.2	10.7	19.3	3.6

Source: National Accounts, Eurostat
Note: Data for LU are for 2013 and for manufacturing (C) in RO for 2012.

Table A 1.3: Percentage change in GVA by sector between 2000 and 2014

	(A) Agriculture, forestry & fishing	(B-E) Industry (except construction)	(C) Manufacturing	(F) Construction	(G-I) Trade, transport, accommodation & food services	(J) Informations and communication	(K) Financial and insurance activities	(L) Real estate activities	(M-N) Professional, scientific, technical, admin. & support services	(O-Q) Public administration, defence, education, health and social work	(R-U) Arts, entertainment and recreation; other services
AT	17.7	28.3	31.0	-11.5	11.8	27.1	51.7	29.6	64.5	18.0	12.2
BE	9.7	9.8	9.5	42.7	14.6	42.3	17.1	15.6	43.1	19.3	13.9
BG	-20.5	64.3	n.a	53.9	86.0	239.9	505.0	-3.3	93.4	10.4	121.1
CY	-22.6	-16.3	-28.6	-53.0	27.8	79.3	42.1	46.8	61.8	37.0	37.4
CZ	-7.6	78.5	111.3	10.5	34.3	84.8	61.8	21.7	39.4	10.1	-3.7
DE	-0.5	22.9	24.3	-11.1	21.0	77.9	-24.8	25.1	14.3	14.8	0.5
DK	-14.0	-11.5	7.4	-11.6	1.2	139.0	57.9	3.9	21.8	9.2	-2.6
EE	60.5	79.5	90.3	67.9	55.2	158.5	173.2	10.0	158.4	27.2	28.5
EL	-26.9	-29.0	-25.4	-61.8	-0.2	29.8	-19.2	53.8	-20.6	7.8	3.5
ES	4.2	4.2	-3.6	-36.5	21.2	58.6	39.3	92.1	36.5	41.0	43.3
FI	23.2	5.8	2.3	3.4	20.9	91.9	5.3	22.2	30.5	-1.6	15.8
FR	2.3	6.3	9.6	-5.3	14.6	70.8	39.3	16.7	17.8	18.1	25.6
HR	-15.9	2.4	7.2	16.2	46.5	56.4	54.4	26.9	50.9	1.9	43.9
HU	24.5	28.6	41.0	8.1	28.6	99.9	-7.7	20.4	64.1	16.7	18.7
IE	-51.7	10.2	19.0	-30.0	-40.6	413.0	85.2	74.2	143.6	20.8	-54.2
IT	-6.5	-11.6	-10.7	-17.8	-3.1	41.7	28.4	11.4	-7.2	0.7	7.7
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	-55.5	-25.4	-26.9	34.3	24.2	92.4	29.9	50.1	83.4	55.4	7.9
LV	44.0	28.6	30.0	84.3	104.9	39.6	190.2	83.1	94.5	28.2	99.0
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	16.7	10.6	13.1	-14.2	19.6	43.7	25.6	20.5	12.0	29.9	9.7
PL	31.9	99.6	147.0	51.0	52.2	133.0	83.9	25.3	87.0	36.6	69.1
PT	1.8	-2.4	-4.4	-54.4	11.5	32.9	51.3	9.4	16.5	2.8	20.4
RO	34.3	56.9	51.9	127.3	129.5	75.2	56.0	74.2	265.4	-17.7	2.6
SE	23.9	25.7	26.4	19.7	41.5	93.2	48.5	13.3	60.9	12.9	30.9
SI	0.4	37.4	38.0	-5.9	39.9	89.2	76.5	26.9	37.1	23.7	4.1
SK	119.3	129.6	181.8	61.0	43.7	109.3	96.8	20.8	102.5	33.4	107.5
UK	2.7	-13.6	-5.6	12.4	23.4	65.0	35.5	46.0	88.2	23.3	21.4
EU-28	5.4	10.2	13.7	-6.7	17.2	68.5	22.7	27.6	30.7	17.2	14.6

Source: Own calculations based on National Accounts, Eurostat
Note: Data for LU are for 2000-2013, and for manufacturing (C) in RO for 2000-2012

Table A 1.4: Share of major sectors in total employment in 2014

	(A) Agriculture, forestry & fishing	(B-E) Industry (except construction)	(C) Manufacturing	(F) Construction	(G-I) Trade, transport, accommodation & food services	(J) Informations and communication	(K) Financial and insurance activities	(L) Real estate activities	(M-N) Professional, scientific, technical, admin. & support services	(O-Q) Public administration, defence, education, health and social work	(R-U) Arts, entertainment and recreation; other services
AT	4.3	16.1	14.7	7.0	27.1	2.5	3.2	1.3	11.7	22.0	4.7
BE	1.3	12.2	11.1	6.0	21.5	2.3	2.8	0.6	18.6	30.5	4.3
BG	19.4	19.9	17.1	5.2	25.1	2.3	1.8	0.8	6.8	16.0	2.9
CY	3.8	8.8	7.6	6.4	34.1	2.5	5.2	0.4	6.9	22.0	10.0
CZ	3.2	28.4	26.0	8.3	24.2	2.5	1.7	1.9	8.6	17.7	3.5
DE	1.5	18.8	17.5	5.7	23.2	2.9	2.8	1.1	13.1	23.9	6.9
DK	2.6	11.3	10.3	6.1	25.6	3.5	2.8	1.7	10.0	30.9	5.6
EE	3.7	20.9	18.4	7.9	25.3	3.6	1.4	1.9	7.3	23.3	4.7
EL	12.5	9.9	8.4	4.0	31.9	2.0	2.0	0.2	8.1	22.0	7.3
ES	4.0	12.4	11.2	5.4	30.6	2.5	2.0	1.0	11.5	21.5	9.1
FI	4.7	15.0	13.7	7.4	20.8	3.9	1.9	0.9	11.2	28.9	5.2
FR	2.8	11.2	10.1	6.7	23.1	3.0	2.9	1.3	14.2	29.3	5.4
HR	9.5	20.3	17.1	6.6	27.4	2.7	2.3	0.4	5.8	21.2	3.9
HU	6.8	20.7	18.7	6.3	24.1	2.8	2.2	1.5	8.9	22.6	4.0
IE	5.7	12.6	11.1	5.7	26.2	4.3	4.7	0.5	9.5	25.5	5.2
IT	3.7	17.3	16.1	6.4	25.1	2.4	2.7	0.8	11.9	18.9	10.7
LT	9.2	17.2	15.1	7.5	27.9	1.8	1.4	1.2	7.2	22.2	4.4
LU	1.2	9.4	8.3	10.4	23.5	4.3	11.0	0.9	14.6	20.3	4.4
LV	7.4	16.1	13.7	7.6	27.8	3.1	1.8	2.5	8.6	20.5	4.5
MT	1.7	14.3	12.4	5.8	26.1	3.8	5.2	0.5	12.0	25.4	5.2
NL	2.4	9.6	8.8	5.3	25.0	3.0	2.7	0.8	19.4	27.6	4.2
PL	11.5	23.0	19.1	7.2	22.5	2.3	2.4	1.0	6.4	20.6	3.1
PT	11.1	16.8	15.5	5.5	24.5	1.8	1.9	0.6	10.6	20.6	6.1
RO	30.0	21.6	18.0	7.5	19.4	1.4	1.1	0.4	3.5	12.3	2.8
SE	2.2	13.6	12.2	6.9	20.8	3.7	2.1	1.6	11.1	33.3	4.8
SI	8.3	22.5	20.2	6.7	21.2	2.8	2.5	0.6	12.6	19.0	3.8
SK	3.3	23.8	21.6	7.3	27.2	2.7	2.0	0.9	9.5	20.5	2.7
UK	1.4	9.4	8.1	6.5	26.1	4.2	3.5	1.6	15.8	26.0	5.6
EU-28	5.0	15.6	14.0	6.3	24.7	2.9	2.7	1.1	12.2	23.6	6.1

Source: National Accounts, Eurostat
Note: Data for ES, FR and LU are for 2013. Due to breaks in series, 2011 data were used for RO.

Table A 1.5: Percentage change in employment by sector between 2000 and 2014 (%)

	(A) Agriculture, forestry & fishing	(B-E) Industry (except construction)	(C) Manufacturing	(F) Construction	(G-I) Trade, transport, accommodation & food services	(J) Informations and communication	(K) Financial and insurance activities	(L) Real estate activities	(M-N) Professional, scientific, technical, admin. & support services	(O-Q) Public administration, defence, education, health and social work	(R-U) Arts, entertainment and recreation; other services
AT	-20.3	-2.1	-2.9	5.1	12.6	22.3	10.5	28.9	70.9	20.4	27.0
BE	-28.0	-20.1	-22.3	10.2	1.1	13.5	-12.6	31.1	52.2	26.1	-2.9
BG	-14.6	-10.9	-9.9	32.3	30.2	49.1	69.2	119.1	87.2	-10.7	68.0
CY	-29.7	-21.6	-26.1	-18.7	10.5	33.6	8.8	45.6	52.2	27.1	69.1
CZ	-26.7	-2.2	-0.6	1.8	8.3	36.2	-1.2	42.9	28.2	4.1	30.9
DE	-13.5	-5.2	-4.6	-15.4	5.4	13.4	-7.2	6.2	46.8	12.6	7.7
DK	-20.7	-26.8	-28.1	-3.4	5.0	3.2	4.1	31.4	36.3	3.1	21.3
EE	-41.6	-17.1	-14.2	21.2	2.2	63.0	0.0	-0.9	46.2	21.3	14.9
EL	-29.3	-26.0	-26.6	-46.9	-7.5	8.5	-27.4	146.0	36.2	6.5	22.7
ES	-25.7	-26.5	-30.4	-47.4	23.3	27.7	-0.6	63.4	85.5	30.5	25.7
FI	-14.8	-20.2	-22.4	16.6	3.0	13.6	9.9	20.2	71.5	15.3	37.1
FR	-18.5	-19.9	-22.3	22.0	11.2	8.8	13.2	-0.6	16.9	6.8	9.6
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	-46.4	-21.0	-19.9	5.5	4.3	49.8	6.7	1.5	96.1	13.6	10.9
IE	-14.0	-24.2	-27.7	-32.7	16.8	31.7	31.4	52.2	40.9	54.1	33.6
IT	-14.8	-13.5	-14.3	3.2	8.2	8.4	1.9	33.4	40.7	0.8	32.8
LT	-53.7	-20.5	-17.9	18.1	18.7	29.7	24.8	122.9	82.5	-12.8	80.1
LU	0.0	-2.9	-5.3	40.9	34.6	90.8	40.6	142.9	90.5	76.2	49.6
LV	-50.7	-24.9	-26.4	19.3	1.4	59.8	17.7	-2.6	103.6	-9.8	12.8
MT	1.6	-26.8	-26.4	25.1	17.8	81.6	54.7	119.0	170.2	41.7	124.5
NL	-9.4	-17.8	-19.6	-17.0	4.6	5.7	-16.8	7.4	9.8	24.1	27.7
PL	-38.4	2.1	3.0	70.8	28.1	59.3	52.7	-13.6	80.5	5.5	33.2
PT	-17.6	-30.6	-32.1	-56.9	6.5	41.7	-8.3	-8.2	32.5	2.9	9.7
RO	-43.7	-17.1	-18.3	20.0	13.0	21.6	8.4	-8.6	60.8	42.6	1.9
SE	-15.4	-18.3	-21.7	42.5	13.2	4.4	5.8	29.9	41.7	11.4	16.3
SI	-27.7	-22.3	-24.4	-7.2	5.5	59.6	13.0	101.1	61.2	24.3	21.5
SK	-42.1	-7.3	-3.1	33.5	30.3	32.5	16.9	11.1	54.8	0.6	21.5
UK	18.1	-29.6	-34.2	8.0	6.7	17.6	-3.2	83.6	40.4	25.7	23.0
EU-28	-32.5	-15.0	-16.1	-4.0	10.1	18.2	2.4	22.7	41.2	13.6	18.8

Source: Own calculations based on National Accounts, Eurostat
Note: Data for ES, FR and LU are for 2000-2013. Due to breaks in series, the percentage change for RO is calculated for 2000-2011.

Table A 1.6: Share of employment in sectors with different technology intensity in 2000 and 2012 (%) and changes in these shares (percentage points)

	2000				2012				Change 2000 -2012			
Manufacturing Sector	Low-tech	Medium low-tech	Medium-high tech	High-tech	Low-tech	Medium low-tech	Medium-high tech	High-tech	Low-tech change	Medium low-tech change	Medium-high tech	High-tech
AT	40.1	28.5	24.5	6.9	34.3	32.0	28.1	5.6	-5.9	3.5	3.7	-1.3
BE	37.2	27.9	28.6	6.3	35.8	30.8	26.5	6.9	-1.4	2.9	-2.1	0.6
BG	57.9	22.2	16.4	3.5	59.6	22.5	14.5	3.4	1.7	0.3	-1.8	-0.2
CY	66.9	23.5	7.2	2.4	61.8	27.8	6.2	4.3	-5.1	4.3	-1.0	1.8
CZ	36.5	31.9	28.1	3.4	28.8	32.9	33.7	4.6	-7.7	1.0	5.6	1.1
DE	29.1	27.0	37.9	5.9	26.4	28.1	39.4	6.2	-2.7	1.0	1.5	0.2
DK	40.5	24.6	26.6	8.3	33.6	26.2	28.0	12.2	-6.9	1.6	1.3	3.9
EL	64.7	22.2	9.9	3.3	56.3	27.8	11.5	4.4	-8.3	5.6	1.6	1.2
ES	43.0	28.6	24.0	4.3	43.3	29.8	22.9	4.0	0.2	1.1	-1.1	-0.2
FI	39.2	26.9	22.3	11.5	33.2	31.6	25.3	9.8	-6.0	4.7	2.9	-1.7
FR	39.2	33.3	22.1	5.4	39.2	35.2	20.8	4.8	0.0	1.9	-1.3	-0.6
HU	47.3	21.0	20.0	11.7	35.7	23.7	27.0	13.5	-11.5	2.7	7.0	1.8
IT	42.2	30.4	23.1	4.3	39.3	31.3	25.0	4.4	-2.9	0.9	1.9	0.1
LV	74.1	13.8	9.7	2.4	62.7	23.0	11.2	3.1	-11.4	9.2	1.5	0.7
NL	46.4	25.8	22.4	5.4	44.8	27.2	23.0	5.1	-1.6	1.3	0.6	-0.3
PL	48.6	24.2	23.8	3.5	45.3	28.7	21.5	4.5	-3.3	4.6	-2.3	1.0
PT	62.9	22.4	12.6	2.1	60.0	25.4	12.3	2.3	-2.9	3.0	-0.3	0.2
RO	49.7	23.7	23.1	3.5	50.1	24.4	22.4	3.1	0.4	0.6	-0.7	-0.4
SI	43.9	29.3	19.9	7.0	29.7	35.7	27.7	6.9	-14.2	6.4	7.8	-0.1
SK	41.7	30.8	23.6	3.9	31.3	34.7	30.1	3.9	-10.3	3.9	6.5	0.0

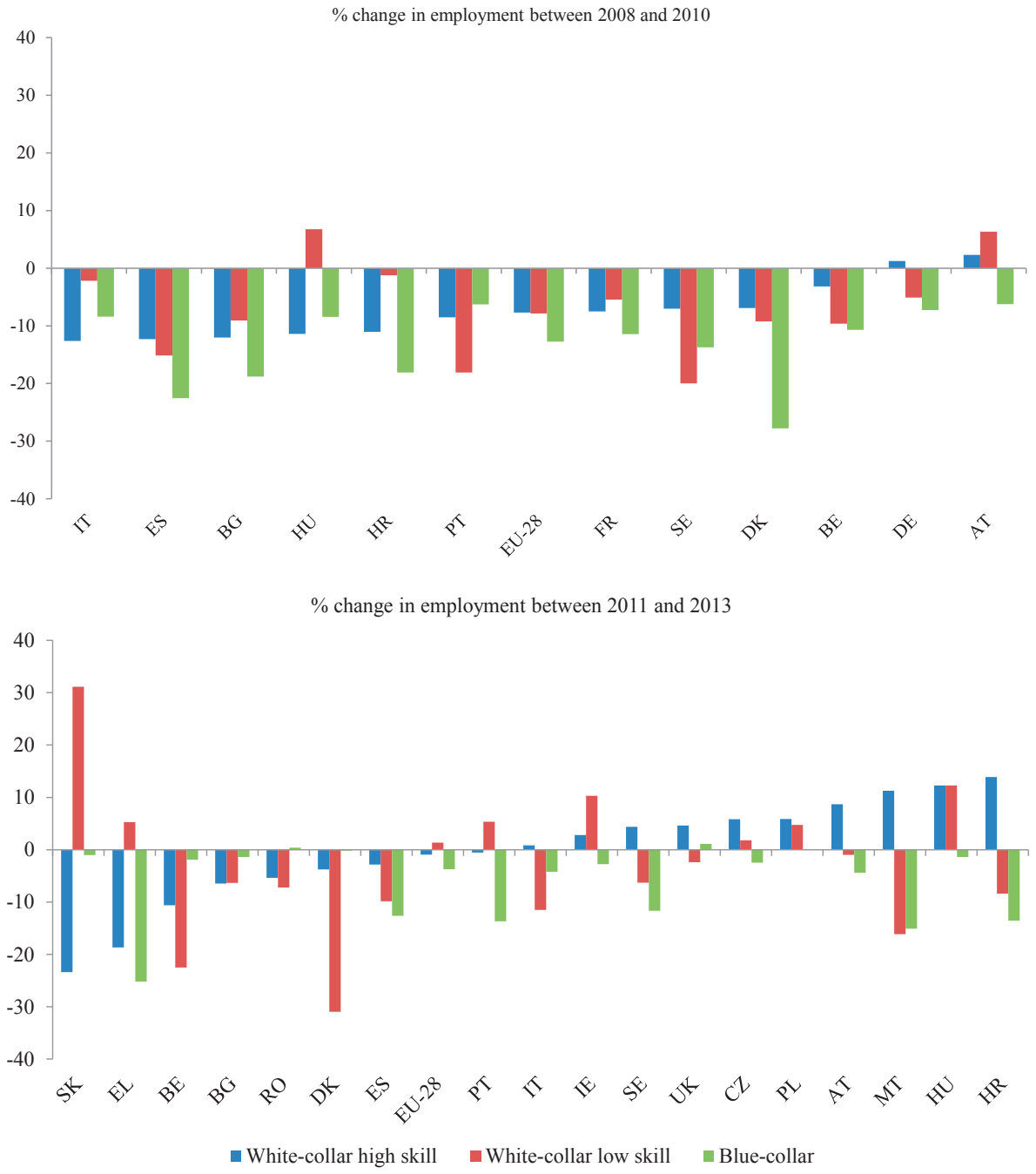
Source: Own calculations based on National Accounts, Eurostat
Note: No data available for HR, IE, LU, LT, MT, SE and UK. Due to breaks in series, the percentage change for RO is calculated for 2000-2011.

Table A 1.7: Average investment growth (2000-2014)

	Total	Dwellings	Buildings and structures	Transport Equipment	ICT equipment	Machinery and equipment	Intellectual property
AT	0.7	-1.0	-0.2	1.9	-1.2	1.6	4.2
BE	2.0	1.1	2.7	0.9	3.3	0.2	4.6
BG	7.3	8.3	10.2	17.6	n.a	n.a	7.5
CY	-1.4	-2.1	1.6	13.8	0.0	-0.1	12.3
CZ	2.6	3.4	0.0	5.7	6.2	3.2	3.8
DE	0.7	-0.3	-0.7	-1.4	n.a	n.a	2.2
DK	1.0	1.1	-0.9	3.3	4.6	0.1	3.4
EE	7.1	11.0	4.2	13.4	11.6	9.2	10.9
EL	-3.1	-9.5	-3.0	7.0	n.a	-1.8	4.0
ES	0.5	-0.9	-1.3	2.6	0.9	1.6	8.5
FI	0.5	1.3	0.7	-0.4	7.9	1.0	0.4
FR	1.3	0.3	1.1	1.8	3.6	0.8	3.2
HR	2.4	n.a	n.a	n.a	n.a	n.a	n.a
HU	1.8	-2.6	0.6	5.1	n.a	1.2	5.5
IE	1.0	-3.3	1.6	0.5	11.2	5.2	8.9
IT	-0.8	-0.6	-1.7	-2.6	2.1	-0.6	0.9
LT	3.7	6.1	3.0	16.1	7.9	2.3	10.8
LU	2.5	5.2	0.7	11.7	n.a	n.a	0.1
LV	7.2	2.7	10.1	12.7	n.a	n.a	5.8
MT	2.6	0.7	3.7	12.2	n.a	n.a	12.5
NL	0.1	-1.8	0.3	-0.1	8.3	-0.4	1.8
PL	3.9	3.8	3.8	5.3	n.a	4.0	3.9
PT	-3.0	-7.1	-3.7	-4.2	n.a	n.a	4.4
RO	5.6	16.4	11.2	11.3	4.8	9.5	2.0
SE	2.8	5.3	2.5	2.0	5.8	2.7	2.2
SI	0.4	-1.9	-1.0	4.7	3.3	4.8	2.7
SK	2.4	0.4	1.8	3.9	-1.2	6.1	5.2
UK	1.5	0.2	1.1	3.2	4.6	1.3	2.7
EU-28	0.8	-0.4	0.1	0.9	3.5	1.1	2.8

Source: Own calculations based on National Accounts, Eurostat.
Note: Due to data availability, the average growth rate is calculated for 2006-2014 for LT, for 2001-2014 for EE and MT and for 2001-2013 for LU. In addition, data were available only until 2013 for GFCF in dwelling, building and structure and intellectual property rights for BE, BG, HU and RO, in transport equipment for BE, BG, CY, HU and RO, in ICT equipment and machinery and equipment for BE, CZ, ES, FI, FR, HU, RO and SI.

Figure A 1.1: Change in manufacturing employment by occupation (%)



Source: Own Calculations based on Labour Force Survey
Note: The occupational groups follow a slightly modified version of the OECD (1998) classification: white-collar high-skill (managers, professionals, technicians and associate professionals), white-collar low-skill (clerical support workers, service and sales workers), and blue-collar (craft and related trade workers, plant, machine operators and assemblers, elementary occupations). Due to the high volume of missing or unreliable data, the 'skilled agricultural and fishery workers' category was excluded and the 'blue-collar high-skilled' and 'blue-collar low-skilled workers' were aggregated in one 'blue collar workers' categories. Changes in occupational structures are examined separately for 2008-2010 and 2011-2013, due to breaks in series following the introduction of ISCO 08.

CHAPTER 2

PRODUCTIVITY AND GROWTH

This chapter studies the productivity of EU manufacturing sectors. The analysis of the first section focuses on classical measures of productivity such as total factor productivity, labour productivity and unit labour costs. We analyse their evolution and sectoral specificities and try to explain trends on the basis of the literature and recent historical developments.

In the following sections, we analyse some specific factors influencing productivity. In particular, we focus on skills (and possible skills mismatches) and R&D, both very important factors for generating economic growth and competing in global markets. On the 'material' side, energy can impact consumer prices, but also firms' decisions on labour, location and more generally investments. There is a special focus on energy-intensive industries that are likely to be suffering most from higher energy costs.

The aim of the analysis is to trace structural changes in European industries. These can be determined by technological changes, reflected both in production processes and products. However, real cost savings can also be secured by learning by doing, whereby, even with a fixed technology, firms are able to improve their efficiency. Finally, changes in capacity utilisation to adapt to cyclical demand changes can influence productivity (see OECD, 2001). This is very relevant in a period of recession, since firms are not always able to disinvest capital to adjust production to demand cycles.

The economic literature proposes a wide range of productivity measures. Some are specific to one factor of production, such as labour or capital. In particular, labour productivity is a fundamental determinant of firms' competitiveness, particularly for sectors or countries more open to trade. However, other measures exist that refer to several inputs simultaneously, e.g. total factor productivity (also known as multifactor productivity). These indicators measure not only the contribution of individual factors of production, but also how efficiently they are combined in production processes.

2.1 LABOUR PRODUCTIVITY

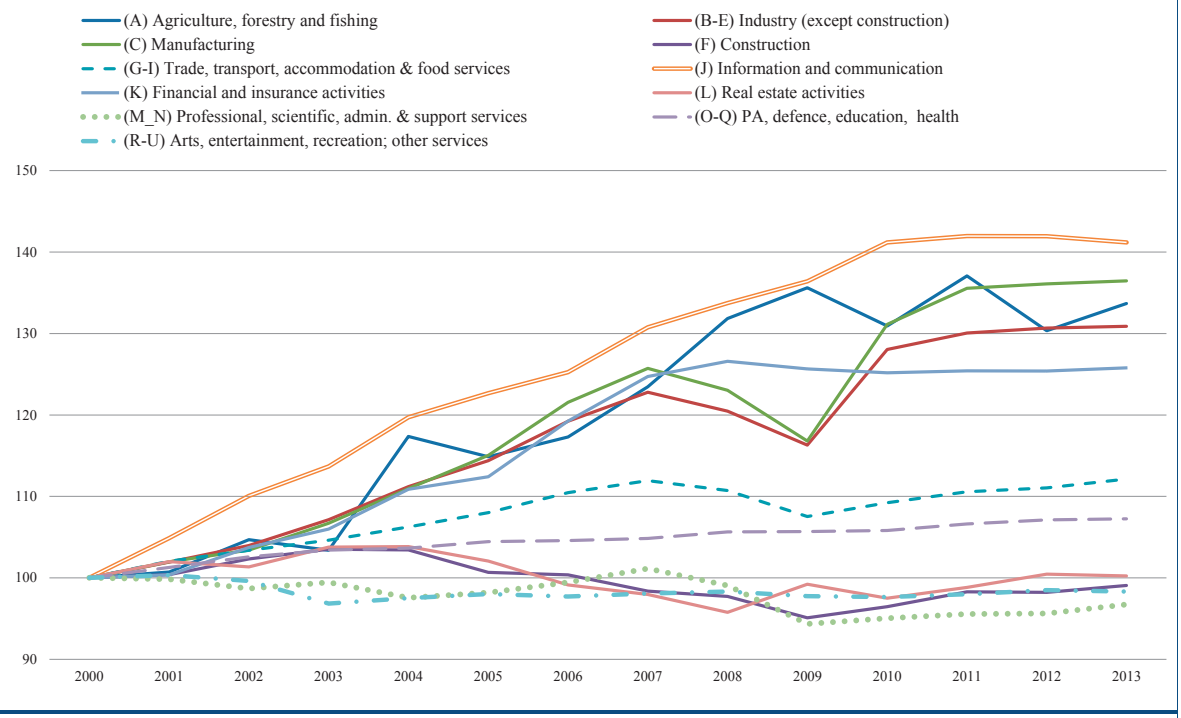
Labour productivity is one of the most interesting indicators of competitiveness and efficiency. It shows how efficient labour is at generating output. The relation between labour and output is very complex, since it is influenced by several factors of production, including capital, infrastructures, technology and the general business environment. For this reason, labour productivity is quite a comprehensive indicator, despite some limitations.[20] We start by analysing general trends in labour productivity growth for the whole economy, considering 10 large sectoral aggregates for the EU-28 (see Figure 2.1).

We can observe a strong decline of labour productivity in *Industry* (excluding construction) following the outbreak of the financial crisis, i.e. in 2008 and 2009. This could be explained

[20] Labour productivity, for instance, fails to incorporate phenomena such as outsourcing, which is more and more relevant with the spread of global value chains. See Box 1.1 and OECD (2001).

by labour-hoarding by firms, either because they perceived the crisis as temporary or because they were not able to dismiss employees in the short term (Leitner and Stehrer, 2012; Dietz et al., 2010; European Central Bank, 2012). A similar pattern is observable for *Trade, transport, accommodation and food services* and, to a lesser extent, for *Financial and insurance activities*, while *Agriculture, forestry and fishery* and *Information and communication* show a much less cyclical pattern. Labour productivity for *Public administration, defence, education and health* is relatively stable and shows a slightly but steadily increasing pattern. On the other hand, *Real estate* shows a moderately declining performance. However, Figure 2.2 shows that, despite a sharp increase, labour productivity is still lowest for *Agriculture, forestry and fishery* and still higher in *Industry* than in most service sectors. On the other hand, *Real estate* shows by far the highest level of productivity in the economy. . Real estate activities are capital intensive, and for this reason their employment share is smaller than their share of value added. This explains the particularly high levels of labour productivity.

