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Skills and Industrial Competitiveness

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This report presents some of the results obtained in a study commissioned by the European Commission (Framework Contract B2/Entr/05/091) which went under the overall title 'Skill Problems in European Industrial Sectors'. The study was coordinated by the Vienna Institute for International Economic Studies (wiiw) in collaboration with Applica/Alphametrics and the Netherlands Bureau for Economic Policy Analysis (CPB).

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Summary

This study has been prepared for the European Commission (Framework Contract B2/Entr/05/091) and is composed of five sections. The first three sections all deal with assessing the role of skills in the European economy: Section 1 undertakes a number of econometric exercises to analyse the relationship between skills and two indicators of competitiveness, productivity growth and exports. This and the next section represent new research effort in that a disaggregated database (by NACE 2-digit industries) has been used to analyse this relationship. Section 2 extends the analysis towards the relationship between skills and economic growth by analysing the role of skills in the context of a growth accounting exercise where skill changes are separately identified in affecting the 'quality of labour services' and hence the contribution of labour input to value added. Again the analysis exploits the detailed, disaggregated database made recently available through the EU KLEMS project (see www.euklems.org). Section 3 presents an overview of skill compositional changes in different groups of EU economies. We distinguish between EU Northern economies, EU South (composed of Greece, Portugal and Spain) and the New Member States (restricted to only four countries, the Czech Republic, Hungary, Slovakia and Slovenia, for data reasons). In this section aggregate, economy-wide skill upgrading is decomposed into 'within' and 'between' (industry) changes in skill composition and the results show interesting patterns distinguished for more advanced and catching-up types of economies.

The last two sections move away from the topic of reviewing the impact of skills on economic performance and the tracking of changing skill demands in EU economies. In section 4, a literature overview is provided of empirical studies regarding returns to skill acquisition through schooling and training. The idea behind this section is that returns to schooling and training reflect both skill shortages and also provide the basis for decisions with regard to skill acquisition. Finally, section 5 presents a country-by-country overview of how information is gathered with regard to skill gaps in different EU economies. The methodologies and sources for assessing skill shortages are reviewed. These are a necessary ingredient into any attempt of designing policies in relation to skill planning and the design of schooling and training institutions. The section closes with a recommendation on useful extension of European-wide vacancy statistics.

Keywords: *skills, competitiveness, European industry*

JEL classification: *D24, F14, J24, O47, O52*

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Skills and industrial competitiveness

1 Skills and the competitiveness of EU manufacturing industries

1.1 Introduction

The relationship between human capital and productivity growth (i.e. GDP per capita) has widely been discussed in the literature on (endogenous) growth at the macroeconomic level. Important contributions also providing overviews over the relevant topics in this respect are e.g. Barro and Sala-i-Martin (1995) and Aghion and Howitt (1998) and for more recent contributions see Helpman (2004), and European Commission (2006). The role of human capital was particularly emphasized in Mankiw et al. (1992) where human capital was introduced in the Solow model (Solow, 1956) as an ordinary factor of production alongside labour and capital. Empirical work along these lines produced somewhat mixed results where also the measurement of human capital was debated (see de la Fuente and Ciccone (2003) and Sianesi and van Reenen (2002) for recent overviews). From a theoretical viewpoint the Mankiw et al. (1992) approach may be questioned in that the treatment of human capital as a direct input is misleading as pointed out by Benhabib and Spiegel (1994). In the latter contribution – based on Nelson and Phelps (1966) – technical progress is a function of the stock of human capital and thus only has an indirect effect; this is in line with contributions from the endogenous growth literature (see e.g. Romer, 1990).

Although there are a number of contributions at the total economy level the effect of human capital at the sectoral level is less developed. At the industry level there exists a large literature on the sectoral patterns of growth and productivity mainly focusing on R&D activities and technological spillovers. For a recent overview, see Los and Verspagen (2004) and for a survey in the context of evolutionary economics, see Castellacci (2007). Seemingly there is a paucity of studies focusing on skills in explaining competitiveness and trade performance in a cross-country/cross-industry perspective (see e.g. OECD, 1996, and Griffith et al., 2004). One of the reasons for this is probably the lack of a comprehensive dataset at the industry level.

In this study we present evidence of the relationship of human capital (skills measured by educational attainment) on productivity growth and export performance as measures of competitiveness. Labour productivity is commonly seen as the most important measure of competitiveness at the country and industry level. In this approach productivity growth is a function of the stock of human capital (skills) available where the underlying assumption is that a better educated workforce is better in adopting, implementing and even creating new technologies. A second measure of international competitiveness is success in foreign markets, i.e. exports. Higher export growth – compared to other countries – can be looked

at as gaining competitiveness in world markets, driven by the dynamics of comparative advantages and thus are a measure of revealed comparative advantages. The dataset used consists of a cross section of eleven manufacturing industries and twenty-four European countries over the period 1995-2004. We do this first by using panel econometric techniques and second, following the Benhabib and Spiegel (1995, 2005) approach which is adapted to the industry level.

1.2 Data

For the estimations we use data from the recently released EU KLEMS database (see www.euklems.org) which provides the most comprehensive set of data for this purpose. The period we look at is 1995-2004. This allows to include a number of Central-Eastern European countries in the analysis. A detailed description of the methodology and data issues related to the database can be found in Timmer et al. (2007) which is also available from the website (www.euklems.org). From this database we use data for labour productivity (i.e. value added at constant prices divided by hours worked). As the skill information in this database is provided only at a more aggregate level (see the detailed discussion in sections 2 and 3) we have to combine these data with information on educational attainment levels using Labour Force Survey (LFS) data (available for the period 1998-2004). We shall use averages of employment shares of different educational attainment groups (ISCED groups high, medium and low educated) over a longer time interval by sector to avoid data problems like fluctuations in shares due to small sample sizes and outliers[1]. This strategy allows to include twenty-four of the current EU member states (not included are Bulgaria, Malta and Romania for data reasons). The industry breakdown is presented in Table 1.1. Data are available for eleven industries corresponding to NACE 2-digit aggregates as indicated in Table 1.1. Below we shall also present evidence for groupings of industries; the groupings are defined with respect to the share of high-skilled workers into low-skill, medium-skill and high-skill intensive branches (see Box 3.1 for details).

In Annex Tables 1.A.1 to 1.A.7 we present detailed descriptive country by industry information on labour productivity growth rates, initial gaps (at PPP 1995), educational shares, growth rates of exports and growth rates of unit labour costs. All of these variables will be used in the econometric analysis below. As already discussed above we use labour productivity growth and export growth as measures of competitiveness.

[1] The analysis here is based on data from the LFS, which enable us to break down population, labour force and employment by educational attainment level (defined in terms of ISCED 97) (ISCO-88) category as well as by (NACE rev. 2) sector of activity. Educational attainment is divided into 'low' – those with lower secondary education or below (ISCED 0-2), 'medium' – those who have completed upper secondary education or training (ISCED 3 or 4) and 'high' – those who have completed tertiary education (ISCED 5 or 6). The division into only three groups is determined by the available data. In particular for the 'medium' category, a more detailed classification between those with vocational qualifications and those with more general educational qualifications would have been more informative, but the data for a number of countries are not sufficiently consistent over time to facilitate such a split to be made. See Box 3.2 for more details.

To provide a first overview, in Figure 1.1 we plot the growth rates of labour productivity by industry aggregates according to the groups shown in Table 1.1 (the average growth rates are weighted by the average value added shares). Similarly, Figure 1.2 plots the structure of the initial gaps (expressed in per cent of the leading industry-country pair).

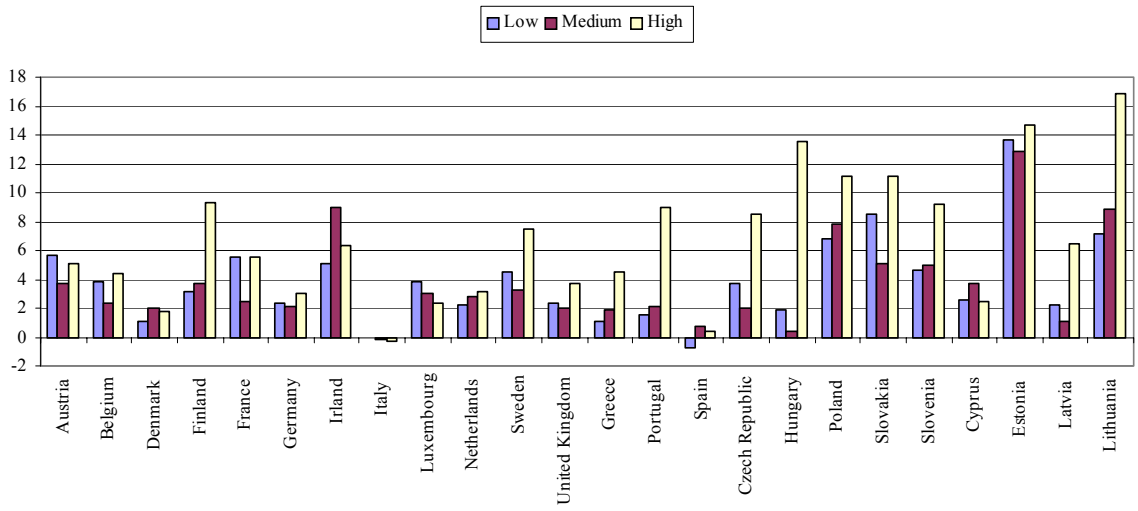
Table 1.1

Industry classification

Code	Description	Industry group
15t16	Food, beverages and tobacco	M
17t19	Textiles, textile products, leather and footwear	L
20	Wood and products of wood and cork	L
21t22	Pulp, paper, printing and publishing	M
23t25	Chemical, rubber, plastics and fuel	M
26	Other non-metallic mineral	M
27t28	Basic metals and fabricated metal	M
29	Machinery n.e.c.	H
30t33	Electrical and optical equipment	H
34t35	Transport equipment	H
36t37	Manufacturing n.e.c., recycling	L

Figure 1.1

Growth rates of labour productivity (value added per hour worked) by industry groups, 1995-2004



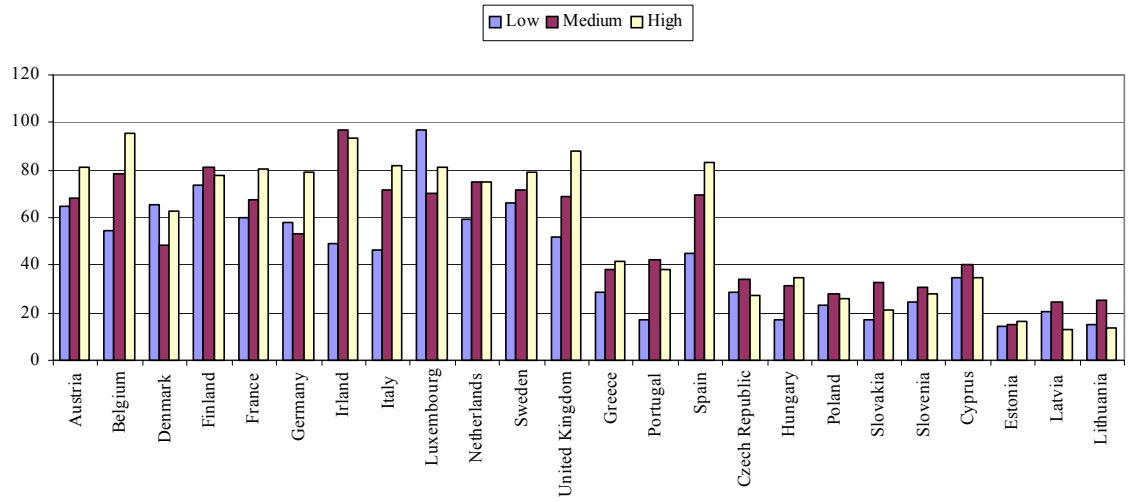
Source: EU KLEMS database, March 2007; wiiw calculations.

The most striking fact is that in a number of countries growth rates of the more skill intensive sectors are higher. This is especially the case for the cohesion countries Greece and Portugal, and for all Eastern European countries except Cyprus. Most of these countries also show higher growth rates on average. In the advanced economies this pattern of higher growth rates in the skill intensive sectors is eminent mainly in Finland and Sweden. From Figure 1.2 it also appears that the initial gaps seem to be lower in the

medium and mainly the skill intensive sectors (i.e. the productivity level in per cent of the leading country is higher in these sectors). Further, the initial productivity gaps are higher for the cohesion countries and the Eastern European countries; in the latter group the initial productivity level relative to the leading industry in 1995 was between less than 20% and up to 40%. From these descriptive statistics one might conclude that the high-skill intensive sectors also show higher labour productivity growth rates in general and that labour productivity in catching-up countries seems to converge faster in these sectors. Further, the initial productivity gap is important as it provides a potential for faster productivity growth ('advantage of backwardness').

Figure 1.2

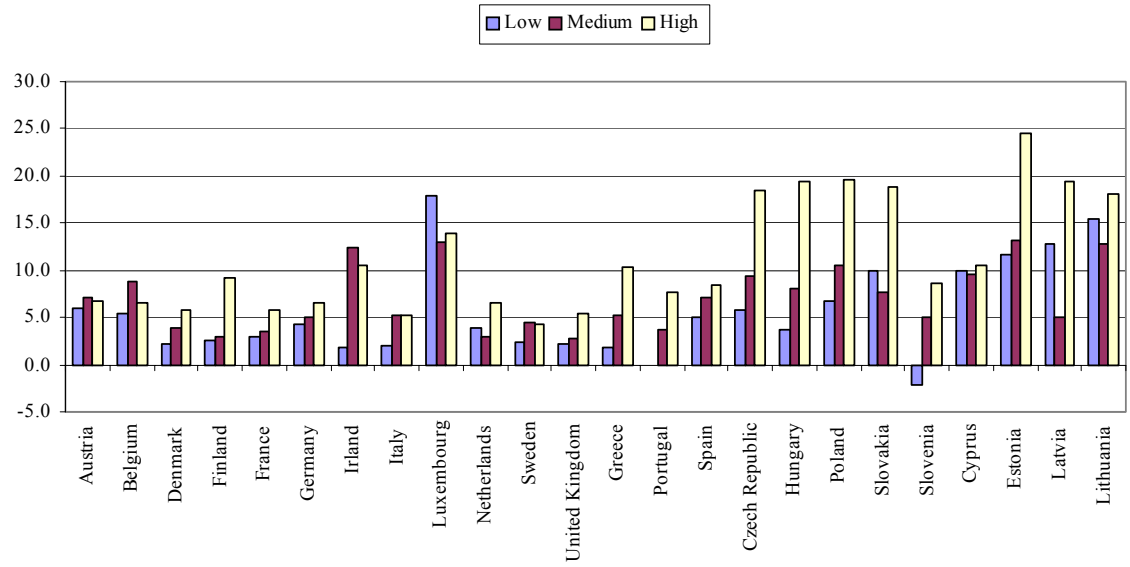
Initial level of labour productivity in per cent of leading country by industry (at PPP 1995)



Source: EU KLEMS database, March 2007; wiiw calculations.

Figure 1.3

Average growth rates of exports (in per cent), 1995-2004

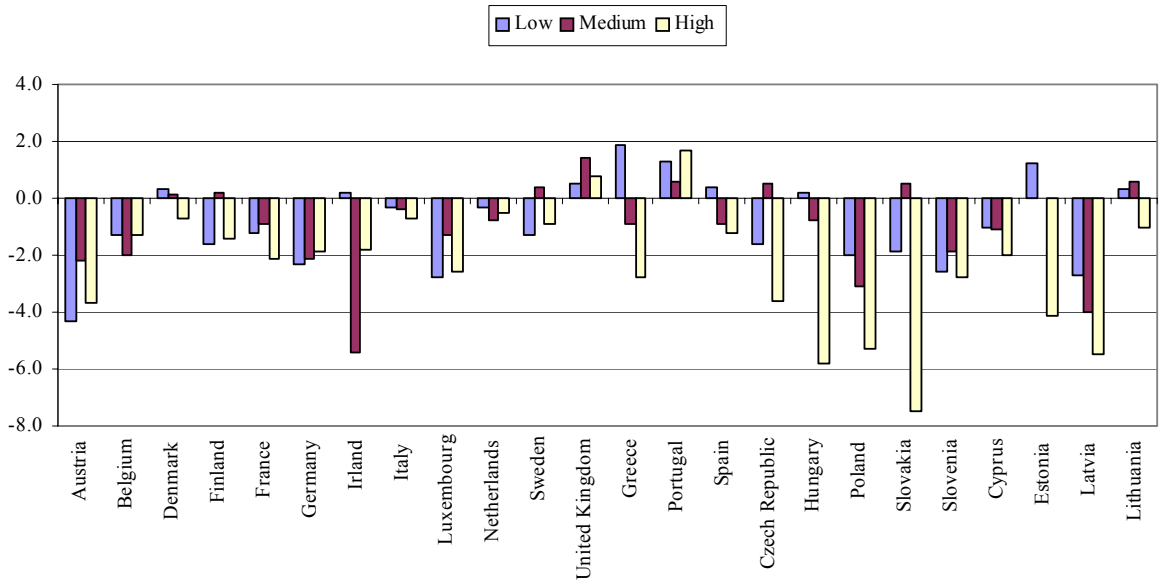


Source: UN COMTRADE database, wiiw calculations.

Figures 1.3 and 1.4 present the growth rates of exports (nominal at current Euro rates; industries weighted by gross output shares) and growth rates of unit labour costs (compensation divided by gross output and weighted by gross output shares) for the three industry groups and each country.

Figure 1.4

Growth rates of unit labour costs (in per cent), 1995-2004



Source: EU KLEMS database, March 2007, wiiw calculations.

Again one can find higher growth rates of exports in the high-skill intensive sectors on average. This is especially the case for Eastern European countries like the Czech Republic, Hungary, Poland, Slovak Republic, Estonia and Latvia. Finally, the pattern of growth rates of unit labour costs mainly reflects the differences in growth rates of labour productivity. Most importantly, these are in particular declining strongly in the medium- and high-skill intensive sectors of the Eastern European countries (e.g. Hungary, Poland, Slovak Republic, and Estonia).

1.3 Skills and competitiveness at the industry level

1.3.1 Skills and productivity growth

We start with studying the effects of skill composition of the employed labour force on productivity growth by estimating the following specification (where we omitted country and industry subscripts)

$$\gamma = \beta_0 + \beta_1 S_k + \beta_2 G + Dummies + \varepsilon$$

The growth rate of labour productivity γ is regressed on the skill intensity variable S (expressed as the share of workers of skill type k = H, M, L in total employment of the particular industry and country), and the initial gap expressed as the log of the productivity

level in a particular sector and country divided by the productivity level of the leading industry-country pair. The results from this regression are presented in Table 1.2. Here we included each of the skill types separately. (Specifications including the shares of two skill types simultaneously yield similar results). The first three columns present results without industry dummies. In specification (2) we introduced industry dummies to account for industry specific characteristics like technology intensity, innovative potential, etc. In this case we performed LSDV regressions; the industry effects are not reported.

Table 1.2

Labour productivity growth and skills

Dependent variable: Growth rates of labour productivity						
	(1)			**(2)**		
Initial productivity gap	-0.027 ***	-0.021 ***	-0.020 ***	-0.041 ***	-0.035 ***	-0.033 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Share of high-skilled workers	0.105 ***			0.082 **		
	(0.001)			(0.020)		
Share of medium-skilled workers		0.061 ***			0.040 ***	
		(0.000)			(0.001)	
Share of low-skilled workers			-0.084 ***			-0.058 ***
			(0.000)			(0.000)
Industry dummies	No	No	No	Yes	Yes	Yes
F-value	25.29	27.25	36.55	9.49	12.77	13.08
R squared	0.21	0.22	0.28	0.40	0.40	0.42
Observations	264	264	264	264	264	264

Note: p-values from robust standard errors are reported.

As expected we find a significant effect of the initial gap on productivity growth pointing towards a catching-up effect known as β-convergence. The implied half-time of closing the gap is between 25 and 35 years. More interesting are the results on the skill variables. We find significant positive effects of the share of high-skilled and medium-skilled on productivity growth where the effect of the latter is smaller with around half of the effect of the share of high-skilled workers on productivity growth. These results suggest that a skilled labour force fosters productivity growth by increasing the capability of adopting, implementing or creating new technologies. The latter is mainly relevant for countries already being near the technology frontier. The parameter measuring the effect of the shares of low-skilled workers is significantly negative suggesting that a skilling of the less educated workers would have a positive effect on productivity growth. The estimations are improved when including industry dummies capturing industry specific effect. In this case the speed of convergence is higher and the implied half-time becomes even less than 20 years. Again the results for the shares of the particular skill types hold, i.e. significantly positive for the high- and medium-skilled (for the latter the effect is again smaller) and significantly negative for the share of low-skilled. The effects are however smaller pointing

towards the importance of the industry characteristics. We also tested a number of other specifications: First, when introducing industry group dummies (according to the skill intensities of industries as given in Table 1.1) these results are confirmed. Second, including country dummies additionally to the industry dummies provides no longer any significant results for the skill shares. This reflects the fact that the skill shares of the various skill types are relatively similar across industries for each country reflecting supply side factors. This thus causes multicollinearity of the skill variables and the country fixed effects resulting in higher standard errors and insignificant results. When including country dummies only the effects of skill shares become significant with the expected signs. Only for the medium-skill shares the coefficient becomes insignificant. Finally, we also tested the relationship with a limited country sample, i.e. excluding the Eastern European catching-up countries. In this case the initial gap shows no longer a significant effect on productivity growth, as most of the countries and industries are close enough to the technology frontier. The results for the skill shares are however confirmed at the 10 % level, i.e. positive for high- and medium-skilled workers and negative for low-skilled workers (the only exception being the share of high-skilled when including industry dummies).

Table 1.3

Labour productivity growth and skills by industry groups

Dependent variable: Labour productivity growth	**Share of high skilled workers**	**Share of medium skilled workers**	**Share of low skilled workers**
Initial productivity gap in low-skill intensive industries	-0.027 ***	-0.016 *	-0.015 *
	(0.002)	(0.076)	(0.057)
Initial productivity gap in medium-skill intensive industries	-0.028 ***	-0.039 ***	-0.033 ***
	(0.000)	(0.000)	(0.000)
Initial productivity gap in high-skill intensive industries	-0.051 ***	-0.048 ***	-0.044 ***
	(0.000)	(0.000)	(0.000)
Skill share in low-skill intensive industries	0.115	0.066 ***	-0.069 ***
	(0.165)	(0.000)	(0.000)
Skill share in medium-skill intensive industries	0.164 ***	0.012	-0.049 ***
	(0.000)	(0.502)	(0.001)
Skill share in high-skill intensive industries	0.004	0.057 **	-0.068 *
	(0.953)	(0.028)	(0.064)
Industry dummies	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes
F-value	11.29	10.52	10.72
R squared	0.43	0.43	0.44
Observations	264	264	264

Notes: p-values from robust standard errors are reported.

The descriptive overview above and also the previous results suggest that the effect of skills on productivity growth might vary across types of industries. Table 1.3 thus presents the results when allowing for different convergence rates and differences in the effects of

skill shares across industry groupings (i.e. high-, medium- and low-skill intensive industries as indicated in Table 1.1 above).

Table 1.4

Labour productivity growth, skills and technology diffusion

Results for total sample

Dependent variable: Labour productivity growth

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high- and medium-skilled workers	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high- and medium-skilled workers
Skill share	-0.063	0.006	-0.150 ***	0.045 ***	-0.114 **	-0.019	-0.160 ***	0.018
	(0.153)	(0.717)	(0.000)	(0.006)	(0.021)	(0.324)	(0.000)	(0.275)
Share x (1-Gap)	0.332 ***	0.096 ***	0.096 ***	(0.069) ***	0.394 ***	0.122 ***	0.132 ***	0.090 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry dummies	No	No	No	No	Yes	Yes	Yes	Yes
F-value	20.68	28.70	5.85	38.5	5.85	12.05	10.67	12.16
R squared	0.19	0.22	0.32	0.28	0.32	0.36	0.34	0.39
Observations	264	264	264	264	264	264	264	264

Results for EU-15 subsample

Dependent variable: Labour productivity growth

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high- and medium-skilled workers	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high- and medium-skilled workers
Skill share	0.082 *	0.027 *	-0.06 ***	0.037 **	0.046	0.035 *	-0.048 **	0.032 *
	(0.059)	(0.100)	(0.001)	(0.027)	(0.363)	(0.059)	(0.016)	(0.076)
Share x (1-Gap)	-0.049	-0.008	0.038 *	-0.006	-0.096	-0.025	0.033	-0.020
	(0.359)	(0.667)	(0.073)	(0.657)	(0.218)	(0.366)	(0.259)	0.355
Industry dummies	No	No	No	No	Yes	Yes	Yes	Yes
F-value	1.85	1.38	5.68	2.58	1.96	2.65	2.80	2.65
R squared	0.049	0.016	0.06	0.046	0.19	0.20	0.21	0.21
Observations	165	165	165	165	165	165	165	165

Notes: p-values from robust standard errors are reported.

The results from this specifications show that convergence is taking place faster in the high-skill intensive industries with a half-time of about 15 years opposed to a half time of more than 25 years in the low-skill intensive industries (dependent on the skill measure). The share of high-skilled workers is only significant in the medium-skill intensive industries. On the other hand, the share of medium-skilled workers is significantly positive in the low- and high-skill intensive industries but not so in the medium-skill intensive industries. This result suggests that country specific idiosyncrasies in the training and educational systems of different countries and in particular those of the Central and Eastern European economies are important. The latter group has a very high share of medium-educated workers and were also the main catching-up economies. This is confirmed when looking at the specification using the share of low-skilled workers that is negatively significant in all

industry groups (for high-skill intensive industries at the 10% level only). As the shares sum up to one this result also suggests that the share of high- and medium-skilled taken together is significantly positive.

Following the above-mentioned contributions at the total economy level we also test the following specification, which is in line with the model suggested in Benhabib and Spiegel (2005) assuming a logistic form of technology diffusion. Following Vandenbussche et al. (2006) we use the share of workers with skill type k rather than the level of workers. Specifically we estimate the following specification

$$\gamma = \beta_0 + \beta_1 S_k + \beta_2 S_k (1 - G) + Dummies + \varepsilon$$

where the gap is now measured as the relative productivity level of the follower country's industry to the leading one. The results of this specification are presented in Table 1.4. Again we present two specifications: the first using simple OLS method whereas in the second we allow for industry specific characteristics using industry dummies.

In the specification without industry dummies only the share of low-skilled is negatively significant which conversely means that the share of high- and medium-skilled together would have a significantly positive effect on productivity growth. The interaction term between the skill share and gap (the gap is defined as 1-G) is positively significant showing again the relevance of skill composition for convergence processes. It is important to note that the parameter is higher for the high-skilled in the interactive term, which shows the importance of this group for the catching-up process in technology, i.e. technology adoption and learning. Introducing industry dummies confirms these results with the exception that the share of high-skilled becomes negatively significant. This term was also negative but not significant in the previous specification without industry dummies. A closer look at the data shows that this result is mainly driven by the fact that the catching-up countries show particularly high growth rates in the higher tech (skill intensive) sectors – which might be driven by other factors like foreign direct investment – and at the same time show relatively lower shares of high-skilled workers compared to the more advanced countries. This is confirmed when restricting the sample to the EU-15 countries. The results are reported in the second part of Table 1.4. In this restricted sample the parameters show the expected sign, i.e. positive for high- and medium-skilled and negative for the low-skill share. These are also significant in both specifications with one exception. The interaction term becomes insignificant as these countries are already operating near the technological frontier where creation of knowledge and new technologies is relatively more important than adoption. The general positive effect of a skilled workforce is confirmed by the significance of the skill share when taking high- and medium-skilled together as reported in Table 1.4; however, this significance for the total sample is lost when introducing industry dummies. When including the share of high and the share of the low-skilled workers simultaneously and accordingly the interactions with the initial gap we

find a negative non-significant effect of the share of high-skilled workers and again a negative significant effect of the low-skilled workers. In this case only the interaction of the high-skill shares with the initial gap is significantly positive which again emphasizes the role of the skilled workers in the catching-up process.

Again we test the same specification allowing for industry group specific parameters. The results are reported in Table 1.5. The results are broadly confirmed in that the share of high- and medium-skilled is particularly important when interacted with the initial gaps. The share of low-skilled workers is negatively significant for all industry groups; the interaction with the initial gaps shows lower estimated values and less significance. The negative effect of the high-skilled workers share in high-skill intensive industries and medium-skilled workers in medium-skill intensive industries again result from the peculiar catching-up process of the Central and Eastern European economies. The second part of the table shows the results for a subsample including the EU-15 countries. For this subsample we find significantly positive effects of high- and medium-skills in the low- and medium-skill intensive industry groups. The effect is however not significant for the high-skill intensive industries.

1.3.2 Skills and international competitiveness

Another indicator for competitiveness is the export performance of the various countries as outlined above. This measures success in international markets. In the following we estimate whether a higher skill share has a positive effect on export growth where we control for growth in unit labour costs. Specifically the estimated equation is given by (again omitting country and industry subscripts)

$$\gamma = \beta_0 + \beta_1 S_k + \beta_2 \mu + Dummies + \varepsilon$$

where γ is now the growth rate of exports and μ denotes growth rates of unit labour costs. Export data are taken from the UN COMTRADE database and are measured at current US-$. Unit labour costs are calculated as labour compensation divided by gross output in local currency units. As above, we report the results for a specification first without including dummies and then including industry dummies capturing industry specific characteristics. The results can be found in Table 1.6.

We find that a higher share of high- and medium-skilled workers spurs growth of exports in both specifications, i.e. also when including industry dummies. Furthermore, the coefficient of high-skilled workers is again higher compared to that for the medium educated workers. The coefficient of the share of low educated workers is negatively significant. The growth rate of unit labour costs relates negatively to export growth as higher unit labour costs decrease competitiveness. The results are confirmed when allowing for industry group specific effects. The results for this are presented in Table 1.7.

Table 1.5

Labour productivity growth, skills and technology diffusion allowing for industry-group specific effects

Results for total sample

Dependent variable: Labour productivity growth

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high- and medium-skilled workers
Skill share in low-skill intensive industries	-0.159	0.038	-0.124 ***	0.040 *
	(0.135)	(0.214)	(0.000)	(0.094)
Skill share in medium-skill intensive industries	0.017	-0.046 *	-0.131 ***	0.023
	(0.839)	(0.091)	(0.000)	(0.335)
Skill share in high-skill intensive industries	-0.196 ***	-0.016	-0.280 ***	0.021
	(0.005)	(0.682)	(0.000)	(0.663)
Share x (1-Gap) in low-skill intensive industries	0.475 ***	0.055	0.070 *	0.053 **
	(0.002)	(0.109)	(0.065)	(0.046)
Share x (1-Gap) in medium-skill intensive industries	0.308 ***	0.130 ***	0.094 *	0.078 ***
	(0.004)	(0.000)	(0.061)	(0.005)
Share x (1-Gap) in high-skill intensive industries	0.414 ***	0.157 ***	0.324 ***	0.117 ***
	(0.000)	(0.000)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes	Yes
F value	7.20	9.86	10.18	10.27
R squared	0.34	0.38	0.38	0.41
Observations	264	264	264	264

Results for EU-15 subsample

Dependent variable: Labour productivity growth

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high- and medium-skilled workers
Skill share in low-skill intensive industries	0.014	0.069 **	-0.068 ***	0.051 **
	(0.910)	(0.025)	(0.009)	(0.035)
Skill share in medium-skill intensive industries	0.128 **	0.046 **	-0.016	0.047 ***
	(0.019)	(0.012)	(0.577)	(0.006)
Skill share in high-skill intensive industries	-0.016	-0.011	-0.111 **	-0.012
	(0.848)	(0.807)	(0.035)	(0.794)
Share x (1-Gap) in low-skill intensive industries	-0.034	0.001	0.023	-0.001
	(0.808)	(0.983)	(0.512)	(0.981)
Share x (1-Gap) in medium-skill intensive industries	-0.212 **	-0.077 *	-0.026	-0.060 *
	(0.046)	(0.099)	(0.581) ***	(0.083)
Share x (1-Gap) in high-skill intensive industries	0.041	0.007	0.194	0.005
	(0.636)	(0.873)	(0.006)	(0.857)
Industry dummies	Yes	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes	Yes
F value	1.95	2.44	3.18	2.58
R squared	0.22	0.23	0.27	0.23
Observations	165	165	165	165

Notes: p-values from robust standard errors are reported.

