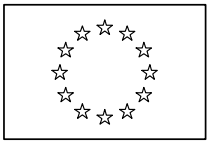

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Innovation Union Competitiveness report 2011

3. Structural change for a knowledge-intensive economy

Highlights

Structural change in the economy is defined in this part as two disjoint phenomena: a) increase in the share of high and medium high tech sectors (combined with the emergence of new knowledge intensive sectors), and b) increase the intensity of knowledge incorporated in more traditional sectors, including by the emergence of specific specialised sub-sectors.

In the last 15 years, the EU economic structure has been smoothly changing the weight of the manufacturing and services sectors. While manufacturing has been reducing its share in employment, the services increased their share in the overall employment to 70%. At Member States level, different situations can be observed: the countries with a higher share of employment in the manufacturing sector are either catching-up countries like the EU-12 Member States and Italy and Portugal (where the traditional sectors still play an important role in the overall economy) or the Member States with a highly knowledge-intensive manufacturing sector (Germany, Finland and Sweden). The growing weight of the services sectors, which in general have a lower R&D intensity, has offset the increasing research-intensity in several manufacturing or in some of the services sectors. However, the gradual evolution towards a higher share of services in the economy is only part of the structural change, as economies around the world are increasingly injecting more knowledge in their activities. This knowledge accumulation can be measured both by the knowledge of the labour force in each sector and by the research intensity of each sector.

Since 2000 the EU economy has become slightly more knowledge-intensive, but the gap with the United States persists. In 2009 knowledge-intensive activities (KIAs) represent 35% of total employment on average in the EU with no large variation around this rate among European countries apart from few exceptions. Change is taking place at country level in R&D intensity in the manufacturing sector, and overall the EU is showing a structural change towards higher knowledge-intensity in the existing sectors, but with a smaller size of these sectors in the total value-added of the economy. The structural change towards higher knowledge intensity within sectors in the EU has not been sufficient in itself to raise the knowledge intensity of the economy. When benchmarking with the United States, which has a similar share of manufacturing and services in its economy, we see that there is still room for further increases in the research intensity of the high and medium high-tech industries in the EU as well as in services. The structural composition of the economy is another aspect that reinforces this trend, as discussed previously in the chapter on fast-growing companies. The capacity of SMEs and of enterprises of intermediate size to grow and to respond better to the emerging needs, is often instrumental for accelerating structural change both within traditional manufacturing sectors and towards new types of knowledge intensive activities.
Structural change from the perspective of R&D intensity can be analysed at the level of firms. The 2010 European Industrial R&D Investment Scoreboard, covering the 1000 EU top firms in terms of R&D investments (both manufacturing and services sectors), shows that in 2009 the R&D intensity of the EU companies slightly increased reaching 2.4%.

The different strategies and policies that countries and regions adopt can define a framework conducive to the stimulation of structural changes. These strategies and policies may need to be adapted to the specific circumstances of the individual countries, and sometimes they may favour moves towards higher knowledge intensive activities within existing sectors, building on the existing experience, and sometimes they may require a shift towards new sectors.

3. Structural change for a knowledge-intensive economy

3.1. Is the economic structure in Europe becoming more knowledge intensive?

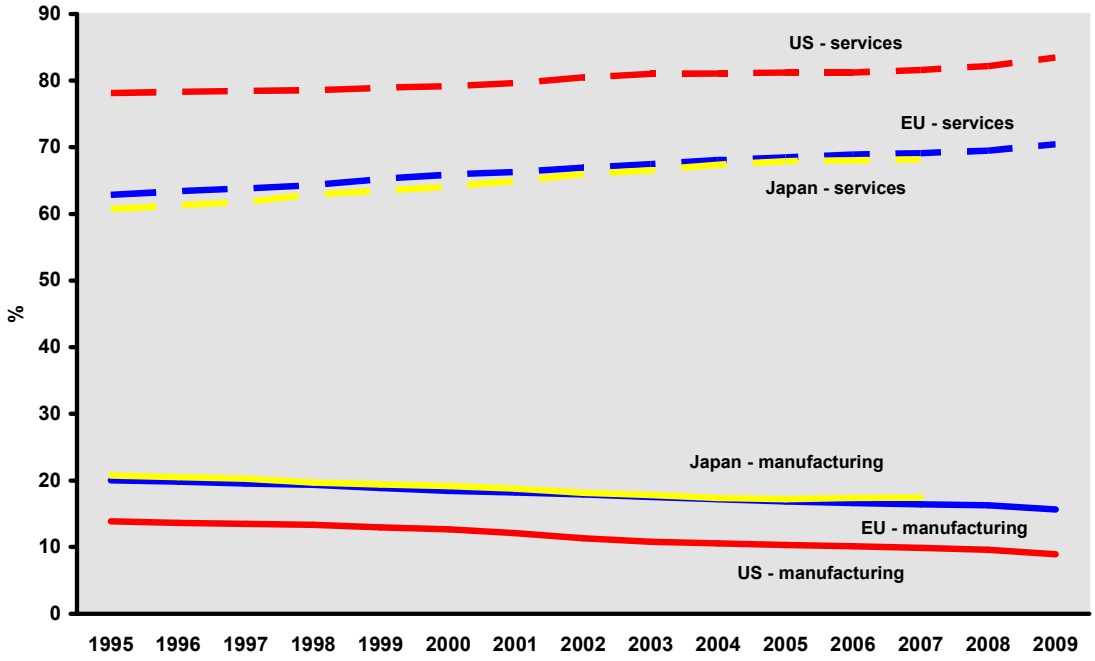
Structural change has been part of economic analysis since the late 1930s, and several definitions have been discussed[33]. The concept shows a substantial and widespread change of the economic structure which can result from policy decisions, by permanent changes in the resources, or by changes in the education and skills profile of the population of a region/country. For the purpose of the present chapter, structural change implies the transformation of an economy towards higher value creation. In general terms, we can consider two means of structural changes in the economy: (1) increasing the share of high and medium high tech sectors, combined with the emergence of new knowledge-intensive sectors and (2) increasing the incorporation of knowledge in more traditional sectors and the emergence of niches of sub-sectors formed by innovative fast growing firms.

In the present chapter, the analysis will be made using different parameters: 1) the shares of employment in the manufacturing and the services sectors; 2) the evolution of the relative weight of the most knowledge-intensive activities; 3) the share of high-tech and medium high-tech sectors and knowledge-intensive services; 4) the research intensity in each individual sector in the manufacturing sector.

In the last 15 years the overall economic structures of the EU, and those of the United States and Japan, have not changed drastically. Nevertheless, all three are smoothly progressing towards economies with an increasing weight in the services sectors and a corresponding decrease in the manufacturing sectors. This slow trend is visible when one compares the changes in the shares of the EU's employment in manufacturing and services in 1995 (respectively 20.1% and 62.9%) and in 2009 (respectively 15.7% and 70.4%). The Japanese economic structure shows very similar figures and progress over the 1995–2007 period (2007 being the last year available), with the employment share of the manufacturing sector dropping from 20.8% to 17.4% while the share of employment in the services sector increased from 60.7% to 68.2%. In 1995, the economic structure of the United States showed a larger share of employment in the services sector. This fact lies in the correspondence between the bigger weight of the ICT services sectors compared to the EU. Back in 1995, the manufacturing sector in the United States had a share of employment of 13.6% and the services sector a share of 78.2%. Twelve years later, manufacturing is accounting for less than 10% of total employment and services have passed 81.6%.

[33] Fisher (1939) and Clark (1940) looked at patterns in changes in sectoral employment.

Figure III.3.1 Employment in manufacturing and services as % of total employment, 1995-2009



Source: DG Research and Innovation
Data: Eurostat, OECD

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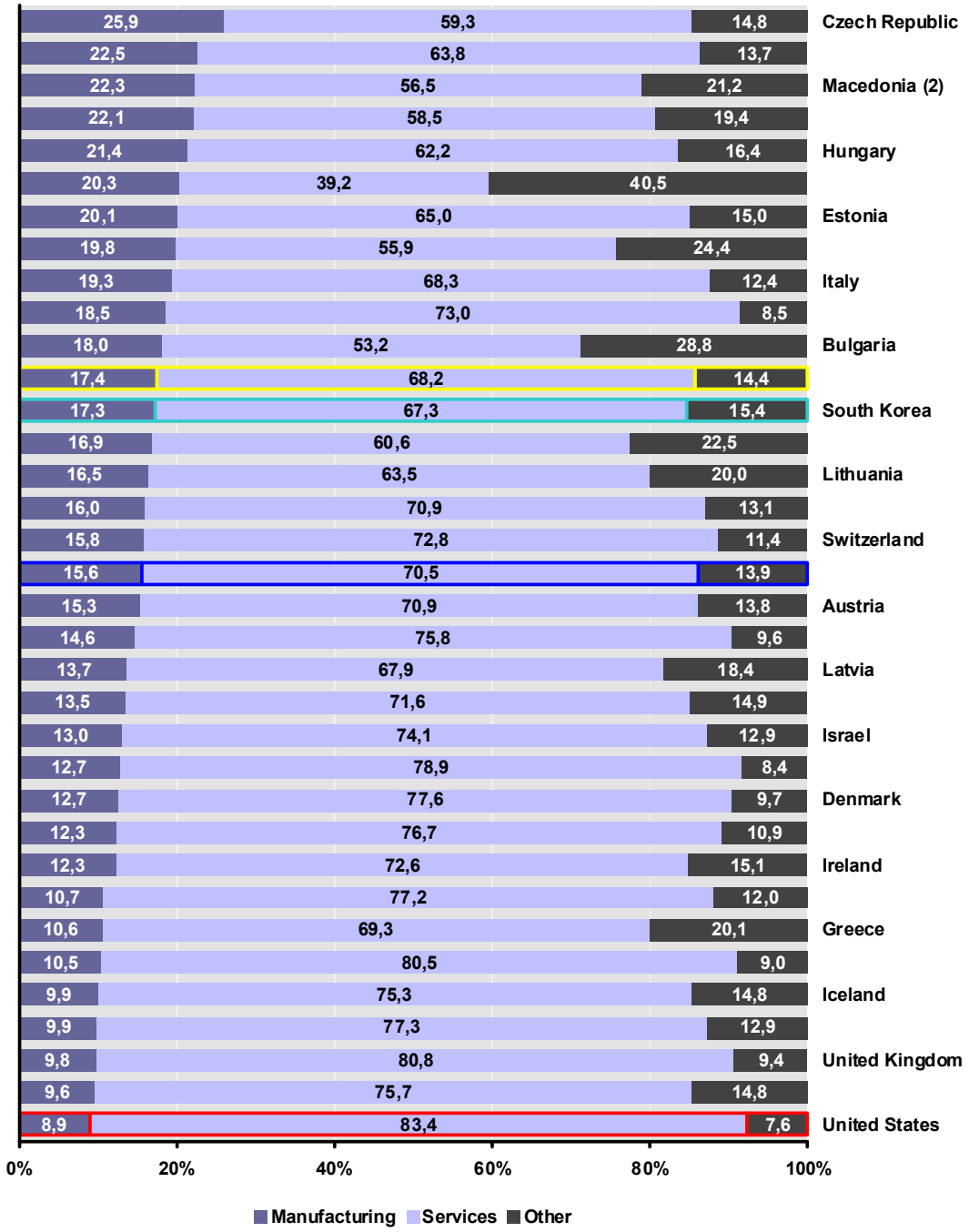
Countries with a higher share of employment in the manufacturing sector are either catching-up countries or Member States with a competitive or research-intensive manufacturing sector