Figure 2.1: Evolution of labour productivity for the EU-28 (2000=100)



Source: Own calculations based on Eurostat.
Note: Gross value added at basic prices (chain-linked volumes, reference year 2000) per thousands of hours worked, EU-28 aggregate.

Focusing on manufacturing using Eurostat's Structural Business Statistics gives us a more disaggregated picture of the different sectors. Figure 2.3 shows levels of apparent labour productivity for the EU-28 for 2011 and 2012, and the non-weighted average for the sectors represented. The *Pharmaceuticals*, *Chemicals* and *Coke and refined petroleum* sectors all show above-average labour productivity, but the most productive sector in manufacturing is *Tobacco products*, which is composed by a small number of large international firms. It is interesting to note, though, that productivity for the *Mining and quarrying* aggregate is significantly larger than for the *Manufacturing* aggregate. This is mainly due to the contribution of the subsectors *Extracting of crude petroleum* and *Natural gas*.

Box 2.1

Labour productivity is a measure of the amount of final goods and services produced by a unit of labour input in the course of a given period of time. Excluding intermediates, labour productivity also measures the ability of workers to generate income given the state of technology and other inputs.

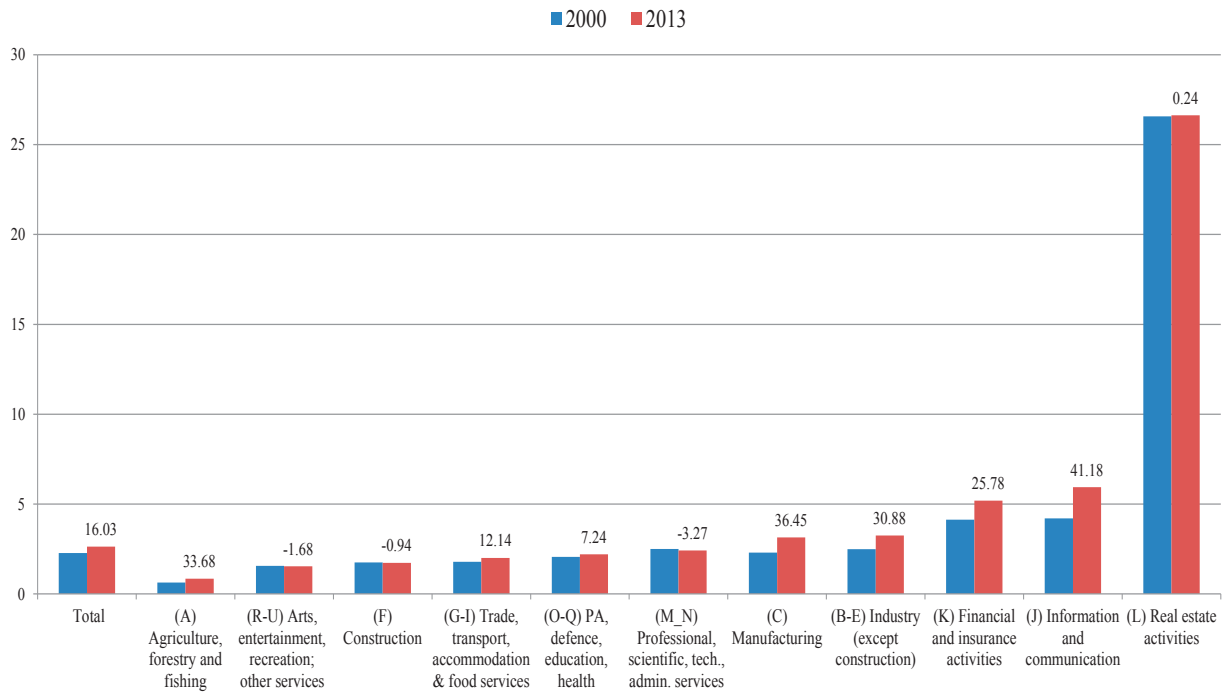
While technology is the key determinant, changes in labour productivity are not necessarily a result of technical change. It also depends on other inputs, such as capital or intermediates. For example, all else (including technology) being equal, increasing capital per worker (capital-deepening) can increase labour productivity. In the longer term, however, technical change in a broad sense is the main source of labour productivity growth, which in turn is the main source of economic growth. This is the dynamic underlying the sustained growth of *per capita* income that has transformed our societies since the start of the Industrial Revolution, which is why aggregate labour productivity attracts so much attention.

On closer inspection, changes in sectoral labour productivity also reveal important trends in our economies. For instance, the faster productivity growth of manufacturing as compared with services explains why workers are increasingly employed in the service sector. Productivity differentials with other countries also explain comparative advantages and, ultimately, the observed specialisation patterns.

Labour productivity can be measured by the ratio of value added to hours worked. The use of value added (production minus intermediates) ensures that intermediates are included only once. When 'hours worked' data are not available, it is common to use value added per person in employment (employees plus the self-employed).

Estimating value added at sectoral level is more difficult and the available data are less recent than data on production. In practice, therefore, production is often used instead of value added to estimate productivity, particularly to assess latest developments in the very short term (i.e. before data on value added are available). However, data on production include intermediates and this induces measurement errors that have to be borne in mind when interpreting production per unit of labour input (productivity 'based on gross output').

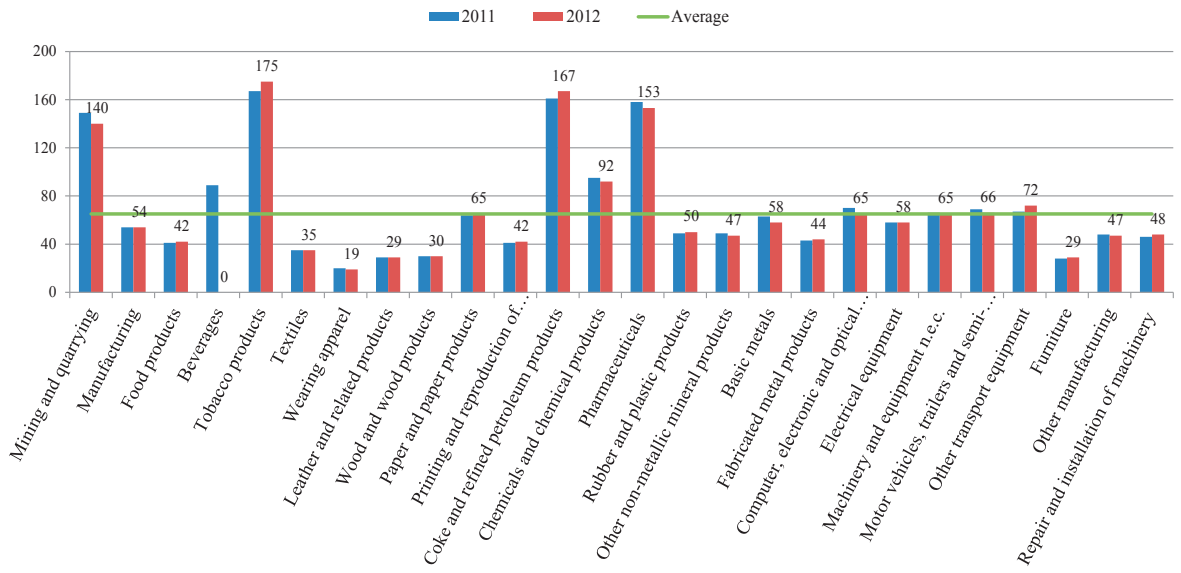
Figure 2.2: EU labour productivity and percentage growth per economic sector (2000-2013)



Source: Own calculations based on Eurostat.
Note: Gross value added at basic prices (chain-linked volumes, reference year 2000) per thousands of hours worked, EU-28 aggregate. The numbers represent the total growth rate for 2000-2013.

It should be noted that productivity has fallen in some sectors since 2011. This is true for nine sectors out of 24, including some high-tech sectors such as *Pharmaceuticals* and *Computer, electronic and optical equipment*. For some sectors, such as *Basic metals*, this decline seems to have started well before the crisis.[21] For others, the phenomenon seems more recent. *Pharmaceuticals* and *Computer, electronic and optical equipment*, for instance, showed a remarkable increase in productivity in 2005-2011 (EU-27 aggregate), but a modest short-term decrease in 2011-2012. This could be a sign of a certain volatility in the data rather than a symptom of structural change.

Figure 2.3: Labour productivity, EU-28 (thousands of euros)



Source: Own calculations based on Eurostat's Structural Business Statistics.
Note: Apparent labour productivity (gross value added per person employed). Numbers and average refer to 2012. Average=65, calculated excluding Mining and quarrying *and the* Manufacturing *aggregate.*

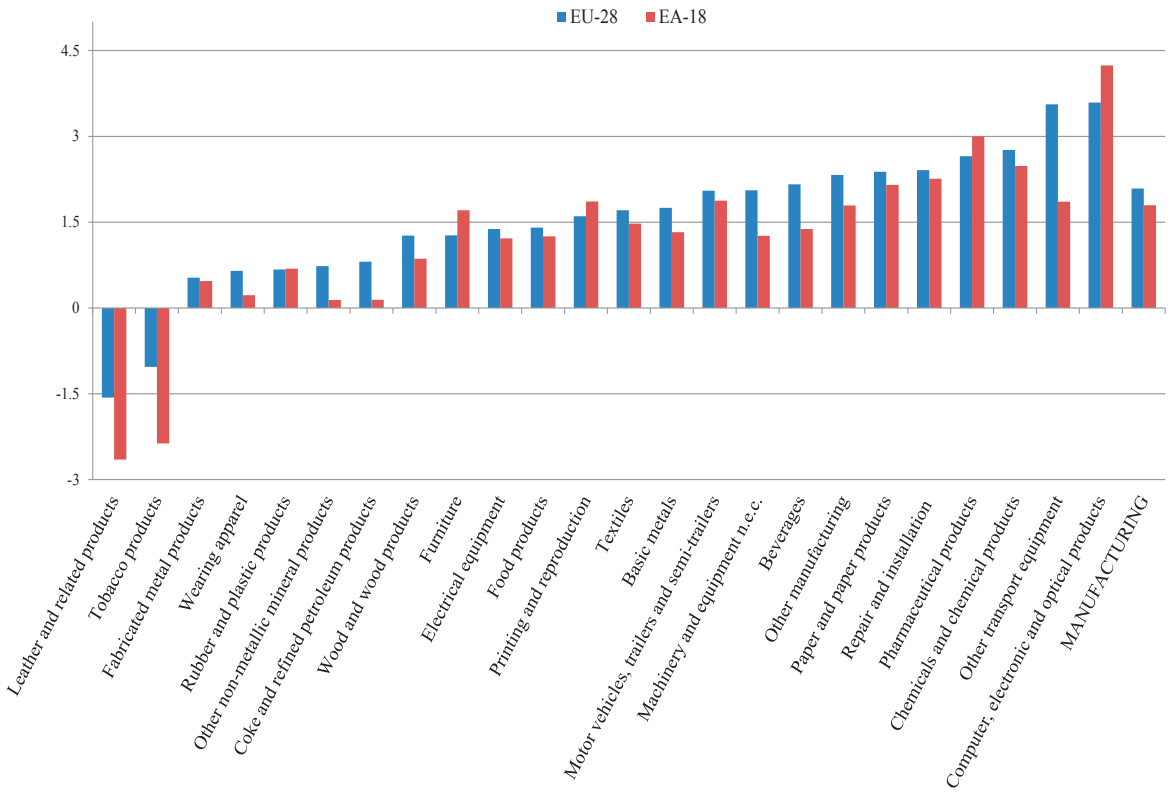
In order to dig deeper into this phenomenon, Figure 2.4 shows the evolution of labour productivity calculated as production per hour worked using more recently updated data from Eurostat's Structural Business Statistics. The growth rates are calculated as averages for 2003-2013. We show results for the EU-28 and the euro area (18 countries).

For the *Manufacturing* aggregate, there has been a moderate improvement, slightly stronger for the EU-28 as a whole, but there are significant differences across sectors. The largest improvements for the EU-28 are observable in *Other transport equipment* and *Computer, electronic and optical products*, both of which are characterised by high technology-intensity but had below-average productivity until 2012. In contrast, the lowest improvements are observable for low-tech industries such as *Tobacco*, *Leather* and *Wearing apparel*.

The pattern is different for the euro area, where the largest labour productivity gain was achieved in the manufacture of *Computers, electronic and optical products*, followed by *Pharmaceuticals*. This could be a reflection of countries' different specialisations and the delocalisation of plants to eastern Europe (in particular for transport equipment).

[21] Data for the EU-28 do not go back before 2011 in this series, but the analysis can be extended to previous periods using the EU-27 aggregate.

Figure 2.4: Labour productivity growth in EU manufacturing, 2003-2013 (average annual rate in %)



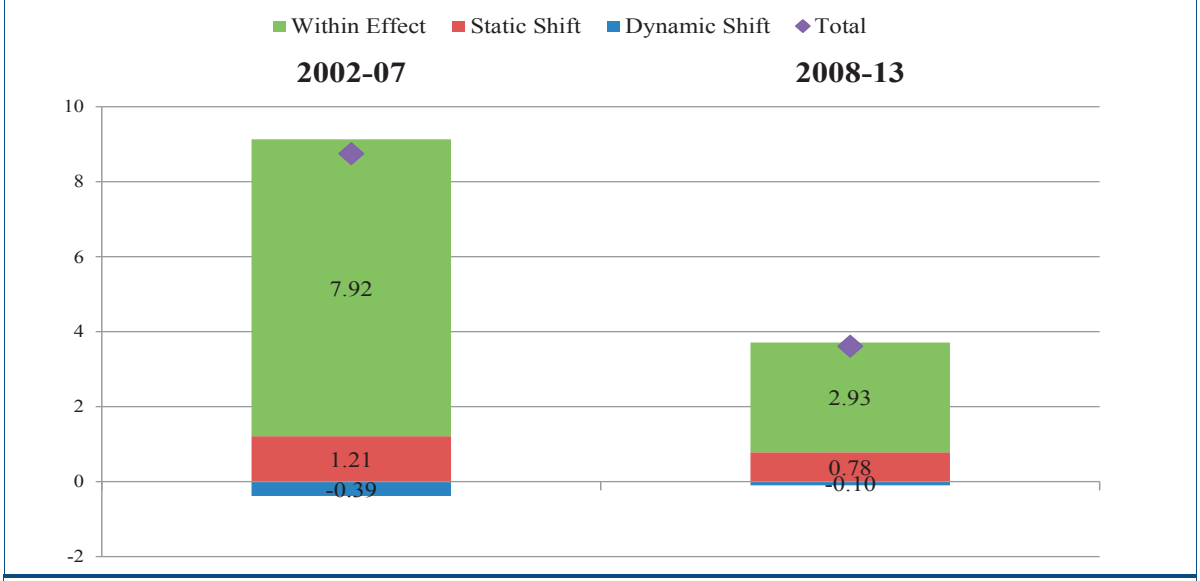
Note: Labour productivity average annual growth rate, volume index of production per hours worked.
Source: Own calculations based on Eurostat's Short-Term Business Statistics

2.1.1 Decomposition of labour productivity growth

The evolution of labour productivity can be analysed in more detail on the basis of a shift-share analysis, whereby changes in labour productivity can be broken down into three effects:

- 'within effect', which measures the contribution of each sector to the total change of labour productivity;
- 'structural change effect', which measures the reallocation of resources across sectors and can be further divided into:
  - static shift, which measures structural shifts in the economy by considering changes in labour shares across sectors with different levels of productivity; and
  - dynamic shift, which measures structural shifts in the economy by considering the changes in labour shares across sectors with different productivity growth.

Figure 2.5: Decomposition of labour productivity growth, EU-28 (%)



Source: Own calculations based on Eurostat's National Account Statistics.
Note: Shift-share analysis for 10 sectors classification of economic activities.

Figure 2.5 shows the results for the EU-28, calculated on the basis of 10 large sectoral aggregates (representing the whole economy) over two five-year periods.[22] In 2002-07, labour productivity increased significantly more than in 2008-13 (by 8.75% as against 3.61%). This is not surprising, given that the latter period was characterised by the financial crisis and the subsequent recession. Interestingly, most of the change can be explained by a sharp reduction in the second period of the 'within effect' (in green), from 7.92% to 2.93%. In 2002-2007, the 'within effect' accounted for 86% of the total variation (in absolute value), but only 78% in 2008-2013. As shown in Figure 2.1, this dynamic is mainly explained by the drop of productivity caused by the financial and economic crisis in sectors such as *Industry* (B-E), *Trade transport, accommodation, food services* (G-I), *Professional Scientific, technical activities* (M-N) and *Financial and insurance activities* (K).

At the same time, the 'static shift' remained more stable in absolute value, decreasing slightly from 1.21% in 2002-2007 to 0.78% in 2008-2013, but increasing substantially in terms of share (from 13% to 21%). This suggests an ongoing structural change in the European economy, in which a larger proportion of workers is employed in more productive sectors. Employment fell sharply in *Agriculture, forestry and fishing* (-20% in 2002-2013) and *Industry* (-14%) (see Section 1.2). In light of Figure 2.1, this suggests a possible shift of employment towards sectors with higher productivity, such as *Information and Communication*, *Finance and insurance* and services in general

The dynamic shift is negative for both periods, but the effect is small. This suggests that a small extra fraction of workers has been employed by sectors with declining productivity, in particular *Professional, scientific and technical activities* (which includes administrative and support service activities).

[22] The sectors considered are the same as in Figure 2.1 and Figure 2.2, i.e. those used by Eurostat for the annual national accounts.

The same analysis can be repeated for the individual Member States. The results are summarised in Table 2.1. Values for the top 20% performance are marked in orange. For 2002-2007, most of the top performers in terms of total productivity changes are 'new' Member States (Estonia, Latvia and Slovakia), but only Latvia managed to maintain the same standard for the following period. For 2008-2013, Ireland's excellent performance stands out. But the performance was mainly due to a sharp decrease in employment in a period of stagnating value added, signalling deterioration in terms of labour market outcomes (European Commission, 2015). The performance of Lithuania seems to be motivated by similar dynamics.

While most countries saw improvements in labour productivity in 2002-2007, the crisis had a negative impact subsequently, especially for countries such as Greece, Finland and the United Kingdom.

Table 2.1: Decomposition of labour productivity growth (%)

	2002-2007				2008-2013			
Country	Within effect	Static shift	Dynamic shift	Total change	Within effect	Static shift	Dynamic shift	Total change
Austria	9.71	2.18	-0.23	11.66	4.21	0.40	-0.13	4.48
Belgium	7.90	-1.24	-0.48	6.19	-0.20	-0.09	-0.31	-0.60
Bulgaria	8.24	4.56	0.47	13.28	11.68	6.13	-1.89	15.92
Cyprus	4.18	3.49	-0.76	6.91	2.48	-1.49	1.15	2.13
Czech Republic	27.83	1.50	-0.13	29.20	0.74	-0.30	-0.21	0.23
Denmark	6.89	0.51	-0.41	6.99	5.94	-0.49	-0.17	5.28
Estonia	43.09	-3.47	-6.93	32.70	13.23	2.42	-1.79	13.86
EU-28	**7.92**	**1.21**	**-0.39**	**8.75**	**2.93**	**0.78**	**-0.10**	**3.61**
Finland	17.51	-0.67	-0.95	15.90	-3.45	-1.01	0.22	-4.25
France	6.24	0.30	-0.39	6.15	3.67	-0.82	-0.11	2.74
Germany	10.27	0.60	-0.52	10.36	1.90	-0.20	-0.12	1.58
Greece	13.78	1.97	-0.56	15.19	-2.63	-4.88	-2.03	-9.55
Hungary	21.05	1.09	-2.69	19.45	-0.70	1.70	-0.25	0.75
Ireland	10.63	-1.13	-1.80	7.69	17.03	3.97	1.37	22.38
Italy	1.59	0.66	-0.40	1.85	0.20	-0.03	-0.08	0.09
Latvia	90.52	-1.57	-23.31	65.64	18.01	1.43	-1.11	18.33
Lithuania	-2.87	15.80	-3.18	9.75	15.64	7.49	-0.91	22.23
Netherlands	13.06	-2.90	-0.22	9.94	8.81	-1.73	-0.35	6.74
Poland	-6.17	4.24	-0.94	-2.86	-3.20	3.13	-0.73	-0.80
Portugal	39.50	-0.62	-0.58	38.31	14.83	-1.36	-1.88	11.59
Slovakia	30.91	2.73	-2.58	31.07	11.12	-1.32	-0.68	9.13
Slovenia	21.57	5.61	-0.55	26.63	7.51	0.02	-0.03	7.49
Spain	4.67	0.93	-1.75	3.84	15.88	0.32	-2.70	13.49
Sweden	15.83	0.26	-1.09	15.00	6.62	-1.28	-0.61	4.73
United Kingdom	12.86	1.75	-1.11	13.51	-3.68	1.55	-0.10	-2.22

Source: Own calculation based on Eurostat data.
Note: Shift-share analysis for 10 sectors classification of economic activities.

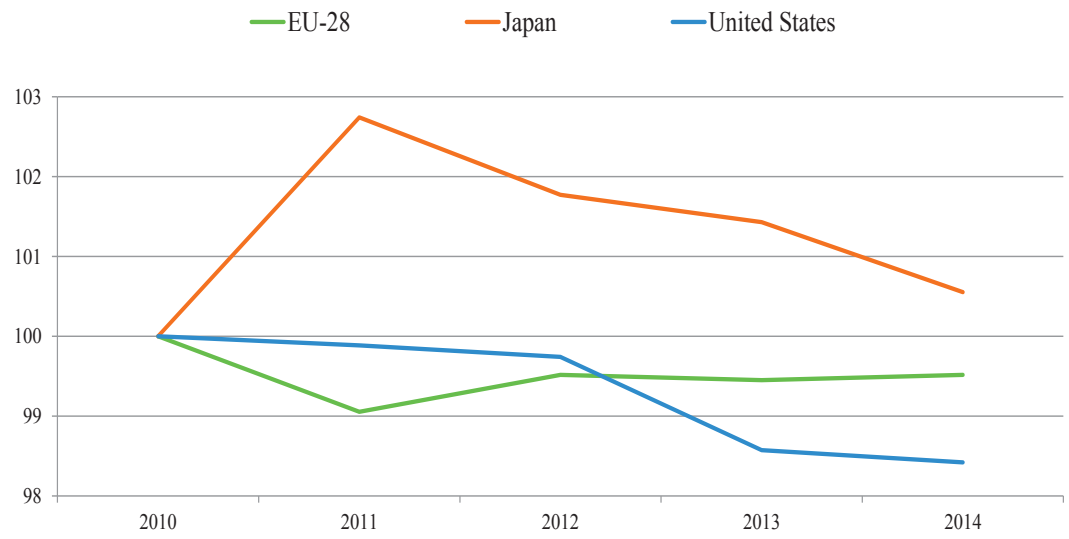
In general, the within-sector improvements explain most of the changes in labour productivity, probably because we consider very large sectoral aggregations. However, there are interesting exceptions, such as Lithuania in 2002-2007, where the static shift was positive and very large. This can be explained by a sharp decrease in the proportion of employment in *Agriculture, forestry and fishing*, matched by an increase in *Industry* and *Trade, transport, accommodation and food service activities*.

2.1.2 Unit labour costs

Unit labour costs (ULCs) measure labour costs relative to labour productivity. Labour productivity and ULCs are inversely related: by increasing productivity, firms lower their ULC at any given level of wages. For firms producing fungible goods and facing strong price competition from low-cost countries, reducing ULCs may be the key to reducing prices (see Box 2.2).

Figure 2.6 shows the evolution of real unit labour costs (RULCs) in the EU as compared with international competitors. EU RULCs have been relatively stable in recent years. On this indicator, the performance of the European economy has been on a par with that of the USA, although US labour costs have been significantly lower since 2012. Japan experienced an increase in RULC until 2011, a trend that started back in the 1990s (Inklaar et al., 2003), but which now seem to be reverted.

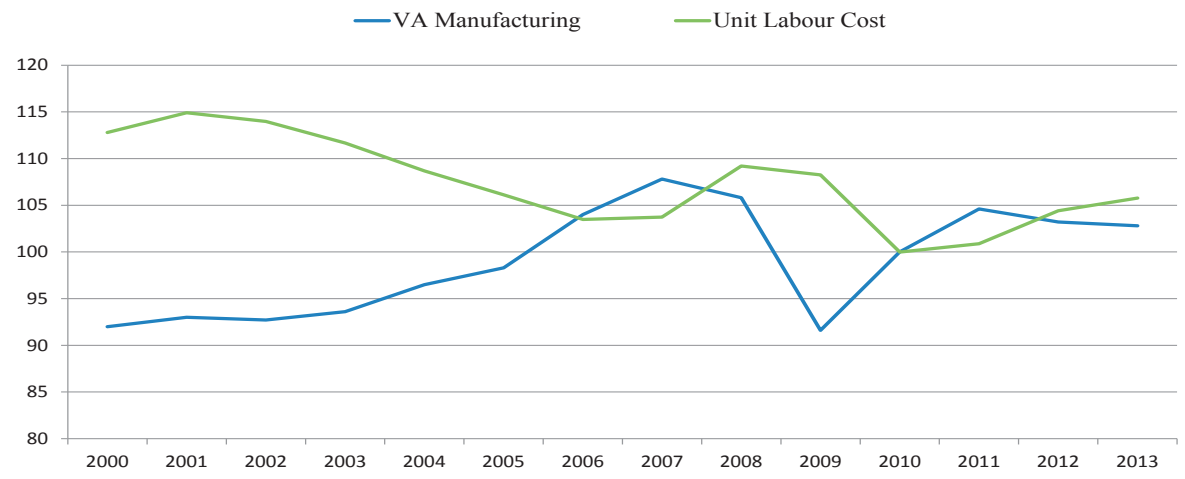
Figure 2.6: Real unit labour cost, Total Economy (2010=100)



Source: AMECO.

Focusing on the evolution of ULCs in EU manufacturing over a longer period, we can observe how the crisis impacted European production activity. Figure 2.7 shows the evolution of ULCs in manufacturing in comparison with gross value added. ULC decreased steadily until 2006, matched by positive developments in gross value added. The crisis determined a sharp increase of ULC in 2008 and a drop in value added, but the former started declining almost immediately, even when value added was still declining, mainly driven by a sharp decrease of wages in 2009.

Figure 2.7 ULCs and GDP, EU-28 (2010=100)

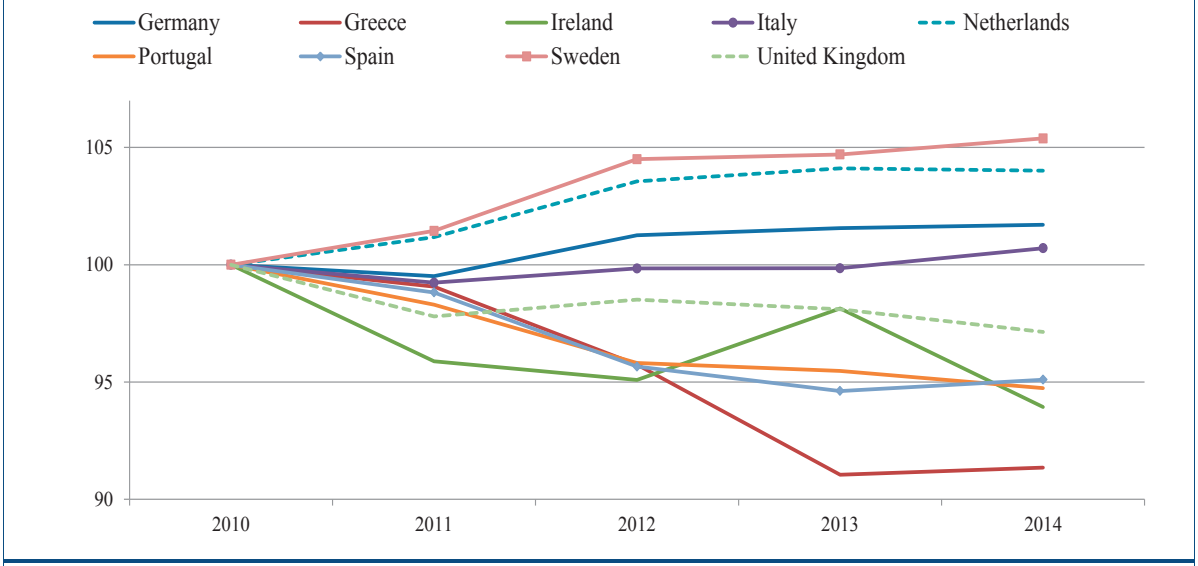


Source: Own calculations based on Eurostat, Short-term Business Statistics for ULC and National Account (ESA 2010) for Gross Value Added.
Note: Gross value added by 10 industry breakdowns. ULC calculated as production per hour worked relative to gross wages.