Table 1.6

Skills and export performance

Dependent variable: Growth rates of exports	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers
Skill share	0.179 ***	0.059 ***	-0.103 ***	0.138 **	0.066 ***	-0.090 ***
	(0.000)	(0.005)	(0.000)	(0.018)	(0.000)	(0.000)
Growth rate of unit labour costs	-0.788 ***	-0.669 ***	-0.558 ***	-0.628 ***	-0.394 *	-0.370 *
	(0.000)	(0.002)	(0.008)	(0.001)	(0.056)	(0.076)
Industry dummies	No	No	No	Yes	Yes	Yes
F value	17.67	12.85	26.01	9.33	11.13	11.76
R squared	0.14	0.10	0.16	0.27	0.27	0.30
Observations	263	263	263	263	263	263

Notes: p-values from robust standard errors are reported.

Table 1.7

Skills and export performance for industry groups

Dependent variable: Growth rate of exports	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers
Growth of unit labour costs in low-skill intensive sectors	-0.746 **	-0.476	-0.480
	(0.035)	(0.292)	(0.288)
Growth of unit labour costs in medium-skill intensive industries	-0.078	-0.058	-0.041
	(0.773)	(0.835)	(0.881)
Growth of unit labour costs in high-skill intensive industries	-1.118 ***	-0.620	-0.454
	(0.000)	(0.104)	(0.254)
Skill share in low-skill intensive industries	0.155	0.060 *	-0.065 *
	(0.320)	(0.093)	(0.095)
Skill share in medium-skill intensive industries	0.119 *	0.052 ***	-0.071 ***
	(0.053)	(0.004)	(0.000)
Skill share in high-skill intensive industries	0.185 *	0.082	-0.164 ***
	(0.084)	(0.125)	(0.001)
Industry dummies	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes
F value	8.52	9.53	10.7
R squared	0.29	0.28	0.32
Observations	263	263	263

Notes: p-values from robust standard errors are reported.

Firstly, we find that the unit labour cost variable is particularly significant in the high- and low-skill intensive groups of industries. These are the industry groups where a deterioration (improvement) in the unit labour cost position has the strongest negative (positive) effect. This could be interpreted as expressing a strong competitive pressure by lower cost producers in the low-skill industries, but also in the lower cost segment of the higher skill

industries. Secondly, we see that a high share of low-skilled workers is particularly detrimental for export competitiveness in the high- and then the medium-skilled industries which is again compatible with a strong competitive pressure in the low quality segments by lower cost producers of such industries. These are the segments that need to be vacated by the higher-cost producers which in our sample (i.e. European producers) are strongly represented.

1.4 Conclusions

This part of the analysis has attempted to find evidence for skill compositional effects on two types of competitiveness variables, (labour) productivity growth and export growth. For this we used a disaggregated industry-level data set to capture the impact of skills on competitiveness for total manufacturing and three industry groups.

Given the data restrictions and the fact that two types of data-sources had to be used (EU-KLEMS data base and LFS statistics) we were restricted to analyse time series for the period 1995 to 2004 and for eleven manufacturing industries, but for a relatively full EU country sample including twenty-four countries of the European Union. Furthermore, we grouped industries into three groups depending upon whether these were industries with a high, medium or low (EU-wide) share of highly skilled workers and we supplied estimates for different effects of skill composition on competitiveness in these three industry groupings.

Overall, the results are promising in that the share of high-skilled turned out to be a significant factor over the entire country and industry sample in explaining relative productivity and export growth, followed by the share of medium-skilled and with the share of low-skilled having a significant negative impact on the two competitiveness variables. Furthermore, when differentiating between the general effect of skill composition on the trend productivity growth rates and the impact which skills might have on the speed of catching-up, we found that the share of high-skilled is particularly important for the speed of catching-up. For a subset of advanced countries we still find evidence for the importance of a higher share of skilled workers. Finally, as regards export growth, we found particularly detrimental effects of a high share of low-skilled in the high- and then medium-skill industries which would indicate that in such industries it is particularly important to vacate low-skill niches which have come strongly under pressure from (both European and non-European) catching-up economies.

References:

Aghion, P. and P. Howitt (1998), *Endogenous growth theory*, MIT Press, Cambridge, MA.

Barro, R.J. and X. Sala-i-Martin (1995), *Economic growth*, MacGraw-Hill.

Benhabib, J. and M. Spiegel (1994), 'The role of human capital in economic development: Evidence from aggregate cross-country data', *Journal of Monetary Economics*, Vol. 34, pp. 143-173.

Benhabib, J. and M. Spiegel (2005), 'Human capital and technology diffusion', in: P. Aghion and S. Durlauf (eds), *Handbook of economic Growth*, Elsevier, Amsterdam.

Castellacci, F. (2007), 'Technological Regimes and Sectoral Differences in Productivity Growth', *Industrial and Corporate Change*, forthcoming.

de la Fuente, A. and A. Ciccone (2003), 'Human capital in a global and knowledge-based economy', Final report for the European Commission, Directorate-General for Employment and Social Affairs, Office for Official Publications of the European Commission, Luxembourg.

European Commission (2006), 'Employment in Europe 2006', Directorate-General for Employment, Social Affairs and Equal Opportunities, Unit D.1, Brussels.

Griffith, R., S. Redding and J. van Reenen (2004), 'Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries', *Review of Economics and Statistics*, Vol. 86, No. 4, pp. 883-895.

Helpman, E. (2004), *The mystery of economic growth*, Belknap Press, Cambridge, MA.

Los, B. and B. Verspagen (2004), 'Technology Spillovers and Their Impact on Productivity', in H. Hanusch and A. Pyka (eds), *Elgar Companion to Neo-Schumpeterian Economics*, Edward Elgar, Cheltenham, UK.

Mankiw, G., D. Romer and N. Weil (1992), 'A contribution to the empirics of economic growth', *Quarterly Journal of Economics*, Vol. 107, No. 2, pp. 407-437.

OECD (1996), 'The Evolution of Skills in OECD Countries and the Role of Technology', *STI Working Papers*, 1996/8.

Romer, P. (1990), 'Endogenous technological change', *Journal of Political Economy*, Vol. 98, No. 5, Part II, pp. 71-102.

Sianesi, B. and J. van Reenen (2002), 'The Returns to Education: A Review of the Empirical Macro-Economic Literature', *Journal of Economic Surveys*.

Solow, R. (1956), 'A contribution to the theory of economic growth', *Quarterly Journal of Economics*, Vol. 70, pp. 65-94.

Vandenbussche, J., P. Aghion and C. Meghir (2006), 'Growth, distance to frontier and composition of human capital', *Journal of Economic Growth*, Vol. 11, No. 3.

Annex

Table 1.A.1

Growth rates of labour productivity (value added per hour worked), 1995-2004

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	3.5	6.4	5.5	4.6	2.9	3.8	3.9	3.7	5.6	6.3	5.4
Belgium	1.2	4.0	4.5	2.0	2.6	0.6	3.5	3.7	5.8	3.6	3.3
Denmark	0.8	1.7	1.6	2.0	4.0	2.0	1.1	0.1	3.8	1.8	0.6
Finland	5.7	1.9	4.6	3.8	4.3	2.0	2.0	2.7	14.3	0.6	1.6
France	0.4	5.2	8.6	2.2	4.6	4.2	1.7	5.0	8.6	2.7	4.7
Germany	0.5	3.6	3.2	1.2	3.5	3.1	1.7	1.3	5.1	2.7	0.6
Ireland	7.0	8.5	3.3	10.6	10.4	0.1	4.7	5.6	6.7	3.0	2.9
Italy	-0.6	-0.7	1.8	-0.1	-1.2	-0.6	1.0	-0.6	0.1	-0.3	0.1
Luxembourg	-3.1	2.1	14.1	0.6	3.2	1.9	5.6	0.3	5.9	4.0	2.6
Netherlands	2.2	5.7	0.2	2.9	3.9	1.1	2.1	2.5	2.0	6.0	1.5
Sweden	2.0	2.2	5.3	3.2	6.3	2.4	1.2	2.7	14.8	5.9	4.2
United Kingdom	0.9	4.2	1.0	1.6	2.1	3.5	3.1	2.8	5.4	2.4	1.1
Greece	0.8	1.5	-2.0	1.6	1.6	4.4	3.6	0.4	7.4	5.2	1.6
Portugal	1.7	1.4	5.7	1.2	2.3	3.1	2.4	4.3	9.1	12.7	-1.5
Spain	0.5	-1.6	-0.4	1.2	0.6	0.9	0.4	1.3	-0.3	0.4	0.4
Czech Republic	2.4	4.8	4.3	5.8	0.7	6.8	-0.6	5.0	9.8	10.5	1.7
Hungary	-4.0	1.8	3.0	8.4	-1.3	3.8	4.7	11.8	15.5	11.4	1.3
Poland	9.0	5.7	9.1	3.0	3.2	20.7	8.3	10.8	11.3	11.3	6.5
Slovakia	-3.7	5.4	11.7	7.4	5.8	8.1	8.3	10.8	10.8	11.9	11.6
Slovenia	-0.4	4.1	4.5	5.5	6.9	5.5	6.1	9.3	8.8	10.0	5.5
Cyprus	1.5	0.9	4.6	3.4	15.5	4.6	4.6	2.5	1.7	3.8	2.8
Estonia	11.3	12.6	14.9	14.1	13.2	16.0	12.7	13.9	15.6	14.0	13.8
Latvia	-0.8	1.9	2.5	2.2	5.0	7.2	2.0	4.7	9.7	4.9	1.2
Lithuania	6.5	4.2	12.7	9.0	9.6	14.4	15.0	17.6	14.1	23.0	10.0

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 1.A.2

Initial level of labour productivity in per cent of leading country by industry (at PPP 1995)

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	64.0	20.0	93.8	73.4	40.4	74.6	84.6	82.4	74.9	91.7	75.8
Belgium	83.0	22.6	100.0	80.5	61.6	90.1	100.0	94.8	91.0	100.0	88.7
Denmark	54.9	18.7	77.7	46.0	32.3	56.7	59.4	68.7	58.6	53.2	81.4
Finland	71.2	17.1	94.1	100.0	39.7	60.3	95.1	78.2	80.2	59.4	80.2
France	73.0	21.9	82.3	67.8	48.6	68.1	83.7	75.7	76.4	88.3	99.7
Germany	56.0	18.3	79.9	47.4	36.7	69.3	70.2	81.2	64.1	90.7	76.4
Ireland	100.0	14.3	74.1	94.3	100.0	84.0	61.1	68.3	100.0	51.1	66.8
Italy	74.9	22.6	78.0	71.7	51.4	72.4	87.3	92.2	74.4	70.6	91.6
Luxembourg	62.6	100.0	78.8	70.8	52.3	100.0	76.2	100.0	52.0	54.3	100.0
Netherlands	92.5	23.4	92.4	57.4	63.6	82.3	86.7	85.9	66.1	71.2	63.2
Sweden	69.0	19.9	93.7	83.1	45.2	66.2	88.5	83.4	68.5	83.6	42.4
United Kingdom	92.5	18.0	68.7	67.7	44.8	71.2	76.0	82.9	84.0	96.6	81.8
Greece	43.7	14.6	42.5	34.5	27.2	41.9	43.8	33.9	51.8	39.7	61.2
Portugal	37.1	9.3	28.7	57.6	29.2	46.2	43.2	39.0	42.1	32.2	43.4
Spain	68.8	19.2	74.3	69.0	47.9	72.0	91.8	84.0	78.5	84.9	69.4
Czech Republic	39.7	7.5	35.3	32.8	22.4	31.9	40.0	31.1	24.3	27.5	50.6
Hungary	32.2	6.4	33.0	29.9	27.3	38.4	38.1	26.7	27.9	51.3	33.9
Poland	27.1	6.4	34.3	42.6	18.9	23.3	33.7	26.3	27.2	23.8	37.4
Slovakia	32.5	5.3	29.6	36.3	31.4	23.2	34.6	20.0	17.0	27.0	29.3
Slovenia	44.0	8.3	35.5	32.4	20.3	29.6	32.3	25.1	30.3	28.9	45.0
Cyprus	41.3	10.3	49.2	32.7	18.8	50.4	39.9	38.2	32.8	30.8	53.5
Estonia	17.4	5.1	18.6	16.0	7.1	15.0	18.8	18.6	14.1	18.6	22.4
Latvia	28.0	5.4	28.3	20.2	8.0	15.2	30.7	14.7	11.6	11.9	23.8
Lithuania	31.2	7.0	16.2	29.1	18.5	19.0	15.1	11.5	14.5	12.8	39.8

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 1.A.3

Average share of high-skilled workers in total employment by industry and country (in per cent), 1998-2004

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	11.5	8.0	8.0	13.1	14.9	7.5	9.9	14.5	16.7	12.9	12.1
Belgium	19.2	15.0	12.3	29.5	37.8	18.0	15.3	22.7	35.5	14.5	12.5
Denmark	11.0	17.8	10.1	20.7	33.5	16.7	10.4	21.6	29.4	13.2	12.1
Finland	16.0	17.0	17.4	27.5	30.2	19.9	18.4	30.1	45.2	19.0	18.8
France	10.5	9.9	9.3	25.2	25.1	12.8	11.4	19.7	30.6	20.7	11.2
Germany	12.0	11.5	12.8	16.3	20.1	13.9	12.8	23.1	26.6	20.5	15.0
Ireland	16.3	9.1	7.7	23.8	31.2	12.0	15.1	17.9	32.0	18.0	11.6
Italy	3.9	2.1	2.1	9.0	11.3	3.9	2.8	5.6	8.3	5.8	2.7
Luxembourg	4.8	6.1	0.0	14.9	14.8	13.2	10.2	19.5	19.5	40.4	22.2
Netherlands	12.4	8.0	6.5	18.0	24.1	9.3	10.4	17.1	31.5	14.3	11.2
Sweden	9.6	8.6	6.0	18.0	21.4	7.6	7.6	16.1	27.6	17.0	8.4
United Kingdom	13.6	9.5	7.1	23.0	25.9	13.5	13.6	19.7	27.1	21.2	11.4
Greece	10.2	6.3	4.6	20.0	23.9	9.6	7.1	13.0	22.2	13.2	5.8
Portugal	3.5	1.4	1.8	11.5	13.1	3.5	2.5	6.2	10.5	5.2	2.4
Spain	16.1	10.2	11.0	31.3	35.0	16.4	21.1	33.0	42.2	31.4	13.2
Czech Republic	5.0	2.4	2.4	13.0	8.7	4.5	5.6	9.3	8.9	6.5	3.2
Hungary	6.9	2.4	3.9	18.0	14.5	8.0	7.5	9.1	9.3	8.0	4.3
Poland	8.9	7.2	4.9	24.5	21.7	8.9	10.8	17.6	15.4	11.8	6.7
Slovakia	4.9	2.5	3.3	11.6	8.9	3.9	6.9	8.3	7.4	5.0	4.4
Slovenia	10.6	4.9	5.6	15.0	14.5	7.5	7.9	9.5	11.6	9.1	6.6
Cyprus	15.5	9.4	2.9	30.2	22.4	11.1	7.4	16.2	47.7	11.6	13.3
Estonia	20.8	23.2	11.3	36.0	37.7	23.0	20.9	27.1	30.1	35.7	13.7
Latvia	14.1	11.2	7.7	34.0	27.5	10.5	15.1	22.6	29.2	23.2	20.6
Lithuania	28.8	20.7	18.4	43.1	33.7	27.0	27.7	23.7	28.9	30.0	20.4

Source: Labour Force Survey data, wiiw calculations.

Table 1.A.4

Average share of medium-skilled workers in total employment by industry and country (in per cent), 1998-2004)

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	63.9	51.0	65.9	68.9	64.7	68.1	69.8	69.8	65.4	70.4	65.4
Belgium	41.4	35.1	48.4	41.2	38.0	39.8	44.0	46.1	39.0	46.6	41.2
Denmark	51.8	49.0	51.4	58.7	46.4	50.6	65.0	58.0	49.4	60.4	53.1
Finland	52.1	50.6	51.1	45.8	46.7	52.6	58.2	53.5	41.8	60.2	51.1
France	52.4	41.1	46.6	45.8	45.2	48.3	54.0	57.0	45.2	50.5	53.0
Germany	54.9	52.2	54.5	53.7	52.4	55.1	56.1	50.9	47.7	53.5	54.4
Ireland	36.6	33.4	44.8	41.2	38.1	36.0	44.2	45.1	40.7	44.9	41.7
Italy	35.4	27.2	27.4	43.9	42.7	37.4	37.4	46.4	54.7	41.1	34.6
Luxembourg	45.0	45.5	51.4	56.5	46.8	33.0	45.0	45.3	35.6	23.7	42.2
Netherlands	43.7	37.1	47.6	45.1	48.3	45.4	47.7	53.3	42.5	45.4	36.8
Sweden	59.1	50.6	57.9	54.1	56.3	56.1	64.5	61.9	55.6	63.0	57.7
United Kingdom	50.7	43.3	61.3	51.7	46.2	51.9	56.3	53.0	46.2	52.8	56.8
Greece	40.3	35.9	29.7	57.4	45.4	36.1	39.4	54.6	52.7	47.2	38.3
Portugal	8.8	4.9	6.1	21.6	22.6	8.0	7.5	15.7	18.0	17.9	7.1
Spain	18.2	14.9	14.9	23.1	21.6	17.7	19.0	20.8	22.9	20.1	16.3
Czech Republic	81.2	82.9	85.9	74.8	78.9	80.7	85.7	84.1	80.9	84.7	85.1
Hungary	65.7	70.4	67.9	65.5	65.4	69.2	75.9	77.6	66.8	77.0	77.7
Poland	79.6	82.8	79.2	70.3	71.8	78.7	83.0	78.7	80.2	82.2	86.0
Slovakia	85.2	86.9	87.2	80.2	84.9	87.4	87.8	87.4	84.4	90.1	88.6
Slovenia	64.6	60.9	64.2	65.0	61.3	60.6	72.4	69.1	57.5	66.8	67.6
Cyprus	43.7	32.6	38.3	46.3	43.6	48.8	47.3	37.2	25.9	47.5	37.5
Estonia	59.4	64.1	64.3	53.5	48.8	61.7	67.0	61.8	57.2	53.1	70.3
Latvia	70.2	75.0	65.2	52.7	54.3	75.7	64.3	69.4	56.2	63.3	62.7
Lithuania	62.2	69.5	66.8	49.9	60.5	63.9	62.6	69.0	59.4	62.2	69.0

Source: Labour Force Survey data, wiiw calculations.

Table 1.A.5

Average share of low-skilled workers in total employment by industry and country (in per cent), 1998-2004

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	24.7	40.9	26.1	18.0	20.4	24.4	20.3	15.7	17.9	16.7	22.4
Belgium	39.4	49.8	39.4	29.3	24.2	42.2	40.7	31.3	25.5	39.0	46.3
Denmark	37.2	33.2	38.5	20.6	20.1	32.7	24.7	20.4	21.2	26.4	34.8
Finland	32.0	32.3	31.5	26.8	23.1	27.6	23.4	16.5	13.0	20.8	30.1
France	37.1	49.0	44.0	29.0	29.7	38.9	34.6	23.4	24.2	28.8	35.9
Germany	33.1	36.2	32.7	30.0	27.4	31.0	31.1	25.9	25.7	26.0	30.6
Ireland	47.1	57.5	47.6	35.1	30.8	52.0	40.8	37.0	27.3	37.1	46.7
Italy	60.8	70.6	70.5	47.2	46.1	58.8	59.8	48.1	37.0	53.1	62.7
Luxembourg	50.2	48.4	48.6	28.7	38.5	53.8	44.9	35.2	44.9	36.0	35.6
Netherlands	43.9	54.9	45.9	37.0	27.6	45.3	42.0	29.6	26.0	40.2	52.0
Sweden	31.2	40.7	36.1	27.9	22.3	36.3	28.0	22.0	16.8	20.0	33.9
United Kingdom	35.7	47.2	31.7	25.3	27.9	34.7	30.1	27.2	26.7	25.9	31.7
Greece	49.5	57.8	65.6	22.7	30.7	54.3	53.5	32.4	25.0	39.6	55.9
Portugal	87.7	93.8	92.1	66.9	64.3	88.5	90.0	78.1	71.4	76.9	90.5
Spain	65.7	74.9	74.1	45.6	43.4	65.9	60.0	46.3	34.8	48.5	70.4
Czech Republic	13.8	14.7	11.7	12.2	12.4	14.8	8.7	6.6	10.2	8.8	11.7
Hungary	27.4	27.3	28.2	16.5	20.1	22.8	16.6	13.4	23.9	14.9	18.0
Poland	11.5	9.9	16.0	5.2	6.6	12.4	6.2	3.7	4.4	6.0	7.3
Slovakia	9.9	10.6	9.5	8.2	6.2	8.7	5.3	4.3	8.2	4.8	7.1
Slovenia	24.8	34.2	30.2	20.0	24.2	31.9	19.7	21.4	30.9	24.1	25.8
Cyprus	40.8	58.0	58.8	23.5	33.9	40.2	45.4	46.6	26.4	40.9	49.1
Estonia	19.7	12.7	24.5	10.5	13.5	15.3	12.1	11.1	12.7	11.1	16.0
Latvia	15.6	13.9	27.1	13.2	18.3	13.8	20.6	8.1	14.6	13.5	16.7
Lithuania	9.0	9.8	14.8	7.0	5.8	9.1	9.7	7.3	11.8	7.9	10.7

Source: Labour Force Survey data, wiiw calculations.

Table 1.A.6

Average growth rates of exports (in per cent), 1995-2004

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	13.0	1.4	9.8	1.2	7.9	5.1	6.3	5.9	7.3	7.2	6.2
Belgium	7.9	2.9	9.7	2.3	10.6	5.3	10.2	7.4	6.7	6.2	7.6
Denmark	2.8	2.6	-0.7	1.8	7.3	1.1	3.7	2.8	8.6	7.2	3.4
Finland	5.4	0.5	3.6	-2.5	5.9	5.5	6.4	6.0	11.6	6.5	0.8
France	2.6	1.7	2.8	1.4	6.1	1.3	2.6	4.3	4.5	7.5	4.7
Germany	5.6	0.4	8.5	2.3	6.5	3.9	4.2	4.2	6.6	7.9	4.9
Ireland	2.7	-4.4	10.7	3.3	19.8	3.5	3.9	3.2	11.4	10.9	1.8
Italy	6.4	1.9	2.3	2.8	6.5	1.9	4.4	4.0	5.0	7.7	2.0
Luxembourg	16.2	21.7	15.8	20.8	13.0	11.2	11.4	10.8	18.5	35.0	0.5
Netherlands	1.4	3.3	2.4	1.5	5.0	1.3	3.0	4.6	8.4	6.1	4.8
Sweden	7.9	4.3	0.9	1.0	6.6	5.1	3.5	4.5	4.9	3.7	4.1
United Kingdom	1.5	-1.1	2.7	1.4	5.9	-0.1	1.7	2.8	3.3	9.0	5.3
Greece	2.1	-0.3	5.2	7.4	10.8	-0.5	6.3	10.9	8.6	12.1	8.1
Portugal	2.9	-2.3	3.0	2.6	6.4	0.9	5.0	6.2	7.1	8.9	6.3
Spain	8.7	3.6	7.6	3.9	9.1	4.8	5.3	6.5	7.6	9.5	5.7
Czech Republic	12.9	2.8	5.5	10.3	9.8	5.5	6.8	13.8	18.0	21.7	9.8
Hungary	6.3	1.6	4.9	13.2	9.9	8.7	5.2	15.4	21.2	17.7	10.1
Poland	12.9	1.7	6.5	14.1	10.1	6.4	6.0	15.3	16.8	24.7	12.6
Slovakia	15.6	10.1	9.8	9.5	6.3	2.4	4.3	15.9	20.8	19.2	9.5
Slovenia	8.5	-5.2	-4.5	-3.4	6.9	1.1	5.8	5.3	6.6	14.7	6.2
Cyprus	8.3	0.1	34.4	9.3	18.9	1.5	9.1	5.4	23.0	3.8	0.9
Estonia	15.6	7.8	15.2	13.6	12.6	9.2	8.9	20.7	24.3	28.0	13.3
Latvia	6.0	4.0	16.1	8.4	0.7	9.1	-2.0	14.1	21.4	22.0	15.2
Lithuania	12.2	10.3	17.3	18.5	14.0	9.7	0.9	19.5	15.9	22.7	29.0

Source: UN COMTRADE database, wiiw calculations.

Table 1.A.7

Growth rates of unit labour costs (in per cent), 1995-2004

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	0.4	-5.7	-4.1	-3.3	-2.6	-2.2	-3.4	-2.6	-3.6	-5.1	-3.1
Belgium	0.4	-0.6	-2.6	-0.7	-3.8	-0.9	-2.2	-0.8	-2.0	-1.1	-1.9
Denmark	1.2	-0.1	0.7	-0.6	-1.0	0.7	0.1	0.3	-1.5	-1.8	0.3
Finland	0.8	0.2	-1.9	1.6	-2.5	-1.6	0.5	-1.4	-1.5	-0.9	-2.5
France	0.9	-1.2	-1.0	-0.2	-2.5	-1.4	-1.1	-1.0	-0.2	-3.8	-1.2
Germany	-0.8	-1.9	-2.2	-2.8	-3.0	-0.6	-2.3	-1.0	-2.1	-2.3	-2.9
Ireland	-1.6	-2.6	2.6	-6.4	-7.2	-1.9	-2.3	-4.5	-1.4	-2.6	1.4
Italy	-0.4	-0.3	-0.3	-0.7	-0.8	-2.0	0.6	0.3	-0.4	-2.7	-0.3
Luxembourg	0.5	-3.0	-5.5	-1.8	-1.0	-0.4	-1.9	-4.2	0.8	0.4	1.9
Netherlands	0.8	-1.2	0.2	0.0	-2.7	-0.2	-0.2	-1.6	0.9	-1.3	0.0
Sweden	1.5	-1.0	-0.7	0.3	-0.7	-0.1	1.1	0.0	-0.9	-1.4	-2.4
United Kingdom	2.3	0.4	1.3	0.8	1.0	0.7	1.5	1.1	1.7	-0.4	0.3
Greece	0.5	1.6	4.4	-0.3	-1.9	-3.5	-2.0	0.8	-4.1	-5.2	1.7
Portugal	1.5	1.7	1.0	2.3	-0.3	-0.1	-1.2	-1.7	2.8	2.4	0.0
Spain	-0.7	2.2	0.3	1.9	-2.1	-2.6	-0.3	-1.0	-1.4	-1.2	-2.2
Czech Republic	2.4	0.0	-4.3	-0.7	1.3	-1.1	-1.0	-0.8	-4.4	-4.7	-1.8
Hungary	0.1	0.3	0.5	1.0	-1.4	-3.0	-1.8	-2.0	-8.4	-2.4	-0.3
Poland	-2.5	-2.3	-0.5	-2.1	-4.1	-2.7	-3.4	-3.0	-3.8	-7.9	-2.8
Slovakia	2.9	-1.1	-1.8	0.4	-0.8	-1.0	0.4	-4.8	-3.9	-11.1	-3.4
Slovenia	-0.1	-3.7	0.1	-2.0	-1.7	-4.2	-2.9	-2.6	-3.2	-2.5	-2.0
Cyprus	-1.5	-1.0	-2.4	-0.4	0.2	-2.9	-0.3	-2.4	-1.2	-2.5	0.2
Estonia	1.0	2.4	0.2	-0.3	-1.4	-0.8	-0.6	-1.7	-4.9	-1.4	0.4
Latvia	-3.1	-2.6	-3.0	-2.5		-5.9	-7.8	-4.2	-6.3	-5.8	-1.5
Lithuania	4.9	1.7	-2.5	-0.9	-3.6	2.3	1.1	3.2	-2.3	-3.3	-0.5

Source: EU KLEMS database, March 2007, wiiw calculations.

2 Skills contribution in a growth accounting framework

2.1 Introduction

The second issue concerns the effects of changes in labour quality within a 'growth-accounting' framework which allows the inclusion of the contribution of changes in skill structures on the overall (value added or output) growth performance and this – consequently – reduces the contribution of total factor productivity. The topic has two dimensions: First it requires the calculation of the labour quality or labour composition changes and, second, to calculate the effects of total factor productivity measures.

The most important recent contribution is probably the study on the US economy by Jorgenson, Ho and Stiroh (2005) where labour composition effects are discussed in detail following the contribution by Jorgensen, Gollop and Fraumeni (1987; Ch.6). There are some further studies on particular countries, especially on the UK as in Oulton and O'Mahony (1994) and more recently in Lau (2002) and Bell et al. (2005). The baseline of these studies is that labour quality has a positive impact on the growth of labour services where education distribution is especially important pointing towards the effects of skill biased technical change. Schwerdt and Turunen (2006) studied the dynamics of labour quality in the Euro area since the 1980s and also gave an extensive overview of related literature focusing on European countries. Their results suggest that labour quality was growing by approximately 0.6% per year and thus has accounted for nearly one third of labour productivity growth. Further, the growth of labour quality was significantly higher in the 1990s compared to the 1980s and was mainly driven by tertiary education labour market experience. The second issue concerns the effects on total factor productivity growth. Thus, the introduction of labour quality by Bell et al. (2005) reduces apparent total factor productivity growth by more than 50%. One should note however that most of these studies (an exception is Jorgenson et al., 2005) have focused on the total economy level mainly driven by data availability.

We address these issues with a focus on manufacturing industries in a comparative perspective for a number of European countries relying on a new source of data that has been collected for growth accounting purposes. The next section gives an overview of the data and methodological issues. A summary of the most important results with respect to the nature and effects of labour composition changes then follow this.

2.2 Data and methodology

For both of these issues we can draw on results from the recently released EU KLEMS database (see www.euklems.org.) A detailed description of the methodology and data issues can be found in Timmer et al. (2007) also available from the website. A first set of overall comparative results is presented in the first EU KLEMS productivity report (see van Ark et al., 2007). This dataset includes results from a detailed growth accounting exercise for sixteen European countries (but also including Japan and the United States). The

countries are Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Luxembourg, Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. Additionally, information on labour quality is available for the Slovak Republic whereas labour composition variables are not available for Luxembourg. In the following we summarize these results for the period 1995-2004 for which data are available for all of these sixteen countries as the series for the Eastern European countries (Czech Republic, Hungary, Poland, and Slovenia) only start in 1995. Further, the quality of the data has improved from 1995 on as all countries started to report according to the ESA'95 methodology. As already mentioned above, the EU KLEMS dataset includes data at a rather detailed industry level basically according to NACE 60 industries (and additional breakdowns for some of the industries). However, for reasons of data quality and comparability across countries only for a subset of these industries are growth accounting results reliable. In this report we concentrate on the manufacturing sector (D) only for which a further breakdown to eleven industries is available and for which growth accounting results are possible.[2] These industries are listed in Table 2.1.