It is interesting to analyse what is happening in the EU at country level concerning the changes in employment in manufacturing and in services. Figure III.3.2. represents the actual share of employment (for the year 2009) in the manufacturing and services sectors, where the Czech Republic is the only EU country with a share of total employment in the manufacturing sector bigger than 25% (one quarter of total employment). With the exception of Romania, which has a special situation, which will be discussed later in more detail, the services sector is the big employer with shares that range from 39.2% to 80.8% in the United Kingdom. Different situations can be observed: the countries with a higher share of employment in the manufacturing sector, are either catching-up countries like the EU-12 Member States (the Czech Republic, Slovakia, Slovenia, Hungary, Poland, Romania, Estonia, Bulgaria, and Lithuania) and Italy and Portugal (where the traditional sectors still play an important role in the overall economy) or the Member States with a well-developed and research-intensive manufacturing sector (Germany, Finland and Sweden). Countries like Denmark, Belgium and France have a very similar distribution of employment shares between manufacturing and services, where services represent between 76% and 78% of total employment of these countries. The Netherlands and the United Kingdom have a particular sectoral distribution in employment: they mirror the United States' distribution of employment shares. Greece and Ireland are the EU-15 Member States which still have an important share of employment in the primary sector.

Figure III.3.2 Employment by type - % shares, 2009 (1)



Source: DG Research and Innovation
Data: Eurostat, OECD
Notes: (1) PT, JP: 2007; FR, RO, UK, IS, CH, MK, IL, KR: 2008; BG: 2010.
(2) The former Yugoslav Republic of Macedonia.
(3) Malta is not included on the graph due to unavailability of data.

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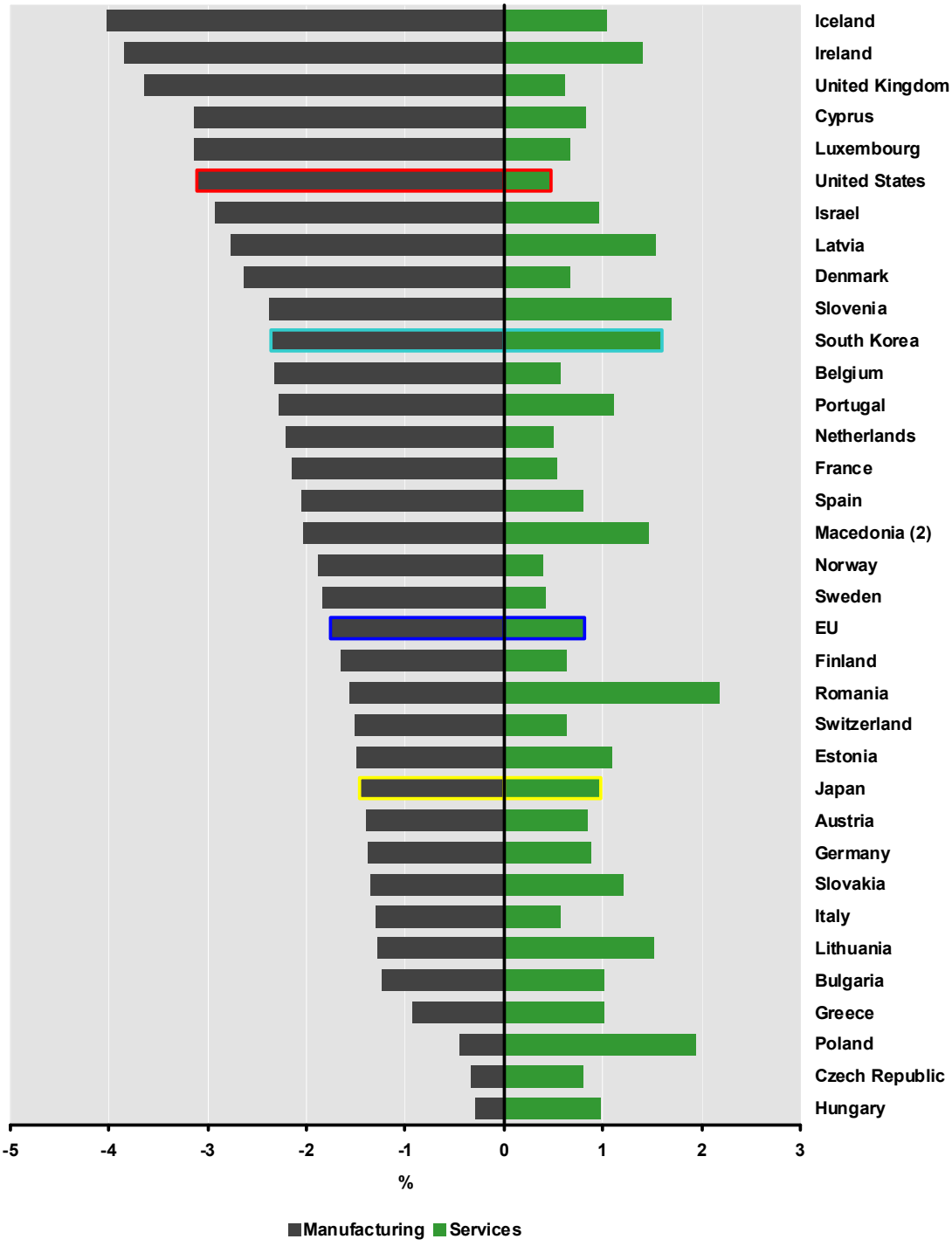
The growing weight of service sectors, which have a lower R&D intensity, has offset the effect of increasing research-intensity in individual sectors

Complementing the previous discussion on shares of employment, Figure III.3.3. presents the average annual growth rates of employment in manufacturing and in services between 1995 and 2009. All the growth rates of employment in manufacturing are negative. Figure III.3.3. indicates that the highest growth rates of employment in services are taking place in catching-up economies, or in countries like Ireland, which had an ICT sector boom.

In the period 1995–2009, the EU average annual growth rate of employment in the manufacturing sector was -1.7%, compared to -1.5% in Japan and -2.7% in the United States. In the services sector, the average annual growth rate between 1995 and 2009 was 0.8%, 1% in Japan and 0.4% in the United States. This implies a gradual trend towards a services economy, with a decrease in the manufacturing sector. This fact explains in part (not totally, since other aspects have to be taken into consideration) why the R&D intensity of the EU and the United States have been stagnating in the last decade.[34] Generally, services sectors are less research-intensive. This is aggravated by the fact that in many countries the statistics on R&D in the service sectors are not accurate, nor considered by default. The growing weight (in terms of GDP) for the low R&D-intensive services sectors offsets the effect of increasing research intensities in many individual sectors. Moreover, the increase in research intensity in low-tech and medium low-tech manufacturing sectors has a limited impact on the overall business R&D intensity of the EU, the level of which is predominantly determined by the research intensity and size of the medium high-tech and high-tech industries.

[34] For a comprehensive analysis of the R&D intensity in the EU and the United States, see Part I, Chapter 1, 2, 3 and 5.

Figure III.3.3 Share of employment in manufacturing and services - average annual growth (%), 1995-2009 (1)



Source: DG Research and Innovation — Innovation Union Competitiveness Report 2011
Data: Eurostat, OECD
Notes: (1) PT, JP: 1995-2007; FR, UK, IS, CH, IL, KR: 1995-2008; RO: 1996-2008; MK: 1997-2008; IE: 1998-2009; EL: 2000-2009; BG: 2000-2010.
(2) The former Yugoslav Republic of Macedonia.
(3) Malta is not included on the graph due to unavailability of data.

The gradual evolution towards a higher share of services in the economy is only part of the structural change. In parallel, the economies in the world are increasingly injecting more knowledge into their activities. From a statistical perspective, this knowledge accumulation can be measured by two aspects: the knowledge of the labour force in each sector and the research activity of each sector. For the first aspect, a new indicator has been constructed by Eurostat, focusing on Knowledge-Intensive Activities. For the second aspect, the current statistical system focuses on the business R&D intensity using OECD taxonomy of high-tech, medium high-tech, medium low-tech and low-tech manufacturing sectors combined with the classification knowledge-intensive services. The current chapter will explore the data according to both of these aspects, relating them to the economy as share of employment.