Repeating the same exercise within Europe produces some interesting results. Figure 2.8 shows the evolution of RULCs for some of the richest countries and for some that suffered more from the crisis.

RULCs in Sweden, Germany and the Netherlands all rose in the period to. On the other hand, Greece, Spain and Portugal all show a dramatic decrease. Ireland's ULC had a bounce in 2013, but is on a downward trend. These developments could be due to the effects of the programmes to which these countries have been subject. Interestingly, Italy shows a fairly stable pattern, suggesting that its efforts have not matched the structural reforms in the programme countries.

Figure 2.8: RULCs, total economy (2010=100)



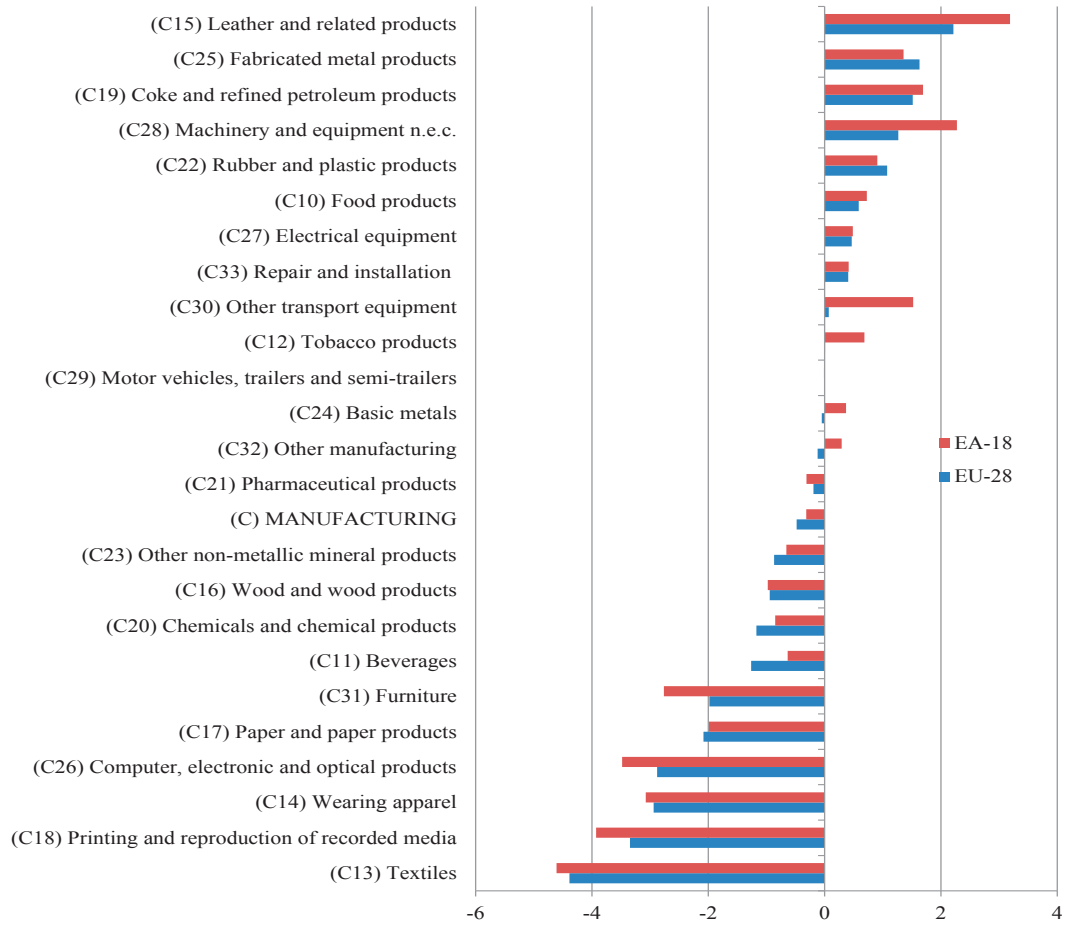
Source: AMECO

It is also interesting to analyse ULCs at sectoral level. Figure 2.9 shows changes in 2003-2013 for the EU-28 and the euro area (18 countries). Manufacturing ULCs fell slightly overall, in particular for the EU-28, but for 11 sectors out of 24 (12 for the EA-18) they actually increased.

Comparing Figure 2.9 and Figure 2.4, for sectors such as *Leather and related products* the sharp increase of ULCs was matched by an equally sharp decrease in productivity. This suggests that the former is due not to wages but to a decrease in output relative to hours worked. A similar reasoning, but *vice versa*, can be applied to *Computer, electronic and optical products*, for which we observe increased productivity and decreased labour costs.

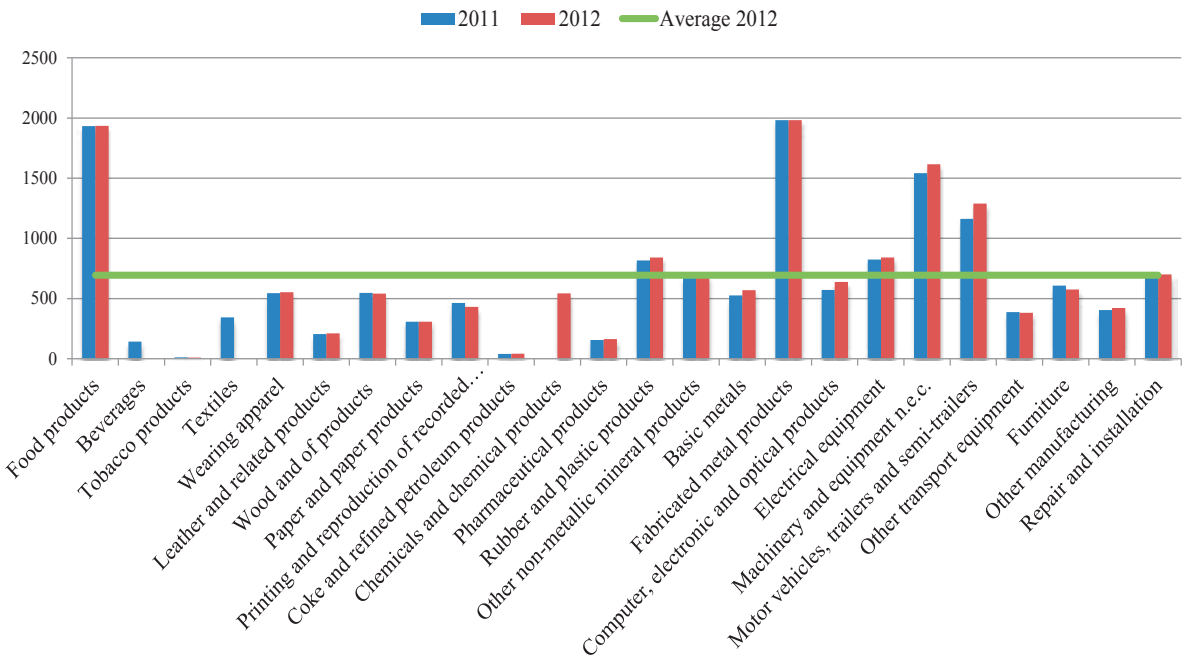
By contrast, for a number of sectors, e.g. *Food products*, we observe increases in both labour costs and productivity. This could be explained by technological change, leading firms to hire more specialised and better-paid personnel. However, in these cases, higher wages are only partially compensated by increased productivity, leading to an overall fall in competitiveness. This phenomenon seems to be partly related to technology-intensity. No high-tech sector experienced increases in both ULCs and labour productivity. While few medium/high-tech sectors did (C27, C29, C30), the increase in their ULCs is relatively small compared with those in medium/low-tech (C19, C25, C33, C22) and low-tech sectors (C10, C15).

Figure 2.9: EU ULCs in manufacturing, average annual change, 2003-2013 (%)



Info: Average annual growth rate, 2003-2013. ULC calculated as production per hour worked relative to gross wages.
Source: Own calculations based on Eurostat's Short-Term Business Statistics.

Figure 2.10: EU ULC levels in manufacturing



Source: Own calculations based on Eurostat's Structural Business Statistics.
Note: The average for 2012 includes all manufacturing sectors except Beverages and Textiles, for which no data are available.

Box 2.2

Unit labour cost (ULC) is the ratio of labour compensation to labour productivity. The index measures whether labour costs rise in line with productivity gains. Negative ULC growth indicates that productivity is growing faster than labour costs, while positive ULCs indicate that wages are rising more. ULC is widely used as an indicator of cost-competitiveness: all other things being equal, if labour cost growth is not compensated by productivity growth, firms that face intense price competition will lose profits and/or market share. In other words, a firm's competitiveness is affected by whether ULCs grow faster (or decline more slowly) than those of its competitors.

Total labour compensation usually includes not only employees' gross wages and salaries, but also other costs of labour borne by employers, including contributions to social security and pension schemes. Here, only gross wages are taken into account.

ULCs can be measured relative either to the number of employees or to the number of hours worked. For a given level of employment and wages per hour or per employee, ULC variations reflect changes in productivity. ULCs are also influenced by business-cycle fluctuations, as employment adjustments to shifts in demand lag behind those of output.

Using ULCs as an indicator of cost-competitiveness has some limitations:

- ULC changes should not be attributed only to changes in labour cost, since technology and quality upgrades also have a significant impact on productivity;
- ULCs are not an exhaustive measure of cost-competitiveness, since only labour is taken into account, while the cost of capital and other inputs such as energy and raw materials are ignored.

Therefore, ULCs are more informative for labour-intensive sectors than for capital- or energy- and material-intensive sectors. Similarly, they are a more reliable indicator for tradable goods and service sectors.

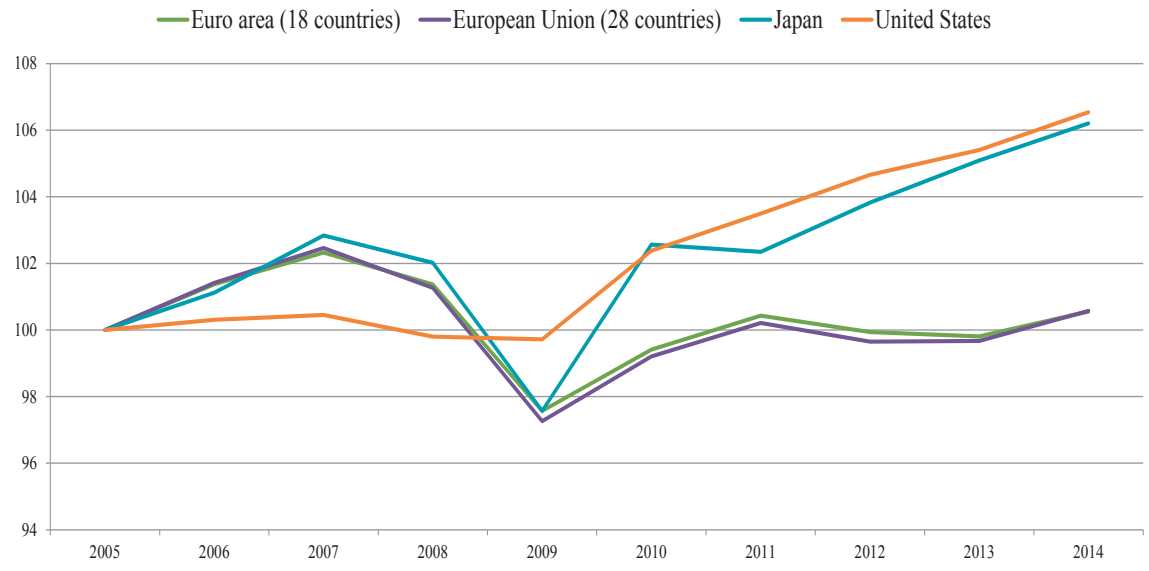
2.2 TOTAL FACTOR PRODUCTIVITY

In this section, we compare the performance of the EU and other developed countries in terms of total factor productivity (TFP). This captures changes in productivity that are not accounted for by changes in quantities of capital and labour inputs, but rather by the way they are combined, i.e. the degree of capacity utilisation and the technology or organisation used in production.[23]

The analysis starts by considering the total economy and then takes a sectoral approach. The selection of countries competing with the EU is somewhat limited by the availability of comparable data across countries, especially for sectoral TFP estimates.

Figure 2.11 shows the evolution of EU TFP between 2005 and 2014 against that of some major competitors. During the crisis and in its immediate aftermath, TFP decreased everywhere, reaching its lowest level in 2009. This may be the effect of short-term excess capacity due to the drop in demand following the crisis. In the United States, however, TFP decreased significantly less than elsewhere and then increased sharply. Japan shows TFP behaviour very similar to the EU's until 2009, but its subsequent recovery is more pronounced and in line with that of the United States.

Figure 2.11: Evolution of TFP (2005=100)



Source: AMECO
Note: Index, 2005=100

[23] The European Commission produces estimates of TFP based on the production function methodology approved by the ECOFIN Council (see European Commission, 2014b), which accounts for the fact that:
- due to cyclical shifts of demand or other market frictions, the economy may not utilise its capacity fully;
- inputs can be combined in different ways, depending on the technologies available and the efficiency of the organisation.

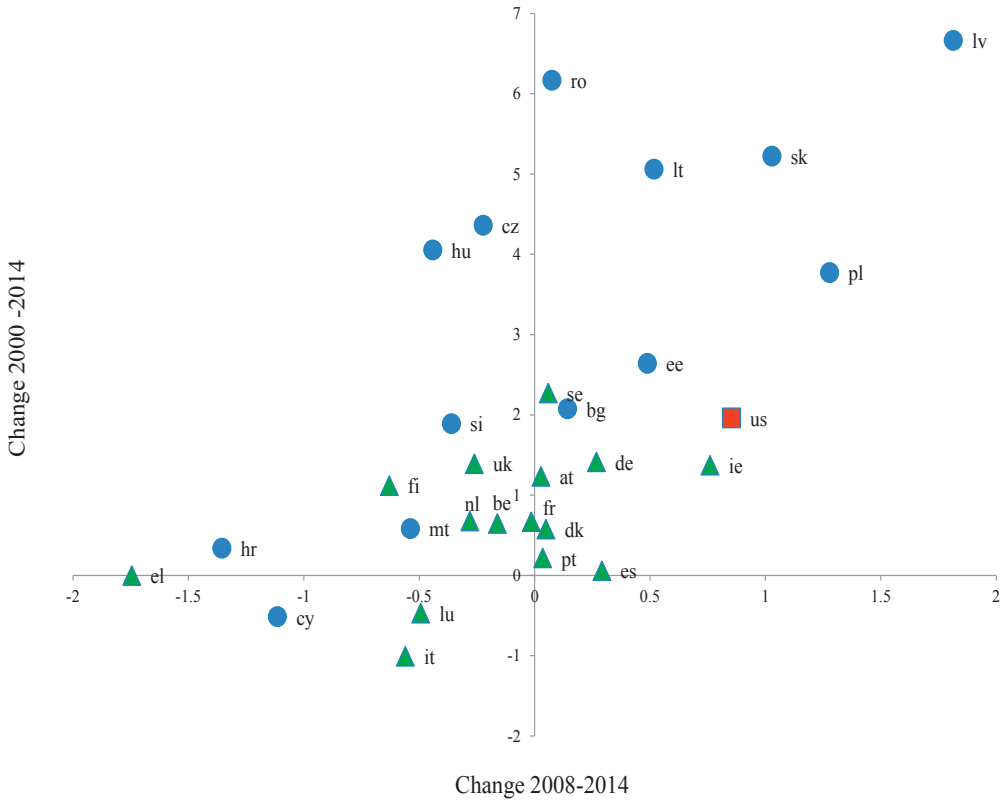
These corrections are measured by TFP, which should be interpreted as an indicator of the degree of utilisation of inputs and the efficiency of their combination (see appendix for details).

Figure 2.12 analyses TFP changes for EU Member States and the USA in more detail. The horizontal axis shows changes in 2008-2014, i.e. the evolution since the start of the financial crisis. The vertical axis shows the long-term change for 2000-2014.

The USA (in red) has improved its TFP both with respect to 2000 and since the beginning of the crisis. This hints at a greater degree of resilience in the US economy as compared with the EU's. Productivity has improved in a large majority of Member States since 2000. This is particularly true for some of the 'new' Member States (in blue), some of which started from low levels, which is evidence of convergence.

The crisis had different impacts on TFP across Member States. Some (SK, PL, the Baltic states, IE and DK) recorded considerable gains even during the crisis, but roughly half, including some 'new' Member States (CZ, HU, SI, HR, MT and CY) are still underperforming as compared with the beginning of the crisis (i.e. they are in the left half of the graph). In some (EL, CY, LU and IT), the crisis brought TFP back to 2000 levels or below. For MS like ES and IT, the negative trend started even before the crisis.

Figure 2.12: Changes in TFP (%)



Source: Own calculations based on ECFIN estimates of TFP.
Note: Solow Residuals in log, total changes for the periods considered.

Evidence on TFP by sectors in the pre-crisis boom years can be obtained from the EU KLEMS dataset.[24] Since TFP series are volatile, Table 2.2 shows average growth for 2005-2009. The green cells represent countries/sectors in which TFP improved on average from 2005. From a comparison across countries, it emerges quite clearly that Italy and Spain have lost competitiveness in almost all sectors, while Austria and most northern European countries improved across all manufacturing sectors. The aggregate for total manufacturing (C) declined for France, Italy, Spain and Belgium, but increased in all northern European countries and the United States.

There is wide variation across sectors, however. While the *Textiles, wearing apparel, leather* sector became more productive for all countries in the sample, a decline is observable for almost all in *Basic metals and fabricated metal products* or *Coke and refined petroleum*.[25] On the other hand, high-tech sectors such as *Electrical and optical equipment* and *Chemicals and chemical products* improved their performance in most countries. *Electrical and optical equipment* is the sector that showed the biggest changes, in particular in the USA, where the improvement is remarkable.

Table 2.2: Average TFP (value-added based) growth, 2005-2009 (2005=100)

	AT	BE	ES	FI	FR	DE	IT	NL	SE	UK	USA
MINING AND QUARRYING (B)	100.92	115.45	99.10	99.44	99.94	119.70	89.55	96.68	80.79	86.75	102.23
TOTAL MANUFACTURING (C)	107.77	99.44	99.89	106.95	99.81	103.98	98.92	103.81	102.01	104.95	102.15
Basic metals & fabricated metal (C24-25)	101.80	102.82	99.50	96.82	99.36	102.46	98.04	104.02	92.99	99.25	94.61
Chemicals (C20-21)	107.67	93.20	98.94	105.30	102.81	105.22	101.62	105.72	97.93	109.72	104.54
Coke & refined petroleum (C19)	246.19	93.81	78.87	75.95	90.55	87.11	82.31	100.25	180.48	93.41	82.89
Electrical & optical equipment (C26-27)	109.72	95.27	107.04	125.27	107.12	116.78	98.61	104.44	122.82	107.20	133.00
Food, beverages & tobacco (C10-12)	109.43	106.89	99.77	104.05	96.39	98.00	95.63	103.67	106.63	101.40	103.31
Machinery & equipment n.e.c. (C28)	110.98	101.05	104.49	113.34	100.78	98.11	101.53	101.49	98.85	108.01	103.78
Other manufacturing (C31-33)	109.63	94.02	103.29	100.19	103.13	102.10	99.72	103.51	109.06	106.48	103.66
Rubber & plastics (C22-23)	100.77	104.12	96.96	102.53	101.36	106.06	96.01	105.97	108.88	106.40	90.04
Textiles, wearing apparel, leather (C13-15)	107.60	114.14	108.03	105.31	103.58	104.82	101.44	107.12	104.92	112.89	100.44
Transport equipment (29-30)	112.17	88.64	99.44	95.19	90.04	105.06	105.99	102.48	91.50	103.82	96.06
Wood, paper, printing (C16-18)	107.44	104.62	97.20	103.42	102.64	104.76	98.21	103.49	101.48	105.94	102.49

Source: EU KLEMS data

[24] The EU KLEMS is a project funded by the European Commission's Research Directorate-General under the Sixth Framework Programme. The dataset contains measures of economic growth, productivity, employment creation, capital formation and technological change at industry level for all Member States from 1970.

[25] The particularly high value of TFP in the sector *Coke and refined* petroleum in Austria is hard to interpret, but may be due to the enlargement and restructuring of Schwechat refinery that took place in the period considered in this analysis.

2.2.1 Skills

In the previous sections, in particular when discussing the EU's performance in terms of TFP, we highlighted how important it is to mix production factors efficiently in order to improve productivity. The combination of input factors and available technologies determines what and how much economies are able to produce and, ultimately, the growth rate over time. In this section, we focus on the quality of the production factors. In particular, we analyse the role of labour, taking into account the skills necessary in the various production processes. Long-term growth can be achieved by improving the quality of labour input, since highly qualified workers can help firms innovate and make the best use of high-tech processes.

Human capital is not a perfectly substitutable input which can be transferred between sectors at no cost. The labour force consists of individuals with different types of skill and levels of education. This variety makes hiring and firing decisions costly, as they entail search and transaction costs. At any given time, highly educated employees or workers with a specific set of skills can be difficult to find. This makes firms reluctant to make such staff redundant during recessions. Also, there are firm-specific skills that the labour force can acquire only within the firm.

Human capital is therefore an input factor which can explain differences in growth across countries, but is not easy to measure. Level of education is widely used as a proxy for skills, but it has its limitations, as it does not take into account the whole stock of knowledge and skills acquired through post-school education, on-the-job training and team-learning in the labour force. Below we analyse the sectoral distribution of employment by education level, using International Standard Classification of Education (ISCED) categories. ISCED measures education level on a scale of 0 to 6. In our analysis, we consider three aggregated categories: low-skilled, medium-skilled and high-skilled labour (see Box 2.3).

Figure 2.13 shows sectoral shares of low-, medium- and high-skilled workers. The market and non-market service sectors *Education*, *Information and communication, Professional, scientific and technical activities* and *Financial and insurance activities* are among the most human-capital-intensive. The share of high-skilled workers is the largest not only across, but also within, these sectors. Manufacturing sectors that produce goods requiring a high proportion of high-skilled labour are *Pharmaceuticals*, *Computer, electronic and optical industries* and *Coke and refined petroleum*. While the first two are sectors with high technological intensity, *Coke and refined petroleum* is classified as a mid/low-tech sector. However, as shown in Figure 2.3, this sector has above-average labour productivity and is dominated by large enterprises (over 250 employees), most of which operate in global markets.[26]

[26] For more information, see http://ec.europa.eu/eurostat/statistics-explained/index.php/Manufacture_of_coke_and_refined_petroleum_products_statistics_-_NACE_Rev._2.

Box 2.3: Definition of skill categories

The International Standard Classification of Education (ISCED) distinguishes seven levels of education:

- Level 0: pre-primary
- Level 1: primary
- Level 2: lower secondary
- Level 3: upper secondary
- Level 4: post-secondary (non-tertiary)
- Level 5: first stage of tertiary
- Level 6: second stage of tertiary.

In this publication, we aggregate the levels in three categories, breaking down total employment in each sector into three skill categories:

- Low-skilled: Levels 0, 1 and 2
- Medium-skilled: Levels 3 and 4
- High-skilled: Levels 5 and 6

Around 50% of pharmaceutical firms' employees have been through tertiary education. The lowest proportion of low-skilled labour is found in *Financial and insurance activities*, where only 4.67% of the labour force has no more than primary education, closely followed by *Professional, scientific and technical activities* with 4.7%. More than 25% of the workforce in *Chemicals*, *Other transport equipment, Beverages* and *Tobacco* manufacturing are high-skilled. Low-technology manufacturing industries such as *Textiles*, *Clothing*, *Leather products* and *Wood products* employ small proportions of highly skilled labour. The same applies to labour-intensive service industries such as *Accommodation and food*, and *Agriculture and forestry*.

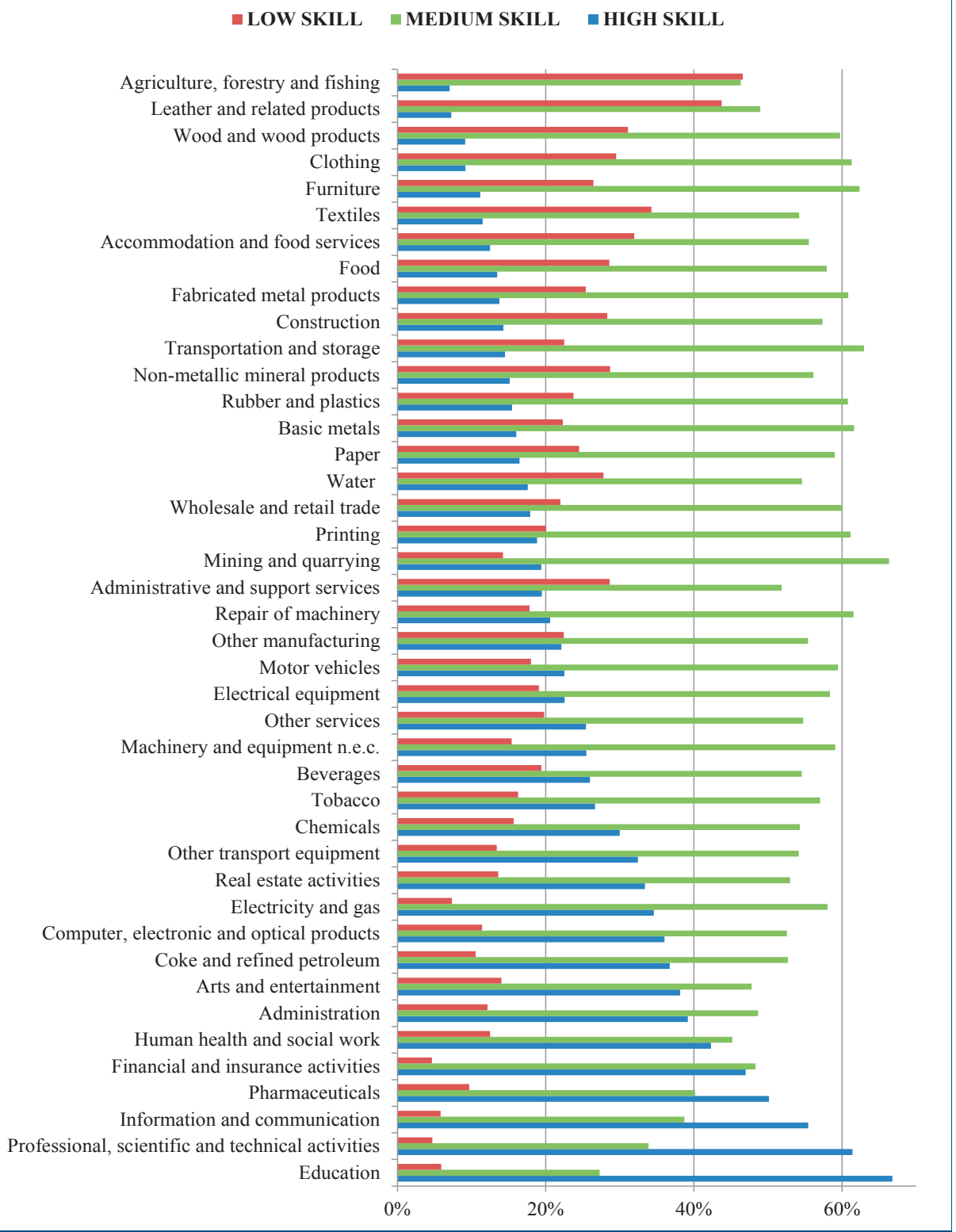
We can also use the dataset to analyse the evolution over time of employment shares. In Table 2.3, we show changes in 2008-2013. The pink cells correspond to sectors that saw a decrease in the share of a particular category of worker. Changes are relatively small overall, but it is interesting to note that the share of low-skilled workers has decreased in all sectors, whereas that of high-skilled workers has increased slightly. The picture for medium-skilled workers is less clear, since roughly half the sectors experienced a decrease. This finding can be explained in different ways. First, the level of education is generally increasing in Europe and that can, at least in part, explain the general decrease of low skilled workers. Secondly, the economic and financial crisis may have hit *low -pay* jobs more, determining an overall decrease of low-skilled workers (and mid-skill-skilled workers in some sectors), while skilled workers managed to keep their position. Labour -hoarding is more likely to involve highly educated and specialised workers.