So far we have shown the labour composition index for a particular industry i. At a more aggregated level the corresponding variable has to be summed up for the respective industries of the aggregate and the same method is applied as outlined above. Note that an index of aggregate labour input with the industry dimension as another characteristic of the individual workers is not appropriate for a well-defined aggregate production possibility frontier or an aggregate production function. This would have to include the importance of reallocation of workers among industries (see Jorgensen et al., 2005, for a discussion on this).

The methodological framework uses a number of assumptions that are questionable and deserve some more elaboration. Let us summarize the most important issues. First, the concept is based on a framework of perfect competition (not only on product but also on factor markets). Although this assumption might partly be relaxed (e.g. by allowing for mark-ups) this would require even more detailed data which are in most cases not available. With respect to the modelling of the labour market, one first should notice that the whole concept arises from a production function framework, i.e. producer behaviour, with labour types as factors of production (usually measured as hours worked). The measure of labour input via hours worked cannot take into account the intensity of work (see e.g. Becker, 1985), which is not accounted for in the data. However, this is partly taken into account as far as intensity of work is reflected in labour compensation. A similar issue arises from discrimination of groups in the labour force (e.g. by gender or age). Again conceptually this should not be a problem when assuming perfectly competitive price-taking behaviour of the producers.

[2] For industry 23t25 (Chemical, rubber, plastics and fuels) a further breakdown is possible for some countries. To assure comparability across countries we shall however not present these details.

Table 2.1

EU KLEMS industries with growth accounting details

Code	Description	Industry group
15t16	Food, beverages and tobacco	M
17t19	Textiles, textile products, leather and footwear	L
20	Wood and products of wood and cork	L
21t22	Pulp, paper, printing and publishing	M
23t25	Chemical, rubber, plastics and fuel	M
26	Other non-metallic mineral	M
27t28	Basic metals and fabricated metal	M
29	Machinery n.e.c.	H
30t33	Electrical and optical equipment	H
34t35	Transport equipment	H
36t37	Manufacturing n.e.c., recycling	L

These caveats are the reason why the EU KLEMS methodology speaks of 'changes in labour composition' rather than 'labour quality' as the latter has a normative connotation, which might be misleading (e.g. lower female wages would suggest that the 'quality' of labour is lower compared to men when wages differ because of gender discrimination). A second issue is that one has to assume that compensation reflects marginal product, which might not be true when wages reflect e.g. market power by trade unions. As long as market power is exercised on the supply side of the labour market this is conceptually consistent with price-taking behaviour of producers. A related issue is signalling (see Arrow, 1973 and Spence, 1973 and 1974) which might violate the equality of compensation and marginal products. However, empirical studies based on longitudinal data for individuals show that years of schooling dominates the rank in the educational distribution which serves as a proxy for unobserved ability under the signalling hypothesis (see Kroch and Sjoblom, 1994). Thus, the potential methodological reservations might be acceptable from a theoretical point-of-view or some of them could, in principle, be dealt with in empirical studies through the use of more detailed data which are however not yet available to us at the industrial level. Thus, despite potential problems with the chosen framework and the level of disaggregation, we expect it to capture nonetheless essential features of labour markets and be useful for productivity analysis.

A partial index of labour input incorporates only a subset of the characteristics of individual workers. To single out the contributions of skills this can be calculated by summing up hours worked and the corresponding value shares over the other characteristics and then forming a Tornqvist index over qualifications, i.e.

$$\Delta \ln L_{it}^{S} = \sum_{s} \overline{v}_{ist} \Delta \ln H_{ist}$$

where $\overline{v}_{ist} = 0.5\left(v_{ist} + v_{is,t-1}\right)$ and v_{ist} denotes the compensation share of skill type s. The contribution of education to labour quality then is

$$\Delta \ln LC_{it}^{s} = \Delta \ln L_{it}^{s} - \Delta \ln H_{it}$$

We here ignore the terms with higher orders as these are negligible in other studies and cannot be calculated from the data provided in the EU KLEMS database. In the tables below we present the percentage share of labour composition change due to skills in total labour composition change, i.e. $\Delta \ln LC_{it}^{s} / \Delta \ln LC_{it}$ in per cent.

2.3 Results at the total manufacturing level

Let us now come to the results of these calculations. We first present the results at the total manufacturing (D) level and then go on to give an overview of the results at the more detailed industry level. Table 2.2 presents the index of labour services, hours worked and the difference (the labour composition effect) for 25 EU countries in 2000 and 2004 (the index is for 1995=100). Here we also include countries for which only hours worked is available (the missing EU member countries are the new member states Bulgaria and Romania).

Labour input measured in hours worked were declining over the period 1995-2004 in all countries with the exception of Finland, Ireland, Italy, Spain, and Hungary. The decline was relatively modest in countries like Luxembourg, Sweden and the Czech Republic. In the other countries the decline was between 10% and 15% and reached even 20% in the United Kingdom, Poland, Cyprus and Malta. The declines seem to be have been stronger in the second period (2000-2004) in a number of countries of the old EU member states Belgium, Denmark, France, Netherlands, Sweden and the United Kingdom). Even countries with a positive employment growth face a decline in the second period (Finland, Ireland, Hungary and to a less extent Spain). For the Eastern European member states the declines in the second period were particularly strong in Poland and Malta. In the remaining countries, i.e. Slovak Republic, Slovenia, Latvia and Lithuania the decrease in hours worked was less strong; positive employment growth in the second period can be observed only for Estonia. The results for labour services are similar. The magnitude of the changes is however smaller in the case of declines and higher in the case of increases of employment which points to a substitution towards higher quality of labour. This can be better seen from the last two columns showing the labour composition effect, i.e. the difference of the index of labour services and hours worked. This composition change is positive in all cases with the exception of Hungary and the Slovak Republic over the period 1995-2000. Over the whole period the difference of the two indexes is between 3 and 6 percentage points and even higher in the United Kingdom with 8.4, Spain with 6.5 and France with 6.1 percentage points. Only small but still positive changes are observed in Italy and the Slovak Republic where the difference is about 1.2 percentage points. The changes in labour composition ('labour quality') have been stronger in the period 2000-2004 in most countries and particularly so in Finland, Spain and the Eastern European countries Czech Republic, Hungary (where it turned from negative to positive) and Poland.

Table 2.2

Index of hours worked and labour services, 1995=100

Country	Hours worked		Labour services		Labour composition[1)]	
	2000	2004	2000	2004	2000	2004
Austria	91.2	86.2	93.6	89.7	2.4	3.6
Belgium	97.5	89.0	100.3	94.0	2.8	5.0
Denmark	99.4	88.8	102.7	94.4	3.2	5.6
Finland	111.0	103.7	112.2	108.0	1.2	4.3
France	94.9	87.0	98.4	93.1	3.5	6.1
Germany	93.1	87.0	94.0	91.0	0.9	4.1
Ireland	108.8	100.9	n.a.	n.a.	n.a.	n.a.
Italy	101.0	100.2	102.0	101.3	1.0	1.2
Luxembourg	99.0	96.8	n.a.	n.a.	n.a.	n.a.
Netherlands	100.0	90.3	102.3	94.1	2.3	3.8
Sweden	101.3	94.2	104.1	100.1	2.8	6.0
United Kingdom	96.2	79.7	101.5	88.1	5.3	8.4
Greece	96.0	89.9	n.a.	n.a.	n.a.	n.a.
Portugal	97.0	90.0	n.a.	n.a.	n.a.	n.a.
Spain	121.1	118.4	123.4	124.9	2.3	6.5
Czech Republic	99.3	94.1	100.6	97.5	1.3	3.4
Hungary	110.6	102.1	109.5	107.0	-1.1	4.9
Poland	91.5	80.0	92.2	83.7	0.8	3.8
Slovakia	90.6	88.4	89.9	89.5	-0.7	1.2
Slovenia	90.9	87.8	95.5	91.8	4.6	3.9
Cyprus	84.1	76.3	n.a.	n.a.	n.a.	n.a.
Estonia	82.1	92.4	n.a.	n.a.	n.a.	n.a.
Latvia	88.4	87.2	n.a.	n.a.	n.a.	n.a.
Lithuania	88.8	87.9	n.a.	n.a.	n.a.	n.a.
Malta	94.6	77.0	n.a.	n.a.	n.a.	n.a.

Note: 1) Difference between index of labour services and hours worked in respective year.

Source: EU KLEMS database, March 2007; wiiw calculations.

To relate these changes to the growth of multifactor productivity one also has to go into the details of the growth accounting exercise. We cannot present the method but refer to Timmer et al. (2007) for a detailed description of this in the context of the EU KLEMS project. However, we present the results from this growth accounting exercise, i.e. the contributions to growth of hours worked, labour composition, ICT and non-ICT capital, and multifactor productivity growth to value added growth in Table 2.3.

The upper part of the table contains the average annual growth rates of value added in the last component and the growth rates of the factor contributing to growth in the other columns. By definition the contributions of labour are those of the sum of hours worked plus that of labour composition. Labour composition (see third column) has in all cases a

Table 2.3

Average annual value added growth rates and contributions to growth

Country	Labour	Hours worked	Labour composition	ICT capital	Non-ICT capital	Multifactor productivity	Growth rate of value added
			Average annual value added growth rates (in per cent)				
Austria	-0.76	-1.06	0.30	0.49	0.05	3.18	2.97
Belgium	-0.47	-0.87	0.40	0.59	0.74	0.99	1.84
Denmark	-0.47	-0.94	0.48	0.86	0.59	-0.24	0.75
Finland	0.51	0.26	0.25	0.44	0.89	4.32	6.16
France	-0.54	-1.06	0.52	0.48	0.24	2.23	2.40
Germany	-0.82	-1.22	0.39	0.17	0.18	1.57	1.10
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	8.87
Italy	0.10	0.01	0.09	0.09	0.72	-0.99	-0.07
Luxembourg	-0.22	n.a.	n.a.	0.38	0.27	2.26	2.70
Netherlands	-0.44	-0.74	0.30	0.41	0.05	1.68	1.70
Sweden	-0.02	-0.46	0.44	0.55	0.85	3.26	4.65
United Kingdom	-1.20	-2.05	0.85	0.53	0.04	0.96	0.32
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.97
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2.01
Spain	1.58	1.20	0.38	0.33	0.97	-0.52	2.36
Czech Republic	-0.17	-0.39	0.23	0.39	2.13	1.31	3.66
Hungary	0.45	0.17	0.28	0.39	1.32	3.20	5.37
Poland[1)]	-1.39	-1.72	0.33	n.a.	0.591)	7.00	6.20
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5.57
Slovenia	-0.74	-1.11	0.37	0.34	1.26	4.10	4.95
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2.87
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	12.45
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.72
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	8.20
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-0.79
			Growth contributions in % of value added growth				
Austria	-25.59	-35.69	10.10	16.50	1.68	107.07	100.00
Belgium	-25.54	-47.28	21.74	32.07	40.22	53.80	100.00
Denmark	-62.67	-125.33	64.00	114.67	78.67	-32.00	100.00
Finland	8.28	4.22	4.06	7.14	14.45	70.13	100.00
France	-22.50	-44.17	21.67	20.00	10.00	92.92	100.00
Germany	-74.55	-110.91	35.45	15.45	16.36	142.73	100.00
Italy	-142.86	-14.29	-128.57	-128.57	-1028.57	1414.29	100.00
Luxembourg	-8.15	n.a.	n.a.	14.07	10.00	83.70	100.00
Netherlands	-25.88	-43.53	17.65	24.12	2.94	98.82	100.00
Sweden	-0.43	-9.89	9.46	11.83	18.28	70.11	100.00
United Kingdom	-375.00	-640.63	265.63	165.63	12.50	300.00	100.00
Spain	66.95	50.85	16.10	13.98	41.10	-22.03	100.00
Czech Republic	-4.64	-10.66	6.28	10.66	58.20	35.79	100.00
Hungary	8.38	3.17	5.21	7.26	24.58	59.59	100.00
Poland[1)]	-22.42	-27.74	5.32	n.a.	9.521	112.90	100.00
Slovenia	-14.95	-22.42	7.47	6.87	25.45	82.83	100.00

Notes: 1) For Poland the column Non-ICT capital also includes ICT capital.

Source: EU KLEMS database, March 2007; wiiw calculations.

positive contribution to value added growth. To allow for a better comparison across countries we express the various factor contributions in per cent of value added growth in the lower part of Table 2.3. Not considering the countries with very low growth rates of value added, i.e. Italy and the United Kingdom, the contributions of labour composition changes is between 4% in Finland up to 64% in Denmark which seems rather high. The country showing the second largest contribution of labour composition changes is Germany with 35%. Leaving out these countries from the average, the arithmetic mean over the remaining countries is about 13%. The contributions of labour composition changes are also higher in the old new member states compared to the Central-Eastern European countries where the contribution is between 5% and 7.5%.

Table 2.4

Contribution of skills to labour composition change

Country	Contributions (In per cent)
Austria	71.8
Belgium	53.9
Denmark	44.6
Finland	55.3
France	57.1
Germany	53.8
Ireland	n.a.
Italy	13.7
Luxembourg	n.a.
Netherlands	42.4
Sweden	69.8
United Kingdom	41.9
Greece	n.a.
Portugal	n.a.
Spain	113.7
Czech Republic	55.4
Hungary	61.2
Poland	66.9
Slovakia	88.0
Slovenia	70.5
Cyprus	n.a.
Estonia	n.a.
Latvia	n.a.
Lithuania	n.a.
Malta	n.a.

Source: EU KLEMS database March 2007; wiiw calculations.

The inclusion of labour composition changes reduces the contribution of multifactor productivity growth by definition. In percentage terms the share of the contribution of labour

composition changes to multifactor productivity growth plus labour composition changes (which is a measure of multifactor productivity growth when labour compositional changes are not included) differs between countries and ranges from 4% (Poland) to almost 50% (United Kingdom) (leaving out the countries with very small multifactor productivity growth rates, i.e. Denmark and Spain). Table 2.4 shows that in most countries labour composition changes due to changes in the skill composition are responsible for more than 50%. Only for Denmark, Netherlands, Italy and the United Kingdom is this component lower.

2.4 Results at detailed industry level

Let us next turn to present the results at the industry level. We present the difference of the index of labour services and of hours worked to which we refer as changes in labour composition (quality) in Table 2.5. The contribution of labour composition changes is in most cases positive. Notable exceptions are Italy where the composition effect is negative in most industries (not in 15, 16, 20, and 26 to 29) and all Central-Eastern European countries except Slovenia together with Austria in industry chemicals, rubber, plastics and fuel (23-25). Further Hungary shows negative labour composition effects in industries machinery n.e.c. (29), electrical and optical equipment (30-33) and transport equipment (34t35).

Table 2.6 presents the index for 2004 for hours worked, labour services and the resulting compositional change for the three types of industries as listed in Table 1.1 (weighted by average annual value added shares). At the detailed industry level these indexes are presented in Annex Tables 2.A.1 and 2.A.2.

The index of hours worked in 2004 is on average lower in the low- and medium-skill intensive sectors, albeit there are some exceptions like the Baltic states. This structure will be discussed in more detail in section 3 using employment figures. A similar pattern can also be seen for labour services. The index in 2004 is plotted in Figure 2.1.

Again the index of labour services is higher in the more skill intensive industries in most countries, i.e. when comparing it to the aggregate of the low-skill and the medium- and high-skill intensive sectors. A more equal pattern is evident for the United Kingdom, Spain and Poland. In the latter country labour services were declining even more in the skill intensive sectors. Figure 2.2 presents the difference of the index of changes in labour services and hours worked.

As already discussed above this difference is positive in most cases. For the aggregate industries exceptions are only Italy in the low-skill intensive sectors and Hungary in the high-skill intensive sectors (despite high growth rates of labour services as can be seen from Figure 2.1). Here the pattern that this difference might be larger in the skill intensive sectors is less prominent but evident in particular in Finland, Netherlands and Sweden.

Table 2.5

Labour composition changes (difference between index of labour services and index of hours worked, 1995=100)

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	3.8	2.8	2.0	2.0	-1.6	1.9	2.3	4.1	3.2	4.7	3.7
Belgium	4.6	4.0	4.2	3.9	4.7	4.3	4.3	3.7	3.0	3.8	3.7
Denmark	4.7	5.1	4.1	2.3	7.2	2.6	4.2	5.1	8.0	2.4	4.5
Finland	2.7	2.4	3.0	2.7	2.0	3.6	3.8	6.8	7.9	5.2	3.5
France	8.3	4.5	6.0	6.1	3.4	5.9	6.6	3.6	3.7	4.1	7.3
Germany	3.2	1.9	2.7	3.3	1.3	2.6	3.6	3.6	2.9	3.5	2.4
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	2.0	-1.1	2.9	-1.1	-3.9	4.6	4.6	3.4	-3.2	-1.0	-1.5
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	5.1	2.7	1.8	0.7	2.2	1.7	1.9	9.5	8.1	8.5	1.9
Sweden	4.3	4.3	3.4	3.8	7.8	3.3	5.4	5.4	11.0	5.5	3.5
United Kingdom	4.8	13.3	39.0	7.1	1.0	6.1	5.0	6.1	8.1	7.3	17.9
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	7.6	8.8	5.3	5.8	3.0	5.4	5.9	6.9	6.0	2.8	5.9
Czech Republic	3.4	2.3	2.2	1.9	-2.3	1.7	1.7	1.0	1.7	1.4	4.0
Hungary	4.3	3.5	7.8	6.7	-0.4	6.7	7.9	-1.1	-2.8	-2.6	6.4
Poland	2.6	1.7	3.4	3.7	-2.4	2.5	2.9	1.9	2.6	2.3	3.4
Slovakia	0.6	0.6	2.6	1.7	-0.2	1.9	2.4	1.0	2.3	2.0	0.7
Slovenia	3.2	1.9	1.5	1.5	2.3	1.4	1.8	1.1	1.3	1.1	2.7
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

The contribution of labour composition changes contributed positively to value added growth in most cases as can be seen from Table 2.7 where we present the growth rates of labour composition, multifactor productivity and value added growth for the low, medium and high-skill intensive sectors. Data for detailed industries are presented in Annex Tables 2.A.3 to 2.A.5. However there seems not to be a clear-cut relationship across industries and countries with respect contributions to value added growth and the effect on measured multifactor productivity growth as can be seen from the figures when expressing the growth rates in labour composition in per cent of value added growth and or in composition and multifactor productivity growth. Again the more detailed industry data are given in Annex Table 2.A.6 and 2.A.7. These shares are only presented for cases with positive value added or multifactor productivity growth, respectively.

Table 2.6

Indexes in 2004 of hours worked, labour services and labour composition change (1995=100)

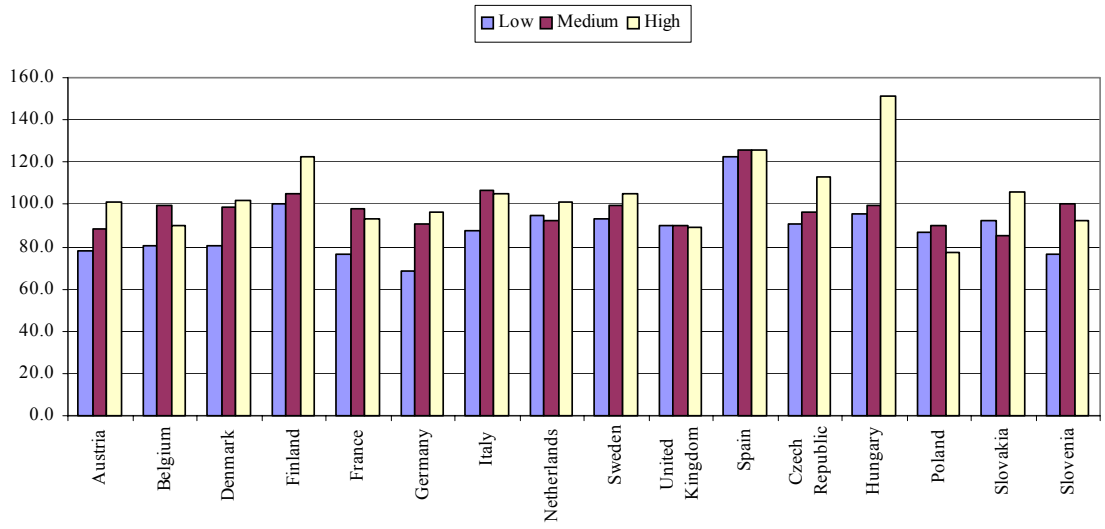
	Hours worked			Labour services			Labour composition[1)]		
	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries
Austria	75.0	86.9	97.6	77.9	88.6	101.4	2.9	1.6	3.9
Belgium	76.3	94.7	86.3	80.2	99.1	89.7	3.9	4.5	3.5
Denmark	76.1	93.7	95.6	80.6	98.4	101.6	4.6	4.7	6.0
Finland	97.6	102.6	115.4	100.6	105.5	122.8	3.0	2.8	7.3
France	70.9	91.9	89.6	76.7	97.8	93.4	5.8	5.9	3.8
Germany	65.9	88.1	93.2	68.3	90.7	96.5	2.4	2.7	3.3
Ireland	87.8	110.8	107.4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	88.2	105.8	104.7	87.5	107.0	104.9	-0.7	1.2	0.2
Luxembourg	116.1	93.3	116.3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	92.5	90.0	92.0	94.6	92.7	100.8	2.1	2.7	8.7
Sweden	89.9	94.4	98.3	93.5	99.8	105.4	3.6	5.4	7.1
United Kingdom	70.4	85.7	81.7	89.7	90.0	89.0	19.3	4.3	7.3
Greece	79.0	96.5	93.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	86.8	93.5	96.8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	115.6	120.0	121.4	122.8	125.4	126.2	7.2	5.5	4.8
Czech Republic	87.9	95.4	112.0	90.7	96.7	113.4	2.8	1.3	1.4
Hungary	90.5	95.6	153.9	95.3	99.2	151.5	4.9	3.6	-2.4
Poland	83.9	88.8	75.0	86.6	90.3	77.2	2.7	1.5	2.3
Slovakia	91.0	83.9	104.3	92.1	85.1	106.1	1.1	1.2	1.8
Slovenia	74.7	98.3	91.5	76.8	100.4	92.7	2.1	2.1	1.2
Cyprus	53.7	103.2	84.8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	103.8	87.4	85.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	119.8	87.6	53.7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	119.2	81.9	71.3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	59.7	93.1	108.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Note: 1) Difference between index of labour services and hours worked in the respective year

Source: EU KLEMS database; March 2007; wiiw calculations

Figure 2.1

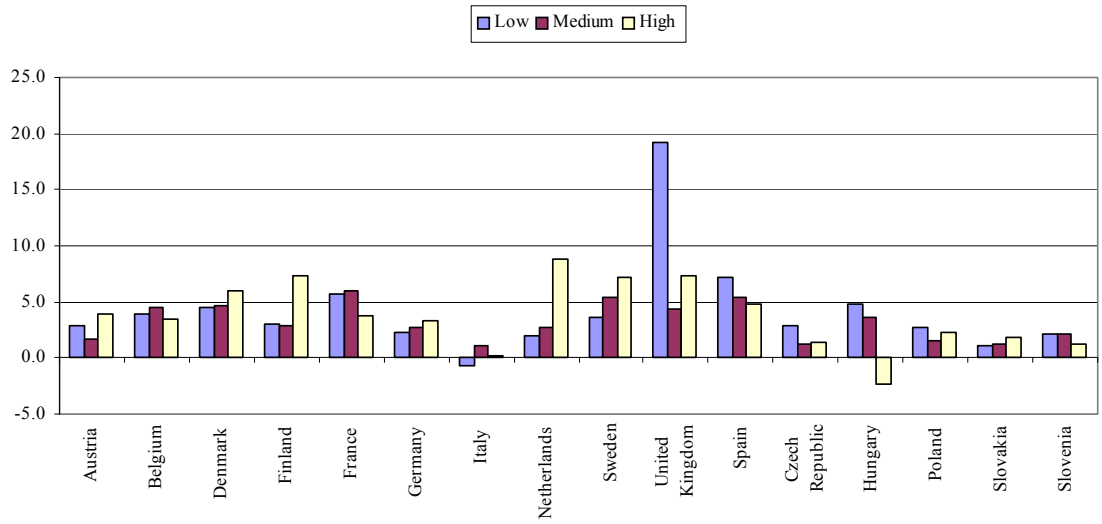
Index of labour services in 2004, 1995=100



Source: EU KLEMS database, March 2007; wiiw calculations.

Figure 2.2

Labour composition changes 1995-2004



Source: EU KLEMS database, March 2007; wiiw calculations.

Finally we again show the effect which skill upgrading has on labour composition changes in Table 2.8 and for detailed industries in Annex Table 2.A.8. In some countries and industries the contributions of skill change are quite large (e.g. Hungary in the high-skill intensive industries and Poland in the medium-skill intensive industries). For Italy the contributions are negative in all cases which might be a data problem. Further negative contributions are also found in Netherlands and the Slovak Republic. The differences of this share for the remaining countries are however still quite large ranging from less than 20% to more than 100%. On average, however, the upskilling made a positive and also significant positive contribution to changes in labour composition.

Table 2.7

Labour composition change and growth

	Labour composition			Multifactor productivity			Value added growth			Contribution of labour composition change to value added growth in per cent			Share of composition change in composition and MFP contribution		
	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries
Austria	0.33	0.14	0.29	4.20	2.43	3.89	2.40	2.13	4.65	13.75	6.57	6.24	7.28	5.45	6.94
Belgium	0.40	0.33	0.33	2.29	0.11	2.77	0.68	1.66	2.71	58.82	19.88	12.18	14.87	75.00	10.65
Denmark	0.50	0.35	0.47	-1.39	0.30	-0.70	-2.15	1.24	1.06	n.a.	28.23	44.34	n.a.	53.85	n.a.
Finland	0.25	0.17	0.33	2.67	2.90	7.18	2.86	3.87	10.97	8.74	4.39	3.01	8.56	5.54	4.39
France	0.62	0.47	0.34	3.67	1.25	3.58	1.45	1.55	4.26	42.76	30.32	7.98	14.45	27.33	8.67
Germany	0.35	0.24	0.31	1.34	1.17	2.07	-2.44	0.65	2.18	n.a.	36.92	14.22	20.71	17.02	13.03
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.81	10.18	7.05	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-0.07	0.08	0.00	-0.98	-1.11	-0.78	-1.58	0.39	0.20	n.a.	20.51	0.00	n.a.	n.a.	n.a.
Luxembourg	n.a.	n.a.	n.a.	1.71	2.65	0.76	2.59	2.72	3.22	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	0.23	0.18	0.75	1.40	1.68	1.92	1.05	1.62	2.30	21.90	11.11	32.61	14.11	9.68	28.09
Sweden	0.30	0.33	0.66	3.55	0.86	6.15	3.19	2.62	7.27	9.40	12.60	9.08	7.79	27.73	9.69
United Kingdom	2.29	0.42	0.74	-0.85	0.75	1.81	-2.46	0.22	1.32	n.a.	190.91	56.06	n.a.	35.90	29.02
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-1.59	1.53	3.59	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-0.25	1.34	8.57	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	0.51	0.31	0.27	-1.66	-0.14	-0.80	0.83	2.64	2.56	61.45	11.74	10.55	n.a.	n.a.	n.a.
Czech Republic	0.30	0.09	0.05	1.88	-0.36	4.92	1.74	1.47	9.47	17.24	6.12	0.53	13.76	n.a.	1.01
Hungary	0.45	0.24	-0.13	1.02	-0.98	12.23	0.37	-0.16	17.75	121.62	n.a.	n.a.	30.61	n.a.	-1.07
Poland	0.23	0.12	0.19	5.57	6.71	9.58	4.26	6.46	7.83	5.40	1.86	2.43	3.97	1.76	1.94
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	7.35	3.03	11.08	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	0.27	0.17	0.14	3.46	3.09	7.04	1.16	4.77	8.19	23.28	3.56	1.71	7.24	5.21	1.95
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-5.93	3.89	0.60	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	14.10	11.21	12.87	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	3.80	-0.59	-0.41	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	9.00	6.53	12.29	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-2.00	0.52	-1.96	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 2.8

Contributions of skills to labour quality change

	Low-skill intensive industries	Medium-skill intensive industries	High-skill intensive industries
Austria	61.6	120.4	52.8
Belgium	49.2	65.3	34.7
Denmark	27.2	43.4	28.3
Finland	22.4	36.7	48.4
France	32.7	65.7	67.7
Germany	32.0	76.3	55.5
Ireland	n.a.	n.a.	n.a.
Italy	-87.5	-31.1	-531.0
Luxembourg	n.a.	n.a.	n.a.
Netherlands	99.8	93.4	-9.3
Sweden	34.7	66.1	60.5
United Kingdom	30.7	47.4	35.2
Greece	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.
Spain	80.8	113.9	95.6
Czech Republic	21.1	99.1	83.1
Hungary	-9.5	99.3	303.7
Poland	47.5	179.3	88.1
Slovakia	-59.3	16.2	-9.0
Slovenia	93.4	112.9	14.1
Cyprus	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

2.5 Summary and conclusions

In this section we used a recently available disaggregated data-set (EU-KLEMS) which allowed us to undertake two exercises: The first exercise decomposed labour input into a purely quantitative labour input component which measures the numbers of hours worked and a skill compositional component which takes account of the change in skill composition of the labour force. The second exercise analysed within a growth accounting framework the degree to which changes in skill composition contribute to the development of total factor productivity. The analysis was done at the detailed industry level for manufacturing industries and these were in turn grouped into low, medium and high-skill industry groups.

Generally one can see that the labour composition ('quality') effect is positive for total manufacturing but also at the more detailed industry level (with some exceptions). Over the

period 1995-2000 the differences of the quantity index and the index of labour services is between 3 and 6 percentage points and even higher in some countries (United Kingdom, Spain and France) but lower in the Slovak Republic and Italy. Skill upgrading turns out to be one of the most important factors in explaining labour composition changes. The change in labour composition also had positive effects on value added growth and explains about 13% (not including some outlier countries). The contributions of labour composition are higher in the 'old member states' compared to the 'new member states'. With respect to industry groups the labour composition changes are relatively more important in the more skill intensive industries which is mainly the case in the 'old member states'. On average, upskilling had a positive and also significant contribution to changes in labour composition albeit country and industry differences are important. Similarly with respect to the contribution to value added growth where no clear-cut relationship at the level of detailed industries or even industry groups can be detected.

References

Arrow, K.J. (1973), 'Higher Education as a Filter', *Journal of Public Economics*, Vol. 2, No. 2, pp. 193-216.

Becker, G.S. (1985), 'Human Capital, Effort, and the Sexual Division of Labor', *Journal of Labor Economics*, Vol. 3, No. 1, pp. 33-58.

Bell, V., P. Burriel-Llombart and J. Jones (2005), 'A Quality-Adjusted Labour Input Series for the United Kingdom, 1975-2002', Bank of England's *Working Paper Series*.

Diewert, W.E. (1976), 'Exact and Superlative Index Numbers', *Journal of Econometrics*, Vol. 4, No. 2, pp. 115-146.