Currently the best-known research and innovation taxonomy of industries is the distinction between high-, medium-high-, medium-low-, and low-technology manufacturing industries brought forward by the OECD[35]. In this taxonomy, economic sectors are grouped according to their R&D intensity[36]. This taxonomy is valid only for a small part of the statistical classification of economic activities (NACE[37]), namely the manufacturing industry. It has a strong technological bias and excludes from the 'high-technology' category some of the less R&D-intensive but potentially knowledge-intensive and innovative sectors.

The knowledge economy develops largely through the structural evolution of economic activities towards more knowledge-intensive ones, beyond the R&D-intensive manufacturing sectors. This can be monitored by observing the evolution of the relative weight of the most Knowledge-Intensive Activities (KIAs) in the economy. KIAs are defined as economic sectors in which more than 33 % of the employed labour force have completed academic-oriented tertiary education (i.e. at ISCED 5 and 6 levels). They cover all sectors in the economy, including manufacturing and services sectors, and can be defined at two- and three-digit levels of the statistical classification of economic activities.

Over the period 2000–2007, the EU economy has become slightly more knowledge-intensive, but the gap with the United States persists

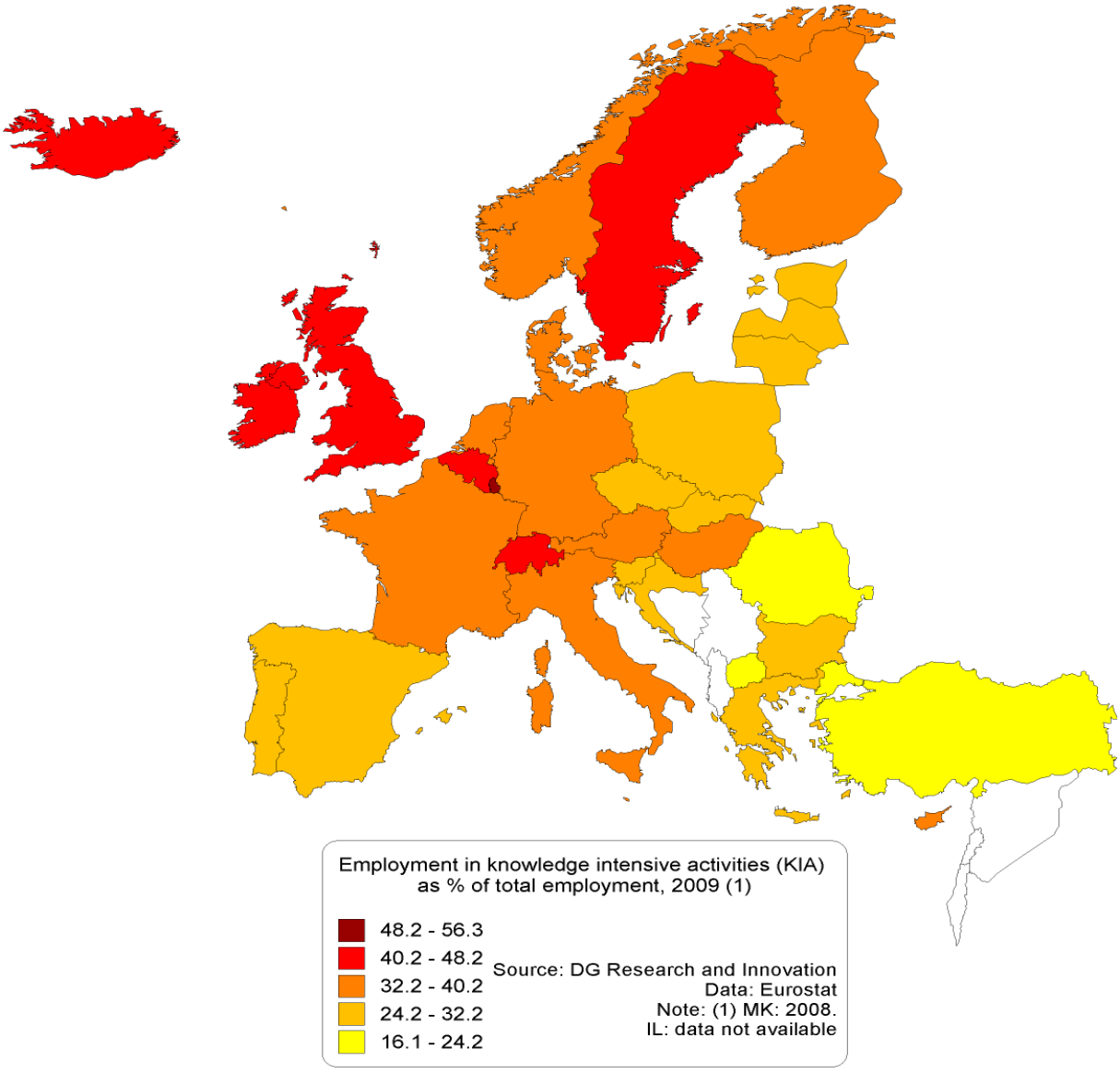
In general, the economy is increasing the incorporation of knowledge, making use of more advanced technologies, and increasing the demand on the corresponding skills and education of those using them. As a general movement, the minimal skills required in the labour market, have been growing. The embedding of skilled and highly educated labour into the economic structure is a highly relevant aspect of a knowledge economy. A shift towards a higher incorporation of knowledge in the economy can therefore be measured by the share of employment and the share of value added of the activities with skilled employed persons that have completed ISCED 5 or ISCED 6. This new indicator captures the market demand for innovation and avoids any bias, regarding manufacturing versus services, or technology-oriented versus non-technological innovation. It is also a useful tool to benchmark the potential of a region or country for future innovation.

[35] Hatzichronoglou, T. (1997), Revision of the High-Technology Sector and Product Classification, STI Working Papers, Paris. OECD.
[36] More precisely, the direct (production of technology) and indirect (acquisition of technology) R&D intensity of each sector is used. .
[37] Nomenclature statistique des Activités économiques dans la Communauté Européenne.

Knowledge-Intensive Activities represent 35 % of total employment on average in the EU. Between 2008 and 2009 there was a slight increase

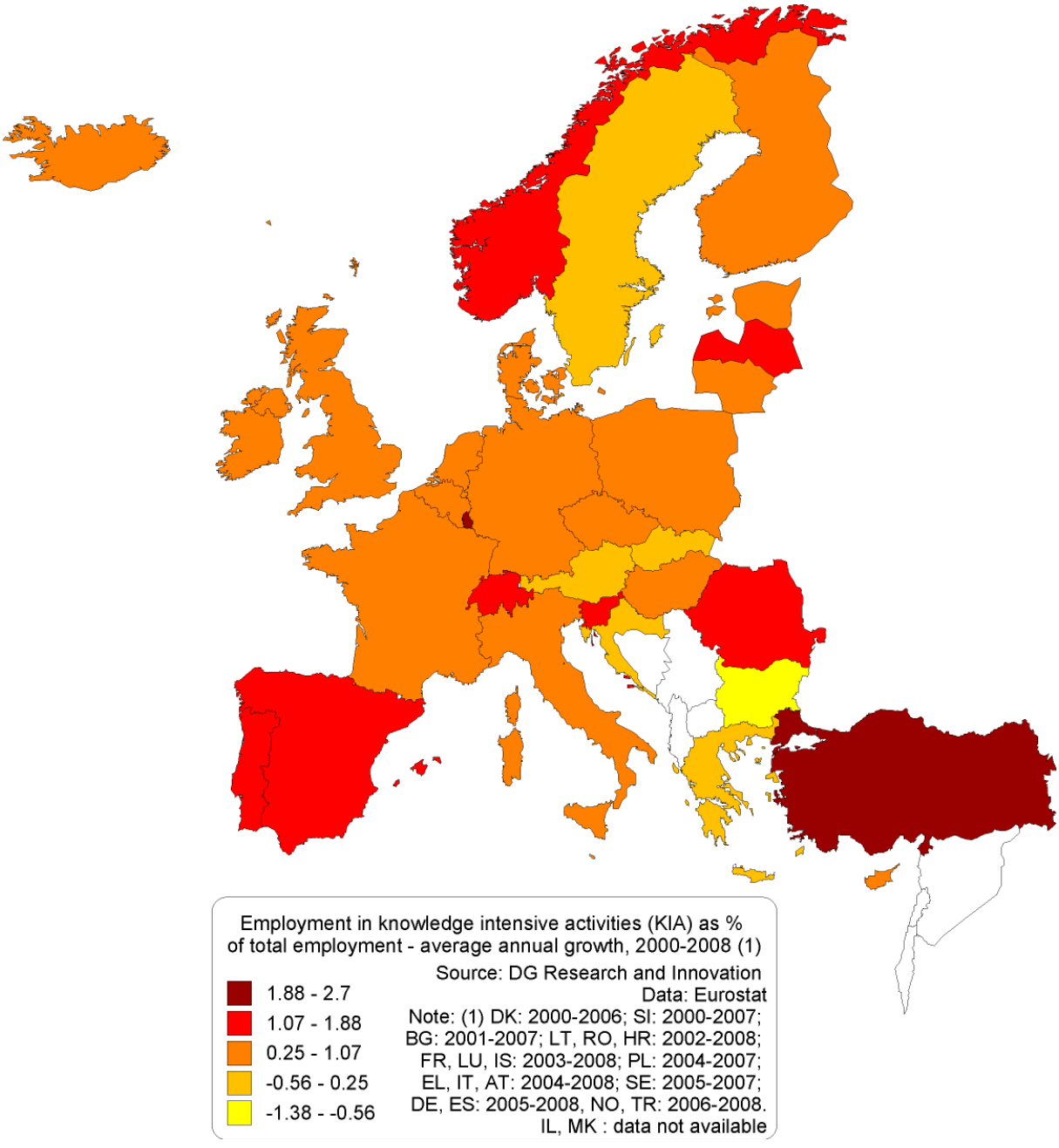
Knowledge-Intensive Activities (KIAs) can be measured as a share of employment. In this sense, Europe is becoming more knowledge-intensive since its shares of employment in the knowledge-intensive activities have grown. Central and Northern Europe are more knowledge-intensive, while the Southern European countries and in general the EU-12 Member States have a smaller share of employment in knowledge-intensive activities. In 2009, KIAs represented 30–40 % of total employment in the vast majority of countries, and 35 % in the EU on average. Luxembourg stands out with 56 % of employment in KIAs, while Romania and Turkey are below all other European countries, with less than one fifth of total employment in KIA. Apart from the Netherlands and Cyprus, the share of KIAs in total employment increased slightly in 2009 compared to 2008 by 2.4%.