However, a smaller proportion of low-skilled workers does not necessarily correspond to a decrease in the *number* of low-pay jobs. People may accept jobs for which they are overqualified. According to the theory of job polarisation, technological change and 'routinisation' of tasks can determine a decrease in the number of mid-skilled (and typically mid- paid) jobs, together with an increase in high- and low-skilled jobs (see Autor *et al.*, 2003). There is evidence of this phenomenon in Europe (see Goos *et al.*, 2009, 2014).[27]

[27] See also Section 1.2 and Figure A 1.1.

The fact that the share of medium-skilled workers increased in some low-skill-intensity sectors such as *Accommodation and food service activities* or *Agriculture, forestry and fishing* may suggest that some low-skilled, low-pay jobs have been taken by more qualified workers.

Figure 2.13: Share of low-, medium- and high-skilled workers (2013)



Source: Eurostat, EU Labour Force Survey

Table 2.3: Changes in share of low-, medium- and high-skilled workers, 2008-2013 (p.p.)

	Difference 2008-2013 in %-points		
	HIGH SKILL	MEDIUM SKILL	LOW SKILL
ACCOMMODATION AND FOOD SERVICE ACTIVITIES	3.6	2.0	-5.7
ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	3.0	0.4	-3.4
Agriculture, forestry and fishing	1.6	4.1	-5.7
ARTS, ENTERTAINMENT AND RECREATION	4.7	-2.2	-2.5
CONSTRUCTION	3.9	4.1	-8.0
Education	3.6	-1.9	-1.7
ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	9.4	-6.8	-2.6
FINANCIAL AND INSURANCE ACTIVITIES	7.7	-6.0	-1.7
Human health and social work activities	5.6	-3.1	-2.5
INFORMATION AND COMMUNICATION	7.8	-5.1	-2.7
Manufacture of basic metals	3.0	1.1	-4.1
Manufacture of basic pharmaceutical products and pharmaceutical preparations	4.9	-1.8	-3.1
Manufacture of beverages	6.0	-2.2	-3.8
Manufacture of chemicals and chemical products	2.4	0.3	-2.7
Manufacture of coke and refined petroleum products	6.8	-2.1	-4.7
Manufacture of computer, electronic and optical products	3.8	-1.4	-2.4
Manufacture of electrical equipment	4.7	-0.4	-4.2
Manufacture of fabricated metal products, except machinery and equipment	1.7	3.0	-4.7
Manufacture of food products	1.4	2.5	-3.9
Manufacture of furniture	-0.1	5.7	-5.6
Manufacture of leather and related products	3.4	-2.5	-0.9
Manufacture of machinery and equipment n.e.c.	3.7	-1.0	-2.7
Manufacture of motor vehicles, trailers and semi-trailers	3.4	-0.1	-3.3
Manufacture of other non-metallic mineral products	3.0	3.6	-6.5
Manufacture of other transport equipment	9.4	-5.5	-3.8
Manufacture of paper and paper products	1.7	2.1	-3.8
Manufacture of rubber and plastic products	3.7	1.2	-4.9
Manufacture of textiles	4.5	1.9	-6.5
Manufacture of tobacco products	8.7	-1.1	-7.6
Manufacture of wearing apparel	2.1	2.2	-4.3
Manufacture of wood and of products of wood and cork, except furniture	1.0	5.9	-6.8
MINING AND QUARRYING	5.7	-0.9	-4.8
Other manufacturing	2.9	0.7	-3.6
OTHER SERVICE ACTIVITIES	4.1	0.4	-4.5
Printing and reproduction of recorded media	2.3	1.6	-3.9
PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	6.3	-4.3	-2.0
PUBLIC ADMINISTRATION AND DEFENCE	5.7	-2.8	-2.9
REAL ESTATE ACTIVITIES	5.4	-1.9	-3.5
Repair and installation of machinery and equipment	4.0	2.3	-6.3
TRANSPORTATION AND STORAGE	2.5	1.3	-3.8
WATER SUPPLY	2.3	1.3	-3.6
WHOLESALE & RETAIL TRADE; REPAIR of MOTOR VEHICLES & MOTORCYCLES	4.1	-0.0	-4.0

Source: Own calculations based on Eurostat, EU Labour Force Survey

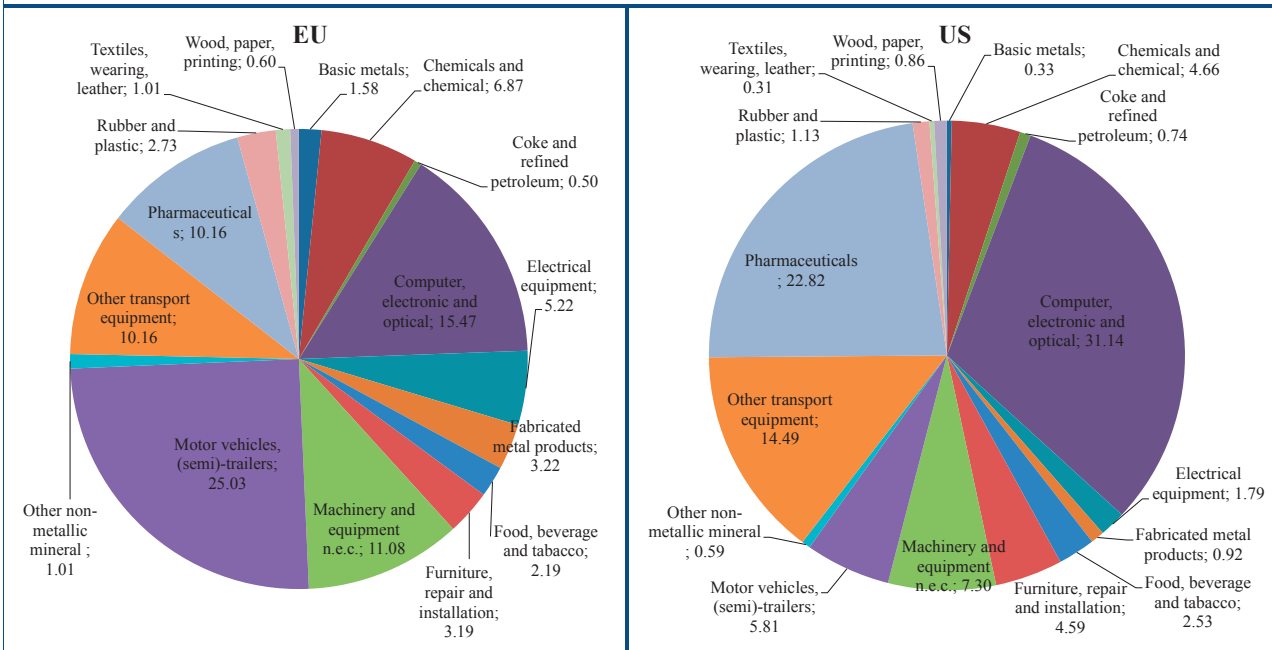
2.2.2 Technology

The adoption of a particular technology determines how efficiently input factors are combined. In turn, use of the best available technologies fosters the long-term growth of a sector by lowering costs, improving quality and ultimately promoting competitiveness. This section presents indicators of EU firms' investment in technologies and innovation. R&D expenditures can be regarded as an indicator of the inputs that firms dedicate to innovation.

In 2012, R&D expenditures represented 2.01% of GDP in the EU-28, which marked a minor improvement from 2011 (1.97%). In the United States, R&D expenditures amounted to 2.77% of GDP in 2011. We produced an EU aggregate to analyse R&D expenditures relative to value added in each manufacturing sector. Manufacturing attracts 65.7% of total R&D expenditures in the EU. The analysis focuses on business enterprise R&D expenditures by economic activity. Due to the large number of missing observations, we focused on a reduced sample of European countries and sectors and compared this aggregate with performance in the USA. The data in Figure 2.14 do not include government expenditures in sectoral R&D.

The difference in how resources are allocated in the two aggregates is quite large. The USA invests a larger share in high-tech sectors such as *Computer, electronic and optical products* and *Pharmaceuticals*. The EU focuses more on *Motor vehicles*. This signals a different type of specialisation. In other sectors, the differences are less relevant in terms of magnitude and tend to follow a more similar pattern.

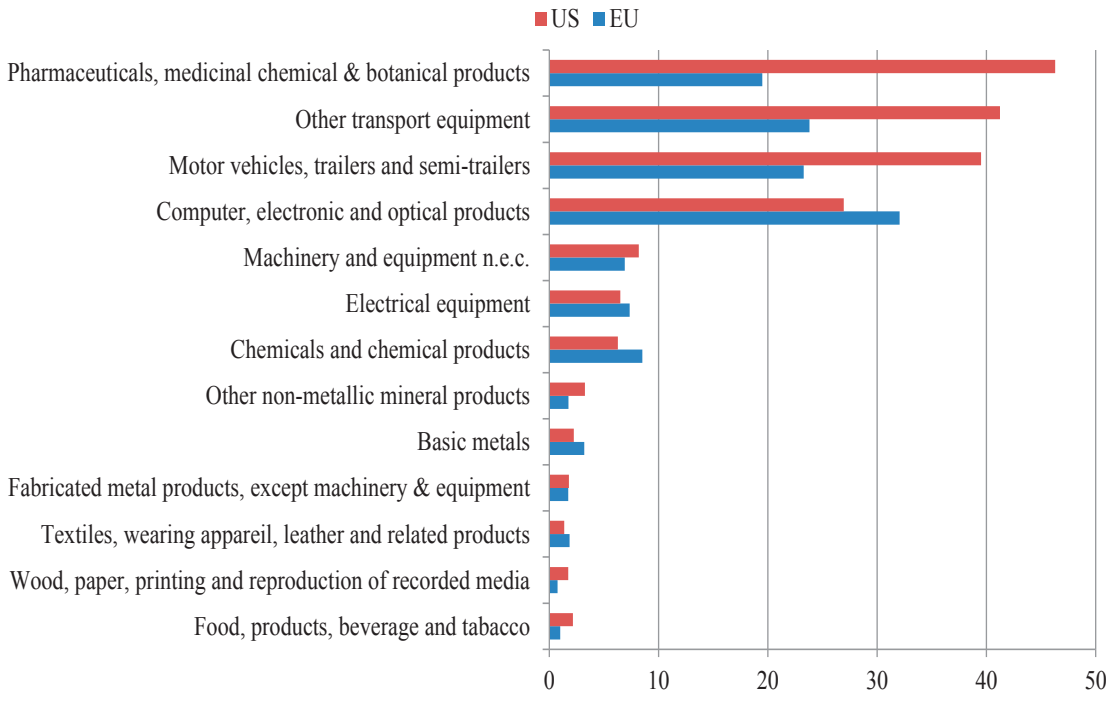
Figure 2.14: R&D expenditures across EU and USA manufacturing industries, 2011 (% of total)



Source: Own calculations based on OECD STAN.
Note: % of total R&D expenditures in manufacturing. The numbers in the left-hand graph refer to R&D expenditure by 12 EU Member States: Austria, Belgium, the Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Poland, Portugal, Spain and the United Kingdom.

In Figure 2.15, we show R&D intensity per sector, calculated as the ratio of R&D expenditures to value added. At this level of aggregation (ISIC Rev. 4), the EU shows a higher intensity than the United States in a few sectors, in particular *Computer, electronic and optical products*, *Electrical equipment* and *Chemicals*. Although the overall ranking across sectors is very similar, the figure shows that American firms, on average, tend to invest much more than European firms in innovation and technology. This is a worrying trend that was highlighted in European Commission (2013).

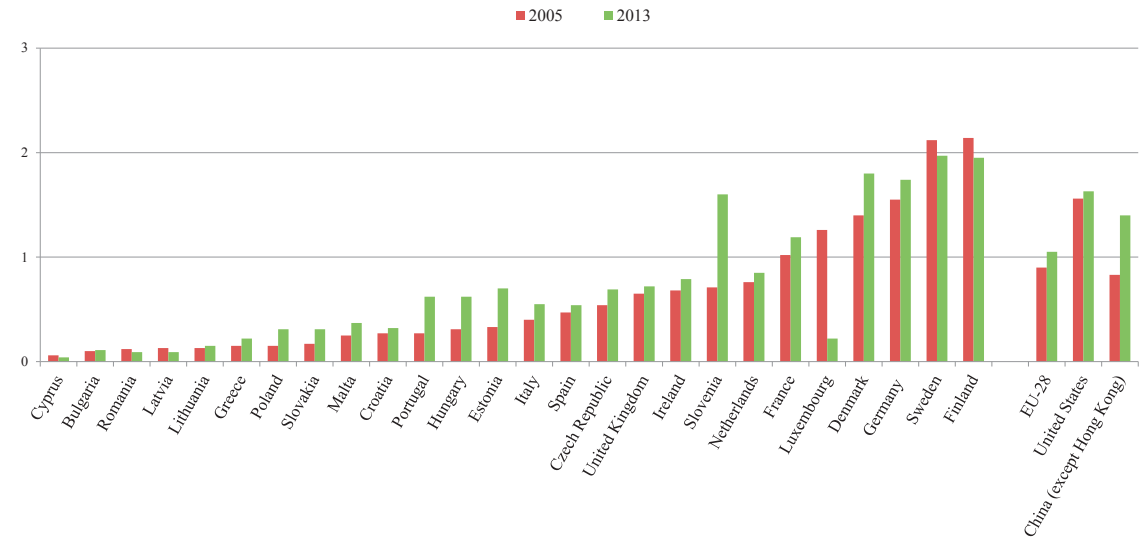
Figure 2.15: R&D intensity in EU and US manufacturing industries (% of value added), 2009



Source: Own calculations based on OECD STAN.
Note: Ratio of enterprise R&D expenditure to value added. The EU is represented by 11 countries: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, the Netherlands and Slovenia.

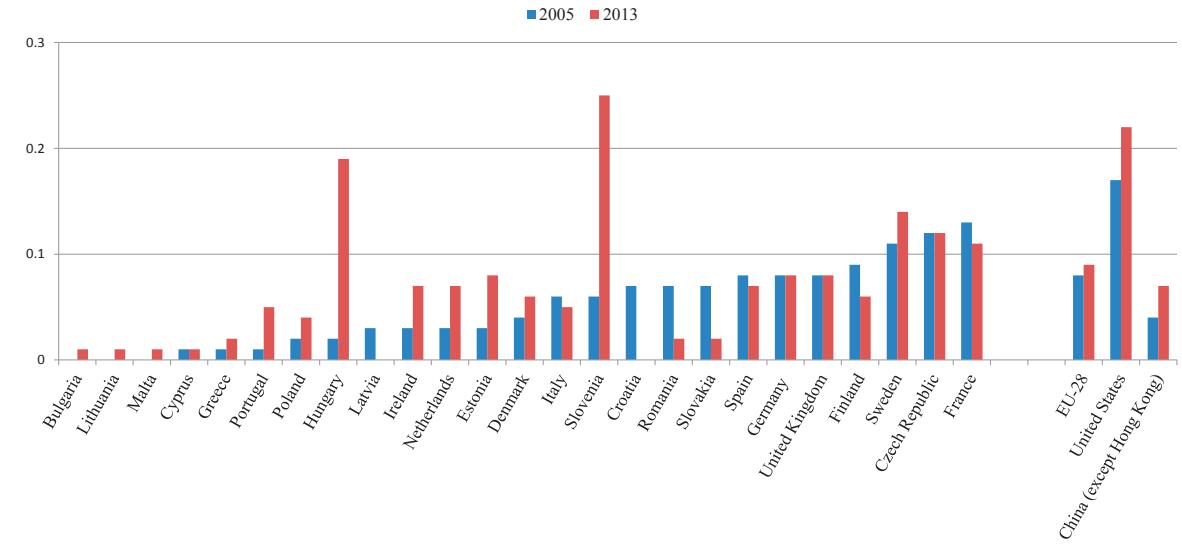
To look more closely at R&D performance at Member State level, we can use Eurostat data on business enterprise R&D expenditures funded by the private and public sectors (see Figure 2.16 and Figure 2.17). Most countries (20 out of 26) increased their privately funded expenditures in the period in question. In some countries, in particular Poland, Portugal, Slovenia and Hungary, the increase was significant, although these countries started from relatively low levels. Interestingly, the top European performers (Sweden and Finland) are among the few in which R&D expenditures decreased.

Figure 2.16: R&D expenditure funded by business enterprise sector (% of GDP)



Source: Eurostat
Note: Business enterprise R&D expenditure (BERD) by economic activity and source of funds (NACE Rev. 2), percentage of gross domestic product. Data for EU-28, USA, China, Cyprus, Italy, Portugal, Ireland and France are for 2012. No data for Belgium and Austria available for the years in question. Data for Luxembourg were provisional at the time of writing this Report.

Figure 2.17: Business enterprise R&D expenditure in EU-28 funded by the public sector (% of GDP)



Source: Eurostat
Note: Business enterprise R&D expenditure (BERD) by economic activity and source of funds (NACE Rev. 2). Data for EU- 28, USA, China, Cyprus, Italy, Portugal, Ireland and France are for 2012.

The picture is somewhat different for publicly funded business R&D expenditure. Only 12 out of 26 countries improved their performance.

Independently of the source of funding, the difference in the share of business R&D expenditure in the EU and in the USA is striking.

2.3 RELATIVE PRICES

Other important indicators of competitiveness are relative prices. These show how prices in a given sector vary as compared with the rest of the economy. Changes in relative prices can signal various phenomena:

- an increase in relative prices can be the result of stronger demand for one sector relative to the total average and to relative supply;
- price changes may stem from changes in the cost of production, due for instance to productivity growth; and
- firms may modify prices in response to changes in market structure, due to increased competition domestically or from abroad.

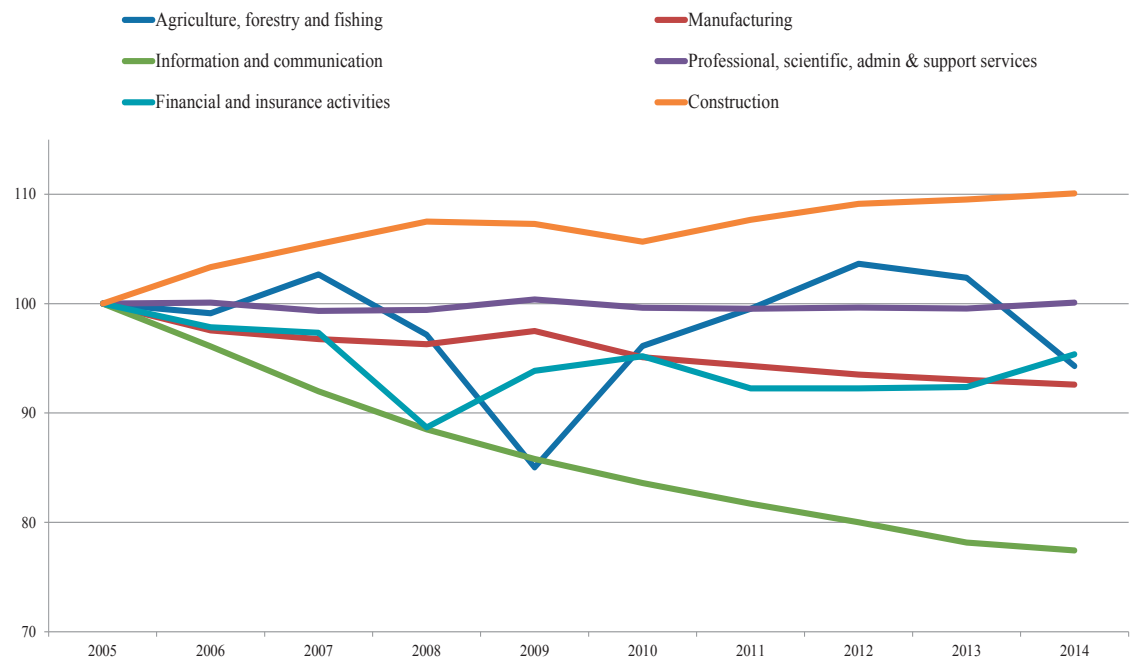
Relative prices are calculated by comparing price indices (in this case, gross value added implicit deflators) in one sector with those in industry as a whole.

Of the relative price developments in Figure 2.18, the most striking is the steady and sharp fall for *Information and communication*. As noted in European Commission (2013), this can be explained by the rapid technological development observed in this sector. The strong productivity growth in the sector (see Figure 2.19) is also a factor. Productivity grows when input costs decrease for a given level of output. In competitive markets, this normally translates into lower relative prices.

The general trend of *Manufacturing* relative prices is also downward. As argued in Chapter 1 (see Section 1.1), the higher productivity gains in manufacturing *vis-à-vis* services are one of the drivers of the decline of relative prices in manufacturing and the nominal shrinking of the share of manufacturing in GDP.

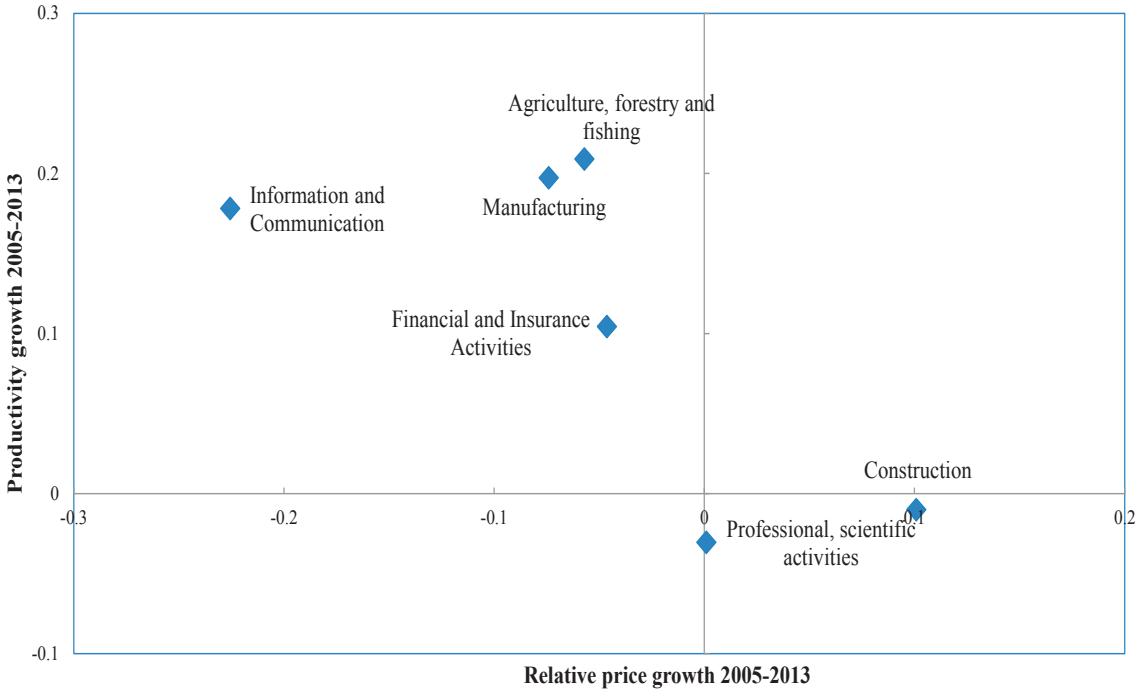
This relationship is analysed in Figure 2.19, which depicts labour productivity growth against relative price changes. In general, high productivity growth corresponds to a decrease in relative prices. (Labour productivity is defined here as the ratio between value added and hours worked).

Figure 2.18: Changes in relative prices (2005=100)



Source: Own calculations based on Eurostat data.
Note: Relative prices measured as value-added implicit deflators in the individual sectors as compared with the total economy. Indices, 2005=100

Figure 2.19: Labour productivity growth vs relative price changes, 2005-13



Source: Own calculations based on Eurostat data.

2.4 ENERGY

High and increasing energy prices have increased the economic importance of energy as an input in the production process. Moreover, the large price differential between the EU and the USA amplifies the effect of this increase on competitiveness. The recent shale gas revolution has led to a sharp decrease in energy costs in the USA that many consider to be one of the main drivers of its reindustrialisation.

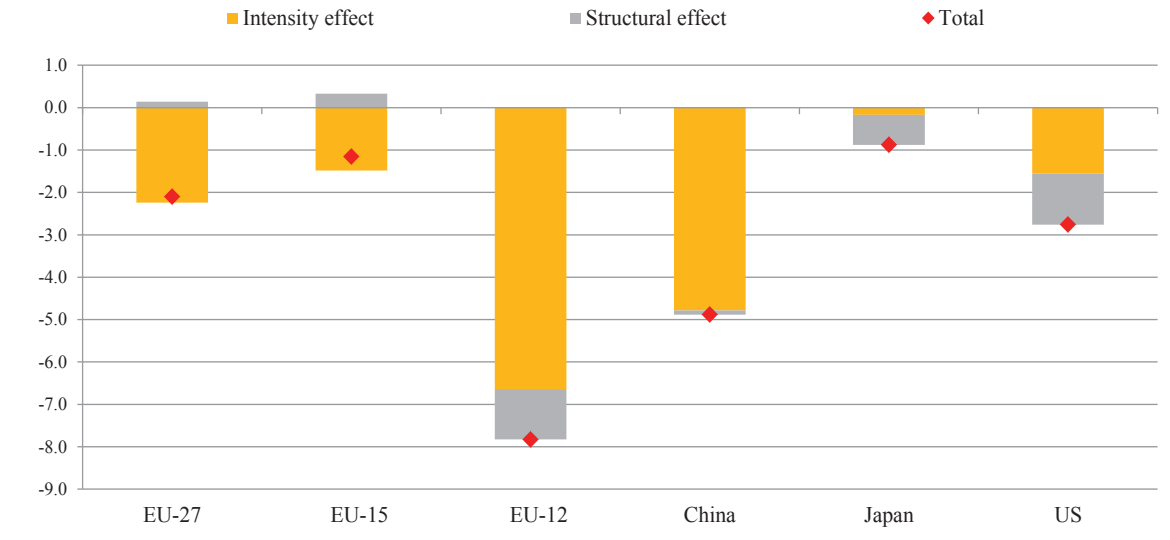
To oppose this phenomenon, European firms have made enormous progress in terms of efficiency, managing to reduce the amount of energy needed for a given level of output. A standard measure of energy intensity is given by the ratio between total energy use, measured as terajoules, and a measure of output, such as value added. Figure 2.20 shows the average annual change of manufacturing firms' energy intensity, for the EU and its main competitors. The graph clearly shows an improvement for all economies and particularly for the EU-12. In absolute terms, the USA and China performed better than the EU-27.

However, changes in energy efficiency can be driven simultaneously by two factors:

- energy intensities in each industry might decline; and
- the structure of the economy may shift towards less energy-intensive activities or industries.

Figure 2.20 shows that the structural effect made a negative contribution in China and the USA, which is mostly explained by a strong shift towards higher-tech industries such as *Electrical and optical equipment* and *Transport equipment*. Surprisingly, structural shifts relative to intensity reductions are negligible in China; this is because the initial energy intensity was quite high. For the EU-27 and the EU-15, the structural shift was small, but positive, suggesting that production increased in some energy-intensive sectors.