Jorgenson, D.W., F.M. Gollop and B.M. Fraumeni (1987), *Productivity and US Economic Growth*, Harvard University Press, Cambridge MA.

Jorgenson, D.W., M. Ho and K. Stiroh (2005), *Information Technology and the American Growth Resurgence*, MIT.

Kroch, E.A. and K. Sjoblom (1994), 'Schooling as Human Capital or a Signal', *Journal of Human Resources*, Vol. 2, No. 91, pp. 156-180.

Lau, E. (2002), 'Skills and Productivity. Developing New Measures', The Office for National Statistics, www.statistics.gov.uk/events/REC02/downloads/res_paper.pdf.

Oulton, N. and M. O'Mahony (1994), *Productivity and Growth. A Study of the British Industry 1954-1986*, Cambridge University Press, Cambridge.

Schwerdt, G. and J. Turunen (2006), 'Growth in the Euro Area Labour Quality', European Central Bank *Working Paper Series* No. 575.

Spence, A.M. (1973), 'Job Market Signaling', *Quarterly Journal of Economics*, Vol. 87, No. 2, pp. 355.374.

Spence, A.M. (1974), *Market Signaling*, Harvard University Press, Cambridge, MA.

Timmer, M., T. van Moergastel, E. Stuivenwold, G. Ypma, M. O'Mahony and M Kangasniemi (2007), 'EU KLEMS Growth and Productivity Accounts – Version 1.0', Part I Methodology and Part II Sources by Country, www.euklems.org.

Van Ark, B., M. O'Mahony and G. Ypma (eds) (2007), 'The EU KLEMS Productivity Report. An Overview of Results from the EU KLEMS Growth and Productivity Accounts for the European Union, EU Member States and Major Other Countries in the World', Issue No. 1, March 2007, www. euklems.org.

Annex

Table 2.A.1

Index of hours worked in 2004 (1995=100) by industry

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	81.8	60.1	83.4	82.3	87.0	78.7	96.0	104.6	80.2	118.2	79.3
Belgium	95.8	66.2	101.9	89.3	98.3	89.9	91.8	92.1	78.3	89.4	80.7
Denmark	89.1	52.6	83.5	85.9	111.0	78.5	88.4	86.1	116.0	62.4	83.0
Finland	86.0	74.4	101.4	91.0	106.1	120.4	129.8	106.7	125.2	82.4	110.3
France	99.2	53.3	82.4	84.0	93.2	80.6	91.1	84.0	86.7	96.8	88.0
Germany	93.9	56.3	70.8	84.7	87.0	67.8	93.2	91.7	84.4	103.0	70.6
Ireland	97.7	33.7	137.9	103.4	117.6	119.9	118.0	80.6	111.7	100.7	105.2
Italy	102.1	82.1	97.9	103.3	104.5	120.9	105.0	108.2	107.3	92.3	98.8
Luxembourg	105.0	113.3	169.1	142.3	75.3	96.3	89.3	105.9	126.4	170.0	74.3
Netherlands	86.4	57.0	94.8	80.5	96.0	91.2	94.5	99.7	84.7	90.8	102.9
Sweden	88.6	72.9	101.4	81.0	104.5	90.5	103.0	95.8	90.5	107.4	78.8
United Kingdom	97.9	39.3	88.6	84.5	84.6	79.6	75.4	72.7	73.3	98.7	95.1
Greece	92.0	72.9	112.6	99.1	95.6	100.3	103.4	118.0	96.9	74.9	81.8
Portugal	91.8	78.5	85.2	87.7	94.9	92.4	101.4	92.5	87.8	110.2	125.4
Spain	103.9	104.8	117.9	129.2	117.7	120.7	131.4	132.7	114.9	118.2	129.8
Czech Republic	89.1	58.9	112.1	99.1	115.3	87.9	88.4	79.0	137.7	116.8	106.0
Hungary	88.2	70.4	112.0	96.0	92.8	95.9	113.8	70.1	178.4	165.2	129.1
Poland	84.4	54.7	100.2	110.2	91.4	74.1	85.5	63.0	84.6	76.8	111.4
Slovakia	80.8	83.1	108.4	73.5	73.3	82.1	100.7	60.4	131.7	115.9	88.3
Slovenia	103.7	61.7	84.5	83.7	102.6	80.4	102.5	85.6	99.5	82.1	89.6
Cyprus	116.6	22.7	83.8	93.5	81.6	86.8	98.4	76.2	102.3	79.1	62.8
Estonia	75.9	107.4	95.2	92.4	82.5	69.8	129.6	102.5	82.6	75.4	111.1
Latvia	76.2	79.0	137.0	107.3	69.9	83.3	123.7	59.8	47.8	54.1	147.6
Lithuania	77.3	100.7	130.2	72.6	94.7	53.2	97.5	42.5	96.1	44.6	162.5
Malta	93.2	50.9	109.5	94.3	96.7	75.3	96.6	110.2	120.8	41.7	66.8

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 2.A.2

Index of labour services in 2004 (1995=100) by industry

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	85.6	62.9	85.4	84.3	85.4	80.6	98.3	108.7	83.4	122.9	83.0
Belgium	100.4	70.1	106.0	93.2	103.0	94.2	96.1	95.8	81.3	93.1	84.4
Denmark	93.8	57.8	87.6	88.2	118.2	81.1	92.6	91.2	124.0	64.8	87.5
Finland	88.7	76.8	104.4	93.7	108.1	124.0	133.7	113.5	133.1	87.6	113.8
France	107.5	57.8	88.4	90.0	96.6	86.4	97.7	87.5	90.4	100.9	95.4
Germany	97.1	58.2	73.5	88.0	88.3	70.4	96.8	95.3	87.3	106.5	73.0
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	104.2	81.0	100.8	102.2	100.6	125.6	109.6	111.6	104.0	91.3	97.3
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	91.6	59.7	96.6	81.2	98.3	92.9	96.4	109.2	92.7	99.3	104.8
Sweden	92.9	77.2	104.8	84.9	112.2	93.8	108.4	101.2	101.4	112.9	82.3
United Kingdom	102.7	52.6	127.5	91.6	85.6	85.7	80.4	78.8	81.4	106.0	113.1
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	111.5	113.6	123.2	135.0	120.6	126.1	137.3	139.6	120.9	121.0	135.7
Czech Republic	92.5	61.2	114.3	101.1	113.1	89.6	90.1	80.0	139.4	118.3	110.1
Hungary	92.5	73.8	119.8	102.7	92.5	102.5	121.7	69.0	175.7	162.7	135.5
Poland	87.0	56.4	103.5	113.8	89.1	76.5	88.4	64.9	87.1	79.1	114.8
Slovakia	81.4	83.7	110.9	75.3	73.1	84.0	103.1	61.5	134.0	117.9	88.9
Slovenia	106.9	63.6	86.0	85.1	104.9	81.8	104.3	86.7	100.8	83.2	92.3
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 2.A.3

Average annual contribution of changes in labour composition to value added growth (in percentage points)

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	0.34	0.43	0.18	0.18	-0.11	0.17	0.17	0.30	0.31	0.24	0.37
Belgium	0.33	0.45	0.29	0.31	0.29	0.34	0.38	0.30	0.31	0.36	0.37
Denmark	0.40	0.74	0.39	0.22	0.39	0.26	0.40	0.49	0.47	0.41	0.44
Finland	0.20	0.31	0.19	0.14	0.12	0.17	0.24	0.50	0.21	0.59	0.32
France	0.59	0.64	0.55	0.58	0.23	0.54	0.56	0.37	0.32	0.33	0.63
Germany	0.26	0.32	0.36	0.28	0.11	0.29	0.34	0.35	0.30	0.29	0.37
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	0.15	-0.11	0.25	-0.09	-0.23	0.25	0.32	0.24	-0.25	-0.10	-0.12
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	0.35	0.44	0.15	0.07	0.11	0.12	0.17	0.79	0.77	0.68	0.19
Sweden	0.32	0.51	0.24	0.27	0.36	0.26	0.38	0.42	1.28	0.35	n.a.
United Kingdom	0.36	2.76	3.13	0.71	0.08	0.63	0.62	0.65	0.84	0.68	1.48
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	0.49	0.66	0.38	0.30	0.14	0.31	0.32	0.38	0.38	0.14	0.36
Czech Republic	0.19	0.30	0.19	0.15	-0.10	0.10	0.12	0.08	0.02	0.04	0.38
Hungary	0.31	0.44	0.51	0.52	-0.04	0.37	0.51	-0.14	-0.13	-0.12	0.44
Poland	0.23	0.29	0.27	0.30	-0.18	0.19	0.20	0.25	0.17	0.17	0.12
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	0.20	0.32	0.18	0.15	0.16	0.17	0.16	0.16	0.12	0.15	0.25
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 2.A.4

Average annual growth rates of multifactor productivity, 1995-2004

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	2.59	4.82	4.07	1.32	2.08	2.77	3.12	3.11	3.63	5.74	3.83
Belgium	-0.08	2.17	3.33	-0.79	-0.50	-0.83	2.26	2.85	3.67	1.89	1.97
Denmark	-0.71	-0.69	-0.49	0.10	2.20	0.47	-0.88	-1.66	0.28	0.01	-2.14
Finland	4.63	1.61	3.78	2.87	3.51	2.41	1.28	2.06	11.02	-0.52	1.27
France	-0.53	2.87	6.59	0.50	3.46	1.81	0.61	3.64	6.24	0.81	3.33
Germany	0.12	2.42	2.21	-0.46	2.46	1.94	1.06	0.51	4.10	1.66	-0.09
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-1.49	-1.71	1.23	-1.29	-1.68	-1.61	-0.11	-1.18	-0.47	-0.43	-0.25
Luxembourg	-3.19	-1.37	15.21	-2.59	5.79	-2.02	5.03	-1.86	5.14	1.13	3.22
Netherlands	0.61	3.98	-0.92	1.53	3.09	0.32	1.27	0.71	0.42	5.80	1.09
Sweden	-0.71	1.10	4.23	0.72	3.28	1.87	-0.83	2.00	13.59	3.83	n.a.
United Kingdom	0.03	0.24	-3.13	0.03	0.95	2.05	1.82	0.98	3.01	1.10	-1.10
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	-1.23	-2.40	-1.75	0.38	-0.38	0.49	0.48	0.30	-1.76	-0.91	-0.54
Czech Republic	-0.92	2.61	3.08	3.04	-2.00	4.42	-2.01	2.60	6.41	5.61	-0.03
Hungary	-4.32	1.07	2.41	7.07	-3.69	2.00	4.07	9.70	15.07	9.02	-0.36
Poland	7.11	4.79	7.04	2.03	2.34	18.25	8.73	10.21	9.47	8.99	5.51
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	-2.34	2.87	3.24	3.60	4.24	3.55	4.99	7.00	6.89	7.58	4.57
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 2.A.5

Average annual growth rates of value added, 1995-2004

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	1.24	0.75	3.45	2.48	1.30	1.12	3.48	4.24	3.19	8.11	2.79
Belgium	0.68	-0.63	4.68	0.69	2.41	-0.59	2.59	2.81	3.06	2.33	0.88
Denmark	-0.52	-5.43	-0.42	0.36	5.17	-0.73	-0.29	-1.57	5.48	-3.43	-1.50
Finland	3.98	-1.40	4.78	2.75	4.95	4.11	4.93	3.42	16.81	-1.54	2.64
France	0.34	-1.78	6.42	0.31	3.85	1.81	0.66	3.02	6.99	2.39	3.25
Germany	-0.23	-2.80	-0.69	-0.63	1.93	-1.19	0.96	0.32	3.18	3.07	-3.27
Ireland	6.70	-3.60	6.91	10.99	12.24	2.13	6.58	3.19	7.88	3.11	3.50
Italy	-0.33	-2.85	1.56	0.25	-0.73	1.47	1.49	0.29	0.91	-1.23	0.01
Luxembourg	-2.54	-0.20	19.46	4.13	4.22	0.77	3.54	0.06	7.98	7.53	-0.92
Netherlands	0.59	-0.59	-0.41	0.53	3.48	0.08	1.42	2.49	0.18	4.94	1.86
Sweden	0.68	-1.33	5.45	0.81	6.80	1.32	1.51	2.22	13.72	6.69	1.51
United Kingdom	0.68	-6.21	-0.33	-0.30	0.24	1.00	-0.03	-0.77	1.99	2.21	0.55
Greece	-0.16	-2.04	-0.72	1.50	1.15	4.38	3.93	2.27	7.00	1.97	-0.68
Portugal	0.76	-1.31	3.95	-0.25	1.75	2.19	2.52	3.41	7.64	13.81	1.02
Spain	0.93	-1.06	1.39	4.09	2.37	3.02	3.44	4.40	1.23	2.22	3.29
Czech Republic	1.11	-1.12	5.54	5.71	2.26	5.32	-2.01	2.42	13.33	12.28	2.39
Hungary	-5.42	-2.14	4.28	7.99	-2.12	3.28	6.13	7.85	21.90	16.98	4.11
Poland	7.10	-0.98	9.15	4.12	2.20	17.39	6.59	5.69	9.41	8.32	7.69
Slovakia	-6.09	3.30	12.56	3.95	2.35	5.92	8.39	5.21	13.87	13.57	10.18
Slovenia	0.01	-1.29	2.61	3.55	7.14	3.12	6.35	7.62	8.79	7.78	4.25
Cyprus	3.19	-15.53	2.66	2.68	13.25	3.06	4.44	-0.48	1.99	1.16	-2.41
Estonia	8.23	13.35	14.33	13.22	11.11	12.02	15.62	14.21	13.47	10.89	14.97
Latvia	-3.83	-0.72	6.03	2.99	0.98	5.20	4.32	-1.02	1.46	-1.94	5.54
Lithuania	3.67	4.31	15.67	5.42	8.95	7.41	14.75	8.08	13.69	14.02	15.37
Malta	1.09	-3.90	-1.73	2.18	-1.06	-1.24	0.75	4.18	-0.09	-13.85	-0.20

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 2.A.6

Average annual contribution of changes in labour composition to value added growth (in per cent of value added growth)

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	27.4	57.3	5.2	7.3	-8.5	15.2	4.9	7.1	9.7	3.0	13.3
Belgium	48.5	n.a.	6.2	44.9	12.0	n.a.	14.7	10.7	10.1	15.5	42.0
Denmark	n.a.	n.a.	n.a.	61.1	7.5	n.a.	n.a.	n.a.	8.6	n.a.	n.a.
Finland	5.0	n.a.	4.0	5.1	2.4	4.1	4.9	14.6	1.2	n.a.	12.1
France	173.5	n.a.	8.6	187.1	6.0	29.8	84.8	12.3	4.6	13.8	19.4
Germany	n.a.	n.a.	n.a.	n.a.	5.7	n.a.	35.4	109.4	9.4	9.4	n.a.
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	n.a.	n.a.	16.0	-36.0	n.a.	17.0	21.5	82.8	-27.5	n.a.	-1200.0
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	59.3	n.a.	n.a.	13.2	3.2	150.0	12.0	31.7	427.8	13.8	10.2
Sweden	47.1	n.a.	4.4	33.3	5.3	19.7	25.2	18.9	9.3	5.2	0.0
United Kingdom	52.9	n.a.	n.a.	n.a.	33.3	63.0	n.a.	n.a.	42.2	30.8	269.1
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	52.7	n.a.	27.3	7.3	5.9	10.3	9.3	8.6	30.9	6.3	10.9
Czech Republic	17.1	n.a.	3.4	2.6	-4.4	1.9	n.a.	3.3	0.2	0.3	15.9
Hungary	n.a.	n.a.	11.9	6.5	n.a.	11.3	8.3	-1.8	-0.6	-0.7	10.7
Poland	3.2	n.a.	3.0	7.3	-8.2	1.1	3.0	4.4	1.8	2.0	1.6
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	2000.0	n.a.	6.9	4.2	2.2	5.4	2.5	2.1	1.4	1.9	5.9
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 2.A.7

Change in labour composition in per cent of change in labour composition plus multifactor productivity

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	11.6	8.2	4.2	12.0	-5.6	5.8	5.2	8.8	7.9	4.0	8.8
Belgium	n.a.	17.2	8.0	n.a.	n.a.	n.a.	14.4	9.5	7.8	16.0	15.8
Denmark	n.a.	n.a.	n.a.	68.8	15.1	35.6	n.a.	n.a.	62.7	97.6	n.a.
Finland	4.1	16.1	4.8	4.7	3.3	6.6	15.8	19.5	1.9	n.a.	20.1
France	n.a.	18.2	7.7	53.7	6.2	23.0	47.9	9.2	4.9	28.9	15.9
Germany	68.4	11.7	14.0	n.a.	4.3	13.0	24.3	40.7	6.8	14.9	n.a.
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	n.a.	n.a.	16.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Luxembourg	n.a.	n.a.	0.0	n.a.	0.0	n.a.	0.0	n.a.	0.0	0.0	0.0
Netherlands	36.5	10.0	n.a.	4.4	3.4	27.3	11.8	52.7	64.7	10.5	14.8
Sweden	n.a.	31.7	5.4	27.3	9.9	12.2	n.a.	17.4	8.6	8.4	n.a.
United Kingdom	92.3	92.0	n.a.	95.9	7.8	23.5	25.4	39.9	21.8	38.2	n.a.
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	n.a.	n.a.	n.a.	44.1	n.a.	38.8	40.0	55.9	n.a.	n.a.	n.a.
Czech Republic	n.a.	10.3	5.8	4.7	n.a.	2.2	n.a.	3.0	0.3	0.7	n.a.
Hungary	n.a.	29.1	17.5	6.9	n.a.	15.6	11.1	-1.5	-0.9	-1.3	n.a.
Poland	3.1	5.7	3.7	12.9	-8.3	1.0	2.2	2.4	1.8	1.9	2.1
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	n.a.	10.0	5.3	4.0	3.6	4.6	3.1	2.2	1.7	1.9	5.2
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EUKLEMS database, March 2007; wiiw calculations.

Table 2.A.8

Contributions of skills to labour quality change

	15t16	17t19	20	21t22	23t25	26	27t28	29	30t33	34t35	36t37
Austria	61.5	32.8	92.2	86.7	-119.7	75.6	98.0	54.9	49.7	53.1	61.3
Belgium	63.2	35.6	66.8	64.5	67.1	62.5	65.1	43.2	26.4	34.1	58.0
Denmark	42.8	4.0	21.2	24.3	55.8	-10.3	31.2	34.4	26.8	-12.1	39.4
Finland	25.9	-8.6	38.3	50.9	59.9	26.7	13.8	59.6	44.1	44.9	11.5
France	37.5	9.4	63.2	63.4	131.1	62.0	64.4	66.5	62.6	72.2	36.1
Germany	54.4	-6.6	13.8	63.9	165.4	42.3	61.2	63.6	48.4	53.3	68.4
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	8.1	-61.5	35.7	85.3	41.6	16.8	0.3	-11.9	74.4	112.9	-6.9
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	67.8	30.0	124.1	199.2	109.9	120.3	117.0	-8.7	-10.4	-9.3	121.2
Sweden	60.8	45.4	38.3	43.8	86.1	55.0	51.2	69.9	45.4	73.2	21.7
United Kingdom	55.6	30.5	46.6	28.4	-61.6	63.5	103.1	43.7	1.9	65.6	15.5
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	83.4	66.6	116.6	99.7	209.5	115.2	106.4	62.9	77.6	171.1	91.6
Czech Republic	32.7	0.4	63.4	58.1	-63.1	70.9	73.2	114.6	73.0	77.2	13.0
Hungary	40.2	-7.8	50.3	66.3	-1096.9	51.7	56.7	379.4	243.0	427.5	-73.8
Poland	78.8	4.9	91.1	79.4	-134.7	78.0	81.6	73.1	118.4	64.8	38.2
Slovakia	-92.0	-104.5	-20.1	-9.9	-592.3	67.2	-8.0	-68.4	32.9	-31.4	-184.7
Slovenia	103.0	75.9	79.4	124.1	107.8	126.6	123.7	-89.1	110.2	-46.6	113.5
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

3 Skill upgrading and employment shifts between sectors

3.1 Introduction

In this section we attempt to trace skill upgrading of the employed labour force in the 27 member countries of the EU to two types of factors: changes in the composition of the labour force within industries ('within effect') and shifts in employment structures between industries which are themselves characterized by different skill compositions ('between effect'). Furthermore, we shall analyse and compare these processes of skill upgrading for different country groups, the more advanced EU-North economies, the Southern cohesion countries (EU South) and the New Member States (NMS). These countries are differently positioned in intra-European patterns of industrial specialization and hence the analysis of different features of skill upgrading is of interest and contributes to an understanding of skill upgrading pressures.

As this report is about skill shortages, we shall focus on the changes in the employment structure in relation to the more highly skilled, i.e. employees with a completed tertiary level degree[3]. However, we shall also use evidence of skill compositional change at the low end, i.e. the substitution of employees with low educational attainment levels by those with higher ones.

3.2 Decomposition analysis

As an initial approach to track such changes we shall use a simple decomposition algorithm used by Berman, Bound and Machin (1998) which attempts to decompose an aggregate change in skill composition (e.g. skill upgrading in the sense of a higher share of employees with tertiary degrees in the economy as a whole) into a 'within sector' (WS) change and a 'between sector' (BS) change.

The basic decomposition used therein can be written as

$$\Delta s = \sum_i \Delta e_i \overline{s_i} + \sum_i \overline{e_i} \Delta s_i \quad (1)$$

where $e_i = \frac{E_i}{\sum_j E_j}$, $s_i = S_i / E_i$ and $\overline{s} = \overline{S} / \overline{E}$. E is employment, S are skilled workers and an overstrike denotes a simple average over time; the index denotes industries.

Particularly interesting in this respect is whether skill-upgrading takes place to the same extent in different industry groupings or whether skill-upgrading is more pronounced in industries which are already characterized by a high initial level of skills. If employment shifts towards the sectors with a high initial level of skills one speaks of a sector-biased form of skill upgrading as against the within sector effect which shows the skill-bias of technical change which might take place in any sector of the economy.

[3] See Box 3.2 for detailed description of Labour Force Survey data used for the analysis.

Box 3.1:

Classification of industries by skill types

NACE code	Skill type	1999 High-skill share	2005 High-skill share	
19	low	4.8	7.8	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
18	low	6.3	7.7	Manufacture of wearing apparel; dressing and dyeing of fur
17	low	6.9	8.1	Manufacture of textiles
20	low	7.5	8.4	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
37	low	8.1	10.0	Recycling
36	low	9.6	10.8	Manufacture of furniture; manufacturing n.e.c.
28	medium	10.1	11.7	Manufacture of fabricated metal products, except machinery and equipment
26	medium	10.3	11.8	Manufacture of other non-metallic mineral products
15	medium	11.1	12.2	Manufacture of food products and beverages
25	medium	11.4	13.4	Manufacture of rubber and plastic products
21	medium	12.6	15.0	Manufacture of pulp, paper and paper products
27	medium	13.0	13.4	Manufacture of basic metals
16	medium	15.4	24.9	Manufacture of tobacco products
34	**high**	16.0	19.5	Manufacture of motor vehicles, trailers and semi-trailers
29	**high**	18.2	20.6	Manufacture of machinery and equipment n.e.c.
31	**high**	20.8	19.8	Manufacture of electrical machinery and apparatus n.e.c.
22	**high**	21.7	26.7	Publishing, printing and reproduction of recorded media
35	**high**	24.9	24.9	Manufacture of other transport equipment
33	**high**	26.1	27.7	Manufacture of medical, precision and optical instruments, watches and clocks
24	**high**	27.8	33.4	Manufacture of chemicals and chemical products
32	**high**	27.8	29.8	Manufacture of radio, television and communication equipment and apparatus
23	**high**	30.5	32.2	Manufacture of coke, refined petroleum products and nuclear fuel
30	**high**	37.2	41.2	Manufacture of office machinery and computers

Shares of industries in EU-27 employment structures and shares of high-skilled employees

	1999		2005	
	High-skill share	Empl share	High-skill share	Empl share
low	7.49	19.63	9.02	18.54
medium	11.08	37.17	12.48	38.46
high	22.22	43.20	24.85	42.99

Notes: The industry groupings (high, medium, low) were obtained by ranking the EU-27 industries – in the aggregate – by the shares of high-skill employees (those with concluded tertiary degrees) in total employment (see columns 3 and 4 in first table above). The second table shows the shares of the high-skilled in the three groups of industries (columns 2 and 4) and their shares in total manufacturing employment in the EU-27 (columns 3 and 5). Industry 16 (Manufacture of tobacco products shows a large increase in the share of high-skilled worker in a number of countries which might be explained by higher investments in R&D, marketing due to increasing regulations. Despite the large high-skill share in 2005 we decided to keep this industry in the medium group as the number of employment is rather low and thus the figures are somewhat unreliable, the initial position is more important for the analysis as the position in the last year and also to guarantee a broadly balanced distribution across industry types.

For some of the analysis a more detailed decomposition of industries is employed which differentiates the group of high-skill intensive industries into a 'high-medium' group (comprising industries 29, 31, 34 and 35) and the rest which we call 'high-high'. The employment and high-skill employee shares of these two groups are respectively (cont'd next page):

Decomposing the shares of high-skill intensive industries in EU-27 into a 'high/medium' and into a 'high/high' group:

	1999		2005	
	High skill share	Empl share	High skill share	Empl share
High/medium	18.04	21.18	20.05	21.31
High/high	26.24	22.01	29.56	21.69

Note: The decomposition into these two groups was done by employing a ranking procedure of industries for each EU country by skill intensity and then taking a cross-country average.

Skill upgrading in the economy as a whole will obviously take place as a combination of these two effects and will be more accentuated when there is both within sector skill upgrading combined with a between sector bias.

In the following we analyse the 'within' and 'between' effects of skill upgrading using LFS data for the period 1999-2005 which allow a breakdown to NACE 2-digit industries (15-37). The results are presented for each of the EU-27 countries and for manufacturing industry as a whole as well as for industry aggregates which are distinguished by skill intensity (see Box 3.1 for a classification of industries by skill intensity).

Figure 3.1a presents the results of this analysis for the industry aggregates and for each of the EU member countries [4] which have themselves been grouped into EU North, EU South (comprising Greece, Portugal and Spain) and the New Member States (NMS)[5].

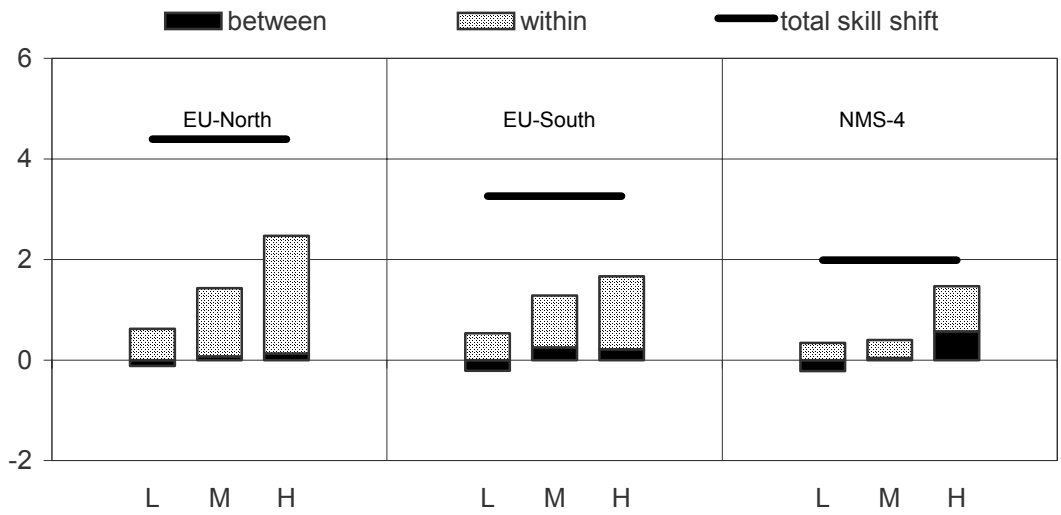
Looking at the between effects it is clear that in all regions, EU-North, EU-South and NMS-4, there is a clear shift of employment away from low-skill industries in all the three groups of countries and towards medium- and high-skill industries. In fact, the strongest shift towards high-skill industries is in the NMS-4. Furthermore, the 'within shifts' are also clearly staggered in that the within shifts are highest in the group of high-skill branches, then in the medium-skill branches and lowest (though also positive) in the low-skill branches. Hence, in other words, the upgrading of skills (measured by the shares of those with highest educational attainment levels in the employed labour force) is strongest in the high-skill industries which also benefit from the strongest 'between' shift effect.

[4] Individual country results can be obtained in the Annex.

[5] The grouping into EU-North comprising the older member states (OMS) with the exception of the Southern EU members Spain, Portugal and Greece (which form the group EU-South) and the New Member States (NMS) has been adopted in this section as in other sections of this study in order to identify different patterns – in the present section of skill upgrading processes – which might depend upon differences in income levels (the Southern cohesion countries and the NMS) and of countries which have undergone dramatic processes of transition and a more recent entry into the European Union (the NMS). In this section, lack of industry level detail (as in the case of Poland) or problems in consistency of time series (as in the case of the Baltic states) limited the analysis for the NMS to a group of 4 NMS economies (Czech Republic, Hungary, Slovakia and Slovenia).

Fig 3.1a

Summary for share of high-skilled in EU-North. EU-South and NMS-4[6] High education

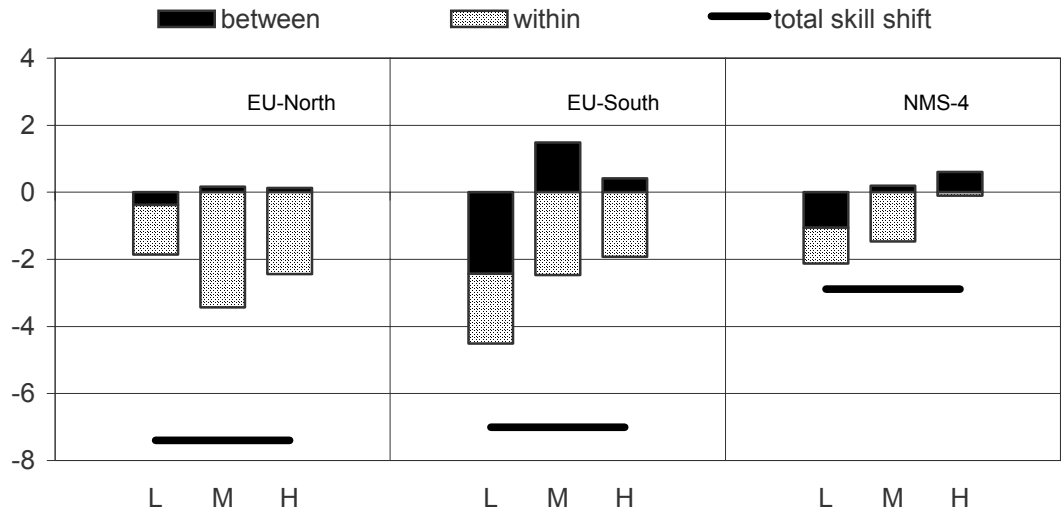


Note L = low-skill sectors, M = medium-skill sectors, H = high-skill sectors.

Source: wiiw, calculated from Labour Force Statistics.

Fig 3.1b

Summary for share of low-skilled in EU-North. EU-South and NMS-4 Low education



Note: L = low-skill sectors, M = medium-skill sectors, H = high-skill sectors.