Figure III.3.4. Employment in Knowledge-Intensive Activities (KIA) as % of total employment, 2009



The map below shows the growth registered in the KIAs, as a % of total employment, over the period 2000-2008. The Central and Northern countries, with the exception of Luxembourg and Switzerland, register smaller growth rates, while Portugal, Slovenia, Spain and Turkey show a catching-up progress towards more knowledge intensive economy. In contrast, Bulgaria, Austria, Iceland and Croatia decreased the % of employment in KIA, over the same period. One should note that the two maps are not completely comparable since there is a break in series in the year 2008. The first map uses the definition of KIA based on the NACE Rev. 2 classification while the second map, the growth in KIA from 2000 to 2008, is based on NACE Rev. 1.1.

Figure III.3.5. Employment in Knowledge-Intensive Activities (KIA) as % of total employment – average annual growth, 2000-2008



The analysis can also focus on the knowledge-intensity of the business sector (i.e. excluding KIAs in the public sectors). The table below presents the data for KIAs in the business sector (which includes also business services). This breakdown gives also an indication of the market demand for innovation, a very pertinent factor in favour of the sustainable development of innovation. KIAs in the business sector represent 10–20% of total employment in the large majority of countries in 2009, with 13.4% in the EU on average. This share is also in slight progression with a growth of 1.5% compared to 2008.[38]

Table III.3.1 Employment in Knowledge Intensive Activities (KIA) as % of total employment, 2008 and 2009

	Total			Business industries		
	2008	2009	Growth 2008-2009 (%)	2008	2009	Growth 2008-2009 (%)
Belgium	41,2	41,4	0,5	14,9	14,4	-2,8
Bulgaria	25,6	26,0	1,3	8,3	8,5	3,2
Czech Republic	28,1	29,2	3,9	11,2	11,3	1,6
Denmark	37,2	39,2	5,3	15,2	15,7	2,8
Germany	36,7	37,3	1,5	15,0	15,2	1,8
Estonia	28,4	31,8	11,9	9,5	10,2	8,2
Ireland	37,5	41,1	9,6	18,0	19,3	7,0
Greece	31,4	31,6	0,6	10,8	10,9	0,1
Spain	28,2	30,3	7,3	11,3	11,5	1,7
France	39,0	39,5	1,4	13,5	13,9	2,8
Italy	33,0	33,0	0,2	13,6	13,5	-0,6
Cyprus	35,0	33,9	-3,3	14,8	14,1	-4,9
Latvia	28,6	30,1	5,1	8,2	9,1	11,9
Lithuania	29,1	31,2	7,1	7,5	8,1	7,3
Luxembourg	54,5	56,2	3,2	23,8	24,9	4,7
Hungary	33,1	33,5	1,0	12,8	12,3	-3,6
Malta	38,4	38,8	1,0	15,7	16,3	3,4
Netherlands	38,0	37,4	-1,5	17,0	15,9	-6,4
Austria	34,1	35,4	3,7	13,8	14,2	3,2
Poland	26,9	28,0	4,2	8,2	8,9	8,1
Portugal	27,1	27,9	2,9	8,8	8,8	0,0
Romania	19,2	19,8	3,1	5,6	5,8	3,7
Slovenia	30,6	31,9	4,5	12,2	13,0	6,4
Slovakia	27,9	29,1	4,2	10,0	10,1	0,7
Finland	35,7	36,5	2,1	15,2	15,2	-0,2
Sweden	41,6	42,3	1,5	16,6	16,8	1,2
United Kingdom	41,7	42,8	2,8	17,0	17,3	1,7
EU	34,3	35,1	2,4	13,2	13,4	1,5
Iceland	42,7	43,1	1,0	18,1	18,8	3,4
Norway	37,6	38,7	3,1	14,2	14,8	4,3
Switzerland	40,2	42,0	4,6	19,5	20,0	2,7
Croatia	26,4	27,4	4,0	9,5	9,2	-3,2
Macedonia (1)	16,1	:	:	10,6	:	:
Turkey	:	18,4	:	:	4,8	:

Source: DG Research and Innovation
Data: Eurostat
Note: (1) The former Yugoslav Republic of Macedonia.

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[38] The KIA classification was developed in 2010 by Eurostat on the basis of NACE Rev. 2 currently in use. To have historical values for reference years prior to 2008, the KIA classification is established on the basis of NACE Rev. 1.1.

Employment in high-tech and medium high-tech industries plus in knowledge intensive services (KIS) has in general not increased between 2008 and 2009

The analysis of KIAs can be complemented by an analysis of structural change building on R&D investment level as main measurement of the knowledge-intensity of the economy. Such an analysis would build on the taxonomy of the OECD, focusing on high-tech and medium high-tech sectors together with knowledge-intensive services. In other words, we can say that while the KIA classification was based on the level of the skills of the human resources working in the sectors, the OECD taxonomy is related with the R&D intensity of the different sectors. Total employment in high-tech and medium high-tech industries and in knowledge intensive services ranges between 30% and 55% of total employment, except for Romania with 24.4% and Turkey with 21.5%. Belgium, Luxembourg, Sweden, Denmark, Finland, the United Kingdom, Iceland and Norway evidence a rate of employment in the high-tech and medium high-tech industries and knowledge intensive services well above the 50% of total employment.

Figure III.3.6. Employment in high-tech and medium high-tech manufacturing and in knowledge-intensive services (KIS) as % of total employment, 2009

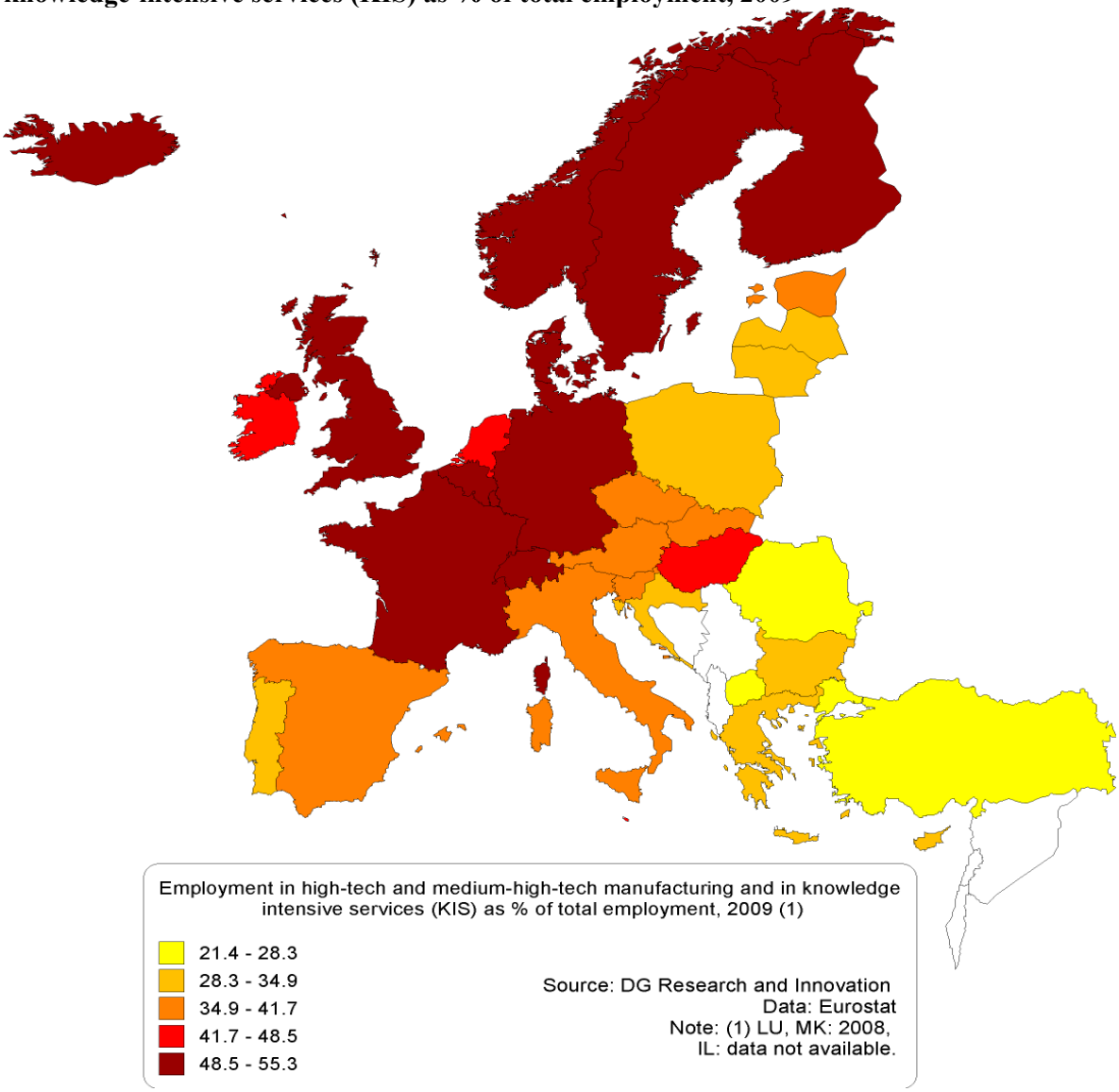
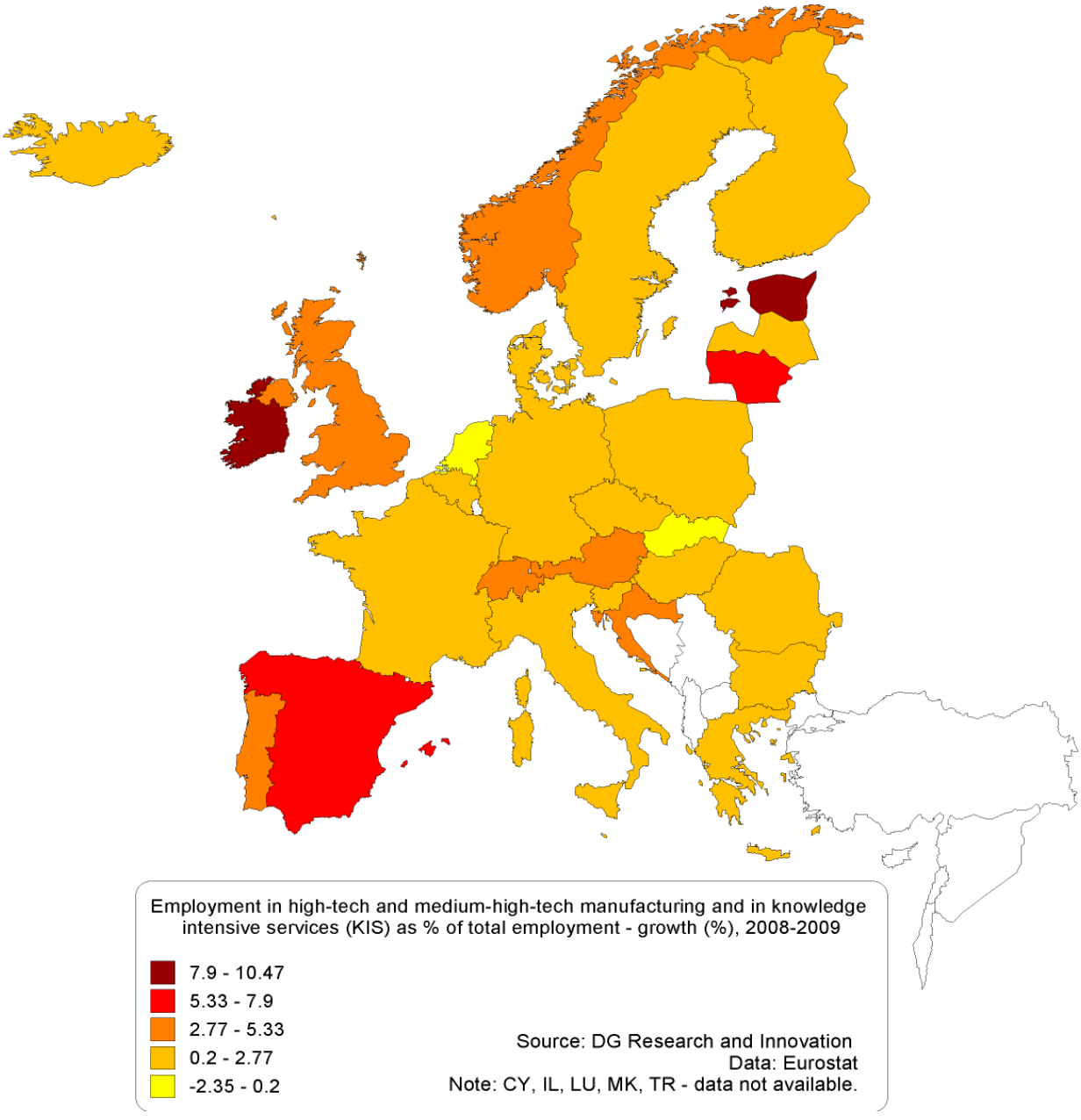