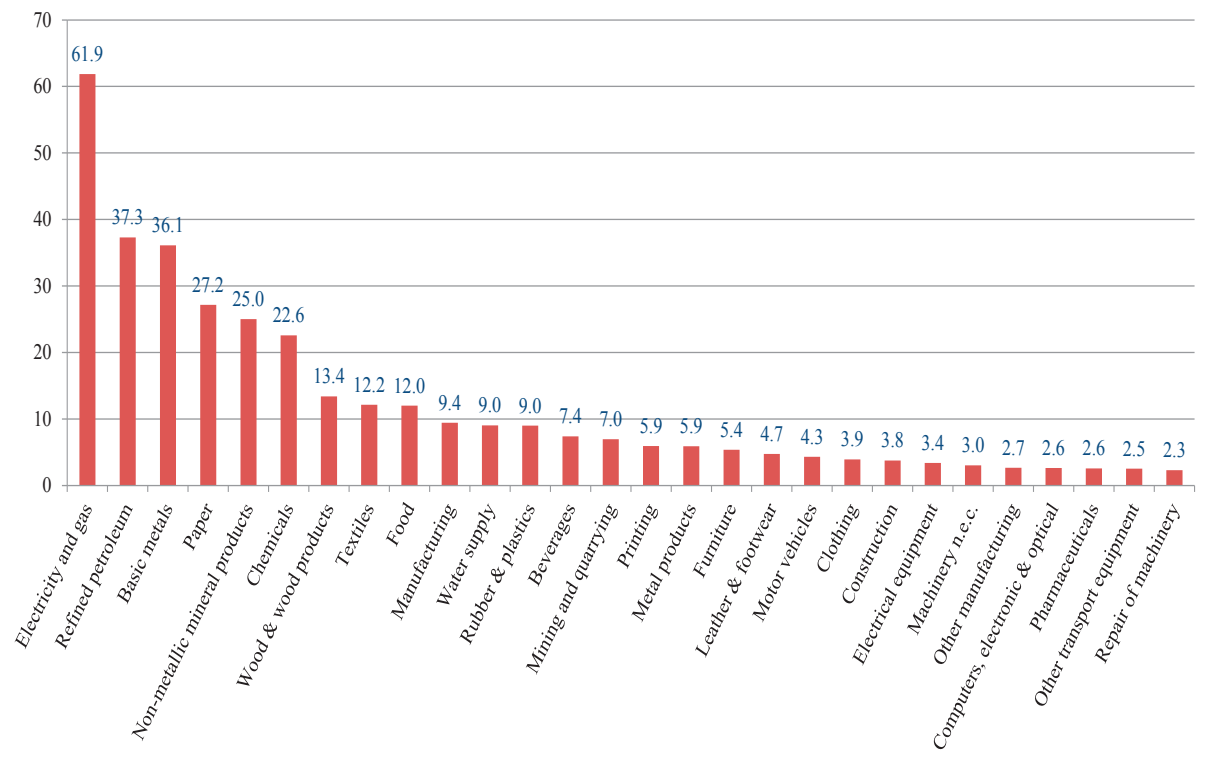
Figure 2.20: Energy intensity, annualised growth (%), 1995-2009 and decomposition



Source: European Competitiveness Report 2014, *based on WIOD, wiiw calculations.*
Note: Energy intensity measured as terajoules divided by value added in constant 2005 prices, and converted with PPP rates for 2005. Decomposition analysis based on the log mean Divisia index, for manufacturing industries excl. NACE Rev. 1 23.

Due to data constraints, the measure presented above cannot be calculated for periods after 2009. Therefore, to gain an overview of more recent developments, below we use, as an alternative measure, the value of purchases of energy used in the production process of a sector relative to value added. This can be interpreted as the energy cost of producing one unit of production in a particular sector. While this is a good measure for analysing the real burden of energy costs per sector, it does not take into account the wide differences in energy prices across the EU Member States (see European Commission, 2014c, 2014d and 2014e). The values for 2012 are shown in Figure 2.21.

Figure 2.21: Energy cost per value added, EU 2012 (%)

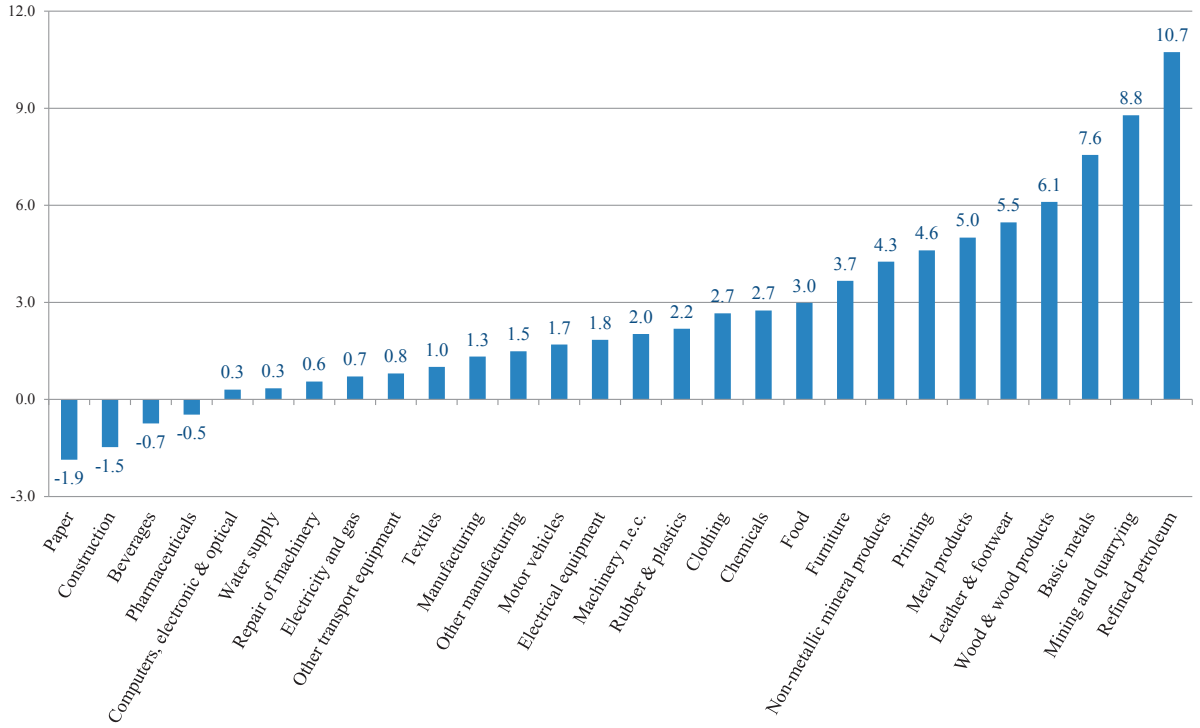


Source: Own calculations based on Eurostat, Structural Business Statistics.
Info: Energy intensity calculated as purchases of energy products (value) over value added (at factor cost). Averages calculated over all Member States except Italy, which has been excluded due to data quality issues.

The highest values of energy intensity are observed for *Electricity and gas* and *Refined petroleum*, which is not surprising, since in these sectors energy and fuels are also used as feedstock. More interesting is the comparison across the other sectors, where energy is used as a production factor only, rather than material input. The figure shows the wide variation across sectors, with values ranging from 36.1% for *Basic metals* to 2.3% for *Repair of machinery*. As a result, some sectors are much more vulnerable than others to changes in energy prices.

The European Commission considers the reduction of energy use as a priority to slow down climate change and decrease dependency on energy imports. It is therefore interesting to analyse how EU industry is reacting to the increase of energy prices and to Commission policy.

Figure 2.22: Energy cost per value added, average annual changes, 2008-2012 (%)



Source: Own calculations based on Eurostat, Structural Business Statistics.
Note: Energy intensity calculated as purchases of energy products (value) over value added (at factor cost), EU-28 averages.

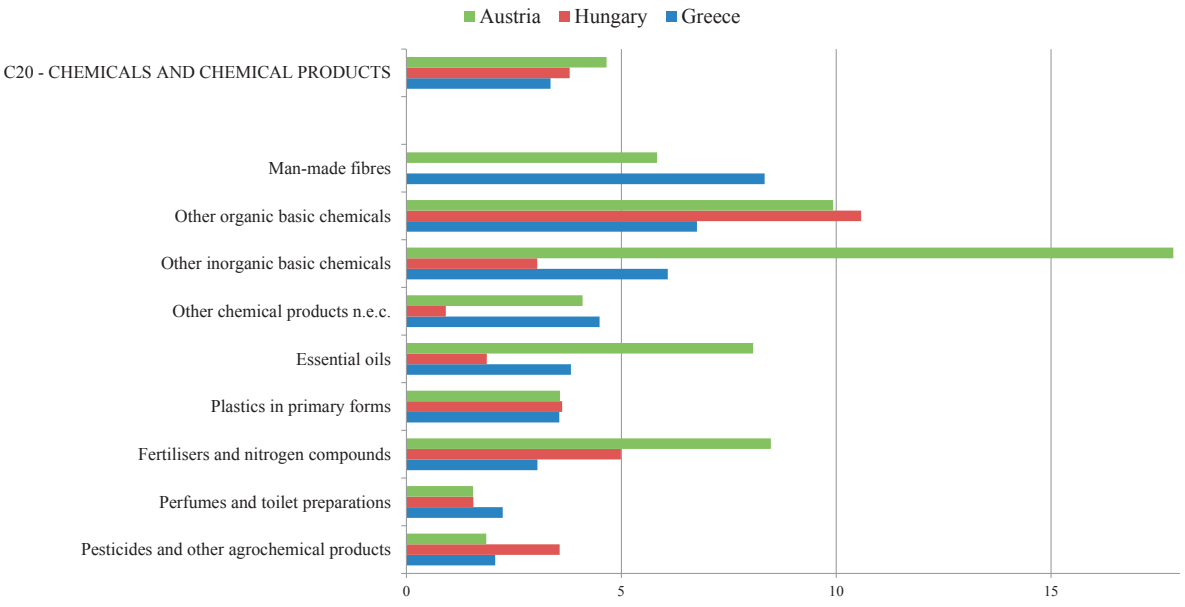
Figure 2.22 shows medium-term changes for 2008-2012, when most sectors suffered a substantial increase in energy intensity. This is due at least in part to the increase in energy prices documented in European Commission (2014e), but other factors may have played a role. For instance, in some sectors, scale economies could also influence the marginal cost of energy. In a period of recession, this may have increased the weight of energy cost per unit produced.

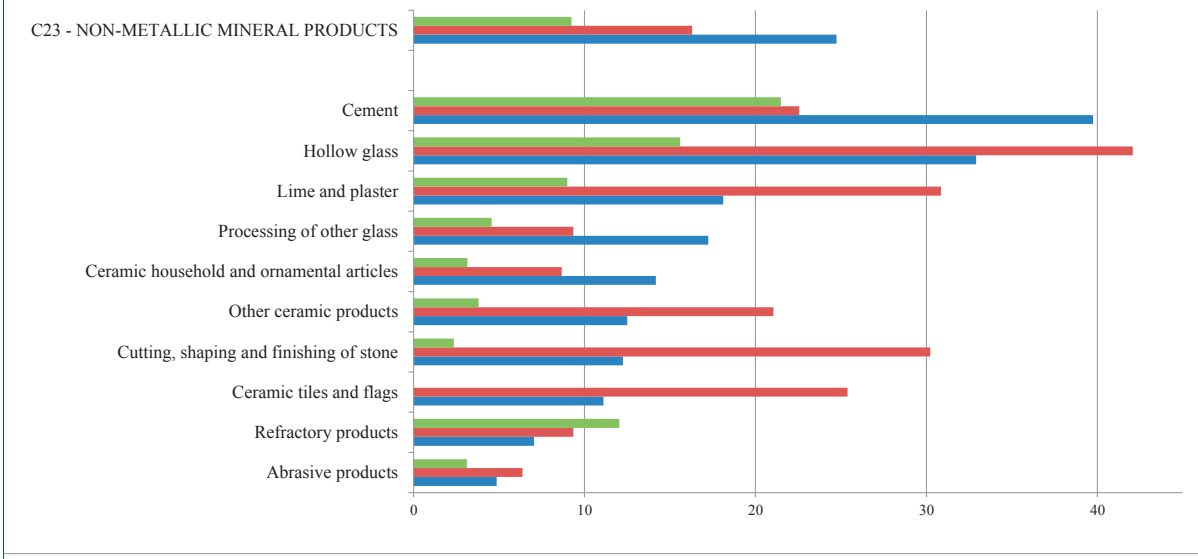
The high level of sectoral aggregation used in the above figures (2-digit NACE classification) hides a large degree of heterogeneity. For some sub-sectors, energy intensity can be much higher. To illustrate this, Figure 2.23 shows values of energy costs per value added for a selection of two sectors, their 4-digit-level sub-sectors and three Member States (Greece, Hungary and Austria). The variation within sector is considerable for all the countries in question.[28]

The upper panel shows energy costs for the *Chemicals and basic chemical products* (C20) sector, which bore an aggregated energy cost of 3.35%, 3.8% and 4.65% in Greece, Hungary and Austria respectively. However, *Other inorganic basic chemicals* (C2013) in Austria presents an energy cost of 17.84%, which differs substantially, for instance, from *Pesticides and other agrochemical products* (1.85%). Similar differences can be found for the other Member States. In Hungary, for instance, energy costs range from 0.92% for *Other chemical products n.e.c.* (C2059) to 18.50% for *Other organic basic chemicals* (C2014).

[28] The selection of countries was driven mainly by data availability. The limited nature of the sample means that care should be taken in drawing general conclusions, but the results suggest that well-targeted policies should be designed on the basis of disaggregate or firm-level data.

Figure 2.23: Energy cost per value added, selected sectors, 2012 (%)





Source: Own calculations based on Eurostat, Structural Business Statistics.
Note: Energy intensity calculated as purchases of energy products (value) over value added (at factor cost).

Similar observations can be made for *Non-metallic mineral products* (C.23), in the bottom panel, where Greece, Hungary and Austria present aggregated energy costs of 24.74%, 16.30% and 9.24% respectively. However, the values in Greece range from 4.85% for *Abrasive products* (C2391) to 39.75% for *Cement* (C2351). In Hungary, *Refractory products* (C2320) presented energy costs of 6.37%, while *Hollow glass* (C2313) reached a remarkable 42.07%.

This heterogeneity can be explained only in part by differences in energy prices across countries. Some energy-intensive industries can benefit from subsidies or tax rebates depending on the country in which they are based and on the type of energy they use. Moreover, even at firm level, energy prices can vary substantially because of long-term contracts with local energy providers. Finally, in some cases, the sectoral aggregations group together production activities that differ substantially from each other.

2.5 CONCLUSIONS

The chapter highlights some important structural changes that are modifying the European economic landscape. While improvements in productivity are observable in most sectors, the most significant progresses are taking place in *Information and communication activities*, which are also providing an increasing share of jobs. At the same time, more traditional activities such as *Industry* and *Agriculture, forestry and fishing* are becoming less and less labour intensive. However, the increasing relative weight of services is likely to be strictly connected to the trend of *servitization* of manufacturing. Knowledge-intensive business services, such as those provided by the *Information and communication* or *Financial and insurance* sectors, are now vital in maintaining the competitiveness of manufacturing.

Productivity is also determined by the quality of the production factors. The quality of labour input, as measured by the level of education of workers, has increased in virtually all sectors, and this may partly explain the progresses made in labour productivity. This development is very important since high-skilled labour is essential for innovation and competitiveness.

The EU has also increased expenditures in R&D, but much more can be done to match the performance of competitors like the USA and China.

In terms of energy, European firms have significantly reduced their efficiency overall, but for most sectors this has not been enough to compensate for the increase of energy prices. The evolution has also been influenced by structural changes of the economy: while in the EU-15 there has been a small shift towards more energy intensive sectors, in the EU-12 a significantly larger shift in the opposite direction took place.

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ANNEXES

Total factor productivity

The values of total factor productivity (TFP) presented in Figure 2.11, Figure 2.12 and Figure 2.13 were calculated on the basis of the 'production function' approach. More specifically, we assume that GDP (Y) can be represented by a function combining labour (L) inputs and capital stock (K). In the production function approach adopted by DG ECFIN, those inputs are then adjusted to take into account two important factors:

- the degrees of excess capacity (U_L and U_K) multiply the labour and capital inputs in order to correct for inputs that are not fully exploited in the production processes, e.g. because of cyclical fluctuations in demand;
- inputs are adjusted for the level of efficiency (E_L and E_K) of labour and capital.

If we assume a standard Cobb Douglas specification of the production function, the relation between output and input is the following:

$$Y = (U_L L E_L)^{\alpha} (U_K K E_K)^{1-\alpha} = L^{\alpha} K^{1-\alpha}\, TFP,$$

where TFP is defined as:

$$TFP = (E_L^{\alpha} E_K^{1-\alpha})(U_L^{\alpha} U_K^{1-\alpha})$$

and α is the output elasticity.

Hence, TFP is a measure of the degree of utilisation of labour and capital, and their technological level (see European Commission, 2014b for a detailed description).

Shift-share breakdown of labour productivity growth

Let P_{it} be a measure of labour productivity at time t in sector i, and Y_{it} a measure of output at time t in sector i. Finally, let L_{it} be total employment at time t, sector i. We can then define:

$$Y_t = \sum_{i=1}^{n} Y_{it}\,,$$
$$L_t = \sum_{i=1}^{n} L_{it}\,,$$

and P_t as Y_t/L_t, i.e. a measure of productivity for the whole economy. The shift-share breakdown of labour productivity is described by the following formula:

$$\frac{P_t - P_{t-1}}{P_{t-1}} = \underbrace{\sum_{i=1}^{n}\left[\left(\frac{P_{it} - P_{it-1}}{P_{it-1}}\right)\cdot\frac{Y_{it-1}}{Y_{t-1}}\right]}_{\text{Within effect}} + \underbrace{\sum_{i=1}^{n}\left[\frac{P_{it}}{P_{it-1}}\cdot\left(\frac{L_{it}}{L_t} - \frac{L_{it-1}}{L_{t-1}}\right)\right]}_{\text{Static shift effect}} + \underbrace{\sum_{i=1}^{n}\left[\frac{P_{it} - P_{it-1}}{P_{it-1}}\cdot\left(\frac{L_{it}}{L_t} - \frac{L_{it-1}}{L_{t-1}}\right)\right]}_{\text{Dynamic shift effect}}$$

CHAPTER 3

EU EXTERNAL COMPETITIVENESS

This chapter analyses the development and external competitiveness of EU goods and service sectors. External competitiveness is analysed across several dimensions in order to provide a broad picture of how the EU is performing in the global marketplace compared with its major trading partners.

The chapter is organised as follows:

- Section 3.1 analyses the EU's export performance by looking at world market shares and revealed comparative advantage in goods trade and services trade;
- Section 3.2 examines EU trade in value added rather than exports in gross terms;
- Section 3.3 examines foreign direct investment and offshoring/re-shoring tendencies in the EU.

3.1 THE EU IN GLOBAL MANUFACTURING TRADE

The EU is the world's largest exporter of manufactured goods. EU manufacturers accounted for 37.5% of global exports in 2013, inclusive of intra-EU flows (see Table 3.1). Roughly 60% of EU exports take place within the EU. If intra-regional flows are excluded,[29] Asia is the world's largest regional exporter of goods. On a country basis, China has become the world's largest exporter, with 14.6% of global export flows. This represents roughly the same proportion as the EU's extra-regional exports.

[29] The regions are as follows:
Other western Europe: Iceland, Norway, Switzerland;
Central and eastern Europe: Albania, Armenia, Azerbaijan, Belarus, Bosnia Herzegovina, Croatia, Georgia, Kazakhstan, Montenegro, Rep. of Moldova, Russian Federation, Serbia, FYR of Macedonia, Turkey, Ukraine;
North America: Canada, USA;
Latin America: Argentina, Bahamas, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Rep., Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Dutch Antilles, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, Uruguay, Venezuela;
Middle East: Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Occ. Palestinian Terr., Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen;
Asia: Afghanistan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, China, Hong Kong SAR, China, Macao SAR, Dem. People's Rep. of Korea, India, Indonesia, Japan, Kyrgyzstan, Lao People's Dem. Rep., Malaysia, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Rep. of Korea, Singapore, Sri Lanka, Tajikistan, Thailand, Timor-Leste, Uzbekistan, Viet Nam;
Oceania: Australia, New Zealand;
Africa: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Rep., Chad, Comoros, Congo, Côte d'Ivoire, Dem. Rep. of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Togo, Tunisia, Uganda, United Rep. of Tanzania, Zambia, Zimbabwe.

Table 3.1: Manufactured goods exports (% of global flows) in 2013

Exporter \ Importer	EU-27	Other Western Europe	Central and Eastern Europe	North America	Latin America	Middle East	Asia	China	India	Oceania	Africa	World
EU-27	22.9	2.0	2.4	2.8	1.0	1.2	3.6	1.3	0.3	0.3	1.3	37.5
Other western Europe	1.7	0.0	0.1	0.3	0.1	0.1	0.3	0.1	0.0	0.0	0.0	2.5
Central and eastern Europe	2.8	0.1	1.1	0.2	0.1	0.3	0.9	0.4	0.1	0.0	0.2	5.6
North America	1.7	0.2	0.2	4.1	2.6	0.4	2.5	0.9	0.1	0.2	0.2	12.2
Latin America	0.7	0.1	0.0	2.6	1.2	0.1	1.1	0.6	0.1	0.0	0.1	6.0
Middle East	0.2	0.0	0.0	0.1	0.0	0.2	0.4	0.1	0.0	0.0	0.1	1.0
Asia	4.2	0.1	1.0	5.1	1.6	1.7	16.4	2.9	0.7	0.8	1.2	32.2
China	2.3	0.0	0.6	2.7	0.9	0.7	6.5	0.0	0.3	0.3	0.6	14.6
India	0.4	0.0	0.1	0.3	0.1	0.4	0.6	0.1	0.0	0.0	0.2	2.1
Oceania	0.1	0.0	0.0	0.1	0.0	0.0	1.2	0.6	0.1	0.1	0.0	1.5
Africa	0.6	0.1	0.0	0.1	0.0	0.1	0.3	0.1	0.1	0.0	0.4	1.7
World	34.8	2.6	4.8	15.5	6.7	4.1	26.6	7.0	1.5	1.5	3.5	100

Source: Own calculations using Comtrade data
Note: The main diagonal in the matrix indicates intra-regional trade. The cells show the proportion of total world exports exported from one region/country to another. The figures are based on manufactured products. Crude oil and other products from mining and quarrying are excluded.

Over the past decade, there have been significant falls in exports between EU Member States, and EU exports as a whole, as a proportion of global exports. Since 2004, intra-EU flows have declined by 7.3 pp and total EU export flows have declined by 6.9 pp as a proportion of global export flows (see Table 3.2). These falls are not due to actual falls in the value of exports over the period: intra-EU exports grew by just over 45%, in current prices,[30] while EU exports as a whole grew by around 62%. However, because global exports grew by over 90% over the same period, the proportions of intra-EU exports and global EU-exports both fell.[31] EU exports to the United States also shrank as a proportion of global export flows, because they grew by only around 33%. To put EU export growth in perspective, over the same period China's exports expanded by 275%, those of India by 335% and those of (non-EU) central and eastern Europe by just over 240%.

Intra-EU exports grew more slowly than extra-EU exports. This is mainly due to the rise of emerging economies, which, together with faster growth overall, have faster-rising import demand. For example, between 2004 and 2013, EU exports to China grew by over 228%, in current prices, and EU exports to virtually all other emerging regions with the exception of the Middle East more than doubled.

It is interesting to examine the periods before and after the onset of the financial crisis (in 2008) for any marked differences in intra- and extra-EU export performance. In the period leading up to the crisis, 2004-2008, intra-EU exports grew by 51% and global EU exports by 55%. This compares with growth in world export flows of just over 75%. Hence, growth in intra- and extra-EU exports of manufactured goods was broadly balanced in this period. In the period following the onset of the crisis, 2008-2013, intra-EU exports fell in absolute terms by just under 4%, in current prices, while extra-EU exports grew by over 20%, easily outpacing

[30] Based on Comtrade data.

[31] Extra-EU exports nearly doubled in the same period (~97%), but this was not sufficient to prevent a fall in EU manufactured exports as a proportion of global manufactured exports.

world export growth in manufactured goods (just over 9%).[32] These figures show the marked divergence between intra- and extra-EU exports since the crisis. The difference in growth rates can be broadly accounted for by two main factors:

- growth in EU economies has been weak since 2008 and import demand has been particularly restrained;
- the value of the euro has fallen, on a trade-weighted basis, which has provided a boost to EU exporters.[33]

Comparing EU export growth with its international competitors', North America's share of global manufactured exports has also fallen since 2004. This is also due to North American export growth being slower than global manufactured goods export growth. Over the period, North American manufactured goods exports expanded by 70%, as compared with global export growth in manufactured goods of over 90% (see above). However, since the crisis, US global exports have kept pace with global growth in manufactured goods exports, expanding by 9.3% in 2008-2013 despite a strengthening US dollar.

China increased its share of global trade by 7.2 pp from 2004-2013. Its exports to all regions, particularly to North America and the EU, increased as a proportion of global goods trade. The market share of exports from Central and Eastern Europe also increased significantly (by 2.5 pp).

Table 3.2: Manufactured goods exports – percentage-point change in global flows (2004-2013)

Exporter \ Importer	EU-27	Other Western Europe	Central and Eastern Europe	North America	Latin America	Middle East	Asia	China	India	Oceania	Africa	World
EU-27	-7.3	0.3	0.5	-1.3	0.2	0.0	0.5	0.5	0.1	0.0	0.2	-6.9
Other western Europe	-0.2	0.0	0.0	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1
Central and eastern Europe	1.0	0.0	0.6	0.0	0.0	0.1	0.6	0.2	0.0	0.0	0.1	2.5
North America	-0.7	0.1	0.1	-1.5	0.4	0.1	-0.1	0.3	0.1	0.0	0.1	-1.5
Latin America	0.1	0.0	0.0	-0.2	0.3	0.0	0.7	0.4	0.1	0.0	0.0	1.0
Middle East	-0.1	0.0	0.0	-0.1	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	-0.4
Asia	-0.5	0.0	0.6	-0.8	0.9	0.8	2.9	-0.7	0.4	0.2	0.6	4.7
China	0.9	0.0	0.4	1.0	0.7	0.4	3.2	0.0	0.3	0.2	0.4	7.2
India	0.2	0.0	0.0	0.1	0.1	0.3	0.3	0.1	0.0	0.0	0.2	1.2
Oceania	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.5	0.0	0.0	0.0	0.6
Africa	-0.1	0.0	0.0	-0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.2	0.2
World	-7.8	0.4	1.8	-4.0	1.9	1.2	5.2	1.6	0.7	0.1	1.2	0.0

Source: own calculations using Comtrade data
Note: The principal diagonal in the matrix indicates the change in intra-regional trade. The cells show the change in the proportion of total world exports exported from one region/country to another. The figures are based on manufactured products. Crude oil and other products from mining and quarrying are excluded. For example, EU intra-regional trade declined by 7.3 pp between 2004 and 2013.

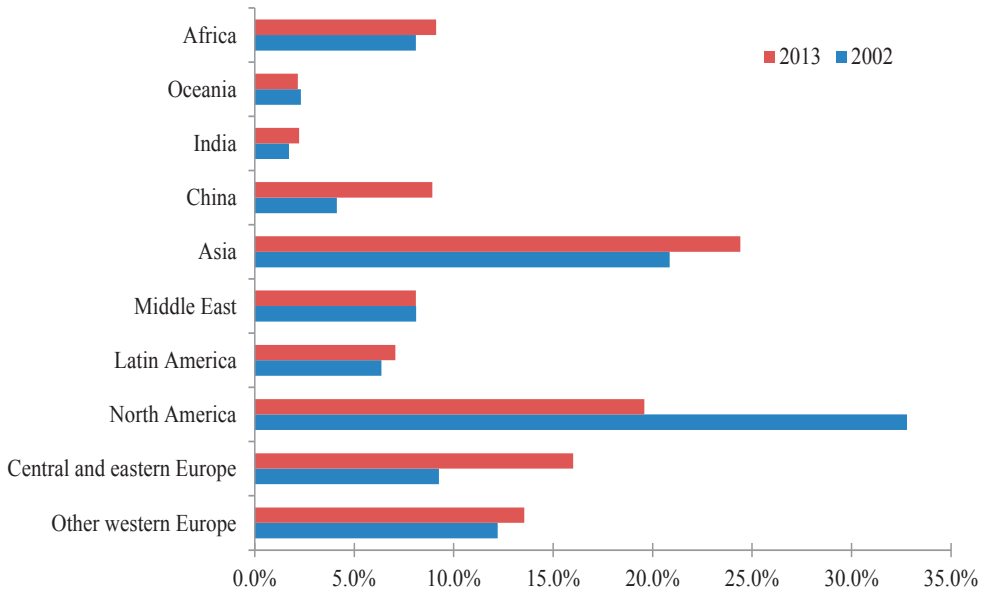
[32] Since 2013, the strong growth in EU exports has been partially reversed. This most recent performance contrasts with continuing growth in the USA.