Source: wiiw, calculated from Labour Force Statistics

Coming to the other end of the skill spectrum, namely the share of the low-skilled (those with lowest educational attainment levels), – see Figure 3.1b – we do not observe the

[6] We restrict the analysis here to the NMS-4 (Czech Republic, Hungary, Slovakia and Slovenia) as Polish figures at the NACE 2-digit level did not exist in the LFS statistics and the statistics for two of the Baltic states (Latvia and Lithuania) are affected by classification breaks of ISCED categories.

same uniform pattern across all country groupings. By definition, the between effects are the same as in Figure 3.1a, but the within effects differ across country groupings: In absolute terms (i.e. percentage point decline in the shares of the low-skilled in the labour force) they are higher in the EU-North and the EU-South than in the NMS countries. In these groups of countries the percentage point shifts are of the order of 7-8 % points over the period 1999 to 2005, while in the NMS they are 2-3%. Furthermore, while in the EU-South and the NMS the shifts are again staggered in a similar way, i.e. in that the low-skilled industries experienced also the strongest shifts in employment composition away from the low-skilled, followed by the medium-skill and then the high-skill industries, in the EU-North the pattern was different in that the strongest shifts were in the medium and high-skill industries. This pattern is consistent with arguing that while there is pressure towards upgrading of skill structures in all industries, the pressure to reduce low-skill segments is highest in the advanced EU-Northern economies in the medium and high-skill industries, i.e. those industries in which also the catching-up EU-Southern and NMS economies make their strongest inroads in terms of between and within shifts.

Let us summarize the results so far before presenting some more detailed results at the individual industry level:

- In general, the upgrading process within industries (i.e. changes in the skill composition within industrial branches) contributes more to the changing demand for higher vs. lower skilled people at the aggregate manufacturing level than shifts of overall employment between sectors or industries. However, the changing demand for different skill types by individual sectors is always a mix of within-industry and between-industry effects, i.e. an industry requires e.g. more skilled workers because it upgrades its internal skill composition and it might also increase its share in total employment and both these two effects show up in the (positive or negative) flows of people with different educational attainment levels into or out of a particular sector.
- What we do observe is that there is a general shift of employment away from low-skill intensive industries and towards the group of medium and high-skill industries and in this order. Furthermore, this (between sector) shift occurs across all groups of countries (the advanced EU-North, as well as EU-South and NMS). This uniformity of between industry shifts is interesting as it conflicts with a traditional specialization story in that some countries specialize in low-skill intensive branches and others in high-skill intensive branches. In fact, we can see a strong move towards changing employment structures towards higher skill branches in all the three groups of European economies.
- Furthermore, the (within sector) skill upgrading process is also more pronounced in the high-skill and medium-skill areas than in the low-skill areas and this pattern is also uniform across the three groups of economies and, in fact, most pronounced in the NMS. This can be interpreted as evidence of a double-sided qualitative catching-up process, i.e. most pronounced employment shifts towards high-skill industries in the

NMS (compared to the other two groups of economies) combined with the above-mentioned hierarchy of (within industry) upgrading processes which is strongest in the high-skill branches.

- The pattern of within sector shifts away from those with lowest educational attainment levels also reveals an interesting facet of international upgrading processes: while the NMS and Southern EU countries experience the strongest loss of employment shares of low-skilled in the low-skilled industries, in the more advanced EU-Northern economies, this is more the case in the medium- and high-skill branches which indicates a very strong pressure to weed out low-skill segments in higher skill branches in the advanced Northern economies as the shift and competitive pressure (i.e. the between and within shifts discussed above) from successful catching-up economies is particularly strong there. If the more traditional outsourcing story linked to classical (Heckscher-Ohlin) trade theory would be the dominant one, then we would expect to observe more upgrading pressure in the low-skill industries where the low-skill stages would have to be most quickly vacated by advanced, more skill-abundant economies. But this is not what we observe and hence the evidence is compatible with a fast upgrading story of catching-up economies who compete increasingly also in the medium and high-skill branches and hence force 'Northern' economies to intensify their upgrading (focus on the most skill-intensive stages) in these branches.

Let us finally discuss some detailed (NACE 2-digit) industry results.

Figures 3.2a and 3.2b present an overview of between and within sector shifts in the skill composition for high-skilled (Figure 3.2a) and the low-skilled (Figure 3.2b) at the detailed industry level; the industries have been ranked by a general classification of skill intensity (see Box 3.1).

Table 3.1a

Industries in which there was the strongest increase in the shares of high-skilled employees over the period 1999 to 2005

In EU-North:	in LS: 18 (wearing apparel), 17 (textiles), 36 (furniture) in MS: 15 (food pds), 28 (metal pds), 25 (rubber&plastics), 26 (minerals), 27 (metals) in HS: 24 (chemicals), 22 (print&publ), 32 (radio, telev), 29 (machinery), 33 (precision instr)
In EU-South	in LS: 18 (wearing apparel), 36 (furniture), 19 (leather pds) in MS: 15 (food pds), 28 (metal pds), 27 (metals), 25 (rubber&plastics), 26 (mineral pds) in HS: 29 (machinery), 24 (chemicals), 22 (print&publ), 34 (motor veh), 31 (electr. mach)
In NMS:	in LS: 17 (textiles), 19 (leather pds), 20 (wood pds), 36 (furniture), 18 (wearing apparel) in MS: 28 (metal pds), 15 (food pds), 26 (mineral pds), 27 (metals) in HS: 24 (chemicals), 29 (machinery), 31 (electr. mach), 33 (precision instr), 22 (print&publ), 32 (radio, TV, communications equip.)

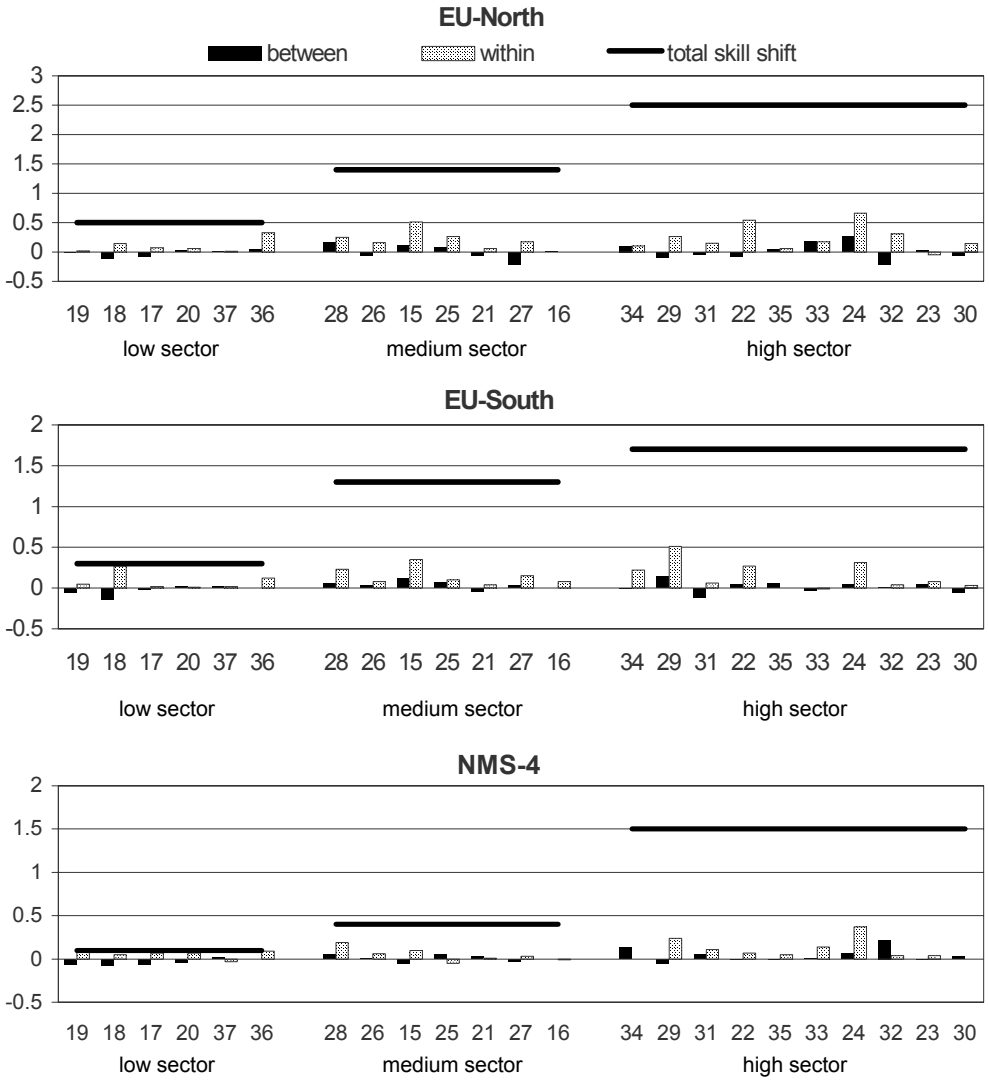
LS, MS, HS refer respectively to low-skill (LS), medium-skill (MS) and high-skill (HS) group of industries.

Amongst the industries which experienced the strongest within industry skill upgrading processes (measured by the increases in the shares of employees with the highest educational attainment levels) are the following:

What is interesting here is that there is quite a bit of overlap of the industries in all the groups in which the strongest skill upgrading did occur in EU-North, EU-South, and the NMS. This would indicate that such (within industry) skill-upgrading would be driven by patterns of technological change which might be quite common across different economies. On the other hand, when we also look at the increases in employment shares for these industries (i.e. between industry shifts), things look somewhat different across the different groups of economies.

Figure 3.2a

Within and between shifts of high-skill workers at detailed branch level



Source: wiiw, calculated from Labour Force Statistics

Most remarkable is the fact that in the industries which have the fastest skill upgrading in the Northern EU-economies (especially in the high-skill segment) there were losses in employment shares while these industries experienced gains (or: mixed gains and losses) in Southern EU and in the NMS. This indicates that the skill upgrading in the catching-up economies in the high-skill industry segment led to successes for these industries in increasing their employment shares in these economies while this was not the case for the majority of the cases for the advanced EU economies. This can be interpreted such that the skill-upgrading (or restructuring) process was less successful in this industry segment in employment terms in the advanced Northern EU economies than in the catching-up economies.

A similar phenomenon can be observed when we look at the loss of employment shares of the low-skilled in the different industries which is also evidence for skill upgrading at the lower end of the skill spectrum. Here again, we can observe in the high-skill segment that in the industries in which there was the strongest decline in the share of the low-skilled, the NMS experienced a rise in the employment share, while this defensive form of restructuring did not have the same degree of success in the advanced Northern EU economies. There the change in the skill composition of the labour force by reducing the shares of the low-skilled did not lead to a rise in their overall employment shares.

Table 3.1b

Industries in which there was the strongest decline in the shares of low-skilled employees over the period 1999 to 2005:

In EU-North:	in LS: 36 (furniture), 20 (wood pds), 18 (wearing apparel), 17 (textiles) in MS: 15 (food pds), 28 (metal pds), 27 (metals), 21 (paper pds), 26 (minerals) in HS: 24 (chemicals), 29 (machinery), 22 (print&publ), 34 (motor veh), 32 (radio, telev), 31 (electr mach)
In EU-South	in LS: 18 (wearing apparel), 20 (wood pds), 36 (furniture), 17 (textiles), 19 (leather pds) in MS: 15 (food pds), 28 (metal pds), 27 (metals), 25 (rubber&plastics), 26 (mineral pds) in HS: 29 (machinery), 34 (motor veh), 22 (print&publ), 35 (other transp), 24 (chemicals)
In NMS:	in LS: 19 (leather pds), 17 (textiles), 18 (wearing apparel), 20 (wood pds), 36 (furniture) in MS: 28 (metal pds), 27 (metals), 25 (rubber&plast), 15 (food pds), 21 (paper pds), in HS: 22 (print&publ), 24 (chemicals), 31 (electr. mach), 34 (motor veh), 29 (machinery), 32 (radio, TV, communications equip.)

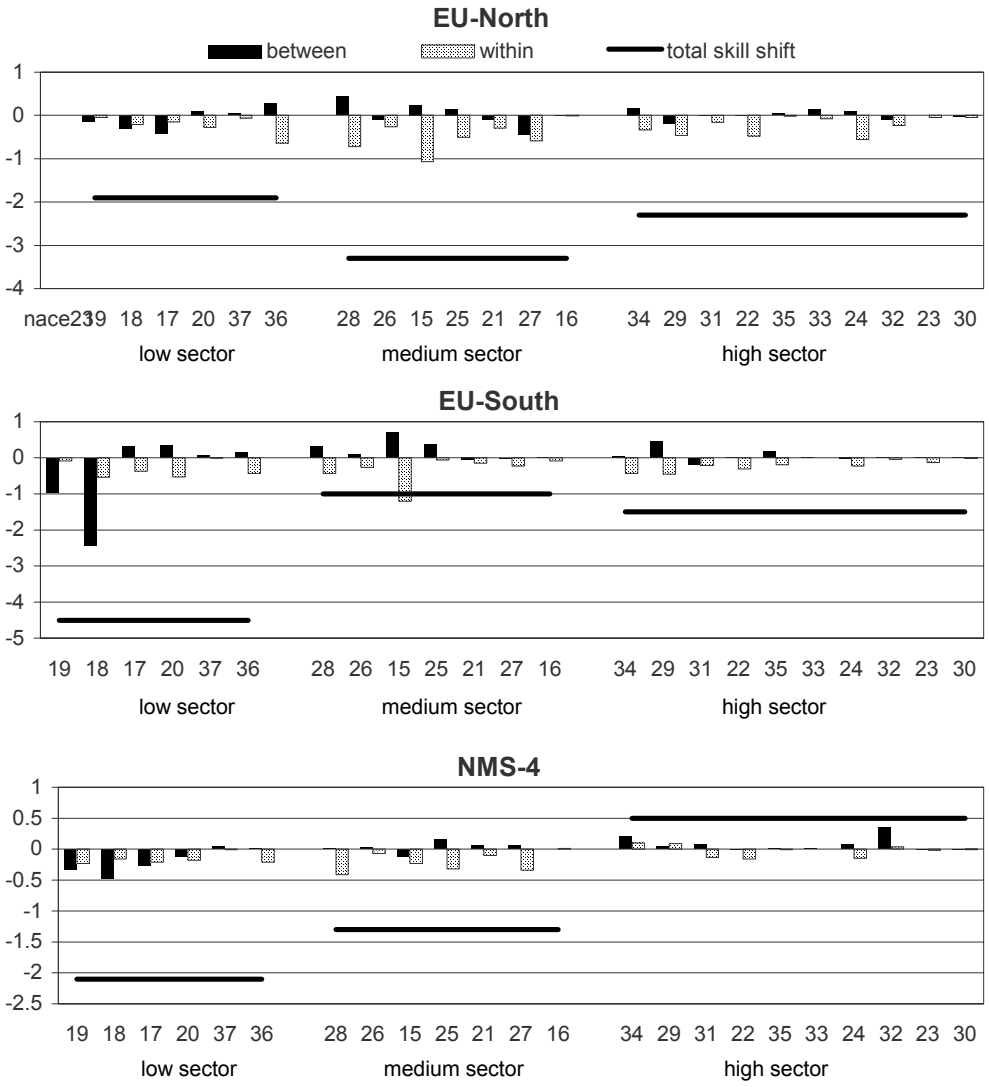
LS, MS, HS refer respectively to low-skill (LS), medium-skill (MS) and high-skill (HS) group of industries.

Summarizing the results at the detailed industry level we can say that while there is an overlap of the industries in which the strongest skill-upgrading processes did occur in the advanced EU economies, the Southern EU and the NMS, we found striking differences whether this skill-upgrading process led to a similar success in these different economies as to whether employment shares could be increased in such industries. With respect to both forms of skill-upgrading, i.e. at the higher end by increasing the shares of the higher-skilled and at the lower end by reducing the shares of the lowest skills, we found that the

EU Northern economies were much less successful to link a strong skill-upgrading process within an industry with an increase in an employment share of that industry. Such a pattern was much more the case with EU Southern and NMS economies.

Figure 3.2b

Within and between shifts of low-skill workers at detailed branch level



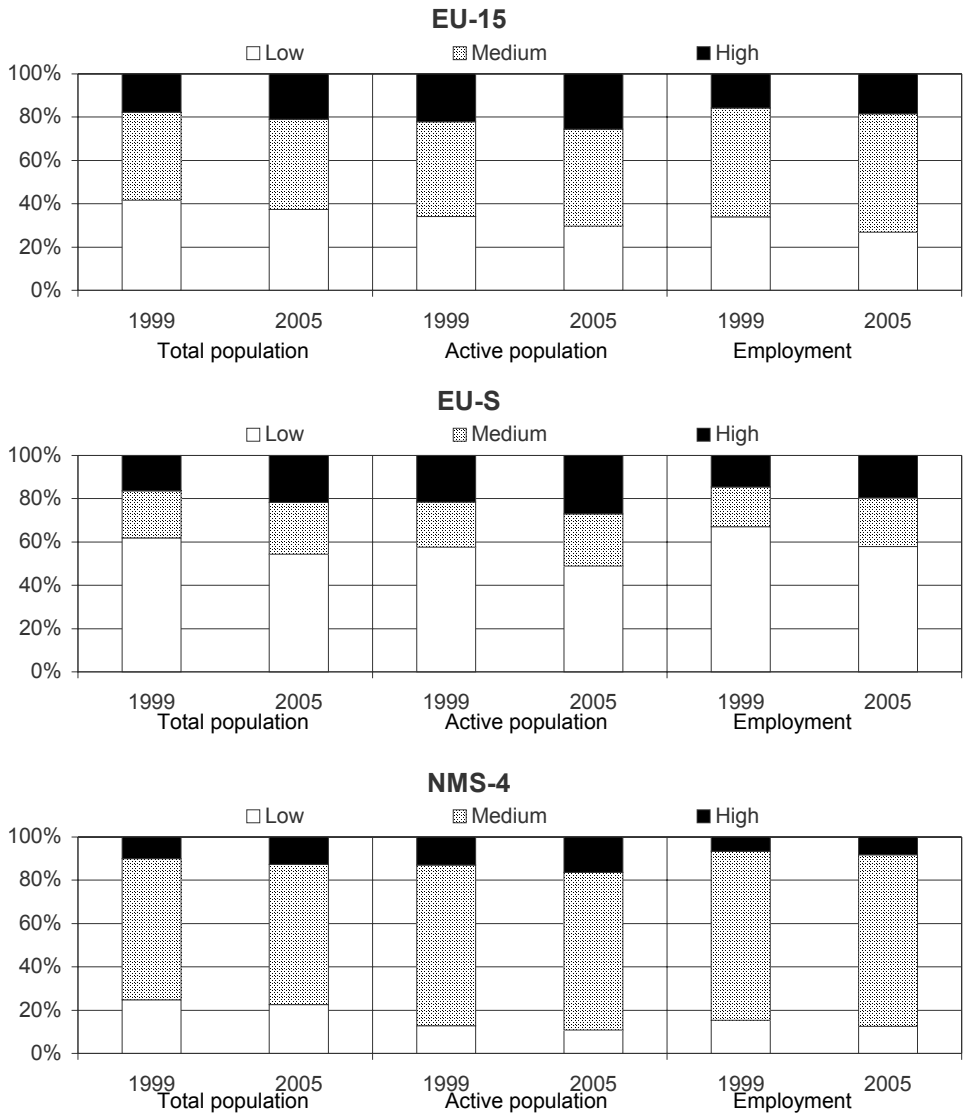
Source: wiiw, calculated from Labour Force Statistics

Finally, we address the issue of how the changing employment structure in manufacturing in the three groups of economies compares with the development of the skill structure of the economy-wide potential and active labour force. This allows us to check whether the changing skill structure of the labour force employed in manufacturing develops in tune with the available (potential or actual) labour supply at the aggregate economy-wide level. If it does not then this can be interpreted as

indicating possible shortages or oversupply of certain segments of the more or less skilled labour force[7].

Figure 3.3a

Skill shares in total population, total active population and employment in manufacturing, 1999 and 2005



Source: wiiw, calculated from Labour Force Statistics

What is clearly visible from Figure 3.3a is the well-know fact that the NMS have a much smaller share of 'low-skilled' people (i.e. those who have completed a secondary school

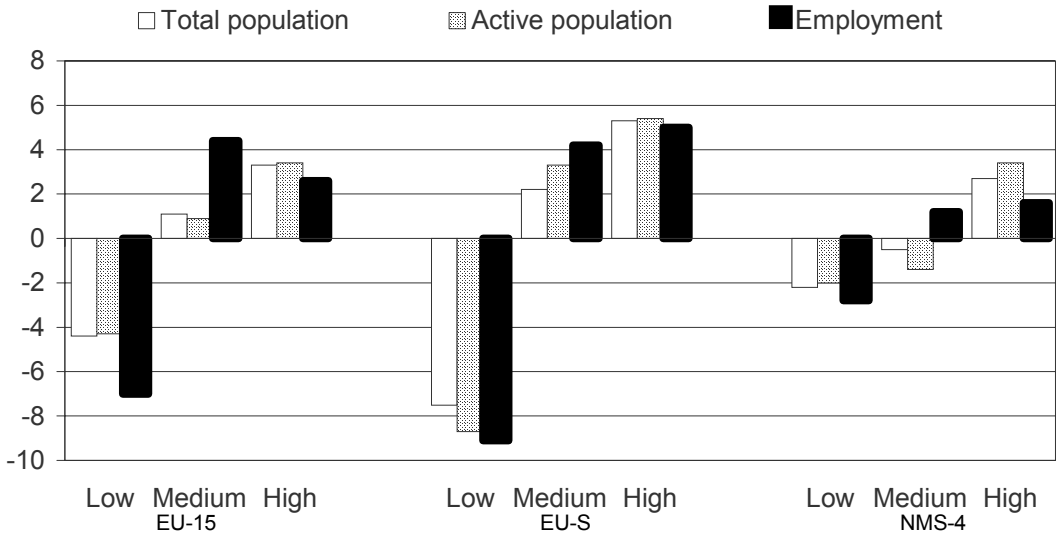
[7] The comparison of skill composition in manufacturing with that of the aggregate (potential or actual) labour force is of course not a direct measure of possible skill shortages in manufacturing, as it depends to which extent the sectors of the economy other than manufacturing develop in terms of their skills demands; nonetheless the comparison allows to obtain a picture of matching or non-matching employment developments in manufacturing compared to those of the aggregate labour force.

degree) than either the Northern EU economies or the EU-South (on this see also Landesmann and Vidovic, 2006). Furthermore, the EU South has a much larger share of people with low skills. In all the three types of economies the share of people with lowest educational attainment levels are declining in all the categories shown in Figure 3.3a, i.e. in total population of working age (15-64), in active population and in employment in manufacturing.

This brings us to Figure 3.3b which shows the changes of skill composition in these three categories and in the three types of country groupings. The changes here are share changes in percentage points over the period 1999 to 2005 and they show in general stronger shifts in skill structures in the EU North and the EU South than in the NMS. Furthermore, as regards the low-skilled, we see a stronger contraction of their shares in employment structures in manufacturing than in either the total population or in the active labour force. This would indicate that the shrinkage of employment opportunities for the least educated is more pronounced in manufacturing than their ongoing shrinkage in the two measures of the labour supply. This discrepancy is most pronounced for EU North and confirms our picture of a strong pressure on this skill segment of the labour market from the skill upgrading tendencies in manufacturing.

Figure 3.3b

Change in skill shares in total population, in total active population and in employment in manufacturing, 1995 to 2005



Source: wiiw, calculated from Labour Force Statistics

For people with medium skills, we can see that their shares in manufacturing employment is increasing in all three country groupings and this share increase is outstripping that in the (potential and active) labour force – which is positive in EU North and EU South and

negative in the NMS – so that one can say that manufacturing employment provides employment opportunities over this period for medium-skilled people which is in excess of that shown by share changes in the two labour supply indicators.

Finally, we come to people with highest educational attainment levels: they increase their shares in both manufacturing employment and in the two labour force indicators and we can see that the share increases in the labour supplies are stronger than in manufacturing employment; hence in this skill segment manufacturing can rely on an expanding share in the available labour force (which of course can also be absorbed in the other – non-manufacturing – sectors of the economy) and this gap is more in evidence for the NMS than for the other two groups of economies. From this rough indicator one could conclude that the manufacturing sectors in the NMS are well placed to satisfy the increased demand for high-skilled labour which our previous analysis has indicated is taking place.

3.3 Summary and conclusions

In this section we have analysed the process of skill-upgrading in manufacturing industry in three groups of EU economies: in the EU-North, the EU-South, and the New Member States.

We have employed a decomposition technique to decompose the upgrading process into two components: a within industry component which looks at the skill compositional changes within individual industries and a between industry component which looks at employment structural shifts between industries which themselves might be characterized by differences in skill intensity.

We found that within sector shifts are dominant in the EU-North and hence account for the majority of overall skill-upgrading in manufacturing, while in the EU-South and particularly the NMS the between sector shifts are also important. This points to the importance of cross-industry shifts in employment structures in these economies as an important component in overall skill-upgrading. In all the three groups of economies, the within sector skill upgrading is strongest in the high-skill group of industries, followed by the medium-skill industries and then by the low-skill industries. This would be interpreted in the literature as ‘sector biased, skill-biased’ technical progress. There is one exception to this pattern and that is if one looks at the reduction of the low-skilled in the employment composition of the three types of industries: here we find that the ‘labour shake-out’ of the low-skilled is strongest in the EU North in the medium- and high-skill industries which can be interpreted as a response to the impact of a particularly strong pressure to move towards the high-skill segments in these types of industries.

Box 3.2

Labour Force Survey statistics on skills

The Labour Force Survey does distinguish the educational attainment levels of respondents at the ISCED 2-digit level – i.e. it tries to identify the nature of programmes completed within ISCED 3 and 4 – but the data are not complete and are not necessarily directly comparable across countries. This reflects the large differences between national systems of education and the scope for classifying similar programmes to different ISCED categories in different countries.

Such differences in classification tend to be gradually rectified over time as statisticians obtain more information about the various programmes. As a result, the data on education levels can be expected to become more comparable between countries from year to year, though by the same token, they are not necessarily consistent over time.

A detailed examination of the ISCED 2-digit data reported by successive annual labour force surveys over recent years indicates that for a number of countries, there are clear signs of shifts in the classification of programmes of this kind. Accordingly, while the data for broad education levels – i.e. low, medium and high, aggregating the ISCED 1 and 2, 3 and 4, and 5 and 6 categories, respectively – seem reasonably consistent, this is less the case for more detailed education levels.

Given the large segment identified in the data – particularly for the NMS – in ISCED categories 3 and 4 (the 'medium-skill' range) it would have been particularly useful to have a further decomposition of this rather heterogeneous group. We shall discuss the structure of the group of medium-skilled in the following.

ISCED data reported by the LFS enable in principle to identify three groups of secondary education levels:

i ISCED 3c programmes, which are not designed to lead to tertiary education, and which are of less than three years duration

ii ISCED 3c and 4c programmes not designed to lead to tertiary education but lasting three years or more, and

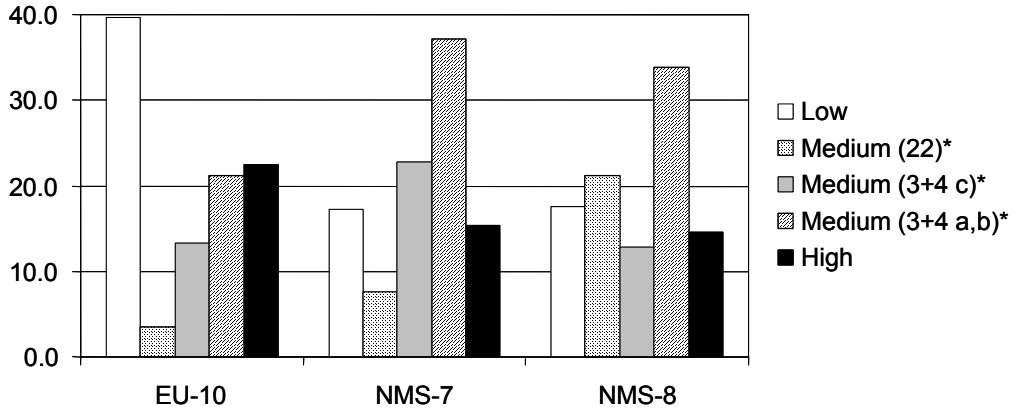
iii ISCED 3 or 4a and b programmes which are designed to lead on to tertiary education.

The programmes included in the first two categories are different from those included under the third, in that they are essentially vocational in character and designed to train people for a particular occupation rather than to prepare them for university education. The general educational content of programmes in this group are therefore relatively small, though this is likely to vary across countries in terms of its relative weight and the occupations might be more or less narrowly defined. Furthermore, programmes under the first two categories will differ not only in terms of duration but also in terms of content, in the sense that those with less than three years duration are likely to be relatively short courses designed to provide basic training for a particular occupation.

Using LFS data for a sub-set of EU economies for 2003 (a number of countries do not report such data, including Germany) we show a breakdown of population and of the employed labour forces of ten of the OMS and of the NMS (with and without Poland which affects the aggregate rather strongly because of its size) in Figures 3.4a and b).

Figure 3.4a

Educational attainment of total population
Population aged 25-64, 2003

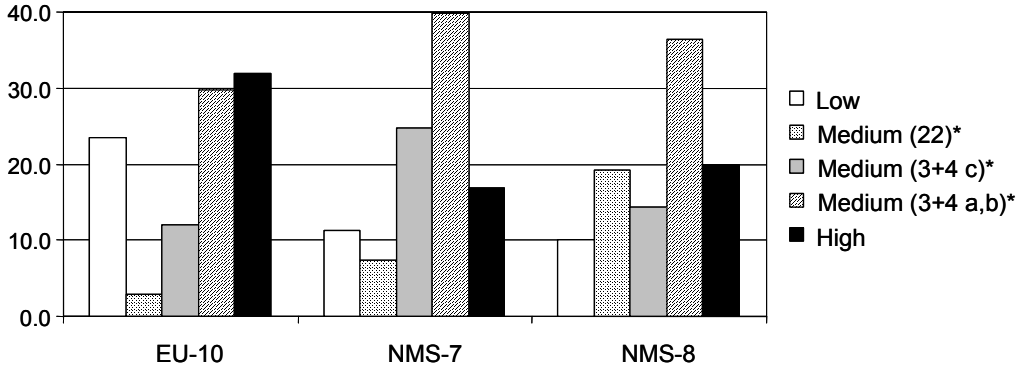


Notes: EU-10: BE, DK, EL, ES, FR, IRL, IT, LU, FI, UK; NMS-7: NMS-8 w/o PL.

*) Medium (22): ISCED 22: Secondary education shorter than 3 years; Medium (3+4 c): ISCED 31, 42: Secondary education programmes not designed to lead to high education level, lasting 3 years and more; Medium (3+4 a,b): ISCED groups 30, 32, 36, 41, 43: Secondary education programmes designed to allow access to tertiary education

Figure 3.4b

Educational attainment in total employment
Population aged 25-29, 2003



Notes: EU-10: BE, DK, EL, ES, FR, IRL, IT, LU, FI, UK; NMS-7: NMS-8 w/o PL.