Figure III.3.7. visualises the annual growth rates of employment in high-tech and medium high-tech industries and KIS between 2008 and 2009: high growth for Ireland and Estonia, followed by Spain and Lithuania. The Netherlands, Lithuania and Cyprus decreased their share of employment in the same sectors.

Figure III.3.7. Employment in high-tech and medium high-tech manufacturing and in knowledge-intensive services (KIS) as % of total employment – average annual growth, 2008-2009



However, the research-intensity has not grown evenly across the different sectors. While in general terms, there is a slight increase in total employment in research-intensive sectors in Europe, it is mostly the research-intensive services that are increasing. Following the general movement of the European economy towards a more service-based economy, the Knowledge-Intensive Services present a positive growth over the period of 2008-2009 (the only exceptions are the Netherlands and Cyprus), while the high-tech and medium-high-tech

sectors have experienced a clear negative growth over the same period. The exceptions are Germany, Sweden, Ireland and Italy, countries with a manufacturing sector bigger than the average. For these same countries, the growth of employment in Knowledge-Intensive Service, as share of total employment, remains positive, although more modest.

Figure III.3.2 Employment in high-tech and medium-high-tech manufacturing and in knowledge intensive services (KIS) as % of total employment, 2008 and 2009

	High-Tech (1)			Medium-High-Tech (2)			Knowledge Intensive Services (KIS)		
	2008	2009	Growth 2008-2009 (%)	2008	2009	Growth 2008-2009 (%)	2008	2009	Growth 2008-2009 (%)
Belgium	1,4	1,2	-17,7	4,5	4,1	-8,7	45,3	46,1	1,7
Bulgaria	0,8	0,8	3,7	3,6	3,0	-15,7	27,1	27,7	2,2
Czech Republic	1,5	1,4	-6,1	8,8	8,1	-7,4	29,7	30,8	3,7
Denmark	1,6	1,6	3,2	3,9	3,5	-11,3	47,0	48,8	3,7
Germany	1,6	1,8	8,0	8,4	8,4	0,4	38,8	39,6	2,0
Estonia	1,1	1,2	14,8	3,0	2,9	-4,0	31,2	34,9	11,7
Ireland	2,9	3,0	3,1	1,8	2,0	9,3	39,0	43,2	10,6
Greece	0,5	0,4	-8,7	1,2	1,1	-12,1	32,4	32,7	0,9
Spain	0,7	0,5	-33,8	3,3	3,2	-3,9	30,6	33,1	8,2
France	1,2	1,0	-12,7	4,1	3,9	-5,1	42,8	43,6	1,9
Italy	1,1	1,1	3,8	4,9	5,0	0,4	33,4	33,6	0,4
Cyprus	0,4	0,3	-37,5	0,4	0,5	21,1	34,5	33,7	-2,2
Latvia	0,4	0,5	31,6	1,4	0,9	-34,8	32,1	33,3	3,8
Lithuania	:	:	:	1,8	1,8	-2,7	30,5	32,4	6,4
Luxembourg	:	:	:	0,7	:	:	54,2	:	:
Hungary	2,8	2,5	-9,6	5,8	5,4	-7,8	33,2	34,2	3,0
Malta	2,7	2,6	-3,0	2,2	1,7	-21,4	39,6	40,5	2,1
Netherlands	0,8	0,7	-9,2	2,3	2,0	-13,2	45,8	45,5	-0,6
Austria	1,1	1,1	-1,9	3,9	3,9	0,3	34,9	36,5	4,8
Poland	0,8	0,8	-3,8	4,6	4,1	-11,4	28,3	29,5	4,2
Portugal	0,6	0,6	-12,5	2,4	2,5	4,2	28,4	29,3	3,3
Romania	0,6	0,6	3,6	4,4	4,0	-8,8	19,0	19,8	4,5
Slovenia	1,7	1,7	-1,8	7,5	6,9	-8,2	31,2	32,3	3,5
Slovakia	1,8	1,5	-18,0	8,4	7,1	-15,4	29,6	31,0	4,9
Finland	1,9	1,6	-11,8	4,2	3,9	-6,7	41,8	43,0	2,8
Sweden	0,8	0,8	5,3	4,8	4,2	-12,6	49,6	50,3	1,4
United Kingdom	1,2	1,0	-12,0	3,4	2,8	-17,6	45,6	48,4	6,0
EU	1,2	1,1	-3,5	4,8	4,6	-4,8	36,9	38,1	3,3
Iceland	:	:	:	0,9	1,1	27,6	48,5	49,1	1,4
Norway	0,7	0,5	-21,5	2,8	3,0	5,0	47,7	50,3	5,5
Switzerland	2,7	2,8	2,6	3,8	3,6	-6,1	40,9	42,9	4,7
Croatia	0,8	0,5	-35,5	3,3	3,0	-9,2	27,6	29,4	6,4
Macedonia (1)	1,0	:	:	2,8	:	:	22,0	:	:
Turkey	:	0,3	:	:	2,7	:	:	18,5	:

Source: DG Research and Innovation — Innovation Union Competitiveness Report 2011
Data: Eurostat
Notes: (1) The values for EE, HR and MK for 2008 and for EE, CY and HR for 2009 are considered to be unreliable or uncertain.
(2) The values for CY and LU for 2008 and for MT for 2009 are considered to be unreliable or uncertain.
(3) The former Yugoslav Republic of Macedonia.