[33] A comparison between EU and North American exports provides further evidence that EU exporters received a significant boost from a weaker euro. Since 2008, extra-EU exports to virtually all regions except Latin America have grown more than North America's; this is almost the reverse of the pattern in the lead-up to the crisis (2004-2008), when the US dollar weakened.

Developing economies' increasing share of world exports has not been solely driven by east-west flows. Since 2004, exports within Asia have grown by just under 3 pp as a proportion of global export flows. This was a result of intra-Asia flows expanding by roughly one-and-a-half times the growth rate of world export flows, partly on account of a rapid expansion in trade between China and India. This expansion is related mainly to fast-growing domestic demand from an emerging middle class, but also to outsourcing of some parts of global value chains from advanced to emerging countries and to well-targeted industrial policies for upgrading technology. Trade barriers have also been lowered to promote the integration of Asian manufacturers in global supply chains. Finally, Asian manufacturers also benefited from the liberalisation of global trade.

Asia has become the main source of demand for extra-regional EU goods exports, absorbing around a quarter of extra-EU exports, followed by North America, (non-EU) central and eastern Europe and (non-EU) western Europe (see Figure 3.1).

Figure 3.1: EU goods export basket — shares (2002 and 2013)

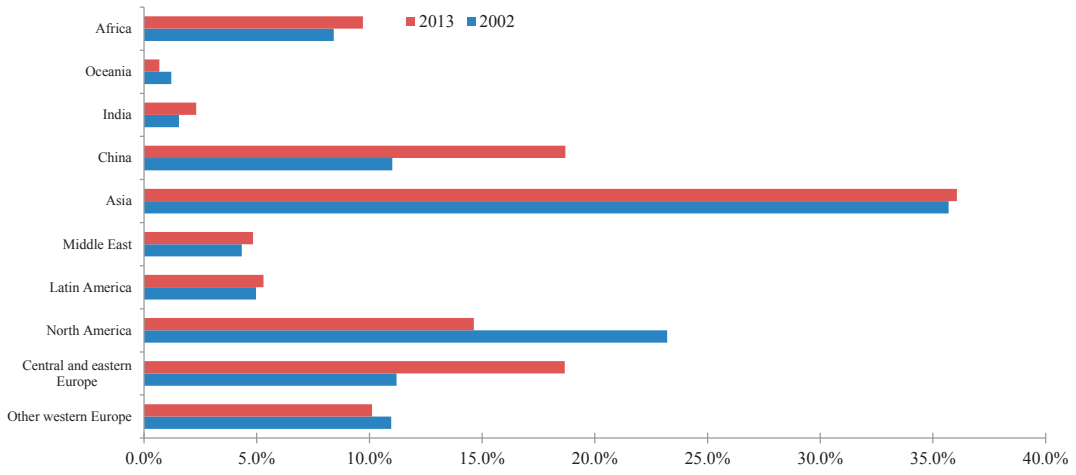


Source: own calculations based on Comtrade data

Overall, the EU's export geography has become more balanced since 2002. The most important change affecting export destinations has been a significant decline of North America as a source of demand relative to other regions. From being the most important trade partner, absorbing demand for over 30% of the EU's exports in 2002, the USA has seen its share of demand fall to below 20%. Asia has significantly overtaken it as the main importer of EU goods exports. The neighbouring and developing region of central and Eastern Europe has also become a more important source of demand. There has been weak or negative growth in the proportion of goods exports destined for Africa, the Middle East and India.

The EU is mainly dependent on Asia for its imports. (Asia is the main source of imports for most regions in the world, with the exception of those neighbouring the EU, including Africa). Since 2002, EU goods imports have shifted away from North America to China and central and eastern Europe. There have been moderate increases in the relative weights of India, the Middle East and Africa in the EU's import basket (see Figure 3.2).

Figure 3.2: EU goods import basket — shares (2002 and 2013)



Source: own calculations using Comtrade data

The EU's trade maps for manufacturing exports and imports reflect the fact that it trades mainly with economic partners at a similar level of development, but there are noticeable variations across sectors. (It is worth underlining that the analysis below refers to manufactured goods only, so agriculture and mining (including energy) products are not included). The main trade partners' shares in EU manufacturing trade are concentrated with high- and upper-medium-income partners.

Table 3.3: Share of trade partners in EU exports of manufactured goods, 2013 (%)

NACE CODE / Trade Partner		High income (non EU)	Upper medium income (non EU)	Low-medium income	Low income	USA	Japan	BRIC	Brazil	China	India	Russia
C10	Food	0.45	0.28	0.21	0.05	0.10	0.05	0.21	0.02	0.07	0.00	0.11
C11	Beverages	0.67	0.18	0.13	0.03	0.32	0.05	0.13	0.02	0.05	0.00	0.06
C12	Tobacco	0.60	0.25	0.14	0.01	0.01	0.15	0.02	0.00	0.01	0.00	0.01
C13	Textiles	0.38	0.26	0.31	0.04	0.11	0.03	0.17	0.01	0.07	0.01	0.07
C14	Clothing	0.56	0.28	0.14	0.03	0.11	0.06	0.21	0.00	0.04	0.00	0.16
C15	Leather and footwear	0.65	0.20	0.14	0.01	0.14	0.08	0.17	0.00	0.06	0.01	0.09
C16	Wood and wood products	0.56	0.23	0.20	0.02	0.08	0.12	0.12	0.00	0.05	0.01	0.06
C17	Paper	0.36	0.35	0.27	0.03	0.09	0.02	0.24	0.02	0.08	0.03	0.11
C18	Printing	0.49	0.33	0.16	0.02	0.21	0.01	0.21	0.03	0.05	0.01	0.12
C19	Refined petroleum	0.43	0.26	0.22	0.09	0.21	0.00	0.04	0.01	0.01	0.00	0.01
C20	Chemicals	0.47	0.30	0.20	0.02	0.20	0.04	0.22	0.04	0.08	0.03	0.08
C21	Pharmaceuticals	0.63	0.22	0.12	0.03	0.29	0.07	0.16	0.03	0.05	0.01	0.07
C22	Rubber and plastics	0.46	0.31	0.21	0.02	0.16	0.02	0.22	0.03	0.08	0.02	0.10
C23	Non-metallic mineral products	0.50	0.29	0.18	0.02	0.17	0.02	0.18	0.03	0.05	0.02	0.09
C24	Basic metals	0.71	0.15	0.14	0.01	0.08	0.01	0.10	0.01	0.05	0.03	0.02
C25	Metal products	0.49	0.30	0.20	0.02	0.15	0.02	0.21	0.03	0.08	0.02	0.09
C26	Computers, electronic and optical	0.55	0.24	0.20	0.02	0.19	0.04	0.22	0.02	0.10	0.02	0.09
C27	Electrical equipment	0.44	0.28	0.26	0.02	0.14	0.02	0.25	0.02	0.11	0.02	0.09
C28	Machinery n.e.c.	0.43	0.29	0.25	0.03	0.17	0.02	0.27	0.04	0.12	0.03	0.09
C29	Motor vehicles	0.46	0.30	0.22	0.01	0.21	0.04	0.28	0.03	0.16	0.01	0.09
C30	Other transport equipment	0.60	0.18	0.20	0.02	0.24	0.03	0.18	0.02	0.10	0.02	0.04
C31	Furniture	0.61	0.23	0.15	0.01	0.15	0.02	0.20	0.01	0.06	0.01	0.13
C32	Other manufacturing	0.69	0.17	0.13	0.01	0.22	0.05	0.13	0.01	0.05	0.02	0.05

Source: own calculations using Comtrade database.
Note: Intra-EU trade is excluded.

In all manufacturing sectors except textiles, paper, electrical equipment, machinery and motor vehicles, about half or more of EU-27 exports were destined for high-income countries in 2013 (see Table 3.3). For basic metals, the figure was just over 70%. However, there has been a 'downhill' shift in demand for EU manufactured exports. Demand from high-income economies fell by just over 2 pp between 2007 and 2013, while demand from low-medium economies, notably China, increased across all sectors.[34]

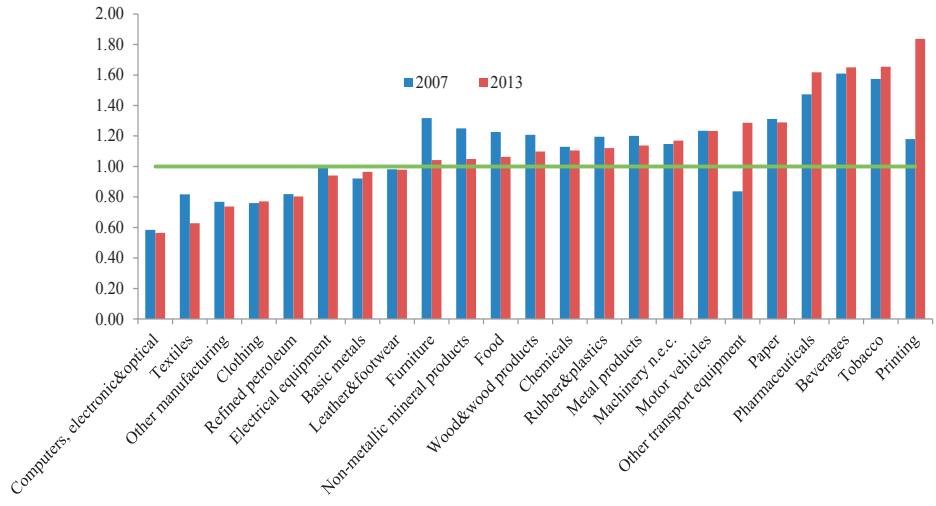
On average, EU industrial sectors import around 40% of goods from high-income economies, just over 20% from upper-medium-income, 35% from low-medium-income and just under 5% from low-income economies. In general, EU industries tend to import from partners with lower income levels than those to which they export. This tendency is more pronounced in the case of sectors lower down the technology ladder, e.g. *Food*, *Beverages*, *Tobacco*, *Textiles*, *Clothing*, *Leather and footwear* and *Wood and wood products*.

3.2 REVEALED COMPARATIVE ADVANTAGES IN MANUFACTURING

In 2013, the EU-28 recorded revealed comparative advantages (RCAs), based on extra-EU exports, above unity in around two thirds of all sectors, namely *Printing*, *Tobacco*, *Beverages*, *Clothing, Pharmaceuticals, Paper, Other transport equipment, Motor vehicles, Machinery n.e.c.*, *Metal products*, *Rubber and plastics*, *Chemicals*, *Wood and wood products*, *Food*, *Non-metallic mineral products* and *Furniture*. In general, the EU has higher RCAs in higher technology sectors. However, it also has a notable weakness in the higher technology sector *Computers, electronic and optical equipment* sector (see Figure 3.3).

As compared with 2007, RCA indices have increased for *Tobacco*, *Basic metals*, *Motor vehicles*, *Printing*, *Machinery n.e.c.*, *Pharmaceuticals*, and *Other transport equipment*.

Figure 3.3: RCA index for manufactured goods (2013)



Source: Own calculations using COMTRADE data

[34] In contrast to the overall pattern, demand from Russia and India actually fell slightly between 2007 and 2011.

Box 3.1: Revealed comparative advantage (RCA) indicator

The RCA indicator for product 'i' is defined as follows:

$$RCA_i = \frac{\frac{X_{EU,i}}{\sum_i X_{EU,i}}}{\frac{X_{W,i}}{\sum_i XW,i}}$$

where: X=value of exports; the reference group ('W') is the EU-27 plus 142 other countries. The source used is the UN COMTRADE database. In the calculation of RCA, X_{EU} stands for exports to the rest of the world (excluding intra-EU trade) and X_W measures exports to the rest of the world by the countries in the reference group.[35] Values greater than unity indicate that a given industry performs better than the group of reference countries.

When interpreting the results, some considerations should be taken into account:

- the level of sector aggregation may mask differing performance in various categories of goods within the same group of products. This is particularly relevant for industries which have a large variety of brands and quality levels for the same type of goods;
- smaller countries tend to have a wider range of RCA indices, because the manufacturing base tends to be narrower. Hence, RCAs alone are insufficient to gauge market competitiveness;
- another consideration concerns country heterogeneity within the EU, as the performance of the EU as a whole is explained in some cases by the performance of a few EU countries;
- finally, the weight of each sector and country in the export structure of the EU should be borne in mind to get to a balanced assessment of the EU's sector performance in external trade.

The EU has a more balanced RCA profile across sectors (see Table 3.4) than its international competitors. This may be partly due to its economy's lower resource endowment and larger size, compared to peers. By comparison, the United States had RCAs in the following groups of products in 2013: *Paper*, *Printing*, *Refined petroleum*, *Chemicals*, *Computers, electronics and optical equipment*, *Motor vehicles*, *Machinery n.e.c.* and *Other manufacturing*, with weaknesses in some low-technology sectors. Japan stands out as having a relatively unbalanced RCA profile across sectors, with very high RCAs in machinery and motor vehicles but also particularly low RCAs in some clothing, leather and footwear, and wood-based products. China's profile is notable in that it has high RCAs in high-technology sectors, but also in low-technology sectors such as textiles and clothing.

[35] See Balassa (1965). A disadvantage with the measure is that it can assume values between zero and infinity. See European Commission (2010) for an alternative specification which keeps the index to a range between -1 and +1, with positive values indicating RCAs.

Table 3.4: RCA index for manufactured goods (2013) — international comparison

	EU-28	USA	Japan	Brazil	China	India	Russia
Food	1.06	0.88	0.08	4.70	0.33	1.58	0.64
Beverages	1.65	0.83	0.07	0.13	0.08	0.11	0.29
Tobacco	1.65	0.28	0.07	0.65	0.17	0.44	1.58
Textiles	0.63	0.50	0.42	0.31	2.45	2.98	0.08
Clothing	0.77	0.16	0.02	0.04	2.73	1.92	0.05
Leather and footwear	0.98	0.22	0.02	1.85	2.59	1.28	0.15
Wood and wood products	1.10	0.60	0.02	1.76	0.83	0.15	3.05
Paper	1.29	1.11	0.30	3.06	0.49	0.24	0.89
Printing	1.84	0.46	0.11	0.40	0.19	0.73	0.69
Refined petroleum	0.80	1.40	0.36	0.41	0.20	3.12	7.22
Chemicals	1.11	1.30	1.03	0.90	0.46	0.99	1.25
Pharmaceuticals	1.62	0.90	0.16	0.33	0.20	1.15	0.07
Rubber and plastics	1.12	0.95	1.03	0.61	1.09	0.59	0.31
Non-metallic mineral products	1.05	0.68	0.93	1.02	1.66	0.77	0.55
Basic metals	0.96	0.77	1.12	1.53	0.48	0.94	2.56
Metal products	1.14	0.89	0.74	0.70	1.26	0.96	0.35
Computers, electronic & optical	0.56	1.02	1.11	0.08	2.08	0.16	0.12
Electrical equipment	0.94	0.87	1.12	0.44	1.58	0.36	0.23
Machinery n.e.c.	1.17	1.33	1.89	0.73	0.73	0.40	0.19
Motor vehicles	1.23	1.04	2.24	0.99	0.25	0.37	0.16
Other transport equipment	1.29	0.45	1.14	3.26	0.53	0.98	0.83
Furniture	1.04	0.48	0.12	0.45	2.17	0.30	0.12
Other manufacturing	0.74	1.57	0.37	0.16	1.47	3.92	0.37

Source: Own calculations using COMTRADE data (extra-EU trade)

Resource endowment is evident in the RCA profile of Brazil, which has comparative advantages particularly in *Food* and *Paper*, but also in *Basic metals*, *Leather & footwear* and *Wood products*. This is also the case with Russia, which has comparative advantages in *Wood products*, *Refined petroleum products*, *Chemicals* and *Basic metals*. India can be contrasted with China in having high RCAs in low/medium-technology sectors but relatively low RCAs in medium/high- and high-technology sectors. The *Pharmaceuticals* sector is a notable exception.

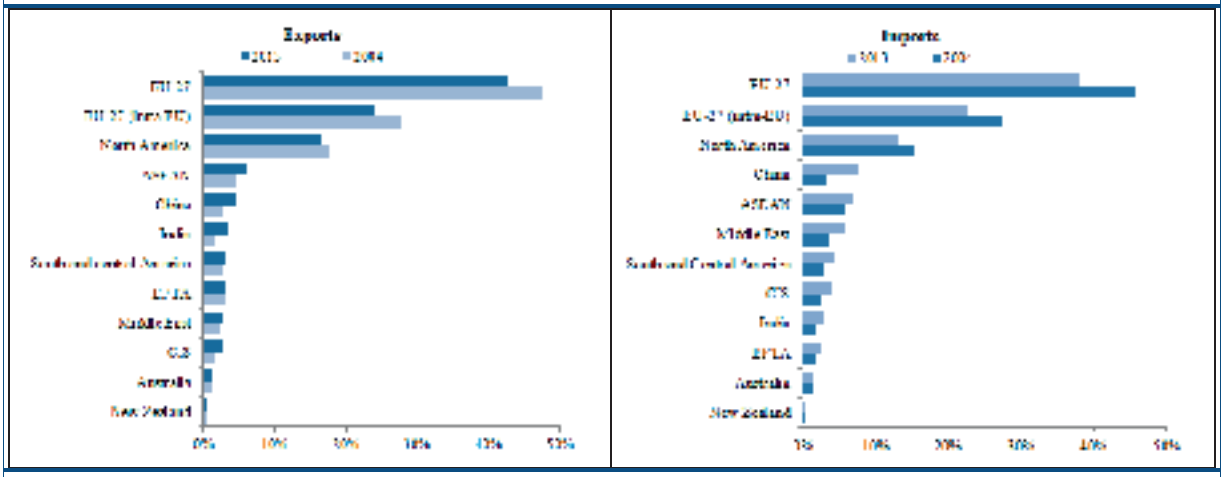
3.3 EU EXPORTS OF SERVICES

The EU is the world's largest exporter of services, accounting for 43% of world trade, when intra-EU trade is included (see Figure 3.4). Extra-EU services trade represents 19% of global flows and intra-EU trade in services represents 24%.[36] Hence, the EU is a more dominant player in global trade in services than in goods trade. North America is the second largest region in terms of services trade, with just under 17% of global flows.

The broad development in services exports is similar to that in manufacturing exports. The EU's share of global services exports declined between 2004 and 2013, as did North America's, albeit at a slower rate. Since 2004, the EU's share of services exports has fallen by approximately 5 pp as a proportion of global services exports at current prices. The EU and North America currently account for around two thirds of global services exports, compared with around a half of global goods exports. Developing economies' shares of services exports are increasing more gradually than those of exported goods. An exception is India, which nearly doubled its share of global services exports between 2003 and 2014.

[36] Intra-regional EU services exports represent 9.1% of total services value added (based on WTO and Eurostat figures for 2013, excluding construction). Extra-EU services exports represent 7.3% of EU services value added.

Figures 3.4 and 3.5: Services exports and imports by region (% of world services exports/imports)



Source: WTO trade statistics, own calculations

The pattern of services imports (see Figure 3.5) is similar to that of services exports. Emerging economies have increased their share of services imports, whereas the share of developed economies has declined. However, the share of services imports has increased more than the share of services exports in most developing economies, with the notable exception of India.

Although services represent only about a quarter of overall trade,[37] the proportion may increase in future as technological developments facilitate more trade in services. In particular, developments in communication technologies have enabled and increased the tradability of many services, including business services, finance, education and health services. Services trade has also been boosted by the liberalisation of monopoly services such as voice telephony and postal services, and regulatory reforms in areas such as transport. In addition, global trade liberalisation has also promoted trade in services.

The most significant development was the completion of the General Agreement on Trade in Services (GATS) in 1995. Trade in services differs substantially from manufacturing trade, for example as regards product transactions between countries. A definition of trade in services and a presentation of the various services industries is provided in Box 3.2.

[37] Services exports represent slightly over 25% of overall exports of goods and services combined according to Eurostat figures. The proportion of services exports has risen about 2 pp over the last 10 years.

Box 3.2: International trade in services: definition, sector breakdown and measurement

International trade in services involves transactions between residents and non-residents of an economy. Services are less tradeable than goods. As they are immediately consumed, they cannot be resold. For many services, the consumer and provider of the service have to be located in the same place.

International trade statistics[38] cover the main components of international services trade broken down into three categories grouping together 11 types of services sector:

1. transportation
2. travel
3. other services, including communication, construction, insurance, financial, computer and information services, royalties and licence fees, other business services, personal, cultural and recreational services and government services

GATS defines trade in services in terms of four modes:

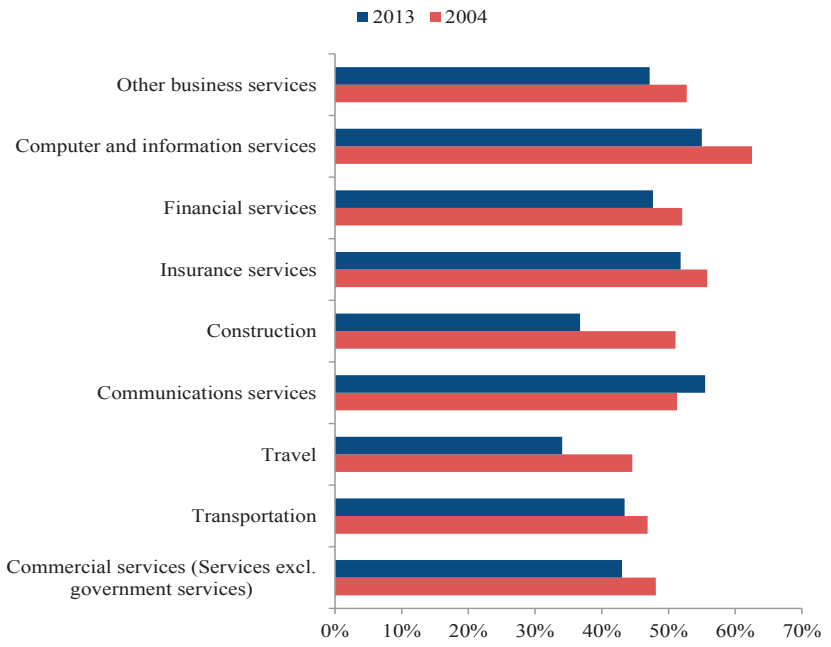
- mode 1 is **cross-border supply**, where only the service crosses the border, e.g. electronically (by internet, telephone, facsimile, etc.). The sectors concerned are most transportation, communication, financial and insurance services, and royalties and licence fees. Parts of computer and information services, other business services and personal, cultural and recreational services can also involve cross-border supply;
- mode 2 is **consumption abroad**. This is the case principally for tourism or business travel, when individuals go to hotels and restaurants. Part of transportation can also be counted as consumption abroad (supporting and auxiliary services for carriers in foreign ports);
- mode 3 is **commercial presence**, e.g. where a foreign company opens branches or subsidiaries in the destination country. Some construction services involve commercial presence;
- mode 4 is the **presence of natural persons**. A self-employed individual (e.g. a consultant or a health worker) or an employee (e.g. a construction worker) moves temporarily to the country of the consumer to supply services. This form of trade is found in part of the computer and information services sector, part of 'other business services', part of the personal, cultural and recreational services sector and part of the construction services sector.

At EU sector level, the shares of communication services and insurance services have increased slightly since 2004 (see Figure 3.6).[39] All other sectors have witnessed a decline. The steepest decline (over 15 pp) has been in construction services, followed by travel (just over 10 pp) and computer and information services (over 8 pp).

[38] *Manual on Statistics of International Trade in Services*, United Nations Secretariat; http://unstats.un.org/unsd/tradeserv/TFSITS/manual.htm.

[39] The market shares include services trade between EU Member States.

Figure 3.6: Market share of EU services by sector (% of world exports)



Source: WTO trade statistics, own calculations

As in the case of manufactured exports, the EU has a more balanced RCA profile than the United States across service sectors (extra-EU services exports). It also displays RCAs in all sectors except travel. The highest RCA value is in personal, cultural and recreational services, which include education and health services, followed by communication services.

The main strength of the US economy is in financial services, followed by insurance services. The services RCA profile of Japan, China and Russia all show a very high index for construction. However, this may reflect underdevelopment of exports in other sectors as much as strength in that sector. India shows a particularly high RCA for computer and information services, which include software engineering (see Table 3.5).

Table 3.5: RCAs in services (2013), EU Member States, USA, Japan and BRIC countries

	EU28	US	Japan	Brazil	China	India	Russia
Communications services	1.36	1.00	0.29	0.31	0.29	0.53	0.97
Computer and information services	1.12	0.52	0.24	0.18	1.14	5.04	0.62
Construction	1.07	n.a.	3.50	0.04	2.15	0.34	3.69
Financial services	1.21	2.05	0.52	1.02	0.20	0.52	0.34
Insurance services	1.28	1.25	0.06	0.54	0.84	0.61	0.38
Other business services	1.18	0.91	1.28	1.93	1.35	1.19	0.99
Personal, cultural and recreational services	1.44	n.a.	0.14	0.14	0.08	0.85	1.23
Transportation	1.07	0.78	1.66	0.70	0.88	0.54	1.53
Travel	0.59	1.19	0.49	0.67	0.93	0.45	0.68

Source: own calculations based on WTO data.
Note: Construction is included on the basis of the WTO classification.

3.4 DOMESTIC VALUE-ADDED CONTENT OF EXPORTS

Trade flow statistics are usually reported in gross terms. Although this is useful for many purposes, gross trade flows do not reveal the proportion of imported intermediate goods and services that go into making a final export good or service. For many industries, there are significant differences among countries depending on where in the value chains these industries are located. Moreover, gross trade flows 'double-account' for underlying intermediate goods and services, as many goods are exported initially as an intermediate good or service and accounted for a second time (or more) when the final product or service is sold, because their value is included in the price of the end product.[40]

Supply chains reflect the value added of separate goods and services that go to make up a final product. By drawing on statistics from national accounting and combining these statistics at international level, it is possible to get a picture of where and how much value is added in individual countries and sectors. As a consequence of global supply chains, the export price of an end product may reflect only a fraction of the value of domestic goods or services involved in its production. For example, an iPod sold by a factory in China has been found to be largely made up of foreign value added.[41] The relevance of measuring international trade in value-added terms is growing as the global economy has become increasingly integrated.[42] Around two thirds of international trade is in intermediate goods[43] and the degree of double accounting is rising.