*) Medium (22): ISCED 22: Secondary education shorter than 3 years; Medium (3+4 c): ISCED 31, 42: Secondary education programmes not designed to lead to high education level, lasting 3 years and more; Medium (3+4 a,b): ISCED groups 30, 32, 36, 41, 43: Secondary education programmes designed to allow access to tertiary education

An analysis at the detailed industry level furthermore contributed to this type of interpretation in that we found that the impact on inter-industry employment share changes is quite different between the EU North, on the one hand, and the EU South and the NMS, on the other hand: in the latter group of economies, it occurred in many of the cases in the high- and medium-skill groups of industries that industries which experienced the strongest skill upgrading also experienced an increase in their shares in total manufacturing employment, while in the EU North, strong skill upgrading would in the majority of the cases go along with losses in employment shares. This means that in an environment of strong international competitive pressure measures of skill upgrading were not successful in leading to an increase in employment shares in these types of industries.

Finally, we confronted the patterns of skill compositional changes on the employment side in manufacturing with the supply-side of the aggregate labour supply (i.e. the population in working age and the active available labour force). We found a stronger contraction of employment opportunities for the low-skilled in manufacturing compared to the developments on the labour supply side (in the economy as a whole). For the medium-skill we found that manufacturing provided more positive changes in employment opportunities than would be indicated by the changes on the labour supply side. And for the high-skilled, we found that the labour supply shifts were in fact exceeding the changes in the employment structures in manufacturing; this discrepancy was particularly pronounced for the NMS.

3.4 An econometric investigation into factor- and sector-biased technical change

3.4.1 Introduction

One of the findings of the shift-share analysis in section 1.3.2 was that there is evidence of a clear shift away from low-skill industries towards the medium- and high-skill industries. Furthermore, the within shifts were found to be highest in the most skill-intensive branches and lowest in the low-skill intensive branches. These findings are in line with the results in Haskel and Slaughter (2002) who showed that technical change in the 1990s was skill biased and concentrated in the skill-intensive sectors. Furthermore, in that paper it was argued that the sector bias of skill-biased technological change is the important factor in explaining rising skill premia. The alternative hypothesis is that the factor bias, i.e. the skill bias, is the important mechanism to explain the rising relative wages of skilled workers. There are a number of contributions addressing these issues: e.g. Krugman (2000) and Acemoglu (2002) favour the factor bias interpretation whereas Haskel and Slaughter (2002) shows evidence for the sector bias hypothesis. Xu (2001) discusses these views in a general model with various combinations of elasticities of substitution of production and demand but finds ambiguous effects in many cases. These issues were addressed in Stehrer (2005) applying a model based on CES production and demand functions which allows to derive clear-cut conditions to evaluate the relative importance of the sector and factor bias of technical change.

In this section we follow the empirical strategy proposed by Haskel and Slaughter (2002) and test more formally whether the above finding of skill biased technical change being concentrated in the skill-intensive sectors is econometrically significant. The econometric strategy used in Haskel and Slaughter (2002) also implies testing whether there is evidence for skill biased technical change, whether capital-skill complementarity plays an important role and whether technical change was concentrated in the skill intensive sectors. All of these three arguments would provide an explanation for the observed rise in the relative demand for skilled workers. In fact, the evidence provided in Haskel and Slaughter (2002) for ten OECD countries was that technical change was concentrated in the low-skill intensive sectors when relative wages of skilled workers were decreasing and was concentrated in the high-skill intensive sectors when relative wages were increasing. Esposito and Stehrer (2007) show evidence for three Eastern European countries (Czech Republic, Hungary, and Poland) that in the period 1995-2004 technical change was concentrated in the skill-intensive sectors which provides an explanation of rising relative wages. One should note however, that in all these contributions the relative share of production versus non-production workers has been used as proxies for skills composition.

3.4.2 Descriptive evidence

In this part we again draw on the EU KLEMS database which was introduced already earlier. However, as was discussed above, skill information regarding earnings is available only at a higher level of aggregation and hence we limit ourselves in the following analysis to the industry classification shown in Table 3.2. As one can see there are three groups of industries – characterized as high-skill intensive (H), medium-skill intensive (M), and low-skill intensive (L) – for which information on skill intensities, relative wages, etc. varies. We thus only provide information on these three groups of industries.

Table 3.2

EU KLEMS industries and availability of skill information

Code	Description	Industry type
15t16	Food, beverages and tobacco	L
17t19	Textiles, textile products, leather and footwear	L
20	Wood and products of wood and cork	M
21t22	Pulp, paper, printing and publishing	M
23t25	Chemical, rubber, plastics and fuel	M
26	Other non-metallic mineral	M
27t28	Basic metals and fabricated metal	M
29	Machinery n.e.c.	H
30t33	Electrical and optical equipment	H
34t35	Transport equipment	H
36t37	Manufacturing n.e.c., recycling	L

Tables 3.3 to I.3.5 present information on the relative wage bill, skill intensity and relative wage rates for these three groups of industries and for the years 1995 and 2004. In these tables we present this information by taking either the high-skilled as one group and compare them to the medium- and low-skilled together or by taking the high- and medium-skilled as one group and compare this group to the low-skilled workers. Table 3.3 presents the wage bill shares of high and high and medium educated workers in the three sectoral aggregates. The general picture is that these wage bill shares are increasing in most cases. Notable exceptions are the shares for high-skilled in the low-skill intensive sectors in the Slovak Republic and Slovenia. For the sector bias hypothesis one should observe that these changes are larger in the skill intensive sectors. To check this we have drawn the difference in percentage points for all countries providing the relevant information in Figure 3.5.[8]

Table 3.3

Wage bill shares

	Low-skill intensive sectors				Medium-skill intensive sectors				High-skill intensive sectors			
	Share of high-skilled		Share of medium and high-skilled		Share of high-skilled		Share of medium and high-skilled		Share of high-skilled		Share of medium and high-skilled	
	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004
Austria	2.4	6.8	71.7	77.0	7.6	11.3	80.3	83.3	7.6	13.2	84.6	86.8
Belgium	10.5	12.5	51.6	64.8	18.8	20.6	61.0	73.9	17.6	18.2	60.2	73.0
Denmark	3.4	4.8	58.6	65.3	5.7	9.2	68.8	74.6	4.8	6.7	73.4	78.5
Finland	22.3	25.7	63.3	73.9	28.3	34.0	68.0	79.3	34.6	46.8	79.8	87.2
France	8.5	6.9	71.1	75.2	14.0	17.9	74.4	79.8	15.4	17.9	79.0	82.3
Germany	6.7	8.7	74.7	76.5	10.7	13.6	76.1	79.4	16.2	20.7	81.5	84.8
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	3.0	3.4	99.2	99.7	3.0	3.4	99.2	99.7	3.0	3.4	99.2	99.7
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	5.4	7.8	90.0	91.6	5.4	7.8	90.0	91.6	5.4	7.8	90.0	91.6
Sweden	5.0	8.5	61.3	73.7	8.2	14.2	67.8	79.1	14.2	23.4	78.9	87.3
United Kingdom	11.0	18.9	76.7	85.3	11.9	19.1	81.8	88.4	15.2	20.9	85.7	89.8
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	8.6	14.7	26.7	43.6	15.3	23.1	41.7	56.0	16.7	23.6	48.9	64.7
Czech Republic	8.6	8.8	89.7	91.9	14.2	15.6	91.3	93.0	14.5	16.1	94.3	95.4
Hungary	12.7	14.2	79.4	82.4	25.1	31.3	84.1	88.6	18.9	18.7	87.1	86.6
Poland	7.4	13.3	90.2	93.0	14.4	23.3	90.2	92.7	14.1	22.5	95.0	96.7
Slovakia	8.6	6.4	89.9	93.8	12.0	13.4	92.1	96.4	12.2	13.8	94.7	96.4
Slovenia	13.0	12.8	76.8	77.5	22.4	24.8	80.1	83.6	16.0	15.0	85.3	80.8
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

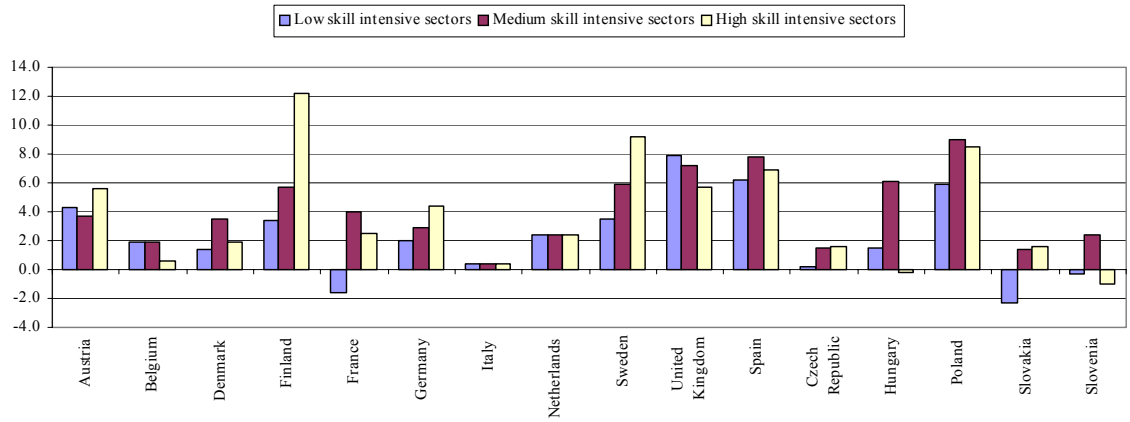
[8] We skipped Italy and the Netherlands as these countries show the same changes in all sectoral aggregates.

This above described pattern is observed in the way that changes are in most cases higher in the medium- and high-skill intensive sectors. A particularly differentiated pattern of changes can be seen in Finland and Sweden. Figure 3.6 presents the same information for the high and medium-skilled workers taken together.

In this case the pattern is less pronounced across sectoral groups and even a reversed pattern emerges for some countries (e.g. Sweden, United Kingdom and most of the Eastern European countries). At the same time the share of hours worked for high and high- and medium-skilled workers has increased as shown in Table 3.4 which is in line with the evidence provided above using shift-share analysis and based on employment data from LFS.

Figure 3.5

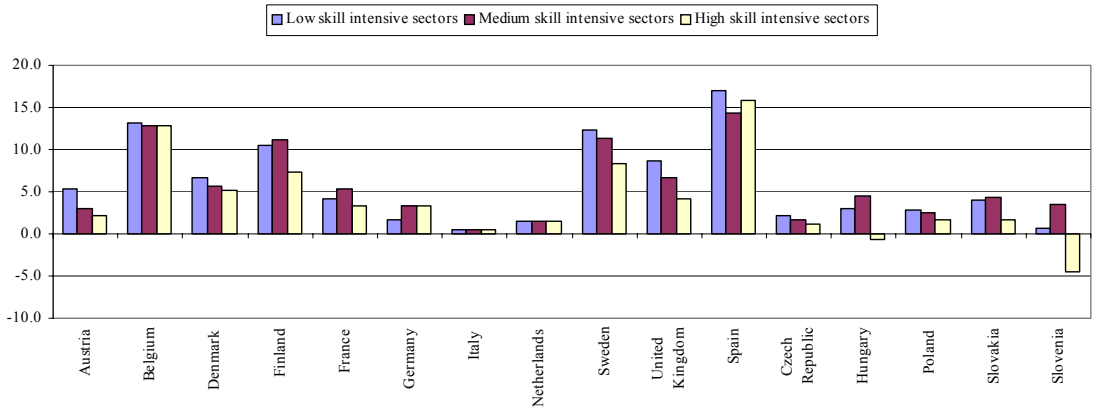
Differences in wage bill shares of high-skilled



Source: EU KLEMS database, March 2007; wiiw calculations.

Figure 3.6

Differences in wage bill shares of high- and medium-skilled



Source: EU KLEMS database, March 2007; wiiw calculations.

Table 3.4

Shares of hours worked by skill types

	Low-skill intensive sectors				Medium-skill intensive sectors				High-skill intensive sectors			
	Share of high-skilled		Share of medium and high-skilled		Share of high-skilled		Share of medium and high-skilled		Share of high-skilled		Share of medium and high-skilled	
	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004
Austria	1.5	4.3	65.4	71.5	4.4	7.3	74.3	77.5	5.4	9.2	78.9	81.6
Belgium	5.1	6.4	45.2	57.9	10.8	12.6	54.2	68.2	10.7	11.4	54.2	67.9
Denmark	1.9	2.8	50.8	58.3	3.4	5.8	60.3	66.7	3.0	4.4	66.0	72.1
Finland	15.8	18.1	60.9	70.6	22.3	26.1	65.5	75.7	27.2	34.6	77.3	83.6
France	3.6	3.7	60.2	71.1	6.7	9.9	66.5	75.4	7.8	9.9	73.2	78.0
Germany	3.2	4.1	66.0	68.9	5.7	7.3	67.8	72.5	10.5	12.0	74.0	78.7
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	1.4	1.9	98.6	99.4	3.3	4.1	98.8	99.5	4.4	6.7	99.2	99.7
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	2.5	5.3	84.6	88.5	3.9	6.9	85.0	89.4	5.5	7.6	92.4	94.7
Sweden	2.8	5.8	58.8	71.5	5.0	9.5	64.5	76.3	8.9	15.7	75.4	84.0
United Kingdom	5.3	8.9	68.6	78.1	7.7	12.3	77.1	83.9	9.3	14.0	80.1	85.7
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	4.2	8.1	20.1	33.9	8.9	14.6	33.7	47.0	10.2	16.2	43.2	59.0
Czech Republic	3.3	3.8	84.3	88.4	6.7	7.6	86.6	89.6	6.8	7.7	90.6	92.9
Hungary	4.2	5.1	72.6	75.9	11.4	14.6	75.4	80.7	8.6	8.1	81.2	80.8
Poland	4.4	7.6	86.9	90.3	9.3	15.1	87.5	90.1	8.6	13.9	93.1	95.1
Slovakia	4.3	3.3	86.3	91.7	6.9	8.1	89.3	95.0	6.6	7.7	92.4	94.5
Slovenia	5.1	8.2	69.9	72.2	9.8	11.2	70.3	75.5	8.1	10.8	76.7	79.1
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: EU KLEMS database, March 2007; wiiw calculations.

Table 3.5 then shows the relative wages of the two groupings in 1995 and 2004. Generally, the relative wages were decreasing in most countries which is surprising. There could be a number of reasons accounting for these trends which have to be investigated in more detail in future research: First, due to deindustrialization in employment terms (i.e. a general fall in the absolute number of (male) high- and medium-skilled workers employed in manufacturing) there might be no actual skill shortage arising of the high- and medium-skilled workers (which could be specific to the manufacturing sector). Second, educational systems may work efficiently enough in the direction of not allowing for a skill gap. Third, there might be a change in the gender mix leading to a relative fall in the wage rates of those workers whose gender mix is changing most if female wage rates are relatively low. Finally, there might be wage policies in some of the European countries which hinder wage differentials to rise or are even aimed at reducing the wage differentials.

The sectoral pattern of these movements can better be seen when looking at Figures 3.7 and I.3.8 where we plot the ratio of the relative wages of 2004 to 1995 (and subtracted 1). Figure 3.7 presents the changes in relative wages of high-skilled workers. As mentioned above, these were decreasing in most countries. Exceptions are Finland, Germany, Poland and the United Kingdom in the low- and medium-skill intensive sectors. Another prominent pattern is that relative wages of skilled workers have increased more pronouncedly or decreased less pronouncedly in the higher- and partly medium-skill intensive sectors in a number of countries like Austria, Finland, Germany, Netherlands, Sweden, Czech Republic and Hungary. A reversed pattern is evident for Italy, the United Kingdom and Spain. This pattern is less pronounced when looking at the relative wages for high- and medium-skilled workers taken together (Figure 3.8). Here also the relative changes seem to be less strong in general.

Table 3.5

Relative wages

	Low-skill intensive sectors				Medium-skill intensive sectors				High-skill intensive sectors			
	Relative wage of high-skilled		Relative wage of high- and medium-skilled		Relative wage of high-skilled		Relative wage of high- and medium-skilled		Relative wage of high-skilled		Relative wage of high- and medium-skilled	
	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004
Austria	1.69	1.62	1.34	1.34	1.77	1.62	1.41	1.45	1.44	1.51	1.46	1.48
Belgium	2.19	2.10	1.29	1.33	1.91	1.80	1.32	1.32	1.79	1.73	1.28	1.27
Denmark	1.87	1.73	1.37	1.35	1.70	1.66	1.45	1.46	1.64	1.58	1.42	1.41
Finland	1.53	1.56	1.11	1.18	1.37	1.46	1.12	1.23	1.42	1.66	1.16	1.34
France	2.51	1.92	1.62	1.23	2.25	1.99	1.46	1.29	2.17	1.99	1.38	1.31
Germany	2.21	2.26	1.52	1.47	1.98	2.00	1.51	1.46	1.65	1.92	1.54	1.52
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	2.23	1.87	1.72	2.05	n.a.*	n.a.*	1.46	1.82	n.a.*	n.a.*	1.00	1.23
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	2.21	1.51	1.64	1.41	1.42	1.15	1.59	1.29	n.a.*	n.a.*	n.a.*	n.a.*
Sweden	1.85	1.52	1.11	1.12	1.69	1.56	1.16	1.18	1.69	1.64	1.22	1.31
United Kingdom	2.23	2.37	1.51	1.63	1.61	1.68	1.34	1.47	1.75	1.63	1.48	1.47
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	2.11	1.96	1.45	1.51	1.86	1.76	1.41	1.44	1.77	1.60	1.26	1.27
Czech Republic	2.76	2.46	1.63	1.49	2.29	2.26	1.62	1.53	2.33	2.29	1.72	1.59
Hungary	3.35	3.12	1.46	1.48	2.62	2.65	1.72	1.85	2.49	2.62	1.56	1.53
Poland	1.75	1.87	1.38	1.44	1.63	1.71	1.31	1.38	1.74	1.80	1.40	1.48
Slovakia	2.08	1.99	1.41	1.37	1.85	1.75	1.40	1.40	1.96	1.92	1.48	1.56
Slovenia	2.79	1.64	1.43	1.33	2.66	2.60	1.71	1.66	2.16	1.45	1.76	1.11
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

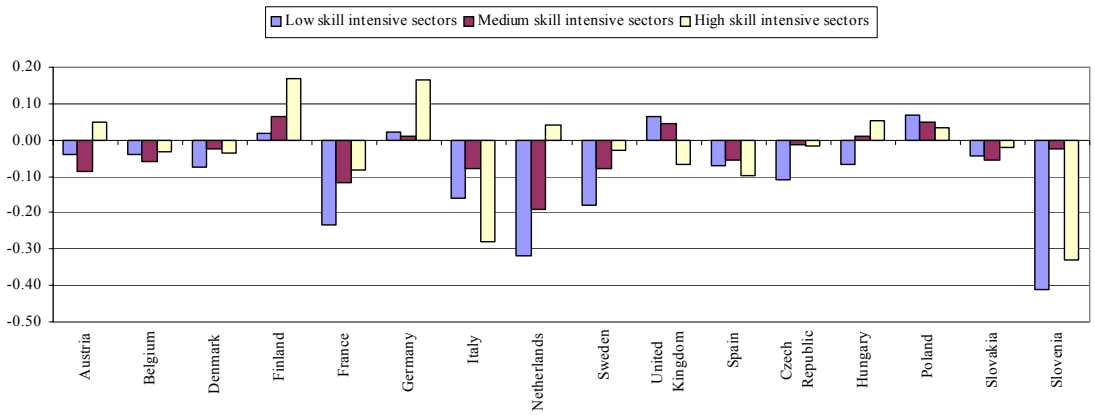
Note: Relative wage of high-skilled is hourly wage of high-skilled divided by hourly wage of medium- and low-skilled. Relative wage of high- and medium-skilled is hourly wage of high- and medium-skilled divided by hourly wage of low-skilled. '*' indicates that data are skipped due to unreliable numbers.

Source: EU KLEMS database, March 2007; wiiw calculations.

Summarizing, there is evidence of higher demand for skilled workers over time as evident from the shifts in hours worked. The shift in wage bill shares indicate further that there might be a pattern of skill biased technical change as wage rate movements seem not to be strong enough to explain the shifts towards more high- and medium-skilled workers. However, this last statement depends on the elasticity of substitution between skilled and unskilled workers.[9]

Figure 3.7

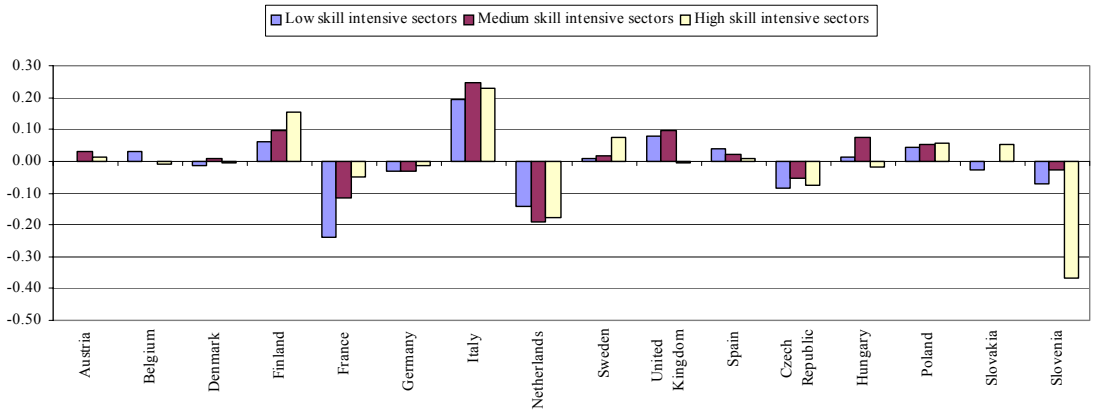
Change in relative wages of high-skilled



Source: EU KLEMS database, March 2007; wiiw calculations.

Figure 3.8

Change in relative wages of high- and medium-skilled



Source: EU KLEMS database, March 2007; wiiw calculations.

3.4.3 Econometric evidence

The rather aggregate information on skill types hinders us to apply the first method proposed in Haskel and Slaughter (2002). However, in their paper other specifications

[9] Regressing the change in the wage bill shares on change in log relative wages including country and industry dummies show significant positive results confirming this statement.

have also been tested for robustness of the results. From these we apply the direct specification of estimating a relationship between the change in the relative wage bill and a skill intensity measure in the initial year, i.e.

$$\Delta\omega_j = \alpha + \beta_{BIAS}\frac{S_j}{U_j} + u_j$$

where $\Delta\omega_j$ denotes the change in the wage bill share, S_j and U_j denote the number of skilled and unskilled labour input (measured in hours worked); the subscript j refers to the industry aggregate, i.e. j=H,M,L. We have tested this specification for the two types of aggregates of skills and also included different sets of dummies for countries and industries (we applied LSDV estimation). A positive parameter β_{BIAS} indicates that technical change is concentrated in the skill intensive sectors. Results of these estimations are provided in Table 3.6.

Table 3.6

Regression results

	High-skilled	High- and medium-skilled	High-skilled	High- and medium-skilled	High-skilled	High- and medium-skilled
Bias parameter	0.32 ***	-0.23 ***	0.49 ***	-0.18 ***	0.77 ***	-0.15 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country dummies	No	No	Yes	Yes	Yes	Yes
Industry dummies	No	No	No	No	Yes	Yes
F-value	17.89	174.23	70.37	193.69	31.39	90.72
R squared	0.24	0.65	0.85	0.95	0.87	0.95
Observations	48	48	48	48		

Note: p-values of robust estimation in brackets.

The results indicate that technical change was biased towards the high-skill intensive sectors which – together with the skill biased nature of technical change – leads to an increasing demand for skilled workers. However, the regressions using the high-skill and medium-skilled workers together show significantly negative signs. However the parameter values are low in absolute terms when compared to the first specification. Further one should note that even in this case the demand for skills can be rising if the skill-biased nature of technical change is strong enough (see Stehrer, 2005, for a detailed explanation).

The evidence provided in section 3.2 concerning supply-side developments indicates that changes in the supply of medium-skilled in the economy as a whole (in share terms) is outstripping the changes on the demand side within manufacturing; this could be one of the explanations for the different results obtained for the joint group of medium- plus high-skilled as compared to the results obtained for high-skilled alone.

3.4.4 Summary

In this section we applied a method proposed by Haskel and Slaughter (2002) to test for the sector bias of technical change. The econometric estimations confirm that sector bias was indeed significant as regards the high-skilled segment of the labour force. An astonishing feature of our analysis was the falling skill premia over the estimation period in many of the countries which – at a first glance – could be compatible with the labour supply vs. employment structural shifts discussed at the end of the previous section 3.1. On the other hand, many other compositional changes took place over this period (such as gender composition, age cohorts, part-time/full time). A proper analysis of developments of skill premia would require a more detailed micro-economic study of this phenomenon.

References

Acemoglu, D. (2002), 'Technical change, inequality and the labour market', *Journal of Economic Literature*, Vol. XL, No. 1, pp. 7-72.

Berman, E., J. Bound and S. Machin (1998), 'Implications of skill-biased technological change: international evidence', *Quarterly Journal of Economics*, Vol. 113, No. 4, pp. 1245-1279.

Esposito, P. and R. Stehrer (2007), 'The sector bias of skill-biased technical change and the rising skill premium in transition economies', *wiiw Working Papers*, No. 43, The Vienna Institute for International Economic Studies (wiiw), Vienna, May.

Haskel, J. E. and M. J. Slaughter (2002), 'Does the sector bias of skill biased technical change explain changing skill premia?', *European Economic Review*, Vol. 46, pp. 1757-1873.

Krugman, P. (2000), 'Technology, trade, and factor prices', *Journal of International Economics*, Vol. 50, pp. 51-71.

Landesmann, M. and H. Vidovic (2006), 'Employment Developments in Central and Eastern Europe: Trends and Explanations', *wiiw Research Reports*, No. 332, The Vienna Institute for International Economic Studies (wiiw), Vienna.

Stehrer, R. (2005), 'The effects of sector and factor biased technological change revisited', *wiiw Working Papers*, No. 35, The Vienna Institute for International Economic Studies (wiiw), Vienna.

Xu, B. (2001), 'Factor bias, sector bias, and the effects of technical progress on relative factor prices', *Journal of International Economics*, Vol. 54, pp. 5-25.

Annex

Table 3.A.1

Between (B) and within (W) components of skill upgrading by type of sectors and country – shares of highly skilled

country	secgroup	B	W
AT	Low_sectors	-0.41	0.9
AT	Medium_sectors	0	0.33
AT	High_sectors	0.59	0.68
BE	Low_sectors	-0.12	0.6
BE	Medium_sectors	0.47	2.68
BE	High_sectors	-0.59	1.33
CY	Low_sectors	-0.62	0.74
CY	Medium_sectors	0.71	2.19
CY	High_sectors	1.13	0.47
CZ	Low_sectors	-0.12	0.09
CZ	Medium_sectors	0.07	0.37
CZ	High_sectors	0.31	0.49
DE	Low_sectors	-0.41	0.18
DE	Medium_sectors	0.05	0.25
DE	High_sectors	0.61	0.86
DK	Low_sectors	-0.31	1.13
DK	Medium_sectors	-0.22	3.2
DK	High_sectors	1.23	4.16
EE	Low_sectors	-0.76	0.98
EE	Medium_sectors	0.24	-0.75
EE	High_sectors	1.05	-0.29
EL	Low_sectors	-0.32	0.66
EL	Medium_sectors	0.3	1.12
EL	High_sectors	0.43	0.62
ES	Low_sectors	-0.26	0.84
ES	Medium_sectors	0.38	1.59
ES	High_sectors	0.09	2.57
FI	Low_sectors	-0.12	0.32
FI	Medium_sectors	0.18	-0.28
FI	High_sectors	-0.07	2.66
FR	Low_sectors	-0.3	0.39
FR	Medium_sectors	0.28	0.7
FR	High_sectors	0.13	2.2
HU	Low_sectors	-0.19	0.22
HU	Medium_sectors	0.22	-0.28
HU	High_sectors	0.36	1.05
IE	Low_sectors	-0.36	0.98
IE	Medium_sectors	0.03	1.72
IE	High_sectors	0.89	6.27
IT	Low_sectors	-0.07	0.24
IT	Medium_sectors	0.02	0.24
IT	High_sectors	0.21	0.59
LT	Low_sectors	0.27	0.3
LT	Medium_sectors	1.3	-2.22
LT	High_sectors	-2.07	-2.04

Table 3.A.1 (continued)

Table 3.A.1 (continued)

country	secgroup	B	W
LU	Low_sectors	0.12	0.07
LU	Medium_sectors	-0.13	3.88
LU	High_sectors	-0.01	2.25
LV	Low_sectors	2.6	2.39
LV	Medium_sectors	-5.35	0.75
LV	High_sectors	2.91	-1.58
NL	Low_sectors	0.63	2.1
NL	Medium_sectors	-0.13	1.21
NL	High_sectors	-1.25	3.08
PT	Low_sectors	-0.04	0.09
PT	Medium_sectors	0.08	0.38
PT	High_sectors	0.1	1.16
SE	Low_sectors	0	0.02
SE	Medium_sectors	0.16	0.7
SE	High_sectors	-0.49	1.37
SI	Low_sectors	-0.42	0.61
SI	Medium_sectors	0.12	0.6
SI	High_sectors	0.79	1.1
SK	Low_sectors	-0.15	0.43
SK	Medium_sectors	-0.25	0.74
SK	High_sectors	0.8	0.95
UK	Low_sectors	-0.15	0.45
UK	Medium_sectors	0.07	1.67
UK	High_sectors	0.29	2.66

Note: Decomposition of sectors into low-, medium-, and high-skill sectors as in Box 3.1

Table 3.A.2

Between (B) and within (W) components of skill upgrading by type of sectors and country – shares of low-skilled

country	sectorgroups	B	W
AT	Low_sectors	-0.86	-1.88
AT	Medium_sectors	0.01	-0.77
AT	High_sectors	0.51	-1.40
BE	Low_sectors	-0.43	-1.39
BE	Medium_sectors	1.08	-4.57
BE	High_sectors	-0.46	-3.14
CY	Low_sectors	-5.69	-1.15
CY	Medium_sectors	2.26	-1.81
CY	High_sectors	1.32	-1.48
CZ	Low_sectors	-0.55	-0.90
CZ	Medium_sectors	0.15	-1.62
CZ	High_sectors	0.24	-1.26
DE	Low_sectors	-0.68	-0.82
DE	Medium_sectors	0.09	-2.11
DE	High_sectors	0.43	-3.19
DK	Low_sectors	-0.84	-1.24
DK	Medium_sectors	-0.60	-4.28
DK	High_sectors	0.85	-0.64

Table 3.A.2 (continued)

Table 3.A.2 (continued)

country	sectorgroups	B	W
EE	Low_sectors	-0.72	-0.23
EE	Medium_sectors	0.15	-0.96
EE	High_sectors	0.26	0.58
EL	Low_sectors	-2.93	-2.63
EL	Medium_sectors	1.40	-3.35
EL	High_sectors	0.56	-0.65
ES	Low_sectors	-1.71	-2.50
ES	Medium_sectors	1.29	-3.48
ES	High_sectors	0.11	-3.55
FI	Low_sectors	-0.19	-1.35
FI	Medium_sectors	0.22	-2.31
FI	High_sectors	-0.04	-3.04
FR	Low_sectors	-1.15	-1.12
FR	Medium_sectors	0.81	-2.36
FR	High_sectors	0.12	-1.36
HU	Low_sectors	-1.35	-0.32
HU	Medium_sectors	0.66	-0.23
HU	High_sectors	0.45	1.16
IE	Low_sectors	-1.35	-1.42
IE	Medium_sectors	0.08	-2.07
IE	High_sectors	0.67	-2.87
IT	Low_sectors	-2.03	-1.99
IT	Medium_sectors	0.35	-2.97
IT	High_sectors	1.05	-3.85
LT	Low_sectors	0.24	1.09
LT	Medium_sectors	0.53	-0.64
LT	High_sectors	-0.66	0.20
LU	Low_sectors	0.36	0.80
LU	Medium_sectors	-0.40	-9.37
LU	High_sectors	-0.01	-1.14
LV	Low_sectors	4.97	-2.73
LV	Medium_sectors	-5.79	2.45
LV	High_sectors	1.04	-0.40
NL	Low_sectors	2.98	-3.82
NL	Medium_sectors	-0.43	-2.18
NL	High_sectors	-1.34	-0.97
PT	Low_sectors	-2.65	-1.10
PT	Medium_sectors	1.76	-0.57
PT	High_sectors	0.56	-1.58
SE	Low_sectors	0.02	-1.11
SE	Medium_sectors	0.66	-3.49
SE	High_sectors	-0.45	-3.03
SI	Low_sectors	-1.91	-2.08
SI	Medium_sectors	0.28	-2.25
SI	High_sectors	1.23	-0.20
SK	Low_sectors	-0.41	-0.98
SK	Medium_sectors	-0.31	-1.77
SK	High_sectors	0.49	-0.10
UK	Low_sectors	-0.40	-2.30
UK	Medium_sectors	0.10	-4.74
UK	High_sectors	0.15	-4.59

Note: Decomposition of sectors into low-, medium- and high-skill sectors as in Box 3.1.