Trends in R&D intensities of companies[39] based in selected Member States:

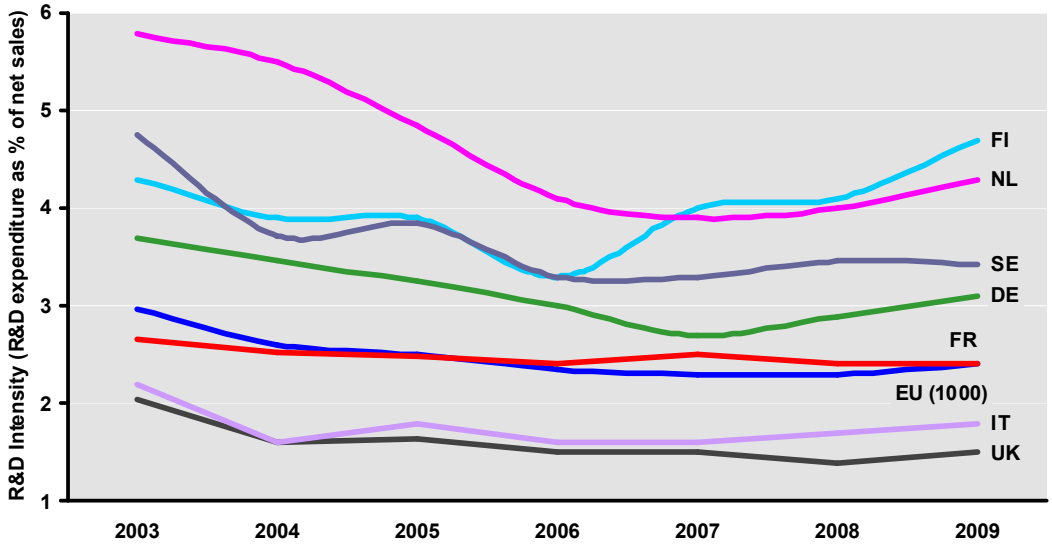
Finally, structural change from the perspective of R&D intensity can be analysed at the level of firms. The European Industrial R&D Investment Scoreboard analyses data on the 1 000 top EU firms in terms of R&D intensity, covering firms active both in the manufacturing and the services sector.

[39] R&D intensity is defined as R&D expenditure / sales.

Worldwide corporate R&D investment growth was high (6.9%) in 2008, but the trend was decreasing, aggravated by the economic and financial crisis that affected business investment globally — albeit with visible sectoral differences. The 2010 Scoreboard showed that, in comparison with 2008, the EU's growth of corporate R&D investment was higher than that of the United States (8.1% compared with 5.7%), and well above the average growth of 6.9%. Individual sectors contributed differently to the growth: the EU's largest growth came from the medium R&D-intensity sector (automobile and parts sector), while in the case of the United States the sectors with high R&D intensity showed significant growth above the average (5.7% plus). This confirms the trend observed over the period 2000–2009, showing a strengthening of high R&D-intensity sectors in the United States and a reinforcement of the medium-high R&D-intensity sectors in the EU.

Comparing data from the Scoreboards compiled between 2003 and 2008, the average R&D intensity of the EU-1000 companies fell because net-sales growth was higher than R&D investment growth. In 2009, R&D investment growth was higher than net-sales growth, leading to a small increase in R&D intensity from 2.3 to 2.4% for the EU-1000. Higher R&D intensity in 2009 than in 2008 can be observed in most of the countries in figure III.3.8: Finland (continuing the sharp R&D intensity increase due to Nokia largely maintaining R&D despite falling sales), Germany, France and Italy. For companies from the Netherlands and Sweden, R&D intensity fell because net sales developed at a similar pace to R&D investment. This is also the case for UK companies, where R&D intensity has remained unchanged since 2008, and in Italy, where it has stagnated since 2004. However, over the longer time period of 2003–2008, the R&D intensity of firms dropped in all countries except Finland.

Figure III.3.8 Intensity trends for EU *Scoreboard* companies



Source: DG Research and Innovation Innovation Union Competitiveness Report 2011
Data: The 2010 EU Industrial RD Investment Scoreboards (of 2004, 2005, 2006, 2007, 2008, 2009 and 2010).

3.2. Is the manufacturing sector becoming more research intensive?

3.2.1. R&D intensity in the manufacturing sector

The technology gap between the EU and the United States in the manufacturing sectors is growing — in high-tech as well as in medium-high and low-tech industries

Technological change is a major factor for competitiveness, and in the case of manufacturing industries, for advantage gains. The technology gap is visible in the distribution of manufacturing value added and the average R&D intensity by type of industry for the EU and the United States.[40] These values, as well as research intensity in competing firms, are of a comparable order of magnitude (although not identical) in both economies. The overall level of business R&D intensity in an economy is strongly influenced by the research intensity in high-tech and medium high-tech industries. In chapter 5 of Part I of this report, we saw that in the EU, most of the sectors that perform the majority of BERD, in particular in the high-tech sectors, have become more research intensive during the last decade. But, at the same time, the weight of these same sectors in the EU economy has decreased thus provoking a counter balance effect. And the main reasons for the gap of the EU benchmarked with the United States, Japan or South Korea are a smaller and less research-intensive high tech industry (compared to the United States) and the structure of the economy, more dominated by the services sector (when comparing to South Korea).

The EU has seen a substantial increase in the R&D intensities of the low- and medium-tech manufacturing sectors

The knowledge incorporated in the manufacturing industry has increased significantly in all sectors. There has been a drastic change from layout to production chain in the technologies used today, the equipment used in industry, the incorporation of ICT, not to mention managerial and organisational aspects. Consequently, there has been a substantial increase in the R&D intensities of the low- and medium-tech manufacturing sectors at EU level.

[40] See analysis in Part I, chapter 5.

Box: Reconversion and modernisation of traditional sectors — the textile industry

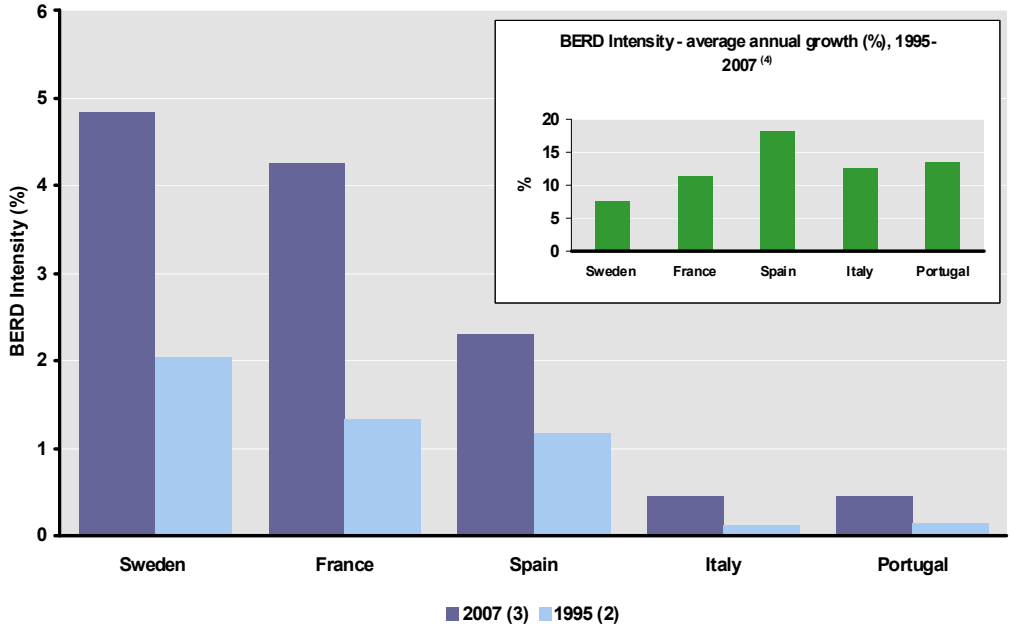
Lessons can be drawn from successful reconversions: the EU has a higher 'technological specialisation' in textiles compared to its competitors the USA and Japan. How has this transformed the activities in this sector?

Case studies on the textile industry: Italy, Spain, Portugal, France and Sweden

The textile sector is an important part of the European manufacturing industry, playing a vital role in the economy and in social well-being in numerous regions of the EU. In 2006 there were 220 000 companies employing 2.5 million people and generating a turnover of EUR 190 billion. The textile and clothing sector accounted for 3 % of total manufacturing Value Added in Europe. How have countries like Italy, Spain and Portugal, where textiles and clothing are a traditional manufacturing sector, coped with the competition from China and India?

During the 1980s and 1990s, some countries (such as France and Sweden) invested in a technological upgrade of their textile sector so that their 1995 BERD intensity was respectively 2.03 % and 1.33 % — values well above the R&D intensities registered for Portugal, Italy and Spain (respectively 0.13 %, 0.11 % and 0.43 %), as shown in the Figure III.3.9. And even if these three latter countries had strong increases of their BERD intensity of the textile sector over the period 1995–2007, with growth values varying from 12.10 % in the case of Portugal to 16.59 % for Italy, this cannot be compared with the level of incorporated knowledge for the equivalent sectors in France and Sweden, which reached a BERD intensity of 4.26 % and 3.86 % in 2006. Given the global evolution of the textile market, the competitiveness of the textile sectors of Spain, Portugal and Italy are at risk if the BERD intensity is not substantially raised.

Figure III.3.9 BERD Intensity (BERD as % of value added) in the textile sector (1), 1995 (2) and 2007 (3)



Source: DG Research and Innovation — Innovation Union Competitiveness Report 2011
Data: OECD
Notes: (1) SE: Textiles includes wearing apparel and fur and leather and footwear.

3.2.2. Knowledge-intensity and economic weight of individual sectors

In order to secure economic competitiveness in high-Value-Added activities, the European Union will have to shift its economic structure to more knowledge-intensive (including research-intensive) activities. The economic structure of the EU and its individual Member States is the result of its competitive position in the global value-added chain of activities. As such, it conditions the levels of R&D investment, primarily in the private sector, as covered in Part I, chapter 5 of this report. In addition, levels of R&D intensity also condition the economic structure, as they reflect the ability of a country to compete internationally in specific sectors or segments of these sectors. In other words, there is a cause–consequence relationship between BERD and economic structure. The existing economic structure affects the BERD investments, which in return affects the resulting economic structure of a country, and its position and capacity to compete in a globalised market.

As a result, it is important to understand the moves of overall BERD investments by discomposing it between increases in BERD intensity and shifts in the economic structure towards more research-intensive activities. Total business R&D intensity is determined by the research intensity of individual economic sectors and by the relative weights of these sectors in the economy. Progress in total business R&D intensity can therefore be obtained through an increased research intensity of individual economic sectors and/or an increase in the share of research-intensive sectors in the economy. The following graphs depict the impact that these two different forces have had in European economies in terms of volumes of private investment over a time spam of more than ten years.