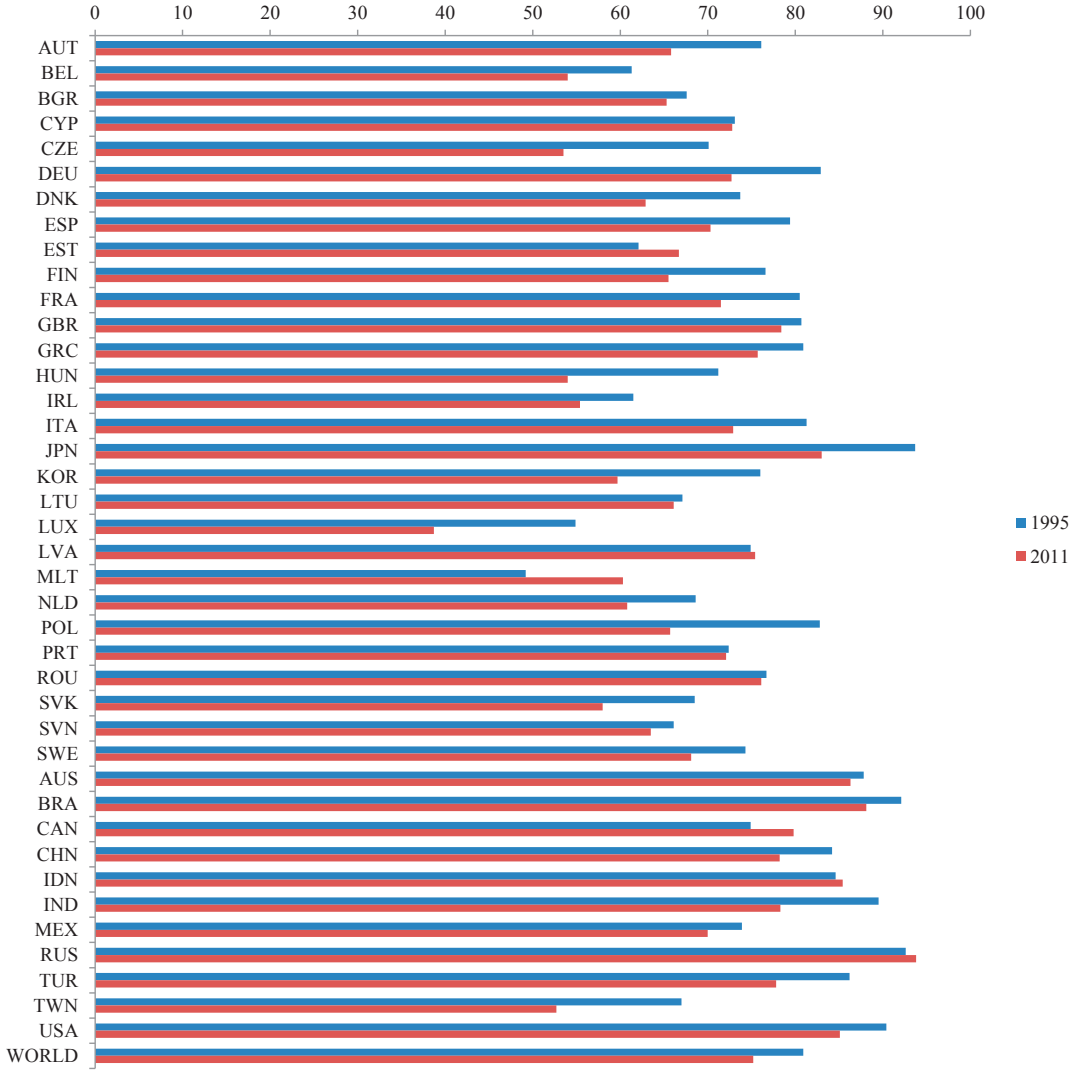
40 Koopman *et al.* (2010), Leamer *et al.* (2006).

40 Dedrick *et al.* (2008).

42 The spread of global value chains has been enabled by technological advances that have reduced trade and coordination costs. Container ships and jet engines, for example, have decreased transport costs and facilitated the movement of goods and people. The development of ICT technologies has also been an important driver, as the internet and more reliable communication infrastructures have substantially reduced companies' costs as regards coordinating activities across countries.

43 Johnson and Noguera (2012).

Figure 3.7: Domestic value added in gross exports (goods and services) (%)



Source: WIOD data

One indication of how much an economy or a sector is integrated in global value chains is the proportion of foreign intermediate goods or services it uses to produce its exports and how much it supplies intermediate goods and services for the production of other countries' exports. As global trade continues to grow, the domestic content of exports is declining. Since 1995, the share of domestic value added in gross exports has fallen for the majority of exporters (see Figure 3.7).[44]

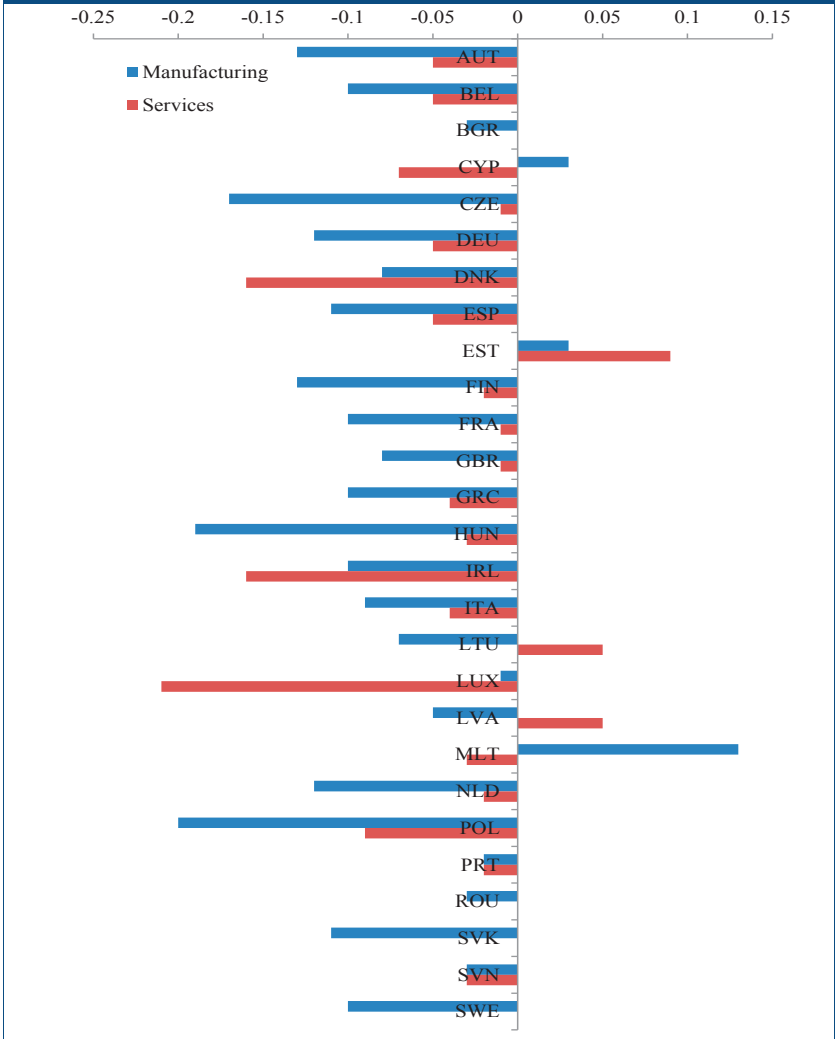
This is an indication of the growing integration of economies in global supply chains.[45] The biggest declines in the EU have been in Hungary, Poland and the Czech Republic. On average, the decline in domestic valued added as a proportion of gross exports has been greater in EU Member States than in other countries. This may be partly due to the impact of

[44] Figures taken from Stehrer (2013).

[45] Of the EU Member States, only Malta, Estonia and Latvia have increased their share of domestic value added in gross exports.

the single market. Internationally, the biggest declines have been in Korea and Taiwan, which have comparatively large manufacturing sectors increasingly sourcing intermediate products and services from abroad. The three economies outside the EU for which the proportion of domestic value in gross exports has risen since 1995, namely Canada, Russia and Indonesia, are all resource-rich economies which are less reliant on imports.

Figure 3.8: Change in proportion of domestic value added in services and manufacturing, 1995-2011 (pp), EU-27 Member States



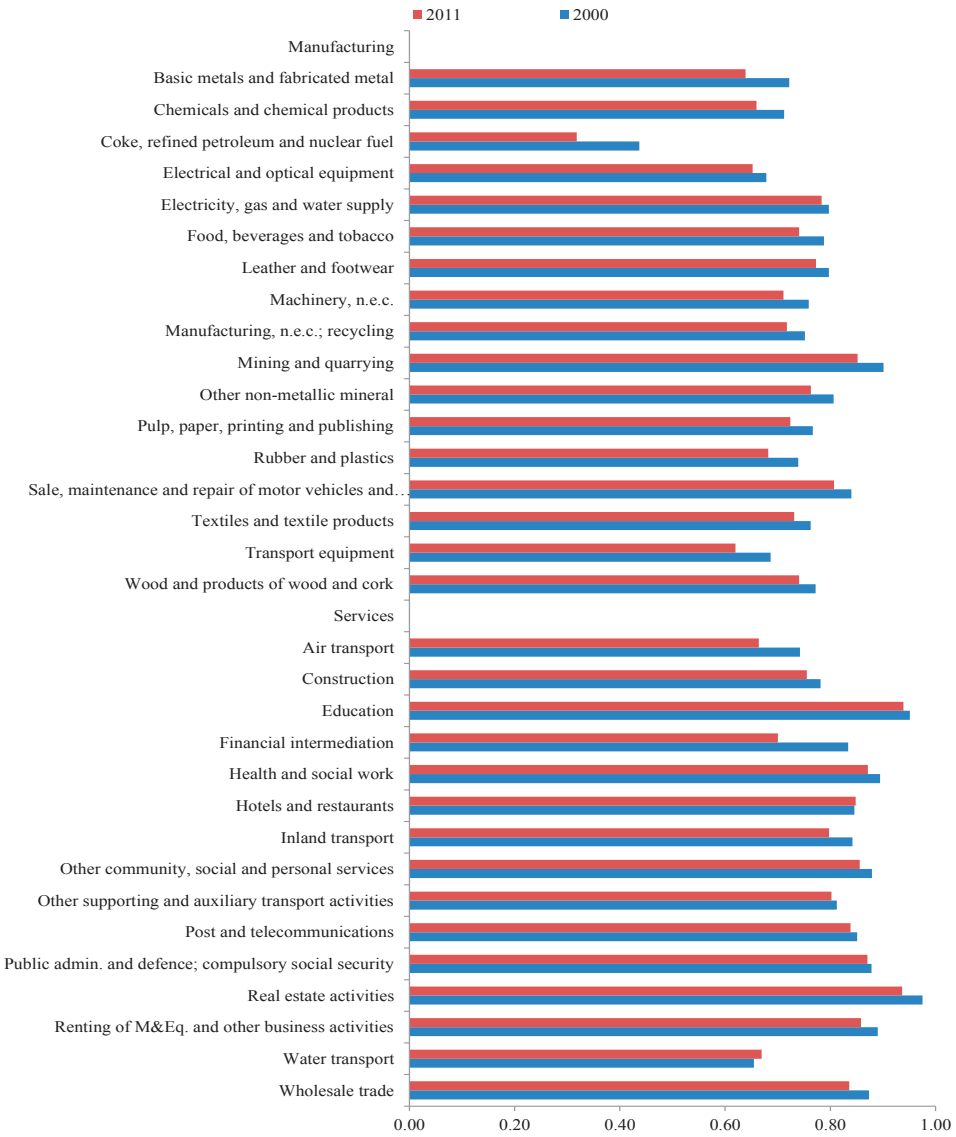
Source: own calculations based on WIOD data

The decline in domestic value added as a proportion of gross exports has occurred in both manufacturing and services. In general, the shift towards greater integration in global value chains is more apparent in manufacturing than in services, because the latter are less tradable. The decline in the manufacturing sector between 1995 and 2011 was roughly twice that in service industries (around 7 pp as compared with 3 pp). There are a few notable exceptions among EU Member States: for Luxembourg, for example, domestic value added as a proportion of exports has fallen much more in services than manufacturing. This is mainly due to the financial intermediation sector, where there was a sharp decline of 23 pp (see Figure 3.8).

The increasing cross-sector integration of the EU economy in global value chains can also be seen from the point of view of dependency on foreign demand, which has increased since 1995 for all sectors of the EU economy, with the exception of public administration including defence (see Figure 3.9).[46]

Manufacturing sectors have increased their dependency on external demand more than services. The greatest increases have been in manufacturing sectors such as *Chemicals and chemical products* and *Coke, refined petroleum and nuclear fuel*. In services, the largest increases have been in *Water transport* and *Financial intermediation*.

Figure 3.9: EU value added in exports due to foreign demand (%)



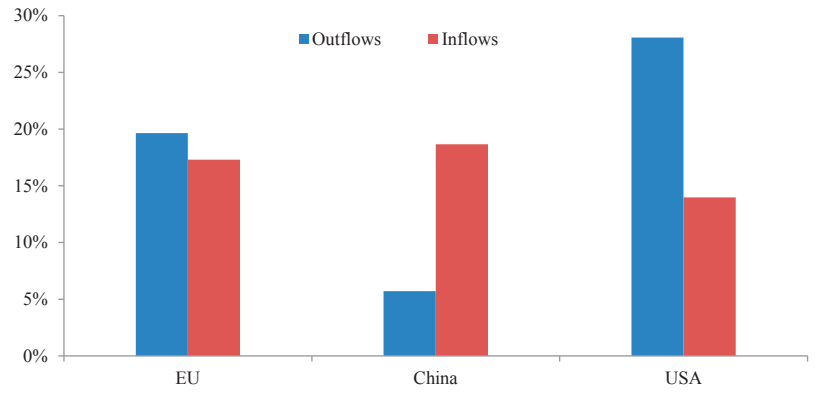
Source: Foster et al. *(2013) based on WIOD data*

[46] Foster *et al.* (2013).

3.5 FOREIGN DIRECT INVESTMENT AND INTERNATIONAL OUTSOURCING

The EU accounts for a significant proportion of global FDI flows, with around 31% and 28% of global inflows and outflows respectively, calculated on the basis of extra-EU flows (see Figure 3.10) in 2012. It is the primary destination for global inflows and until 2011 was the primary source of FDI outflows. However, the latest figures, for 2012, show that it is currently on a par with the United States as a source of global FDI outflows.[47]

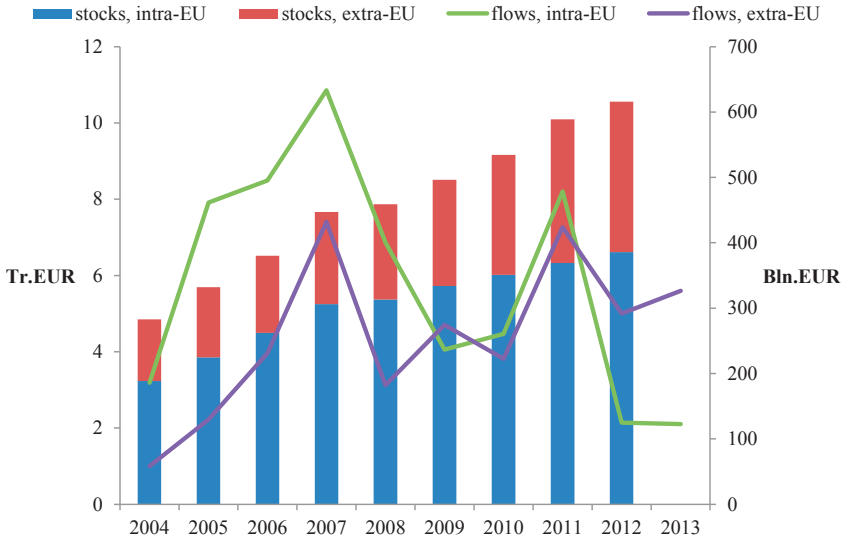
Figure 3.10: FDI flows in 2012 — proportion of world flows



Source: OECD

As shown in Chapter 1, the recession and the slow recovery had a strong negative effect on investment in the EU and there has been a steep decline in cross-border flows. In 2013, intra-EU inflows were 20% of their highest level in 2007, in nominal terms (see Figure 3.11).

Figure 3.11: EU inbound FDI stocks (lhs, EUR trillion) and flows (rhs, EUR billion) (2004-2013)



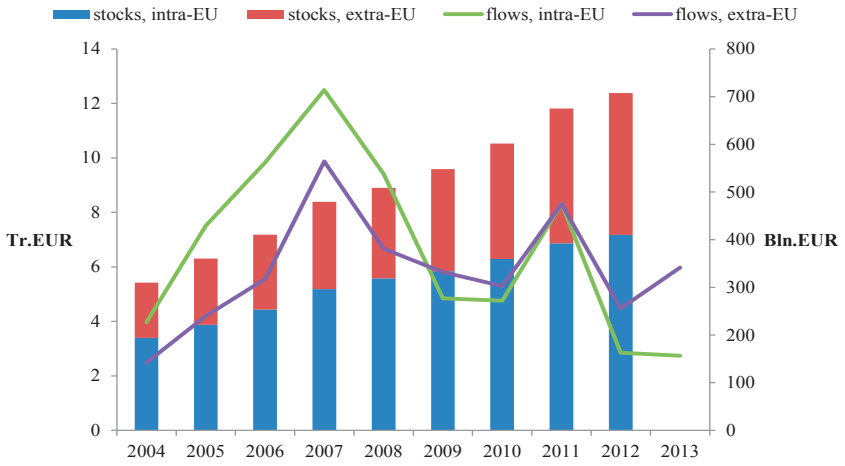
Source: Eurostat

[47] Based on Eurostat and UNCTAD figures.

Partly as a consequence, non-EU countries have become a more important source of FDI, because extra-EU inflows, though lower before the crisis, have been more resilient and have fallen far less. The falloff in FDI flows since 2007 is in line with the broader pro-cyclical trend of declining investment spending, in both the private and public sectors.

Both intra- and extra-EU inflows started rising in 2011, in response to an improving economic outlook, but fell sharply again in 2012, below 2008 levels. In 2013, combined intra- and extra-EU FDI inflows increased by around 7% compared to 2012. This was due to the positive contribution of extra-EU inflows, as intra-EU inflows fell slightly. The fall in intra-EU inflows since the crisis has been broad-based, rather than concentrated in the Member States in which growth has been worst hit by the crisis. A key factor in the decline of EU FDI has been a fall in mergers and acquisitions combined with an increase in the divestment ratio (OECD 2014).[48]

Figure 3.12: EU outbound FDI stocks (lhs, EUR trillion) and flows (rhs, EUR billion) (2004-2013)



Source: Eurostat

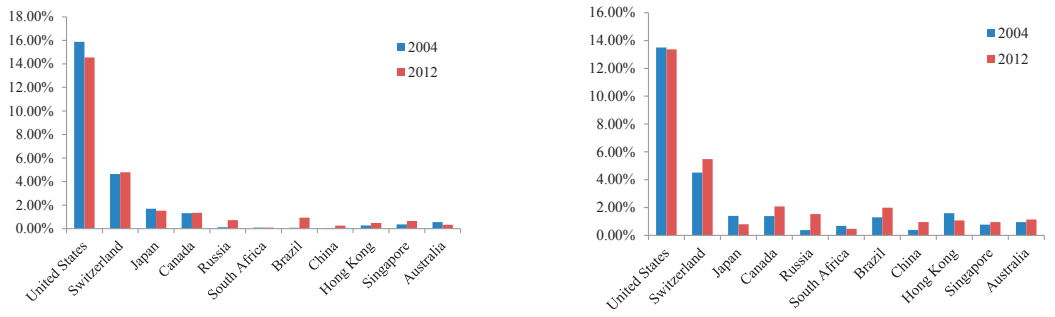
FDI outflows have followed a similar pattern to FDI inflows (see Figure 3.12), falling sharply at the start of the crisis, rebounding partially in 2011 and subsequently falling back again. Since the crisis, intra-EU FDI outflows have fallen more than outflows to the rest of the world, indicating that EU enterprises have been more positive about external prospects. While the fall in extra-EU outflows has been much less in absolute terms than the fall in intra-EU outflows, neither component has recovered to pre-crisis levels.

With respect to FDI stocks, the United States is the EU's biggest FDI partner for both outflows and inflows, followed by Switzerland and Japan. Although stocks with FDI partners in emerging economies are still low, there have been marked developments in relationships with Russia, Brazil and China.

FDI flows tend to be mutual, i.e. shares of inward- and outward FDI with the EU's main trade partners are similar (see Figure 3.13). The main partner for inward and outward FDI is the USA, which has a considerably larger proportion of EU FDI than other countries. There is a trend of emerging economies participating increasingly in FDI with the EU. Most of the development in FDI relationships has been with these economies, albeit from a low base.

[48] The increase is partly due to a revival of inflows to Germany, Spain and Italy.

Figure 3.13: Main FDI partners with the EU (stocks) – inward FDI and outward FDI

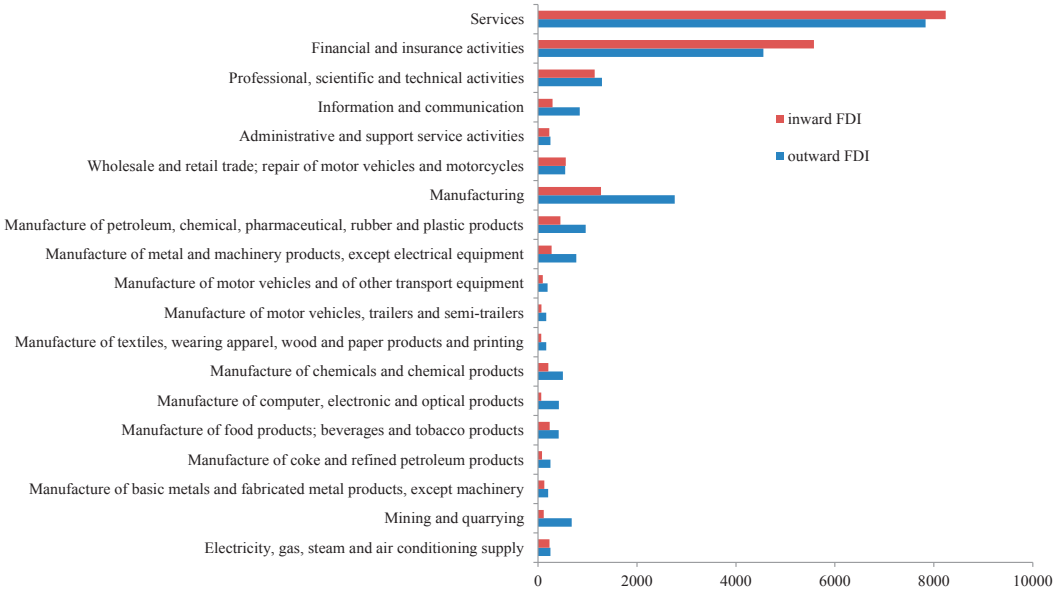


Source: own calculations based on Eurostat data

FDI stocks are more concentrated in services than manufacturing (see Figure 3.14). The larger share of services in FDI contrasts with the minor share of services in trade flows. These positions are sometimes considered to be partly complementary in that the non-tradability of many services encourages investment abroad to open up new markets, while the greater tradability of goods encourages more direct trade flows. Services are more dominant with respect to inflows, whereas the gap between services and manufacturing is narrower with regard to outflows.

In the future, technical and regulatory developments in international trade are likely to encourage greater trade flows in services. At sector level, inward and outward stocks are also mutual in the sense that they are loosely balanced for most sectors with respect to the overall stock of FDI. For example, stocks in the financial and insurance sector comprise nearly 40% of all outward FDI stock and just over 56% of all inward FDI stock. As well as the impact of equity investment, the balance between inward and outward FDI on a sector basis may be due to inter-company lending between parents and affiliates, which is also a component of FDI.

Figure 3.14: EU inward and outward FDI stocks by main sectors (2011) — EUR billion



Source: own calculations based on Eurostat data

3.5.1 Offshoring/re-shoring

Offshoring is the relocating of business functions outside the current country of operations. The practice can involve significant numbers of jobs being transferred overseas, but the long-term consequences may be positive in terms of productivity gains for the enterprises concerned and the wider economy. More recently, the economic literature has referred to a growing phenomenon of 're-shoring', whereby enterprises repatriate their operations. This section examines both sides of the equation, including the sectors and business functions most affected, current trends, main drivers and benefits, and the economic factors that may influence current and future relocation decisions.

Business functions can be relocated within or outside an enterprise structure and at home or abroad. Intra-firm (captive) offshoring overlaps with the concept of FDI in that it is carried out for the purposes of shifting existing production facilities.[49]

Schema of offshoring activities		
Relocation of production	Intra-mural	Extra-mural
Home country	Production retained in-house	Production outsourced
Foreign country	Production offshored	Production offshored and outsourced

A lack of data has hampered research on the motivation for and effects of offshoring, and there is only a limited body of research on the topic. Survey information indicates that reducing labour costs is one of most common motives (ECR 2012). Offshoring firms have also cited proximity to customers and expansion of markets as important factors. An econometric analysis based on survey information found that offshoring was positively related to firm size and revenue per employee.[50] These results are in line with findings on domestic outsourcing, where more productive firms are more likely to outsource their inputs and less productive firms more likely to internalise them (Defever and Toubal, 2013), and research on FDI (Markusen, 2002) which has found that large and more productive firms choose to go abroad. These results appear to contrast partly with a study on offshoring in US firms, which found that less profitable firms are more likely to offshore, as well as firms with higher labour and administrative overheads (Donna and Wooster, 2008). The study also found that firms operating in more competitive industries, as measured by the number of firms in an industry, were more likely to offshore, as were manufacturing firms as a whole compared with firms in the service sector.

As noted above, trends in offshoring and re-shoring are difficult to identify due to limited data availability. Because there is no official obligation to classify international relocation activities, most information is obtained from surveys, e.g. Eurostat's International Sourcing Survey. In addition, this section draws on the European Restructuring Monitor (ERM) produced by Eurofound, which gathers information from press coverage of restructuring events.

Estimates of the proportion of EU companies undertaking intra- or extra-mural offshoring vary from a few per cent to over 10%. Given that micro-sized enterprises make up 92.4% of all firms,[51] it seems likely that the true figure is at the lower end of this range, because such

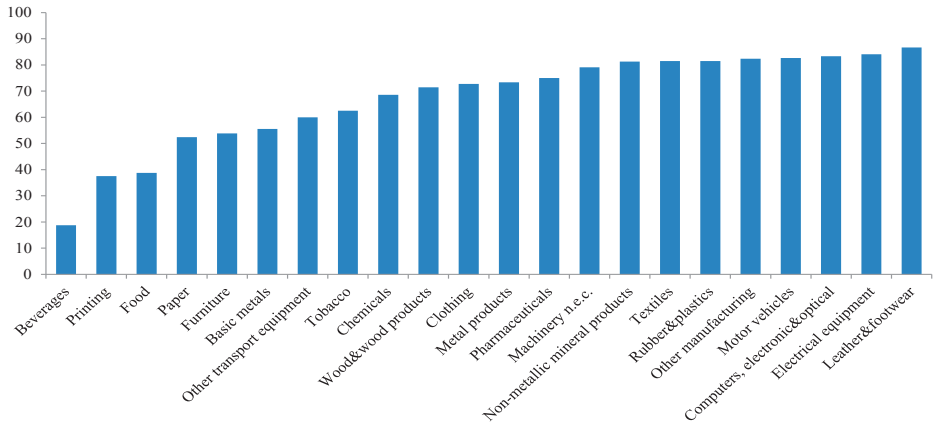
[49] Intra-firm offshoring is considered to be roughly twice as common as extra-firm offshoring (Alajääskö, 2009).

[50] The sector of operation was also found to be important: firms in the machinery and equipment, electrical and optical equipment and transport equipment sectors were found to be more likely to offshore than firms in other sectors.

[51] http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/files/supporting-documents/2014/annual-report-smes-2014_en.pdf (p. 15).

enterprises are less likely to have the capacity to offshore activities.[52] However, offshoring is a common practice among larger firms that choose to restructure. Based on the ERM dataset, in 2001-2013 nearly three quarters of all manufacturing firms which undertook restructuring activities chose to offshore, compared with just over half in services. This is not surprising given that services activities are more difficult to export,[53] due to language barriers, national regulation, etc. Within manufacturing, the offshoring rate[54] is highest in the leather and footwear industry, at over 85%, and lowest in the food and beverages industry, at just below 20% (see Figure 3.15).

Figure 3.15: Offshoring rate (2001-2013) by manufacturing sector, EU-28 (%)



Source: own calculations based on (Eurofound) ERM dataset.

There has been no comprehensive survey of offshoring across EU Member States. Of the limited number of countries surveyed by Eurostat in 2007 and 2012, the offshoring rate[55] was highest in Ireland by a considerable margin and fell dramatically in the most recent survey. This might be linked to a post-crisis effect, but could also be due to the effects of a small sample size. Ireland is also notable in that it has the EU's second highest level of FDI, as a proportion of GDP, after Luxembourg. Therefore, there may be a link between offshoring activities and existing FDI operations between parents and foreign affiliates.