4 Industry-specific returns to schooling and training – a survey

4.1 Returns to education

Starting with Becker (1964) and Schultz (1961) education has explicitly been interpreted as an investment in the expanding stock of skills of an economy. From that time on a growing literature both in the field of macro- and microeconomics has dealt with figuring out the growth-enhancing effects of education in the form of schooling and training. The two main approaches in the field of macro-studies of the impact of education are the augmented Solow neo-classical approach, which focuses on growth accounting methods, whereas the approach based on new growth theories, relies on macro growth regressions. While the former predicate that enhanced education affects the long-run level of output the latter point out that the long-run growth rate of an economy is raised as well. Both approaches point out that educational investments create not only higher wages but also externalities, which are not captured by the individual, but spill over to other employees and the society as a whole. Sianesi and van Reenen (2002) provide a comprehensive overview of the empirical macro-economic literature dealing with the issue of wider benefits of education. In the following survey we concentrate on the microeconomic literature concerning studies on the returns to schooling and training. In the last section we discuss reasons for the paucity of results obtained on either private returns or social returns to education or training at an industry or sector level.

4.2 Private returns to education

Most of the empirical work done on the relationship between human capital and labour market outcomes has focused on the consequences of education acquired through schooling, as it is the component that is easiest to measure. From that literature it is a well-established result that higher levels of schooling lead not only to higher wages but also to lower incidents of unemployment as well as higher labour force participation rates.

Many authors analysing returns to schooling draw on a wage regression model initially introduced by Mincer (1974). In his specification the log of wages is estimated by years of schooling, labour market experience and a quadratic in terms of experience as well as a set of other individual characteristics. The parameter associated with years of schooling then delivers the private return to schooling. Strictly speaking these returns are referred to as Mincerian or gross returns to schooling, since pure private returns to schooling are only reflected when no private costs (except the foregone earnings) occur.

Private returns in the US as well as in Canada range between 6%-10% per year of schooling at the end of the 1990s and onwards, whereas in Europe returns seem to be around 6.5% on average (see Card, 1999 and Harmon et al., 2002). However, the differences within Europe are quite remarkably. Harmon et al. (2000) find that the gross returns are with about 4% the lowest in Scandinavian countries, except in Finland,

whereas in Ireland and the UK they reach about 12%. Similar results are found among others by Trostel et al. (2002). Most of the literature points out that significant changes in the returns to education occurred over time, and these changes evolved quite similarly across OECD countries. In the US as well as Europe Mincerian returns to schooling decreased during the 1970s most probably because the rising supply of better-educated school leavers was not matched by growing demand for higher qualifications. While in the US a recovery could be observed already at the beginning of the 1980's, in Europe the trend lasted till the end of the decade until educational returns rose again. (de la Fuente and Ciccone (2002)

More recently several authors have analysed the diversity of returns to schooling when moving to the level of regions in European countries. For instance Ciccone et al. (2006a) focus on Italy, de la Fuente et al. (2003) on Spain. Furthermore the availability of ECHP data made it possible to perform studies on Western European countries from a comparative perspective, which was done by de la Fuente and Jimeno (2005) and Brunello et al. (2004).

A main problem when estimating the effect of schooling on wages is that not all characteristics of the individuals, which could influence wage outcomes, can easily be observed, like family background or ability. Therefore estimates done with OLS methods may be over- or understated.

This problem can be tackled either by using data on twins or siblings (literally), which should have relatively similar characteristics compared to randomly chosen individuals. A second approach is the use of an instrumental variable in the estimation, which is correlated with years of schooling only. For an overview of technical specifications of Minerian wage regressions see de la Fuente and Ciccone (2002). Ashenfelter et al. (1999) analysed whether there are considerable differences in results between Mincerian returns to schooling when estimated with least-squares techniques compared to estimates which rely on twins or an IV approach. Examining the results of more than 20 studies for the US and several European countries, they find that IV and twin estimates exceed least-squares estimates by only 1.8 and 0.8 percentage points.

Also Blundell et al. (2005) highlight the importance of model specification for the estimation of the effect of education on earnings. In addition to reviewing the outcomes of OLS estimations, propensity score matching models and IV methods, they undertake additional estimations with the use of control function methods. In this approach the earnings regression is augmented with an additional equation determining educational choice. This allows for the possibility that individuals, who have higher average unobserved ability or higher unobserved idiosyncratic returns from schooling, are more likely to opt for more schooling. This kind of selection bias is taken into consideration in the control function

method. The alternative methods and models are applied to the National Child Development Survey 1958 birth cohort study for GB.

4.3 Returns to on-the-job training

As was presented above there is an extensive literature on private return to schooling, whereas much less information is available up to now on returns from training. Since substantial investment into human capital takes place only after an individual's entry into the labour market, training should be of importance in influencing the wages of employees.

Since the beginning of the 1990s there has been growing interest in the study of this relationship in the US. Among others Parent (1999) finds a return to one full-time year of training between 12% and 18% depending on whether partial fixed effects or OLS methods were used in the estimation. Veum (1995) finds an increase of wages for one hour of company training of 0.7% to 0.9%. For Canada Parent (2003) reports that participation in training raises male hourly wages by more than 10%.

Similar work has been done on the returns to training in Europe, particularly in the UK. One of the most comprehensive studies was done by Blundell et al. (1999), employing OLS, fixed effect and instrumental variable estimates. The resulting wage returns to training in the UK range, depending on the method used, between 5% and 8.5% for men and is somewhat higher on average for women.

Pischke (2001) draws on the German Socio Economic Panel and finds that one year of full-time work-related training increases wages by 2.6 to 3.8%. Another study done by Kuckulenz and Zwick (2003) make use of the German Qualification and Carrer survey of 1999 and estimate an average increase of 15% in wages due to work-related training. Similar results are reported by Leuven and Oosterbeek (2002) for the Netherlands, somewhat lower are the estimates for returns in Switzerland (Gerfin, 2003) and especially in Norway as found by Schone (2002), where training participation leads only to a 1% wage increase. For a comprehensive overview on studies performed in the field of returns to training in the US, Canada and Europe see Bassanini et al. (2005).

Bassanini et al. (2005) themselves draw on the recently available ECHP database covering the years 1995-2001, which enables them to undertake a cross-country comparison of private returns to training covering 12 EU countries. OLS estimates of the impact of training incidence on log hourly earnings range between 3.7% and 21.6%. When they turn to a fixed effects model, however, estimated returns are considerably lower and often not statistically different from zero, except for Denmark, Belgium, Italy, Greece, Portugal, the UK and Finland. The increases in log hourly earnings for those countries ranges between 2% for Denmark to 10% for Portugal. Moreover returns to private sector training are high compared to those assigned to schooling as found in Harmon et al.

(2002). However, when Bassanini et al. (2005) apply IV estimates on the ECHP data they find almost non-significant wage returns, as was reported by Leuven and Oosterbeek (2004). Therefore the discussion is going on whether part of high returns to training found in previous studies may be due to a lack of control for spurious correlation of training with confounding factors that affect wages. Different sorts of unobserved abilities of a person may influence the return to training, for example social or analytical skills, which are complementary to the application of acquired knowledge.

4.4 Social returns to education and training

Apart from the widespread microeconomic literature on private returns to education greater attention was only recently paid to the analysis of social returns of education and training. In the literature several arguments can be found why private returns to education do not capture the full benefits accruing from investments into the human capital of an individual. Static human capital externalities exist when the productivity of other factors of production especially that of labour inputs of other workers raise the level of average human capital. This could happen through the diffusion of knowledge among workers independent of the skills of the individual employee as stated in Lucas (1988). These static externalities could be caused by interaction taking place at the workplace but also outside firms. Dynamic human capital externalities evolve because at higher levels of human capital the creation and adoption of new technologies is more likely and learning processes are stimulated; within groups with the same level of prior human capital the transmission of existing and the joint acquisition of new knowledge takes place more easily, an argument pointing to the importance of the composition of human capital (Venniker, 2000).

Moreover education can generate also non-pecuniary benefits, which appear both as private and as social returns. Individuals investing in their education experience not only higher wages but also rewards in the form of improved health or other aspects of individual well-being. A growing amount of literature is dealing with questions to capture the non-monetary social returns stemming from higher levels of education, e.g. Lochner and Moretti (2004) find that in the US social savings from crime reduction associated with high school graduation come up to about 14-26% of the private return of men in this group of educational attainment. Literature on the effects of parents' education on children is surveyed by Greenwood (1997) as well as Maynard and McGrath 1997). The so called intergenerational effects having benefits for the society consist among others of lower educational costs as well as lower dependence on welfare transfers. Wolfe and Haveman (2001) investigate in their survey the causal effects of education on health. The result is that education not only influences the health outcome of the individual positively but furthermore that of their children.

A further social benefit of higher educational attainment acquired by individuals is the subsequent relief of public budgets. This arises from lower transfers as well as higher tax

receipts as investigated by Collins and Davies (2001) as well as Davies (2002) for Canada and the US. Taking into account the different types of non-market external benefits, dynamic externalities, static knowledge spillovers as well as social benefits associated with taxation, Ridell (2004) argues that a conservative estimate of total social returns to schooling should come up to 7-10 percentage points. Davies (2002) points to the fact that estimates of the scale of static market externalities vary strongly and some studies find even no evidence for that. He therefore estimates that total education externalities could amount to 6-8 percentage points. Nevertheless one can conclude that social returns may be of almost the same order of magnitude as the private returns to education accrued in the form of higher earnings by the individual.

In fact, social returns to education, which exceed private returns by a substantial amount, should be a rationale for government intervention into the provision of schooling as well as training. If not only the educated individual but society at large benefits from educational investments state subsidization of schooling and training of its citizens is to be fostered. Since social returns to education are not taken into account by the individual making the decision of how much to invest in the individual human capital stock via schooling or training, this could lead to investments in education being below the socially optimum level.

In the following we shall focus on studies that estimate monetary social returns to education and training.

Contrary to the results on private returns to education, where all studies found positive returns although of different sizes, the empirical evidence on the existence of positive education externalities is more disputed. One of the first empirical studies on human capital spillovers in the form of neighbourhood effects on earnings at the regional level was done by Rauch (1993) on US cities. Evidence was found that higher average education levels in the cities examined are correlated with higher individual wages of workers, controlling for educational attainment levels. An additional year of average education in metropolitan areas leads to a 3.1% rise of individual's earnings. Glaeser et al. (1995) found that for US cities higher initial human capital endowment in the post-war period was the main factor for experienced higher economic growth rates in the period 1960-1990.

A drawback of these early studies is the lack of control for unobserved characteristics, which could lead to the differences in per capita income detected apart from human capital externalities. For instance Rudd (1996, 2000) finds that when introducing state fixed effects almost all of the observed positive correlation between state average education and individual earnings vanish. Furthermore when altering the specification of the functional form so that own education is related to earnings in the individual-level wage regressions the correlation erodes and is economically and statistically insignificant.

The identification problem, which stems from correlation of individual and average education levels with wages, is addresses in more detail in Acemoglu and Angrist (1999). In addition to the OLS estimation, they use instrumental variables, whereby the instruments for average schooling are compulsory attendance laws and child labour laws in the states of birth; the instruments for individual schooling are district of birth. When changing from OLS to IV estimation methods in the study, social returns to education fall from 7%, which are equal to private returns to education to below 1%. For this reason they cannot detect empirical evidence for significant positive human capital externalities. One objection being raised among others by Davies (2002) is that the sample used in the study comprises only US males aged 40-49. While for these middle-aged employees externalities may not be important they might be for other groups, for example minority youth.

In a more recent study Moretti (2002) investigates spillovers from college education by comparing wages for otherwise similar individuals who work in cities with different shares of college graduates in the labour force. With the use of longitudinal data he can observe the same individual over time, thereby controlling for unobserved individual characteristics that may be correlated with wages and shares of college graduates across cities. In addition he accounts for further unobserved city specific demand shocks through the use of instrumental variables. He finds that a percentage point increase in the supply of college graduates in cities raises the wages of lower educated high school drop-outs by 1.9% and even those of college graduates by 0.4%.

A number of European studies have recently been undertaken on human capital externalities at the regional, firm and industry level.

Dalmazzo and de Blasio (2003) apply the Mincerian approach to quantify social returns to education in Italian local labour markets. They point out that differences in outcomes concerning the existence and magnitude of social returns in previous studies may depend on the definition of territorial unit adopted. In studies on US data two types of territorial units were used. In Acemoglu and Angrist (1999) as well as Rudd (2000) US states were applied. These units may not capture what Lucas (1988) had in mind when describing his concept of local labour markets in which positive human capital externalities evolve from the interaction of workers. In contrast Rauch (1993), Moretti (1999, 2002) and Ciccone and Peri (2002) used data on Metropolitan areas to figure out social returns to education.

Dalmazzo and de Blasio (2003) adopt the OECD definition of local labour market, which is demarcated on the basis of daily flows of commuters. Their results show that the average human capital in local labour markets in Italy is positively correlated with wages. The observed social returns to education range from 2% to 3%. The results are robust to an instrumental variable approach designed to deal with the bias that may arise from the correlation between average schooling and omitted characteristics of the local labour

markets. The restriction of the sample to manufacturing workers allows Dalmazzo and de Blasio (2003) to control for potential sources of spurious correlation stemming from local characteristics like intensity of industrial activity or endowment of public infrastructures. They find that social returns in manufacturing range from 3.1% to 4.6%, about 50% higher than those based on the full sample. For the full sample as well as for the manufacturing sample social returns accrue to a larger extent to workers with lower levels of educational attainment. Moreover they find that social returns to education are higher in those local labour markets which have a lower than average educational endowment. Those areas can be predominantly found in the lagged southern regions of Italy. (This result is interpreted as an argument supporting additional expenses on schooling in the southern regions of the country.)

Martins (2004) focus on firm-level social returns to education. He draws on a matched panel of Portuguese firms covering 5000 firms over the years 1991-1999. The empirical results are based on the estimation of Mincer firm-level wage equations. The problem of schooling endogeneity is tackled by considering firm fixed effects and instruments based on schooling lags and the lagged share of retirement–age workers. Evidence of large firm-level social returns ranging between 14% and 23%, which is 2% to 3% per extra year of education is found. Those significant returns accrue to a large extent to less educated workers compared to their better-educated colleagues.

Kirby and Riley (2007) analyse social returns to schooling at the industry level drawing on LFS-data of the UK over the period 1994-2004. The use of repeated cross-section data prevents the analysis from being sensitive to shocks like recessions or product demand shocks in a particular industry. Furthermore they control for potential endogeneity of individual and industry schooling choices by using a set of instrumental variables as well as dummies. Their estimates suggest that a one-year increase in the industry average level of schooling is associated with an increase in individual wages of 2.7% to 4%, which is between 40 and 70 percent of the private return to schooling. Social returns are captured by employees with lower educational attainment levels as well as by those with better education. In addition they illustrate that social returns are sensitive to ICT equipment and capital intensity as well as the union density of the industry.

4.5 Industry specific returns to education or ability?

Industry-specific differences are not dealt with in the literature on returns to education explicitly. The main reason for this is that schooling as well as training returns are investigated, controlling for of various other observed characteristics that influence the wage outcomes of individuals. Apart from determinants of earnings disparities such as individual characteristics of employers (e.g. firm size) and employees (skills, gender, age, occupation), labour market institutions, wage bargaining systems and work organization, one important factor influencing outcomes is the industry affiliation of the worker. In most

estimations of wage equations therefore, education and industry act as counterparts in the investigation of what the sources of individual wage determination are, so that industry specific returns to education have not been tested for in the literature explicitly. Thus there is a lack of microeconomic literature taking account of the fact that educational wage returns differ strongly by industry, which can be seen e.g. from the data on Europe presented in the 'Employment in Europe' Report (European Commission, 2005, Ch. 4). The results presented therein on earnings disparities and distributions in the EU are based on the Structure of Earnings Survey (SES). Wage differentiation is strong across industries with wages being higher in high productivity industries and services (see also Employment in Europe, 2003, Chapter 3).

Explanations for the observable inter-industry differentials of wages which can not be attributed to educational endowment of the workforce or other observed characteristics mentioned above have been discussed more intensively from the 1980s onwards when wage dispersion began to rise, see e. by Krueger and Summers (1987) as well as Dickens and Katz (1987). In an early study Krueger and Summers (1988) already called into question the view that industry wage differentials can be rationalized with classical competitive models. They drew in their estimations on cross-sectional and longitudinal data from the US Current Population Survey (CPS) and find permanent wage differences for equally skilled workers. Their main conclusion is that income differentials do not stem from compensation for differentials in working conditions, efficiency-wage reasons, etc. but from non-competitive rents received in high wage industries. However Gibbons and Katz (1992) suggest that a large part of the measured differentials may be due to the differences in unobserved productive abilities of workers. These abilities are not known by workers as well as employers in advance and are unequally valued by different industries. Endogenous mobility decisions determine the workers' wage and industry affiliations, so that workers with higher abilities move to sectors that are able to use these abilities and pay higher wages. In analysing a sample of workers displaced through plant closure they find that pre-displacement industry affiliation plays an important role in post-displacement wages, which supports their matching model. Similar results are found by Farber and Gibbons (1996) underlining the importance of work experience to find the ability matching job. In a more recent paper Gibbons et al. (2005) give a good presentation of the sorting process of skills (education and ability) into high-wage occupations as well as high wage industries. They estimate their elaborate matching model including learning during the professional life using nonlinear instrumental variables techniques.

References

Acemoglu, D. and J. Angrist (1999), 'How large are social returns to education?', *NBER Working Paper*, No. 7444, Cambridge.

Asplund, R. and E. Barth (2005), 'Education and wage inequality in Europe', ETLA, Helsinki.

Bartel, A. P. (2000), 'Measuring the Employer‘s Return on Investments in Training', *Industrial Relations*, Vol. 39, No. 3, pp. 502-524.

Bartel, A. P. and N. Sicherman (1999), 'Technological Changes and Wages: An Interindustry Analysis', *Journal of Political Economy*, Vol. 107, No. 21, pp. 285-325.

Bassanini, A., A. Booth, G. Brunello, M. de Paola and E. Leuven (2005), 'Workplace training in Europe', *IZA Discussion Paper*, No. 1640, Bonn.

Battu, H. et al. (2003), 'Human Capital Spillovers within the Workplace: Evidence for Great Britain', *Oxford Bulletin of Economics and Statistics*, Vol. 65, No. 5.

Becker, G. S (1964), *Human capital*, Columbia University Press.

Blackburn, M. L. and D. Neumark (1992), 'Unobserved Ability, Efficiency Wages, and Interindustry Wage Differentials', *Quarterly Journal of Economics*, Vol. 107, No. 4, pp. 1421-1436.

Blundell, R., L. Dearden and B. Sianesi (2005), 'Evaluating the effect of education on earning: models, methods and results from the National Child Development Survey', *Journal of the Royal Statistical Society*, Vol. 168, No. 3, pp. 473-512.

Blundell, R., L. Dearden, C. Meghir and B. Sianesi (1999), 'Human capital investment: The returns from education and training to the individual, the firm and the economy', *Fiscal Studies*, Vol. 20, No. 1, pp. 1-23.

Brunello, G. and S. Comi (2004), 'Education and earnings growth: evidence from 11 European countries', *Economics of Education Review*, Vol. 23, No. 1, pp. 75-83.

Card, D. (1999), 'The Causal Effect of Education on Earnings', in: O. Ashenfelter and D. Card (eds), *Handbook of Labour Economics*.

Ciccone, A., F. Cingano and P. Cipollone (2006a), 'The private and social return to schooling in Italy', Banca d’Italia, *Temi di discussione*, No. 569.

Ciccone, A. and G. Peri (2006b), 'Identifying Human Capital Externalities: Theory with Applications', *Review of Economic Studies*, Vol. 73, pp. 381-412.

Collins, K. and J. B. Davies (2001), 'Tax treatment of human capital in Canada and the United States: An overview and an examination of the case of university graduates', mimeo, Department of Economics, University of Western Ontario, Canada.

Dalmazzo, A. and G. de Balsio (2003), 'Social Returns to Education: Evidence from Italian Local Labour Market Areas', *IMF Working Paper* 165.

Davies, J. (2002), 'Empirical evidence on human capital externalities', mimeo, Department of Economics, University of Western Ontario, Canada.

de la Fuente, A. and A. Ciccone (2002), 'Human capital in a global and knowledge-based economy', European Commission.

de la Fuente, A., R. Doménech and J. F. Jimeno (2003), 'Human capital as a factor of growth and employment at the regional level. The case of Spain', *UFAE and IAE Working Papers* 610.04, Unitat de Fonaments de l'Anàlisi Econòmica (UAB) and Institut d'Anàlisi Econòmica (CSIC).

de la Fuente, A. and J. F. Jimeno (2005), 'Schooling and the effect of public policies on private incentives to invest in education: A general framework and some results for the EU', *CESIFO Working Paper*, No. 1392.

Dearden, L., H. Reed and J. van Reenen (2005), 'The impact of training on productivity and wages', *CEP Discussion Paper*, No. 674.

Dickens, W. T. and L.F. Katz (1987), 'Inter-Industry Wage Differences and Industry Characteristics', in: K. Lang and J. Leonard (eds), *Unemployment and the Structure of Labour Markets*, Basil Blackwell, Oxford, pp. 48-89.

European Commission (2003), *Employment in Europe 2003. Recent Trends and Prospects*, DG Employment, Social Affairs and Equal Opportunities, Brussels.

European Commission (2005), *Employment in Europe 2005. Recent Trends and Prospects*, DG Employment, Social Affairs and Equal Opportunities, Brussels.

European Commission (2006), *Employment in Europe 2006*, DG Employment, Social Affairs and Equal Opportunities, Brussels.

Farber, H. S. and R. Gibbons (1996), 'Learning and Wage Dynamics', *Quarterly Journal of Economics*, Vol. 111 (November), pp. 1007-1047.

Gibbons, R. L. and L. F. Katz (1992), 'Does Unmeasured Ability Explain Inter-Industry Wage Differences?', *Review of Economic Studies*, Vol. 59 (July), pp. 515-535.

Gibbons, R., L. F. Katz, T. Lemieux and D. Parent (2005), 'Comparative Advantage, Learning and Sectoral Wage Determination', *Journal of Labour Economics*, Vol. 23, No. 4, pp. 681-723.

Glaeser, E. L., J. A. Scheinkman and A. Shleifer (1995), 'Economic growth in a cross-section of cities', *NBER Working Paper*, No. 5013.

Greenwood, D. T. (1997), 'New developments in the intergenerational impacts of education', *International Journal of Education Research*, Vol. 27, No. 6, pp. 503-512.

Harmon, C., H. Oosterbeek and I. Walker (2002), 'The Returns to Education: A Review of Evidence, Issues and Deficiences in the Literature', *Journal of Economic Surveys*.

Kirby, S. and R. Riley (2007), 'The external returns to education: UK evidence using repeated cross-sections', *NIESR Discussion Paper*, No. 291.

Krueger, A. and L. Summers (1987), 'Reflections on Inter-Industry Wage Structures', in: K. Lang and J. Leonard (eds), *Unemployment and the Structure of Labour Markets*, Basil Blackwell, Oxford.

Krueger, A. and L. Summers (1988), 'Efficiency Wages and the Inter-Industry Wage Structure', *Econometrica*, No. 56, pp. 259-294.

Lucas, R. (1998), 'On the mechanics of economic development', *Journal of Monetary Economics*, No. 22, pp. 3-42.

Martins, P. (2004), 'Firm-Level Social Returns to Education', *IZA Working Paper*, No. 1382, Bonn.

Maynard, R. A. and D. J. McGrath (1997), 'Family structure, fertility and child welfare', in: J. Behrman and S. Nevzer (eds), *The social benefits of education*, University of Michigan Press.

Mincer, J. (1974), *Schooling, experience and earnings*, Columbia University Press, New York.

Moretti, Enrico (1999), 'Estimating the External Return to Education', UC Berkley, mimeo.

Moretti, Enrico (2002), 'Estimating the Social Return to Higher Education', *NBER Working Paper*, No. 9108, Cambridge.

Riddell, W. C. (2004), *The Social Benefits of Education*, University of Toronto.

Sianesi, B. and J. van Reenen (2002), 'The Returns to Education: A Review of the Empirical Macro-Economic Literature', *Journal of Economic Surveys*.

Trostel, P., I. Walker and P. Woolley (2002), 'Estimates of the economic return to schooling for 28 countries', *Labour Economics*, Vol. 9, No. 1, pp. 1-16.

Venniker, R. (2000), 'Social returns to eduction: a survey of recent literature on human capital externalities', *CPB Report*, No.1-2000.

Wolfe, B. and R. Haveman (2001), 'Accounting for the social and non-market benefits of education', in: J. Helliwell (ed.), *The contribution of human and social capital to sustained economic growth and well-being*, Vancouver, pp. 221-250.

5 Country-specific discussion of skill shortages

5.1 Introduction

Despite the difficulties of defining skill shortages from an economic perspective, there is a widespread view among policy-makers that such shortages are a major potential obstacle to improving Europe's economic performance and to maintaining and strengthening its competitiveness. This view has been given added weight by, first, the adoption of the Lisbon strategy aimed at making the EU 'the most dynamic, knowledge-based economy in the world' and, secondly, by prevailing demographic trends which mean that the very slow growth of population of working age which has been a feature of the past decade or so will gradually be replaced in the relatively near future by a decline in most Member States. The population which predominantly makes up the work force is, therefore, set to fall in a few years time which before too long, without an increase in net inward migration, is likely to result in a decline in the labour force itself. This could well lead to shortages of labour with particular skills becoming more frequent and reinforces the importance of avoiding labour market imbalances.

Demographic trends and the pursuit of the Lisbon agenda are occurring against a backdrop of continuing technological advance which is leading to the emergence of new products and processes as well as new methods of working which, accordingly, is giving rise to the emergence of both new jobs and new requirements in respect of existing jobs, implying that workers need to acquire the requisite skills and capabilities for undertaking them. This applies not only to the existing work force but also to young people entering the work force in the coming years, which means that there is a need to ensure that the education and training system teaches the skills and competencies which will be required.

There has, therefore, been an increasing focus across the EU on impending skill problems and on putting in place ways to anticipate them, on forecasting future labour market needs and job requirements. These have typically taken two forms. One consists of developing forecasting models for quantifying the effects of trends in the structure of economic activity and of advances in technology on the demand for particular jobs or occupations. The other consists of more qualitative methods for identifying and assessing developments in particular sectors and the implications of these for the demand for labour, or more accurately, for particular skills and competencies. These so-called foresight methods usually involve participants in the industries in question and outside experts on these industries coming together to apply their detailed knowledge to this end.

In a number of countries, therefore, detailed reports have been produced attempting to describe the prospective demand for labour with different types of skill in different industries in 10 or 15 years time, the main aim being to identify and define the policy measures which need to be put in place in order to ensure that labour with the requisite

qualifications is available to meet this demand[10]. These measures relate to vocational education and training systems, in particular, and to the programmes which need to be introduced or extended to produce the qualified workers of different kinds projected to be required on the basis of these forecasts.

The focus of such exercises tends, in particular, to be on the skills required by the anticipated continuation of technological advance and on the spread of ICT especially, which is thought likely to be an essential element in a growing number of jobs, as well as on the prospective development of new industries which are at present in their infancy or still at the research stage. However, while it is undoubtedly the case that a significant proportion of the new jobs, created in the future, in the sense of those which at present do not exist, are likely to be in these kinds of activity, it is also the case that such jobs are unlikely to account for most of the *gross* additional demand for labour which will occur over the coming years. A great many of the jobs which those completing their education and training are likely to take up, therefore, will be those which have been vacated by people retiring, or withdrawing from the labour force for other reasons. Those retiring each year, in other words, make up, on average, some 2-3% each year of the prevailing number in employment across the EU, which is considerably larger than the net additional increase in jobs in most countries. (It far exceeds the growth of employment over the 10 years 1995-2005, which averaged around 1% a year in the EU as a whole.)

These jobs, moreover, are not necessarily in growing sectors or industries. Indeed, a significant proportion will be in declining industries, at least in employment if not in value-added terms, where the decline in the demand for labour lags behind the number of people leaving the industry. This is particularly the case, since, as indicated below, the proportion of the work force which is approaching retirement tends to be larger in declining industries than growing ones for fairly obvious reasons – namely, a much lower rate of creation of new jobs for young people to move into combined, in a number of sectors, with the skills of the existing work force being in low demand elsewhere in the economy which makes it difficult for them to leave the industry.

The industries concerned, though unlikely to expand much if at all in terms of the numbers employed in future years in most parts of the EU, nevertheless, include many which are vital to both the present and future prosperity of the EU economy as well as to particular regions within it. (This can be illustrated simply by taking the example of manufacturing in Germany, where its share of total employment declined by around 3 percentage points between 1995 and 2004 but its share of value-added went up marginally.) Prospective skill

[10] Examples of such exercises include in Ireland, Tomorrow's skills: Towards a National Skills Strategy, in Finland, the Labour Force 2020 project and in the UK, the Leitch Review – Skills in the UK: the long term challenge, all three of which focus on skill needs in 2020.

shortages in these industries are, therefore, no less important than in the growing sectors of the economy.

Accordingly, it is important for attempts to project the demand for labour skills to span the economy as a whole and not be confined to particular activities, not least because such skills may potentially be deployed in different sectors of the economy. A computer engineer or a sales representative might, therefore, with only a limited amount of additional training, be capable of doing a job not only in several service sectors of the economy but also in a number of different manufacturing industries. It is equally important for such projections to be based, so far as possible, on up-to-date reliable data in order to detect and monitor trends, as well as, of course, being combined with estimates of the future availability of workers with different skill profiles.

At present, however, despite the widespread policy interest in skill shortages, regular surveys of employers to identify such problems and to collect the necessary data for anticipating future problems are by no means the norm across the EU, as is demonstrated in the following section which summarizes the situation in this regard in most of the EU Member States.