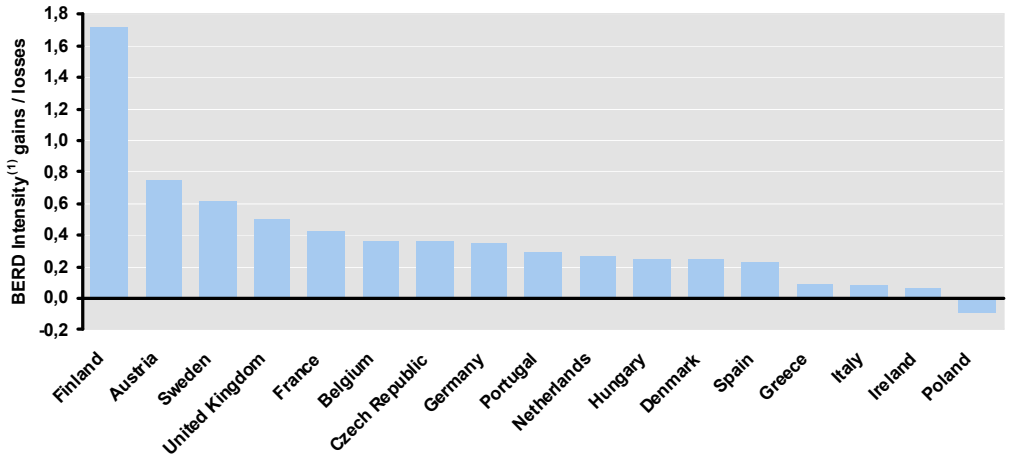
Most EU Member States have increased the overall BERD intensity of their economic sectors, while the economic weight of the most knowledge-intensive sectors has decreased

Figure III.3.10. represents the gains in private R&D based on gains in BERD intensity[41] in economic sectors at country level over the period 1995–2007. As shown, all the countries (with the exception of Poland), registered positive gains, in line with an overall increase of knowledge in the European economy and an increase in R&D intensity at EU level. However, progress was uneven across Member States. Finland, Austria and Sweden made higher progress than Germany and Spain. Italy shows more modest progress compared to Austria or the Czech Republic. These data suggest that some countries have intensified their R&D investments in existing sectors, probably to match the tough international competition in high R&D sectors, such as ICT, while some other countries have made more moderate progress.

These increases in BERD intensity can respond to either (1) a strategy to move towards higher-value-added activities within sectors, or (2) a reaction aimed at maintaining its competitive position in view of the increases of foreign competitors.

[41] BERD intensity is defined as the value of private R&D investment as a percentage of total Value Added.

Figure III.3.10 BERD Intensity [(1)] gains / losses if the economic structure remains constant over the period 1995-2007 [(2)]

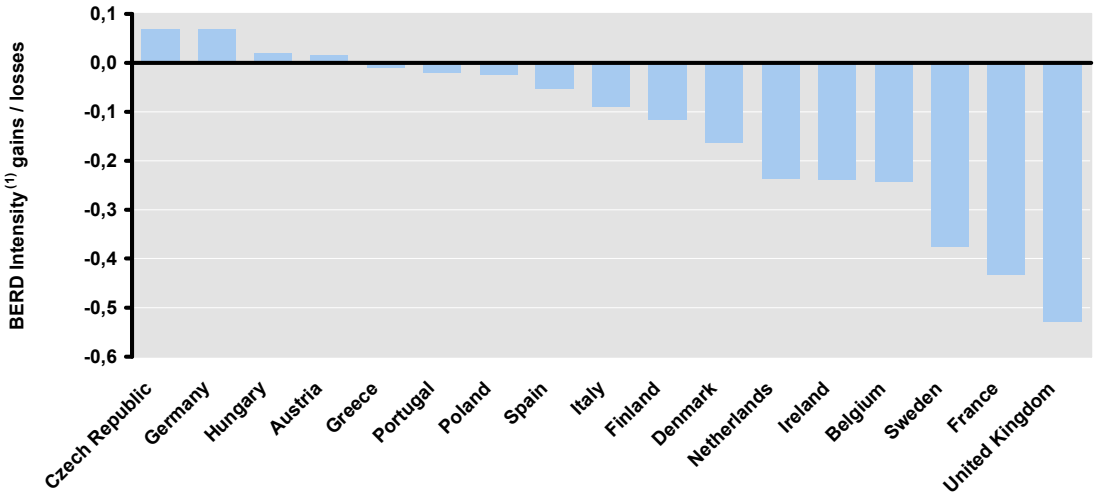


Source: DG Research and Innovation — Innovation Union Competitiveness Report 2011
Data: OECD
Notes: (1) For the purposes of this graph BERD Intensity is defined as BERD as % of value added.
(2) IE, EL, PT: 1995-2005; BE, DE, FR, HU, NL, PL, UK: 1995-2006; AT: 1998-2006; DK: 2001-2006; ES: 2002-2006.

FigureIII.3.11. presents the effect on BERD intensity caused by changes in the economic structure over the same period as the previous figure. In other words, it presents the shifts in the economic structure towards more (or less, if negative) research-oriented activities.[42] As in the previous case, European countries differ in their evolution. Overall, most European economies, with the exception of Germany, Austria, Hungary and the Czech Republic, have experienced an evolution towards a lower weight of research-intensive sectors in the economy, mainly due to the long-term shift from manufacturing to services, in, for example Denmark and the United Kingdom, or construction, as in Spain.

[42] BERD intensity gains result from calculating the gains due to changes in BERD intensity, if the economic structure had remained constant (BERD intensity 2007 – BERD intensity 1995) *VA 1995.
The gains in shifts in the economic structure would result of gains in the difference in the relative importance of each sector in the economy, if the BERD intensity would have remained the same (VA 2007 – VA 1995) *BERD intensity 1995.

Figure III.3.11 The effect on BERD Intensity [(1)] of changes in the economic structure over the period 1995-2007 [(2)]



Source: DG Research and Innovation Innovation Union Competitiveness Report 2011
Data: OECD
Notes: (1) For the purposes of this graph BERD Intensity is defined as BERD as % of value added.
(2) IE, EL, PT: 1995-2005; BE, DE, FR, HU, NL, PL, UK: 1995-2006; AT: 1998-2006; DK: 2001-2006; ES: 2002-2006.

While structural change is largely influenced by the evolution of international economic drivers, the strategies and policies that countries and regions adopt can define a framework conducive to the stimulation of structural changes. These strategies and policies may need to be adapted to the specific circumstances of the individual countries, and sometimes they may favour moves towards higher-value-added activities within existing sectors, building on the existing experience, and sometimes they may require a shift towards new sectors. More precisely, in Europe, there are countries which still have margins to increase knowledge-intensity in existing sectors, as their production may focus on low- or intermediary-value added goods or services. Some other countries are close to the 'technological frontier'[43] and therefore may need to change the weights of its sector composition in their economy, favouring the expansion of more knowledge-intensive sectors. Specificities of each country and their different strategies concerning R&D and innovation such as smart specialisation[44], international exports or the creation of clusters are directly connected to these strategies. At this point it should be noted that these strategies should be the result of a wide-ranging consultation to identify particular strengths that support strategies in an international competitive contest.

This chapter aims to introduce some insights into the current situation of the EU by analysing the changes that have occurred in the sectoral composition of the EU as a whole by tracking the evolution of each sector over a period of 12 years.

[43] The technological frontier is defined as the state-of-the-art level of technological development for one specific sector. The products and services offered at the technological frontier are knowledge-rich and of the highest-value-added.
[44] Foray D, David P A and Hall B (2009): 'Smart Specialisation: the concept', *Expert group 'Knowledge for Growth', May 2009*. See also the section "New Perspectives", chapter 2 in this report.

In addition to the overview presented for the EU (together with a breakdown for the EU-15 and the EU-12) similar graphs for each country are included in the country information sheets found at the end of the report. They identify potential solutions to stimulate the needed structural shift in the national economies.[45] In order to achieve this goal, this chapter will analyse the changes that the EU, EU-15 and EU-12 experienced in a time span of more than ten years, both in the research intensity of the economic sectors and in the shifts of weight that different sectors carry on the economy. More precisely, four variables will be analysed: (1) changes in R&D intensity, (2) changes in the value added, (3) overall level of R&D intensity and (4) share of the sector in total value added.