Even fewer reliable statistics are available on re-shoring. The latest International Sourcing Survey indicates that on average around 2.5% of firms re-shored their activities in 2009-2011 in manufacturing sectors overall.[56] The rate was broadly similar across all sectors, but slightly higher in high- and medium/high-technology sectors.[57] Table 3.16 summarises the responses to a question on the most important factor in companies' decisions to re-shore.[58]

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52 The European Restructuring Monitor covers only large-scale company restructuring events in the EU-27. An event is included if it entails the announced destruction or creation of at least 100 jobs, or at least 10% of the workforce at sites employing more than 250 people. Cross-national restructuring events are also reported to the ERM.

53 Services account for only around 20% of all exports.

54 Calculated as offshored activities as a proportion of offshored and domestically retained activities.

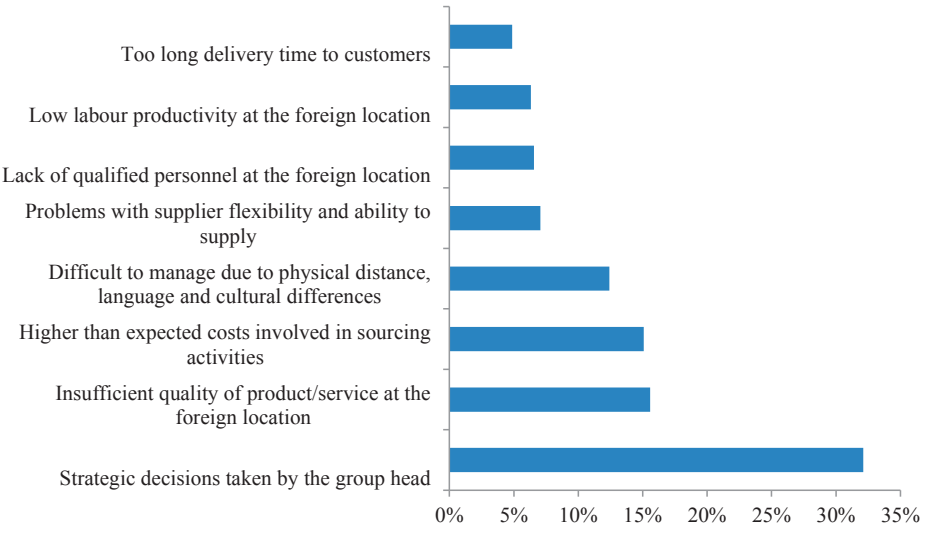
55 Calculated as the number of manufacturing enterprises that undertook international sourcing as a proportion of all manufacturing enterprises that took part in the Eurostat International Sourcing Survey in the respective survey wave.

56 Another recent survey, the European Manufacturing Survey, found that 4% of all firms re-shored production activities between 2010 and mid-2012. It estimated that offshoring is three times more common than re-shoring (EMS, 2014).

57 The first survey did not include a question on re-shoring.

58 The International Sourcing Survey covers nearly 40 000 businesses with over 100 employees.

Figure 3.16: Reasons for re-shoring



Source: own calculations based on Eurostat data

The most common reason given was a 'strategic' decision at group level, followed by low quality of product or service (see Figure 3.16). Higher-than-expected costs figure high on the list, which may be partly a consequence of rapidly rising labour costs over the past 15 years in some emerging economies. Since 2000, average nominal wage costs, calculated in local currency, have risen over 400% in China, nearly 300% in Indonesia and nearly 200% in India. This compares with 24% in Germany or 34% in the Netherlands, for example. Wage growth in the EU has been particularly subdued since 2008 (limited to single digits in many Member States), while wages in China have continued to rise, by around 100%. This means that the labour cost advantages from offshoring are considerably less than before the crisis.[59]

In summary, available data on re-shoring are very limited and probably insufficient to draw any conclusions as to current trends. Based on the data available, re-shoring is at a low level and is undertaken for firm-specific reasons. Comparative costs, particularly labour costs, are clearly an important factor in any decision to relocate activities across borders. The sharp rise in labour costs in developing economies may slow down offshoring in future. However, offshoring is partly associated with FDI and the current trend is for EU enterprises to invest more outside the EU than within it.

[59] Estimates based on figures provided by Boston Consulting Group for nominal wage costs in local currency.

3.5.2 Conclusions

The EU is the world's largest exporter of manufactured goods. On a country basis, China has become the world's largest exporter, with roughly the same proportion as the EU's extra-regional exports. The proportion of global exports stemming from the EU is falling as exports from emerging economies are growing more rapidly. Intra-EU exports are growing far more slowly than extra-EU exports. This development has been accentuated since the crisis as intra-EU exports have contracted while extra-EU exports have continued to expand. Trade as a whole is becoming more integrated. Global value chains are being increasingly cross-border, particularly so in manufactured goods. The EU specialises in higher technology sectors, based on indices of revealed comparative advantage, namely Printing, Tobacco, Beverages, Pharmaceuticals, Paper, Other transport equipment, Motor vehicles, Machinery n.e.c., Metal products, Rubber and plastics, Chemicals, Wood and wood products, Food, Non-metallic mineral products and Furniture. However, the EU still has a weakness in computers, electronic and optical equipment.

Although services exports only make up around a quarter of flows of goods and services, the proportion is increasing and this trend looks set to continue. Services trade has been boosted by a number of factors which have increased the tradability of services, including technological developments, the liberalisation of monopoly services, and the completion of the General Agreement on Trade in Services (GATS) in 1995. In the global market for services exports, the EU is a more important player than in the global export market for manufactured goods. The EU displays strengths in virtually all service sectors and has a more balanced profile in this respect than international peers. This may be partly due to the larger scale of EU services exports.

The decline in the proportion of EU manufacturing as a share of total output combined with high levels of unemployment since 2008 has raised questions about the extent of off-shoring and, more recently, re-shoring. Due to limited data, it is not possible to draw firm conclusions about either development. However, rapidly rising labour costs in emerging economies may be reducing the incentive to offshore production.

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OECD (2014), FDI in figures.

Annex I: EU Member States' RCA indices (extra-EU)

Table 3.6: RCAs for manufactured goods

	Food	Beverages	Tobacco	Textiles	Clothing	Leather &Footwear	Wood& Wood Products	Paper	Printing	Refined Petroleum	Chemicals	Pharmaceuticals	Rubber& Plastics	Non-metallic Minieral Products	Basic Metals	Metal Products	Computers, Electronic &Optical	Electrical Equipment	Machinery n.e.c.	Motor Vehicles	Other Transport Equipment	Furniture	Other Manufacturing
Austria	0.87	1.94	0.00	0.66	0.53	0.74	3.97	2.14	1.41	0.24	0.49	1.59	1.20	1.23	1.21	2.12	0.52	1.27	1.45	1.21	1.04	0.85	0.68
Belgium	1.26	1.10	1.09	0.71	0.71	1.06	0.73	0.94	7.37	1.41	2.20	3.13	0.91	0.91	0.90	0.63	0.21	0.40	0.70	1.07	0.20	0.39	1.23
Bulgaria	1.28	0.76	6.36	1.09	2.65	0.95	1.51	0.93	0.06	2.12	0.48	0.95	1.08	1.98	2.50	0.72	0.26	1.32	0.89	0.34	0.20	1.21	0.39
Croatia	1.33	1.78	3.35	0.58	1.52	2.33	6.19	1.05	1.05	1.89	0.81	1.31	0.73	3.44	0.59	2.57	0.19	1.52	0.85	0.21	1.21	2.82	0.20
Cyprus	1.88	3.05	20.86	0.08	0.23	0.72	0.06	0.17	0.00	0.00	0.68	5.56	0.43	2.62	0.84	0.35	0.61	1.02	0.41	0.25	5.17	0.37	0.44
Czech Republic	0.51	0.60	1.85	0.84	0.31	0.58	1.32	0.94	1.50	0.18	0.53	0.31	1.63	1.48	0.68	2.08	1.03	1.75	1.21	1.94	0.39	1.52	0.84
Denmark	3.00	1.65	1.32	0.91	1.61	0.69	1.07	0.63	0.66	0.85	0.66	1.73	1.00	0.68	0.35	1.50	0.54	0.92	1.69	0.29	0.39	2.31	0.62
Estonia	1.20	2.33	0.27	1.93	1.12	0.94	7.93	1.11	5.89	1.13	0.71	0.11	1.36	1.29	0.40	1.77	1.01	1.37	0.84	0.55	0.73	2.63	0.62
Finland	0.36	0.46	0.02	0.24	0.23	0.25	5.70	10.14	0.72	2.01	0.87	0.48	0.84	0.74	1.58	1.09	0.34	1.33	1.43	0.24	0.50	0.19	0.53
France	1.14	4.49	0.61	0.51	0.73	1.32	0.59	0.94	2.03	0.45	1.28	1.82	1.02	0.88	0.67	0.82	0.49	0.83	0.87	0.98	4.72	0.45	0.83
Germany	0.76	0.62	1.78	0.51	0.49	0.40	0.74	1.14	2.00	0.23	1.02	1.40	1.24	0.93	0.69	1.26	0.60	1.16	1.62	1.81	1.47	0.74	0.59
Greece	2.15	1.15	5.05	0.79	1.19	0.49	0.35	0.60	1.24	5.80	0.65	1.21	0.82	1.50	1.41	0.74	0.18	0.59	0.25	0.06	0.29	0.19	0.32
Hungary	0.96	0.49	1.05	0.39	0.26	0.56	0.73	0.94	0.11	0.39	0.68	1.14	1.55	1.21	0.34	0.84	1.31	1.84	0.89	2.06	0.16	1.06	0.33
Ireland	1.58	1.69	0.53	0.09	0.09	0.06	0.50	0.13	0.01	0.13	2.71	8.42	0.38	0.28	0.10	0.26	0.76	0.23	0.34	0.03	0.47	0.11	1.68
Italy	0.88	2.30	0.03	1.25	1.66	3.41	0.51	1.04	1.20	0.62	0.69	1.29	1.25	1.84	0.99	1.59	0.23	0.99	1.88	0.70	0.72	2.17	1.02
Latvia	1.73	7.85	1.38	1.15	1.13	0.30	18.23	0.86	1.56	0.96	0.51	0.90	0.87	1.92	0.98	1.51	0.71	0.77	0.45	0.42	0.29	2.18	0.49
Lithuania	1.62	2.03	7.80	0.94	1.21	0.65	3.22	1.07	0.26	3.78	1.13	0.43	1.16	1.03	0.17	1.16	0.26	0.62	0.68	0.59	0.18	5.45	0.46
Luxembourg	1.18	0.87	6.58	2.16	0.38	0.20	2.31	1.98	0.00	0.01	0.59	0.19	4.46	2.46	3.47	1.29	0.26	0.57	0.86	0.67	0.66	0.08	0.26
Malta	0.95	0.37	1.88	0.62	0.18	0.14	0.03	0.05	2.26	5.10	0.30	2.08	0.96	0.13	0.04	0.18	1.58	1.19	0.20	0.05	0.94	0.07	1.67
Netherlands	1.94	1.26	4.73	0.43	0.63	0.70	0.32	0.83	0.31	2.12	1.62	1.31	0.79	0.46	0.54	0.74	1.06	0.53	0.93	0.35	0.34	0.37	0.88
Poland	1.57	0.45	5.37	0.59	0.70	0.50	2.29	1.78	0.85	0.55	0.76	0.39	1.85	1.55	0.85	1.74	0.61	1.30	0.68	1.34	1.43	4.51	0.33
Portugal	1.14	3.15	4.48	1.77	2.06	3.22	3.83	3.16	0.86	1.06	0.74	0.42	1.80	2.93	0.57	2.04	0.30	1.05	0.50	1.08	0.18	2.69	0.34
Romania	0.48	0.29	6.28	1.07	2.05	2.24	4.85	0.40	0.89	0.79	0.46	0.53	1.69	0.48	0.80	1.07	0.41	1.53	0.88	2.11	0.84	3.58	0.22
Slovakia	0.49	0.40	0.02	0.40	0.47	1.09	1.04	1.02	0.71	0.74	0.39	0.14	1.39	0.95	0.95	1.43	1.38	0.89	0.75	2.67	0.13	1.41	0.25
Slovenia	0.52	0.59	0.00	0.70	0.33	0.64	3.00	1.66	0.30	0.67	0.89	2.79	1.66	1.48	0.94	2.01	0.23	2.13	1.00	1.25	0.25	2.27	0.40
Spain	1.53	2.27	0.43	0.75	1.48	1.24	0.70	1.31	0.61	0.85	1.09	1.30	1.07	2.13	0.98	1.21	0.15	0.89	0.70	1.94	1.35	0.73	0.35
Sweden	0.56	0.90	0.83	0.31	0.44	0.25	3.65	5.68	0.19	1.07	0.76	1.39	0.87	0.58	1.03	1.11	0.71	1.03	1.31	1.24	0.33	1.45	0.46
United Kingdom	0.56	3.00	0.47	0.41	0.64	0.48	0.14	0.53	1.93	0.92	0.89	1.81	0.73	0.52	3.00	0.60	0.55	0.57	0.96	1.13	1.63	0.30	0.83
EU-28	1.06	1.65	1.65	0.63	0.77	0.98	1.10	1.29	1.84	0.80	1.11	1.62	1.12	1.05	0.96	1.14	0.56	0.94	1.17	1.23	1.29	1.04	0.74
USA	0.88	0.83	0.28	0.50	0.16	0.22	0.60	1.11	0.46	1.40	1.30	0.90	0.95	0.68	0.77	0.89	1.02	0.87	1.33	1.04	0.45	0.48	1.57
Japan	0.08	0.07	0.07	0.42	0.02	0.02	0.02	0.30	0.11	0.36	1.03	0.16	1.03	0.93	1.12	0.74	1.11	1.12	1.89	2.24	1.14	0.12	0.37
Brazil	4.70	0.13	0.65	0.31	0.04	1.85	1.76	3.06	0.40	0.41	0.90	0.33	0.61	1.02	1.53	0.70	0.08	0.44	0.73	0.99	3.26	0.45	0.16
China	0.33	0.08	0.17	2.45	2.73	2.59	0.83	0.49	0.19	0.20	0.46	0.20	1.09	1.66	0.48	1.26	2.08	1.58	0.73	0.25	0.53	2.17	1.47
India	1.58	0.11	0.44	2.98	1.92	1.28	0.15	0.24	0.73	3.12	0.99	1.15	0.59	0.77	0.94	0.96	0.16	0.36	0.40	0.37	0.98	0.30	3.92
Russia	0.64	0.29	1.58	0.08	0.05	0.15	3.05	0.89	0.69	7.22	1.25	0.07	0.31	0.55	2.56	0.35	0.12	0.23	0.19	0.16	0.83	0.12	0.37

Source: Comtrade

Table 3.7: RCAs for services

	Communications services	Computer and information	Construction	Financial services	Insurance services	Other business services	Personal, cultural and recreational services	Transportation	Travel
Austria	0.82	1.15	0.56	0.22	0.82	1.01	0.67	1.13	1.16
Belgium	1.82	0.95	1.03	0.59	0.51	1.48	0.92	1.13	0.49
Bulgaria	0.45	1.34	0.41	0.09	0.97	0.39	0.80	0.97	1.96
Croatia	0.66	0.29	0.25	0.07	0.11	0.31	0.75	0.46	2.77
Cyprus	0.33	0.09	0.20	0.75	0.13	0.99	0.35	1.17	1.42
Czech Republic	0.89	1.46	1.16	0.02	0.54	0.89	1.15	1.14	1.20
Denmark	0.34	0.55	0.13	0.13	0.29	0.65	0.77	3.04	0.38
Estonia	1.46	0.86	2.09	0.21	0.05	0.73	0.73	1.82	0.87
Finland	0.52	3.42	2.25	0.05	2.93	1.21	0.01	0.61	0.57
France	1.27	0.51	1.08	0.38	0.74	1.27	2.77	1.02	0.91
Germany	2.07	1.26	1.50	0.74	0.88	1.25	0.24	1.09	0.56
Greece	0.53	0.21	n.a.	0.07	0.67	0.19	n.a.	2.14	1.64
Hungary	0.52	1.04	0.79	0.12	0.08	1.05	8.07	1.19	0.93
Ireland	0.28	6.47	n.a.	1.07	3.91	1.04	0.29	0.23	0.14
Italy	2.17	0.41	0.11	0.51	1.20	0.99	0.33	0.67	1.51
Latvia	1.04	0.79	1.37	0.91	0.23	0.58	0.53	2.19	0.65
Lithuania	0.55	0.26	1.10	0.12	0.00	0.34	0.51	2.96	0.76
Luxembourg	1.14	0.29	0.14	7.21	1.82	0.61	5.23	0.26	0.23
Malta	0.28	0.22	n.a.	0.71	0.45	0.34	46.00	0.39	1.03
Netherlands	1.85	1.01	1.19	0.17	0.26	1.37	0.62	1.40	0.51
Poland	0.49	1.12	1.58	0.16	0.22	0.88	0.97	1.47	1.05
Portugal	0.87	0.38	1.30	0.13	0.20	0.52	1.51	1.35	1.67
Romania	1.75	2.11	1.62	0.27	0.37	0.98	0.30	1.70	0.37
Slovak Republic	0.68	1.14	1.76	0.10	0.28	0.76	0.63	1.35	1.24
Slovenia	2.14	0.38	2.14	0.06	0.54	0.65	0.97	1.23	1.43
Spain	0.67	0.77	1.32	0.44	0.45	0.87	1.62	0.81	1.52
Sweden	1.03	1.94	0.48	0.30	0.58	1.59	0.79	0.80	0.59
United Kingdom	1.41	0.89	0.38	2.89	2.49	1.10	2.12	0.61	0.53

Source: WTO

ANNEXES

A.1 Statistical nomenclature

Table A.1.1 summarises the codes and names of sectors in the nomenclature of economic activities, NACE Rev. 2. The third column contains the abridged versions of sector names used in the figures and tables.

Table A.1.1. Sectoral nomenclature for economic activities — NACE rev 2

Code	NACE Rev. 2	NACE Rev. 2 (short)
A	Agriculture, forestry and fishing	Agriculture and forestry
B	Mining and quarrying	Mining and quarrying
C	Manufacturing	Manufacturing
C10	Manufacture of food products	Food
C11	Manufacture of beverages	Beverages
C12	Manufacture of tobacco products	Tobacco
C13	Manufacture of textiles	Textiles
C14	Manufacture of wearing apparel	Clothing
C15	Manufacture of leather and related products	Leather & footwear
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Wood & wood products
C17	Manufacture of pulp, paper and paperboard	Paper
C18	Printing and reproduction of recorded media	Printing
C19	Manufacture of coke and refined petroleum products	Refined petroleum
C20	Manufacture of chemicals and chemical products	Chemicals
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	Pharmaceuticals
C22	Manufacture of rubber and plastic products	Rubber & plastics
C23	Manufacture of other non-metallic mineral products	Non-metallic mineral products
C24	Manufacture of basic metals	Basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment	Metal products
C26	Manufacture of computer, electronic and optical products	Computers, electronic & optical
C27	Manufacture of electrical equipment	Electrical equipment
C28	Manufacture of machinery and equipment n.e.c.	Machinery n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers	Motor vehicles
C30	Manufacture of other transport equipment	Other transport equipment
C31	Manufacture of furniture	Furniture
C32	Other manufacturing	Other manufacturing
C33	Repair and installation of machinery and equipment	Repair of machinery
D	Electricity, gas, steam and air conditioning supply	Electricity and gas
D35	Electricity, gas, steam and air conditioning supply	Electricity and gas
E	Water supply; sewerage, waste management and remediation activities	Water supply
E36	Water collection, treatment and supply	Water collection
E37	Sewerage	Sewerage
E38	Waste collection, treatment and disposal activities; materials recovery	Waste collection
E39	Remediation activities and other waste management services	Remediation activities
F	Construction	Construction
F 41	Construction of buildings	Construction buildings
F42	Civil engineering	Civil engineering
F43	Specialised construction activities	Specialised construction

Code	NACE Rev. 2	NACE Rev. 2 (short)
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	Wholesale and retail trade
G46	Wholesale trade, except of motor vehicles and motorcycles	Wholesale trade
G47	Retail trade, except of motor vehicles and motorcycles	Retail trade
H	Transportation and storage	Transportation & storage
H49	Land transport and transport via pipelines	Inland transport
H50	Water transport	Water transport
H51	Air transport	Air transport
H52	Warehousing and support activities for transportation	warehousing & support activities for transportation
H53	Postal and courier activities	Postal & courier
I	Accommodation and food service activities	Accommodation & food
I55	Accommodation	Accommodation
I56	Food and beverage service activities	Food & beverage
J	Information and communication	Information & communication
J58	Publishing activities	Publishing
J59	Motion picture, video and television programme production, sound recording and music publishing activities	Motion picture, TV & music
J60	Programming and broadcasting activities	Programming & broadcasting activities
J61	Telecommunications	Telecommunications
J62	Computer programming, consultancy and related activities	Computer programming & consultancy activities
J63	Information service activities	Information
K	Financial and insurance activities	Financial & insurance activities
K64	Financial service activities, except insurance and pension funding	Financial activities
K65	Insurance, reinsurance and pension funding, except compulsory social security	Insurance activities
K66	Activities auxiliary to financial services and insurance activities	Activities auxiliary to financial and insurance activities
L	Real estate activities	Real estate activities
L68	Real estate activities	Real estate activities
M	Professional, scientific and technical activities	Professional, scientific and technical activities
M69	Legal and accounting activities	Legal and accounting activities
M70	Activities of head offices	Activities of head offices
M71	Architectural and engineering activities	Architecture & engineering
M72	Scientific research and development	Scientific research and development
M73	Advertising and market research	Advertising & market research
M74	Other professional, scientific and technical activities	Other professional, scientific and technical activities
M75	Veterinary activities	Veterinary activities
N	Administrative and support service activities	Administration
N77	Rental and leasing activities	Rental & leasing activities
N78	Employment activities	Employment activities
N79	Travel agency, tour operator and other reservation service and related activities	Supporting transport activities

Code	NACE Rev. 2	NACE Rev. 2 (short)
N80	Security and investigation activities	Security & investigation activities
N81	Services to buildings and landscape activities	Services to buildings
N82	Office administrative, office support and other business support activities	Office support
O	Public administration and defence	Public administration
O84	Public administration and defence	Public administration
P	Education	Education
Q	Human health and social work activities	Human health and social work
Q86	Human health activities	Human health activities
Q87	Residential care activities	Residential care activities
Q88	Social work activities without accommodation	Social work activities
R	Arts, entertainment and recreation	Arts & entertainment
R90	Creative, arts and entertainment activities	Creative activities
R91	Libraries, archives, museums and other cultural activities	Cultural activities
R92	Gambling and betting activities	Gambling
R93	Sports activities and amusement and recreation activities	Leisure
S	Other services activities	Other services activities
S94	Activities of membership organisations	Membership organisations
S95	Repair of computers and personal and household goods	Computer and related activities
S96	Other personal service activities	Other personal service activities
T	Activities of households as employers	Households as employers
T97	Activities of households as employers of domestic personnel	Households as employers of domestic personnel
T98	Undifferentiated goods- and services-producing activities of private households for own use	Private households for own use
U	Activities of extraterritorial organisations and bodies	Extraterritorial organisations and bodies
U99	Activities of extraterritorial organisations and bodies	Extraterritorial organisations and bodies

Table A.1.2. Classification of products by activity (CPA)

Code	Description
01	Crop and animal production, hunting and related service activities
02	Forestry and logging
03	Fishing and aquaculture
05	Mining of coal and lignite
06	Extraction of crude petroleum and natural gas
07	Mining of metal ores
08	Other mining and quarrying
09	Mining support service activities
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment
35	Electricity, gas, steam and air conditioning supply
36	Water collection, treatment and supply

Code	Description
37	Sewerage
38	Waste collection, treatment and disposal activities; materials recovery
39	Remediation activities and other waste management services
41	Construction of buildings
42	Civil engineering
43	Specialised construction activities
45	Wholesale and retail trade and repair of motor vehicles and motorcycles
46	Wholesale trade, except of motor vehicles and motorcycles
47	Retail trade, except of motor vehicles and motorcycles
49	Land transport and transport via pipelines
50	Water transport
51	Air transport
52	Warehousing and support activities for transportation
53	Postal and courier activities
55	Accommodation
56	Food and beverage service activities
58	Publishing activities
59	Motion picture, video and television programme production, sound recording and music publishing activities
60	Programming and broadcasting activities
61	Telecommunications
62	Computer programming, consultancy and related activities
63	Information service activities
64	Financial service activities, except insurance and pension funding
65	Insurance, reinsurance and pension funding, except compulsory social security
66	Activities auxiliary to financial services and insurance activities
68	Real estate activities
69	Legal and accounting activities
70	Activities of head offices; management consultancy activities
71	Architectural and engineering activities; technical testing and analysis
72	Scientific research and development
73	Advertising and market research
74	Other professional, scientific and technical activities
75	Veterinary activities
77	Rental and leasing activities
78	Employment activities

Code	Description
79	Travel agency, tour operator and other reservation service and related activities
80	Security and investigation activities
81	Services to buildings and landscape activities
82	Office administrative, office support and other business support activities
84	Public administration and defence; compulsory social security
85	Education
86	Human health activities
87	Residential care activities
88	Social work activities without accommodation
90	Creative, arts and entertainment activities
91	Libraries, archives, museums and other cultural activities
92	Gambling and betting activities
93	Sports activities and amusement and recreation activities
94	Activities of membership organisations
95	Repair of computers and personal and household goods
96	Other personal service activities
97	Activities of households as employers of domestic personnel
98	Undifferentiated goods- and services-producing activities of private households for own use
99	Activities of extraterritorial organisations and bodies

Table A.1.3. Classification of industries according to ISIC Rev. 3.

Code	Description
A-B	Agriculture, forestry, fishing
C	Mining
15-16	Food, beverages and tobacco
17-18	Textiles and textile products
19	Leather and footwear
20	Wood and products of wood and cork
21-22	Pulp, paper, printing and publishing
23	Coke, refined petroleum and nuclear fuel
24	Chemicals and chemical products
25	Rubber and plastics
26	Other non-metallic minerals
27-28	Basic metals and fabricated metal
29	Machinery, n.e.c.
30-33	Electrical and optical equipment
34-35	Transport equipment
36-37	Manufacturing, n.e.c.; recycling
E	Electricity, gas and water supply
F	Construction
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel
51	Wholesale trade and Commission trade, except of motor vehicles and motorcycles
52	Retail trade, except of motor vehicles and motorcycles; repair of household goods
H	Hotels and restaurants
60	Inland transport
61	Water transport
62	Air transport
63	Other supporting and auxiliary transport activities; activities of travel agencies
64	Post and telecommunications
J	Financial intermediation
70	Real estate activities
71-74	Renting of machinery and equipment, and other business activities
L	Public administration and defence; compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal services
P	Private households with employed persons

A.2 List of abbreviations

BEC	Broad economic classification
BRIC	Brazil, Russia, India and China
BRII	Brazil, Russia, India and Indonesia
CEE	Central and Eastern Europe
CPA	Classification of products by activity
COICOP	Classification of individual consumption by purpose
COMEXT	Statistical database from and between European Union countries
COMTRADE	Commodity Trade Statistics Database
EPO	European Patent Office
FDI	Foreign direct investment
IIT	Intra-industry trade
GDP	Gross domestic product
GVA	Gross value added
GFCF	Gross fixed capital formation
GL	Grubel-Loyd
ICT	Information and communication technologies
IMF	International Monetary Fund
IO	Input-output
M	Imports
NACE	*Nomenclature générale des activités économiques dans les Communautés européennes* (*French*, EU classification system)
n.e.c.	Not elsewhere classified
OECD	Organisation for Economic Cooperation and Development
PAT	Patent
RCA	Revealed comparative advantage
R&D	Research and development
RTB	Relative trade balance
SBS	Structural Business Statistics from Eurostat
S_i	Specialisation index
ULC	Unit labour cost
UN	United Nations
UNIDO	United Nations Industrial Development Organisation
USPO	The United States Patent and Trademark Office
WTO	World Trade Organisation
X	Exports
AT	Austria
BE	Belgium
BG	Bulgaria

CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
EU	European Union
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