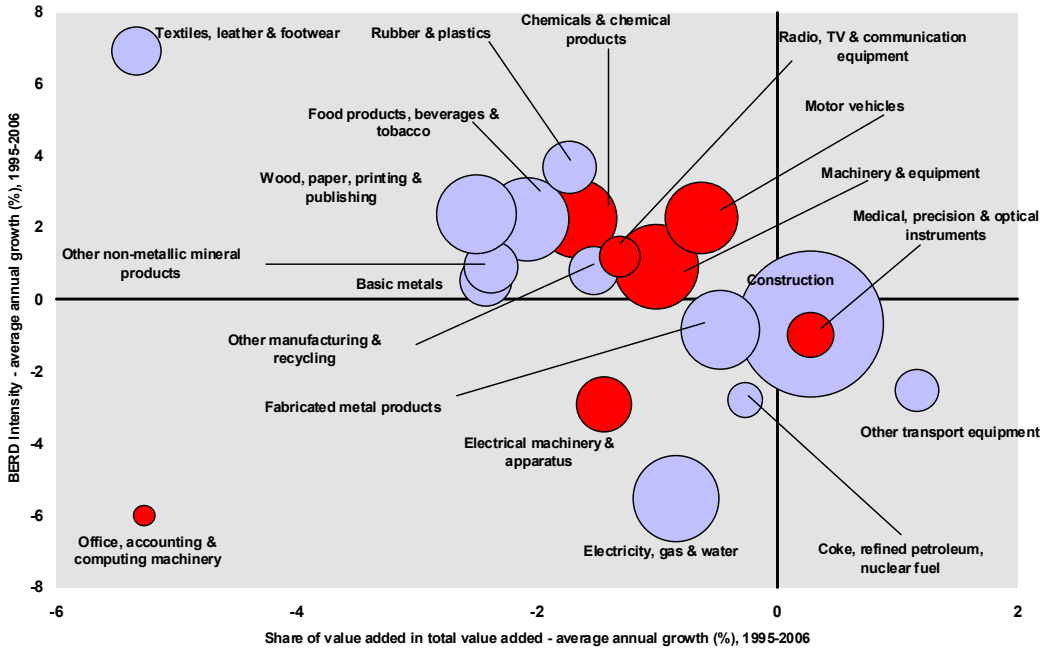
The following three graphs show the evolution of the research intensity of individual economic sectors (sectoral research intensity) and the evolution of the weight of individual sectors in the economy (provided by the respective value added). Sectors above the x-axis are sectors whose research intensity has increased between 1995 and 2007[46]. Sectors on the right-hand side of the y-axis are sectors whose economic weight has increased over the same period of time. The size of the bubble reflects the share of the sector (in value added) in the economy. Red sectors are the high-tech and medium high-tech sectors, i.e. the most research-intensive sectors of the economy. The others are represented in blue. The graphs therefore allow rapid identification of the size of research-intensive sectors in the economy of the country, as well as their evolution in terms of research intensity and of their weight in the economy. It also illustrates the internal structural change of some low or medium-tech sectors such as rubber and plastics, or textile and clothing or food products, where the overall R&D intensity has grown rapidely over the period, demonstrating an intra-sectoral specialisation towards more knowledge-intensive activities.

One caveat: the lack of available data for all 27 EU Member States. The main OECD source used[47] only covers 18 Member States. Also, from this perspective, the inclusion of analysis at the level of the services sectors would be desirable, but data availability makes it impossible at this stage.

The first graph, in which all the available EU Member States are aggregated, illustrates the decrease of the weight of the manufacturing sectors (by the positioning of the majority of the bubbles in the left side of the graph). It is also clear that most of the high-tech and medium high-tech sectors are in the upper side of the graph, thus showing an increase in BERD intensity. The move towards more research-oriented sectors has some notable exceptions: electrical machinery and apparatus, medical precision and optical instruments, and office accounting and computing machinery, which reduced the BERD intensity over the period in analysis.

[45] See section 'Overall review of the EU Member States and Associated countries' in the end of the report.
[46] In some cases, the last available data refer to 2006.
[47] In order to ensure inter-sectoral BERD comparability, the OECD ANBERD database was used. Available data only allowed for the analysis of 17 Member States, albeit representing around 90% of the total EU BERD.

Figure III.3.12 EU [1] - Share of value added versus BERD Intensity - average annual growth, 1995-2006

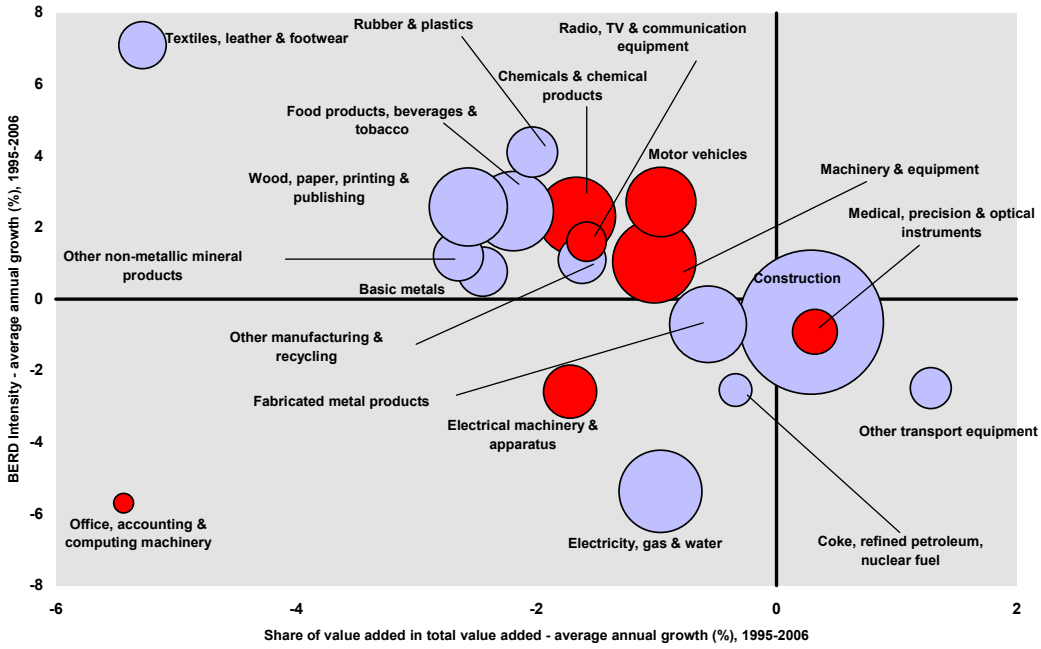


Source: DG Research and Innovation — Innovation Union Competitiveness Report 2011
Data: OECD
Notes: (1) EU does not include BG, EE, IE, EL, CY, LV, LT, LU, MT, AT, PT, RO, SI.
(2) High-Tech and Medium-High-Tech sectors are shown in red. 'Other transport equipment' includes High-Tech, Medium-High-Tech and Medium-Low-Tech.

The figure of the EU-15 Member States below shows a very similar panorama. In contrast, the third figure, of the EU-12 Member States, presents a completely different panorama. This third figure shows the 'catching-up' effect, with a few of the manufacturing sectors still increasing their weight in the overall economy - this partly responds to their capacity to compete internationally in global markets. However, these sectors, mostly high-tech or medium high-tech sectors, have decreased their R&D intensity over the period 1995–2006, weakening their long-term competitiveness. A common feature in both the EU-15 and the EU-12 is the weight of the construction sector.

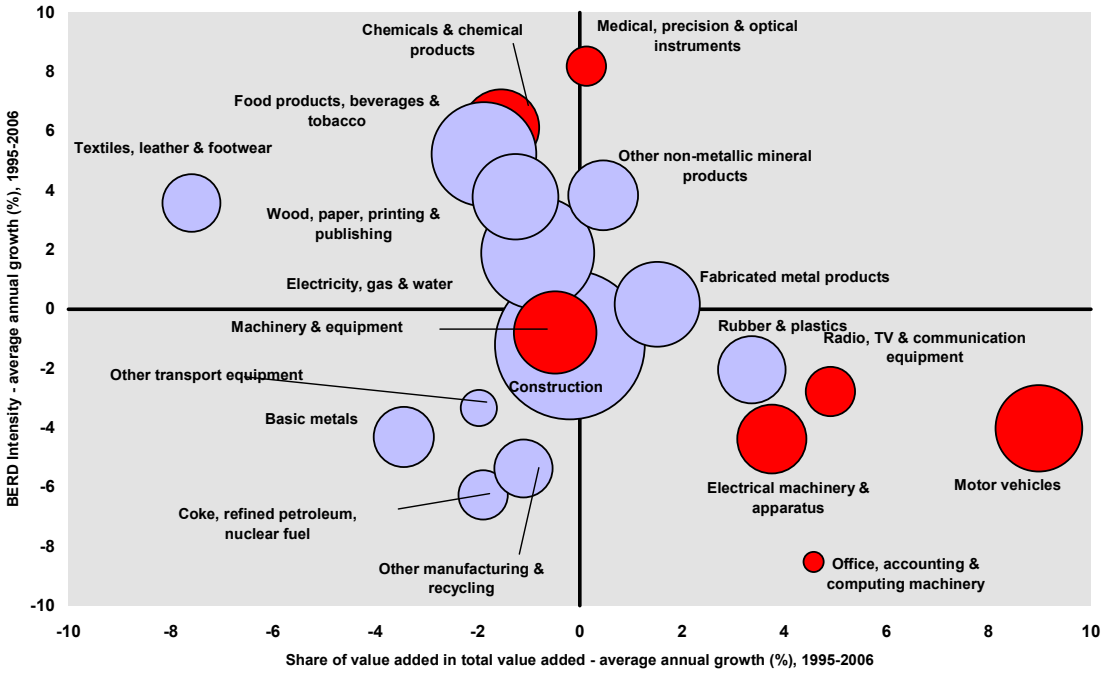
The structural change towards higher R&D intensity within sectors in the EU has not been sufficient in itself to raise the knowledge intensity of the economy. When benchmarking with the United States, for example, we see that there is still room for further increases in the research intensity of the high and medium high-tech industries. The structural composition of the economy is another aspect, as discussed previously in chapter 1 of Part III on fast-growing companies. This aspect alone is linked to the development of lead markets and obstacles to the growth of new technology-based firms. An economy can move towards more and larger knowledge-intensive sectors only with the emergence of new and fast-growing firms.

Figure III.3.13 EU - 15 Member States [(1)] - Share of value added versus BERD Intensity - average annual growth, 1995-2006



Source: DG Research and Innovation — Innovation Union Competitiveness Report 2011
Data: OECD
Notes: (1) EU: BE, DK, DE, ES, FR, IT, NL, FI, SE, UK.
(2) High-Tech and Medium-High-Tech sectors are shown in red. 'Other transport equipment' includes High-Tech, Medium-High-Tech and Medium-Low-Tech.

Figure III.3.14 EU - 12 Member States [1] - Share of value added versus BERD Intensity - average annual growth, 1995-2006



Source: DG Research and Innovation
Data: OECD
Notes: (1) EU: CZ, HU, PL, SI.
(2) High-Tech and Medium-High-Tech sectors are shown in red. 'Other transport equipment' includes High-Tech, Medium-High-Tech and Medium-Low-Tech.

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