This is particularly the case in the new Member States even though there is virtually common recognition of the importance of monitoring labour market trends in the context of ongoing restructuring on a significant scale. In a number of countries, such as the Czech Republic and Hungary, systems have been established for assessing skill needs in different sectors, with the involvement of both industry representatives and education and training providers, but these do not cover the whole economy, and where surveys are carried out, these tend to be on an *ad hoc* basis. In other countries, such as Belgium or Italy, surveys are regionally based and are again partial for this reason.

Moreover, even where there are national surveys, the findings are often not widely published, or publicized, and, therefore, do not serve the purpose of drawing attention to any shortages identified which might potentially be useful for those contemplating career moves. Nor do they necessarily feed into the policy-making process, in the sense of influencing developments in the provision of education and training programmes and the content of these, partly because of a division of responsibilities between different parts of Government.

5.2 Systems for identifying skill problems in EU Member States

The concern here is to review in summary form the different arrangements which exist in EU Member States for identifying skill problems in different parts of the labour market as well as future labour market needs and how far the findings are used to inform and shape the development of vocational education and training in particular. The review, it should be

emphasized, is based on published reports on the Member States in question, especially those which are relatively straight-forward to trace, which are accordingly likely to be most widely known and available. It is, therefore, not intended to be a comprehensive account of the situation in this regard in all parts of the EU but rather as indicative of the position.

It should also be noted that the amount of material collected varies between countries, partly reflecting the information reasonably readily available and partly because of a concern to examine a few Member States in more detail, in addition to those included in the case studies in a later part of this report.

Austria[11]

Responsibility for vocational education and training is shared between the federal and state governments, while tripartite discussions between government, employers and employees have an important influence on economic and social policy.

Because of its high rate of employment and a growing labour supply from inward migration, labour shortages and the anticipation of future skill needs are not major issues in Austria. Emphasis on innovation at regional level, however, has served as a catalyst for building up more extensive systems for anticipation of skill needs in the different regions.

The *Arbeitsmarktservice AMS* (Public Employment Service) is the main promoter of instruments and methods for anticipating skill needs at national level, maintaining a research network (*AMS-Forschungsnetzwerks*) which enables research institutes to collaborate and exchange information on this issue. The AMS produces a number of studies, one of which is the 'Qualifications barometer' which provides a detailed list of vacancy notices, expert assessments and the results of relevant studies, with the intention of identifying the skills required by business both currently and in the foreseeable future. It is published on the Internet so as to be generally available. Although the AMS makes use of econometrics models in combination with surveys and systematic analyses of advertisements, forecasting is given relatively little weight and the information which it publishes remains mainly descriptive.

While there are regular studies of the demand for particular skills and of the supply of education and training at national level, there is no comprehensive analysis which attempts to link demand developments with supply trends and to draw out the implications of such developments for education and training.

[11] Sources: Public Employment Service (AMS): http://www.ams.or.at/neu/; Austrian Institute of Economic Research (WIFO) (Helmut Mahringer), Forecasting Skills and Labour Market Needs, Statement and Comments, June 2006, http://pdf.mutual-learning-employment.net/pdf/finland06/Austria.pdf; AMS Research Network:http://www.ams-forschungsnetzwerk.at

Belgium, Wallonia[12]

In Belgium, responsibility for policy is divided between the Federal Government, the regions and the French, Flemish and German communities according to the area of policy concerned. The communities, therefore, are responsible for education and vocational training, the regions for economic policy and job placement. Responsibility for anticipation of skill needs is jointly shared between employers, public employment services, education establishments, research centres and training institutions.

Studies and surveys are mainly undertaken at the regional level. National bodies (the national offices of labour and of social security) compile statistics that are published every month by the regional agency for employment and training (FOREM) which give a broad picture of the job market by sector of activity and geographic area but with no analysis of the features they show or of developments. The Regional Agency for Employment and training in Wallonia conducts and coordinates surveys as a major part of its function.

Up until 2003, FOREM carried out annual studies aimed at drawing attention to jobs that were susceptible to skill shortages or recruitment difficulties.[13] The studies were based on job advertisements published over the preceding 12 months and were aimed not only at establishing a list of 'critical jobs' but also at examining the number of people with the necessary qualifications to do these but who had been unemployed for more than two years. These studies had the advantage of being objective insofar as they were based on hard evidence data rather than on employers' opinions about the situation. The main disadvantage was that they did not cover other forms of recruitment apart from advertisements, such as employment agencies, spontaneous applications and job fairs. Moreover, while they indicated which kinds of job were subject to recruitment difficulties, they did not identify the kinds of skill which were needed.

Since 2004, FOREM has introduced other kinds of study, based mainly on the notion of 'ecosystems' rather than sectors as such, an ecosystem being a collection of firms with a common relationship to the environment, in the sense of having much the same customers and suppliers, such as firms in the hotels and restaurants and tourist sectors. Twelve studies of different ecosystems in the Walloon region are carried out each year, the approach being to collect both qualitative and quantitative information on the main participants through interviews and other sources (such as reports of trade federations and

[12] Sources: FOREM: http://www.leforem.be; Skills centres: http://www.centresdecompetence.be; Walloon Union of Enterprises: http://www.uwe.be; Walloon Observatory of employment: http://observatoire.emploi.wallonie.be; SIAMT, Anticipation des besoins en compétence. Balises conceptuelles et exemples de pratiques. Groupe de travail 'Anticipation', http://observatoire.emploi.wallonie.be/dyn/14/fichiers/anticipa406.pdf; European Centre for the Development of Vocational Training, Cedefop: fact sheet on Belgium: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp

[13] FOREM/ORBEM, « Détection des fonctions critiques en Région Wallonne en 2003 », 2003, available at: http://www.leforem.be/wcs/ExtBlobServer/Rapport_FOREM_ORBEM_2C0_1138626964451.pdf

academic studies). The data collected is then assessed by a group of FOREM experts. The aim of the studies is to identify current and future trends in an ecosystem, including in relation to skill shortages as well as other aspects such as the degree of competition. An advantage of the studies is to give an overview of developments in related sectors based on the information available. A major disadvantage is that the ecosystems do not give a complete coverage of activities in the region and, therefore, leave out of account some of the jobs and occupations which exist. Moreover apart from gathering and disseminating information about the regional economy, it is unclear how the results of the exercise are used.

In addition, a new monitoring instrument, 'technology watch' (*Veille technologique*) has recently been established in Wallonia by the 19 skill centres, set up jointly by the regional authorities, FOREM, the social partners, trade associations, research centres and universities, in different parts of the region to specialize in different areas. The centres provide training which is intended to assist the development of the regional economy. Each centre monitors developments in a particular area of specialization and attempts to identify factors which could influence the demand for training over the short and longer term, based on ongoing monitoring of relevant, mainly qualitative, information and continuous discussions with experts. A report on developments is published every six months. The aim is to anticipate technological developments in order to inform the design of training programmes to teach the skills expected to be required. A major potential weakness, however, is that the focus is mainly on new technology and occupations which are not affected by this are left out of account, and how far it will prove useful remains to be seen.

Studies are also carried out from time to time by employers' federations. The Union Wallonne des Enterprises (Walloon Union of Enterprises), for example, published a report in 2005 entitled *Recruter du personnel en Wallonie*[14] (Recruitment in Wallonia) based on an analysis of 180 completed questionnaires (out of 800 sent out) which attempted to identify the number of people recruited during the year, recruitment problems and so on, though given the incomplete and questionable representativeness of the firms covered (more large firms answered than small), its usefulness seems limited.

Although there is a reasonable extent of cooperation between the main actors involved in the provision of training, on the one hand, and the demand for labour, on the other, the focus is largely on the implications of technological developments and there is incomplete coverage of the current and prospective needs of the regional economy as a whole.

[14] Sources: Union Wallonne des Entreprises (UWE), Recruter du personnel en Wallonie, June 2005, available at: http://www.uwe.be/docs/etudes/RE2005/RE2005_etude4.pdf

Bulgaria[15]

Bulgaria does not yet have a system for monitoring or anticipating skill needs. The Ministry of Labour and Social Policy carried out a study in 2004 on employers' demand for skills in order to identify areas of shortage. As part of this, a system for classifying occupations was developed and the social partners were involved in identifying the State educational system requirements implied by the demand for labour. There remains a need, however, to develop a model for forecasting labour demand in the medium and longer term.

Since 2006, the National Statistical Institute has published data on employment and unemployment electronically derived from household surveys, which potentially provides the basis for monitoring skill developments on the supply side of the labour market.

Cyprus

Over the last decade, there have been labour shortages which has led to the employment of foreign workers[16]. The responsibility for anticipating skill needs is divided between different ministries: the Ministry of Education and Culture, MoEC (*Ypourgeio Paideias kai Politismou*, YPP), which is responsible for the development of education policy, and the Ministry of Labour and Social Insurance, MLSI (*Ypourgeio Ergasias kai Koinonikon Asfaliseon*, YEKA), which is responsible for the Cyprus National Action Plan for Employment (*Ethniko Schedio Drasis gia tin Apascholisi*, ESDA), which has set up vocational education and training institutions. The Planning Bureau of the Ministry of Finance, PB (*Grafeio Programmatismou*, GP), coordinates policy, compiling information on the economy and making policy proposals.

The Human Resource Development Authority, HRDA, (*Archi Anaptyxis Anthropinou Dynamikou,* AnAD), a semi-government organization, is responsible for planning vocational training and the development of human resources. It conducts research on short and long-term labour market trends and specific groups and assesses the effectiveness of its training activities. It also prepares an annual document identifying priorities for programmes, and accordingly those that will attract subsidies, which is sent to all training providers. In addition, it collects the views of the social partners in order to estimate the number of people required for different occupations in particular parts of the country.

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[15] Sources: European Centre for the Development of Vocational Training, Cedefop: fact sheets on Bulgaria, http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp World Bank, Bulgaria – Education and Skills for the Knowledge Economy – A Policy Note – Executive summary, available at http://siteresources.worldbank.org/INTBULGARIA/Resources/EducationPolicyNote_EN.pdf; National Strategy for continuing vocational training during the period 2005-2010, available at http://www.mlsp.government.bg/en/docs/7%20NATIONAL%20STRATEGY-%20English.doc; National Statistical Institute – Bulgaria, http://www.nsi.bg/ZActual_e/NewE-empl.htm; European Commission – DG Employment & Social Affairs: Peer reviews: Forecasting Skills and labour markets needs, Finland, Contribution of Bulgaria, June 2006, Available at: http://pdf.mutual-learning-employment.net/pdf/finland06/Bulgaria.pdf

[16] Since April 23 2003, Turkish Cypriots have been allowed to work in the South of Cyprus.

The general approach to forecasting has been influenced by the methods in operation in Finland, the UK and the Netherlands.[17] Government policy is to discourage low-value-added tourism and to encourage instead the development of high-value-added services (e.g. business consulting, education and medical treatment), which requires the provision of appropriate training and adequate active labour policies.[18]

The Czech Republic[19]

Various initiatives have been taken in the Czech Republic over a number of years to create a system for early identification of skill needs, though these have taken the form of one-off, independent projects. Some 25 'branch groups' at the National Institute for Technical and Vocational Education, composed of vocational training experts, employers representatives and representatives from of vocational and technical schools, are responsible for monitoring developments in different industries and the associated implications for occupations.

In 2004 and 2005, a number of studies were published on selected activities with a view to influencing the curricula of vocational education and training programmes. An Information System on the Situation of School Leavers in the Labour Market (ISA) which is designed to provide career guidance and up-to-date details of the labour market situation and employment opportunities is published on the Internet as well as in traditional printed form. The main users include applicants to VET schools and those graduating from these, employers, counselling centres, schools and regional education authorities.

In 2001 a combined qualitative/quantitative methodology for forecasting skill needs was developed as part of a project financed by the Leonardo da Vinci programme. The concern was to provide information on employment prospects in the country over a five-year period for those with particular qualifications and on employers' chances of finding people with the

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[17] Christofides L., University of Cyprus and University of Guelph, Canada; Peer Review – Forecasting Skills and Labour Market Needs, Statement and Comments, June 2006, http://pdf.mutual-learning-employment.net/pdf/finland06/Cyprus.pdf

[18] Sources: Human Resource Development Authority, www.hrdauth.org.cy; Planning Bureau, www.planning.gov.cy;Ministry of Education and Culture, MoEC (Ypourgeio Paideias kai Politismou, YPP); NAVIGATOR Consulting Group (2004), Achieving the Lisbon Goal: The Contribution of VET Systems – Country Report: Cyprus; European Centre for the Development of Vocational Training, Cedefop,: fact sheet on Cyprus: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp; Christofides L., University of Cyprus and University of Guelph, Canada, Peer Review – Forecasting Skills and Labour Market Needs, Statement and Comments, June 2006, http://pdf.mutual-learning-employment.net/pdf/finland06/Cyprus.pdf

[19] Sources: European Centre for the Development of Vocational Training, Cedefop: fact sheet fact on the Czech Republic: http://www.trainingvillage.gr; NÚOV – Národní ústav odborného vzdelávání [National Institute for Technical and Vocational Education] www.nuov.cz: ÚIV – Ústav pro informace ve vzdelávání [Institute for Information on Education] www.uiv.cz; MPSV – Ministerstvo práce a sociálních vecí [Ministry of Labour and Social Affairs] www.mpsv.cz; Accreditation Commission for Higher Education www.msmt.cz; CSVŠ – Centrum pro studium vysokého školství [Centre for Higher Education Studies] www.csvs.cz; Centrum pro zjištování výsledku ve vzdelávání [Centre for validation of results in education] www.cermat.cz

qualifications in question. The quantitative model is complemented by consideration of the qualitative aspects of changes in sectoral and regional demand for skills. The methodology is being developed further with support of the Ministry of Labour and Social Affairs (*Ministersvo práce a sociálních vecí* – MPSV).

Forecasts of skill needs have had a growing effect both on the design of VET curricula and on the numbers to admit to various programmes. There is now a proposal for establishing a system for the regular forecasting of skill needs over the economy as a whole rather than individual studies of specific sectors or regions.

Estonia[20]

A number of institutes in Estonia produce studies and reports on labour market developments and skill needs. These include the Tartu University, PRAXIS Center for Policy Studies, the Institute of International and Social Studies (TPU), the Bank of Estonia, the Institute of Economics (TTU) and the Estonian Institute for Future Studies.

The University of Tartu, for example, have published a great many studies on skill shortages since 1999, many of them forward-looking, relating education policy to labour market trends, based on firm-level surveys and sectoral investigations. The PRAXIS Centre for policies studies has been analysing labour market trends since 2001 and since 2002 has made forecasts of education and training needs to meet projected skill requirements in different sectors of activity.

Finland[21]

The National Board Education (*Opetushallitus*), an agency of the Ministry of Education,, is responsible for evaluating the education system on an ongoing basis. Regional Councils in each of the 15 regions are responsible for formulating development plans in cooperation with local authorities, business representatives and civil society. In addition, Employment and Economic Development Centres (*Työvoima- ja elinkeinokeskus*) in each region have the task of improving operating conditions for business and for promoting employment and the efficient functioning of the labour market as well as training.

The 'Development Plan for Education and University Research' (*KESU – Koulutuksen ja tutkimuksen kehittämissuunnitelma*), approved every five years by the Government,

[20] European Centre for the Development of Vocational Training, Cedefop: fact sheet on Estonia: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp; R. Eamets, 'Labour Market studies in Estonia', University of Tartu, available at: http://www.sm.ee/eng/pages/goproweb1044

[21] Sources:Ministry of Labour: http://www.mol.fi/english/index.html; Ministry of Education, http://www.minedu.fi/; European Centre for the Development of Vocational Training, Cedefop: sheet fact about Finland: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp European Commission – DG Employment & Social Affairs: Peer reviews: Forecasting Skills and labour markets needs, Finland, June 2006, Available at: http://pdf.mutual-learning-employment.net/pdf/finland06

defines education policy guidelines. The current KESU for 2003/2008 defines education and research policy and the allocation of resources and sets out measures for each field and level of education. This is based on the results of a project undertaken by the National Board of Education entitled 'Anticipating the Quantitative Educational Needs in Vocational Education and Training', which collected quantitative data on skill requirements and constructed a model for forecasting future skills needs and the implications for education and training.

Quantitative studies are also conducted by the Labour Force 2020 Project coordinated by the Ministry of Labour, which is aimed at forecasting economic developments and labour force requirements up to 2020. This is based on a combination of econometrics methods and expert views on prospective developments for forecasting the demand for labour together with projections of labour supply.

In addition, there are government bodies and committees which monitor, assess and anticipate the skills and competencies required in different sectors and the implications for vocational training.

Coherent and comprehensive systems for assessing and forecasting both skill needs and labour supply, which take account of global developments, combined with close collaboration between the Ministries of Labour and Education, mean that there is an effective means of both monitoring and anticipating labour market developments and the implications for education and training as well as for designing policies in this regard.

France[22]

In France, regular forecasts have made of skill and manpower needs since the late-1960s. The General Planning Commission makes short and medium-term assessments of economic developments and the supply of qualified labour. Studies are also commissioned by the Ministry of Education on developments in specific sectors or occupational groups on a regular basis (in the form of 'Forecasting Study Contracts', which in 2005 were renamed EDEC, 'Development agreement for employment and skills' – *Engagement de développement de l'emploi et des compétences*). These studies involve government and the relevant social partners and are generally divided into three phases: diagnostics,

[22] European Centre for the Development of Vocational Training, Cedefop: fact sheet on France: http://www.trainingvillage.gr; Prospective emploi-formation 2015. DEP. Direction de l'Evaluation etde la Prospective; Ministère de l'Education nationale, de l'Enseignement supérieur et de la Recherche. Les Dossiers (de la DEP), n° 155, juillet 2004, 73 p. ftp://trf.education.gouv.fr/pub/edutel/dpd/dossiers/dossier155/dossier155.pdf; Avenirs des métiers: rapport du groupe 'prospective des métiers et qualifications' présidé par Claude Seibel; rapporteur général Christine Afriat. Paris: Commissariat Général du Plan, 2002, 199 pp., ISBN 2-11-005309-7. http://lesrapports.ladocumentationfrancaise.fr/BRP/024000615/0000.pdf; European Commission – DG Employment & Social Affairs: Peer reviews: Forecasting Skills and labour markets needs, Finland, Contribution of France, June 2006, Available at: http://pdf.mutual-learning-employment.net/pdf/finland06/France.pdf

scenarios of possible changes and recommended actions. The main audience are vocational education training providers.

The Regional Training and Employment Observatories, which date back to 1989, are composed of a number of different bodies at regional level (the Regional Council, Ministerial departments responsible for employment, education and training, departments of the National Institute for Statistics and Economic Studies and, in some cases, the social partners). Their aim is to produce an overview of employment and training possibilities and to provide the basis for forecasting at regional level. These were supplemented in 2004 by the Regional Observatories of Professions and Qualifications (*Observatoires régionaux des métiers et des qualifications*), which are managed by the social partners to assess employment developments and training needs.

In a number of sectors, including the food industry, automobile manufacture and construction, efforts have been made to improve communications between the education system and employers. In addition, Advisory Vocational Commissions (C*ommissions Professionnelles Consultatives* – CPCs) play a role in forecasting skill and in helping the social partners in particular sectors to design training programmes.

Germany[23]

Regular (annual) surveys dealing with skill shortages are carried out by the following organizations:

- German Chambers of Commerce and Industry (DIHK), the latest industry report of which is dated 2006/7
- The German Association of Engineers (VDI), which has been conducting surveys to identify labour shortages in engineering for many years, with the most recent report published in 2007. This survey includes a detailed regional breakdown to reflect the regional distribution of economic activities in Germany
- The Institute for Employment Research (IAB), whose reports have been published in West Germany since 1993, and in East Germany since 1996. The surveys carried out in 2000 and 2005 focused on skill shortages.

[23] Sources: Berufsbildungsbericht 2005 (Report of Vocational Education 2005), Ministerium für Bildung und Forschung (Ministry of Education and Research); Statistisches Bundesamt (Federal Statistical Office)http://www.destatis.de; Bundesagentur für Arbeit (Federal Employment Office).http:www.arbeitsagentur.de; Bundesinstitut für Berufsbildung (Federal Institute for Vocational Education and Training) http://www.www.bibb.de; FreQuenZ http://www.frequenz.net/; Schmidt S., Schömann K. & Tessaring M., Early identification of qualification needs in Germany – the FreQueNz research network, Cedefop Reference Series, 2003; Available at: http://www.trainingvillage.gr/etv/Upload/Projects_Networks/Skillsnet/Publications/3029_11.pdf; European Centre for the Development of Vocational Training, Cedefop:fact sheet on Germany: http://www.trainingvillage.gr

In addition, a complex network has been set up to anticipate skill needs in the form of *FreQuenNz*, which involves a number of research institutes across the country with the aim of early identification of needs. The network coordinates research activities through the organization of events such as joint workshops and publications. It incorporates a range of different research expertise and approaches, including analysis of job advertisements, company surveys and case studies of good practice as well as studies of best practice in other OECD countries.

Examples include the *ADeBar* project which is concerned with the regular monitoring of skill trends in various sectors of activity and which focuses on the early identification of changes at the workplace. Monitoring of developments is conducted jointly between the Fraunhofer Institute for Industrial Engineering (FhIAO) and *Infratest Sozialforschung* (Social Research). The approach is to begin with a qualitative case study and then use this as the basis for quantitative analysis.

Greece[24]

A framework is in place for anticipating skill needs. The Transition Observatory (*Paratiritirio Metavasis*) in the Pedagogical Institute (*Paidagogiko Institouto*) is responsible for monitoring the educational and vocational choices of young people.

The Organization of Vocational Education and Training (*Organismos Epangelmatikis Ekpaidefsis kai Katartisis*, OEEK) provides projections of needs for the Vocational Training Institutes (*Institouto Epangelmatikis Katartisis*, IEK) to respond to and organizes Tripartite Advisory Commitees (*Trimelis Symvouleftiki Epitropi*, TSE) in order to assess regional labour market needs and propose new training programmes.

In addition, the Employment Observatory Research Informatics (*Paratiritirio Apascholisis Erevnitiki Pliroforiki AE, PAEP*), which is affiliated to the Manpower Employment Organization (*Organismos Apascholiseos Ergatikou Dynamikou*), OAED, has developed a system for registering and analysing basic labour market indicators and identifying occupational and skill demands and the medium-term implications for vocational training.

The Greek National Statistical Service also undertakes studies anticipating skill needs which are based on vacancies for different occupations.

[24] European Centre for the Development of Vocational Training, Cedefop: sheet fact on Greece: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp; European Centre for the Development of Vocational Training, Cedefop, Panorama, Identification of skill needs – Projects and actions for Greece – http://libserver.cedefop.europa.eu/vetelib/eu/pub/cedefop/pan/2004_5154_en.pdf

Hungary[25]

In Hungary, there is no regular medium and longer term forecasts of labour market needs. The Public Employment Service (*Állami Foglalkoztatási Szolgálat*), however, publishes short-term assessments and monthly reports on the employment situation, though the emphasis on the provision of data rather than analysis.

A report on training provision is published every third year by the National Institute of Public Education. An important step has been taken for improving methods for anticipating skill needs through the establishment of qualification sub-committees in 21 occupational groups, which are responsible for organizing, and assessing the results of, skill studies in their particular sectors.

Ireland[26]

In Ireland, several different Ministries are involved in identifying skills needs. The department of Education and Science is responsible for policy, funding and direction of educational programmes, The Ministry for Enterprise, Trade and Employment for funding FAS – the National Employment and Training Authority – and other agencies, including those for industrial development. Training in a number of sectors is under the responsibility of particular Ministries, such as those for agriculture, fisheries and tourism.

The Skills and Labour Market Research Unit (SLMRU), which is part of the Employment and Training authority (FAS), was established six years ago to act as a central resource for collecting data and undertaking analysis and research. The unit is in the process of building a comprehensive database containing all available statistics on the supply of and demand for skills in Ireland, including data on employment, the provision of education and participation; the first destination of third level students; data on work permits and visas; job vacancies and jobseekers. The regular reports produced on the basis of these data, however, are largely descriptive and do not indicate clearly the need for training or the prospective demand for skills on the labour market.

The Expert Group on Future Skills Needs (EGFSN), which works closely with FAS, has since 1997 at the government's request, carried out analyses of skill requirements and the related supply in different areas, including in future years, and has advised on how to tackle the needs. The ESFGN also follows up the implementation of its recommendations.

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[25] Sources: National Institute for Public Administration – Hungary http://www.oki.hu/oldal.php?tipus=index&kod=english; European Centre for the Development of Vocational Training, Cedefop: fact sheet on Hungary: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp; Hungarian Central Statistical Office (HCSO) http://www.portal.ksh.hu; Hungarian National Employment Office, www.en.afsz.hu; Hungary.hu; http://www.hungary.hu; http://www.ungarn.hu; Institute of Economics, Hungarian Academy of Sciences http://www.econ.core.hu/eng/index.html; Ministry of Employment Policy and Labour http://www.fmm.gov.hu

[26] Sources: Employment and Training authority (FAS): http://www.fas.ie/en/; Expert Group on Future Skills Needs (EGFSN): http://www.skillsireland.ie/

As well as reports addressing specific issues and sectors, FAS and EGFSN jointly publish the annual Monitoring Ireland's skills supply report and the Irish Labour Market Review aimed in particular at decision makers responsible for education, labour market and immigration policy.

Since 2002, the Irish Labour Market Review has analysed the latest labour trends and prospective developments and made policy recommendations. The range of issues addressed have included the labour market participation of disadvantaged groups, the up-skilling of older workers, immigration, gender pay gaps and incentives to work.

Monitoring Ireland's Skills Supply is an annual report providing information on the supply of skills to the Irish labour market from the formal education system to assist not only those responsible for education, labour market and immigration policy but also career guidance officers and students. The report does not provide recommendations or comments on education policy but instead is a reference document with the most up-to-date information on education at different levels from a wide range of sources. The supply of skills is estimated on the basis of data on the output of graduates (an indicator of the potential current supply) and student inflows (an indicator of potential future supply) by gender and field of study as well as the first destination of students. International comparisons are also made to relate performance in Ireland to that in other countries.

In addition, the National Skills Bulletin is aimed at highlighting key labour market statistics to assist the formulation of policy. The main focus is on analysing employment at occupational level. The analysis is divided into two parts, one concerned with employment developments and the growth of particular occupations, the other with examining available indicators on the supply of different skills, though stopping short of forecasting future needs and prospective shortages.

A forward-looking strategy has been developed (Tomorrow's skills: Towards a National Skills Strategy) in Ireland to identify the skills likely to be required over the period to 2020. This is based on quantitative forecasts of the composition of future labour demand in different sectors as well as of prospective supply, including immigration. The focus, however, is more on the needs of the labour market than on drawing out the implications for the educational system.

Italy

There are two main sources of information on the demand for different occupations and skill shortages in Italy:

- The Excelsior survey (carried out by *Unioncamere*)[27]

[27] http://excelsior.unioncamere.net

- A group of surveys on professional needs carried out independently by 'bilateral institutions' created by trade unions and employers organizations[28].

Unioncamere's Excelsior project, launched in 1997, is the main single source of information on cyclical developments in the labour market, and on emerging trends in occupations and training needs. The survey seeks to identify the employment needs of firms over the coming year, based on the results of a questionnaire sent to a sample of 100,000 firms. Although the main aim of the survey is to monitor vacancies, the data can be used to identify the positions which are difficult to fill.

As a source of information on skill shortages, the survey's main limitation is its limited sectoral breakdown.

The 'bilateral institution' surveys are carried out on an occasional and irregular basis, which restricts the possibility of systematic long-term analysis.. Moreover, the surveys tend to differ from each other in terms of methodology, sample size and ways in which information is collected. A project has recently been launched, however, by the national vocational training agency, ISFOL, in order integrating the different surveys carried out in the last few years by the bilateral institutions[29]. Nevertheless, it should be noted that while ISPOL is the national vocational training agency, much of the responsibility for implementing vocational training policy in Italy is decentralized to the Regional level.

Latvia[30]

No attempt is made to anticipate future skill needs. Projecting educational developments is, in any case, difficult because of a mixture of public and private providers, while on the demand side, forecasting is equally difficult because, given the size of the economy, the development of a particular industry might depend on the success of one or two enterprises. The National Development Plan (NPD) sets out a medium-term vision for 2007-2013 and there is an objective to develop a system for analysing labour market trends and monitoring the major features.

The Labour Force Survey provides information on employment, unemployment and underemployment by industry, occupation, status in employment and education levels, while the State Employment Service conducts surveys of employers at regional and sectoral level and attempts to forecast developments over the coming year.

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[28] Tra gli altri Ente Bilaterale Nazionale Artigianato, ENFEA, Organismo bilaterale nazionale

[29] see http://fabbisogniprofessionali.isfol.it

[30] Sources: European Centre for the Development of Vocational Training, Cedefop: fact sheet on Latvia: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp; European Commission – DG Employment & Social Affairs: Peer reviews: Forecasting Skills and labour markets needs, Finland, Contribution of Latvia, June 2006, Available at: http://pdf.mutual-learning-employment.net/pdf/finland06/Latvia.pdf, Latvian National Development Plan, etc.

An annual report published since 2002 identifies key skills which people need to acquire (such as knowledge of foreign languages, IT and social skills and monitors improvements. At present, however, details of the ability of workers and skill requirement exist only in a small number of areas, such as IT and construction.

Luxembourg[31]

Luxembourg, as an economy, is in the atypical position of attracting substantial numbers of workers from surrounding countries. Because of access to a considerable pool of labour, the anticipation of skill needs is not high on the policy agenda. Moreover, Luxembourg has had a university only for two years or so.

There are no established mechanisms to anticipate the skills likely to be needed on the labour market. The Ministry of Education and Vocational Training, however (in cooperation with the Chambers of Labour and Trade) has set up a number of ad hoc Committees to match the provision of education with labour market requirements.

In addition, the public employment service (ADEM) has launched in recent years a new series of statistics on unemployment and those participating in labour market measures, based on surveys intended to improve understanding of cyclical unemployment trends. Nevertheless, the exercise remains descriptive and does not provide any information on the underlying reasons for the trends observed.

At the same time, Fédil (*Fédération des industriels luxembourgeois* – Federation of Luxembourg Industrialists) has for some years carried out a survey among its members to pinpoint the needs of enterprises for both skilled and unskilled labour. The 2002/2003 survey (*Les qualifications de demain dans l'industrie* – Qualifications of tomorrow), for example, underlined the employment opportunities for skilled workers in agri-foodstuffs, iron and steel, heavy engineering, chemicals and pharmaceuticals and construction. The surveys seem to have had concrete results in identifying skills needs, such as for manufacturing representatives, and have led to the setting up of new training programmes. In general, however, the surveys do not go deeply into the types of skill required or the factors underlying observed shortages.

On the other hand, there is exchange of information across the wider region, encompassing the French Region of Lorraine, the Belgian Region of Wallonia and the two German States of Rheinland-Palatinate and Saar as well as Luxembourg. Cooperation, for

[31] Administration of Employment (ADEM): http://www.adem.public.lu; Federation of Luxembourg Industrialists (Fédil): http://www.fedil.lu; European Centre for the Development of Vocational Training, Cedefop: sheet fact about Luxembourg: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp European Commission – DG Employment & Social Affairs: Peer reviews: Forecasting Skills and labour markets needs, Finland, Contribution of Luxemburg, June 2006, Available at: http://pdf.mutual-learning-employment.net/pdf/finland06/Luxembourg.pdf

example, has been established with the careers advice service in Trier to promote educational and vocational opportunities in both areas.

Neglect of any forward-looking policy to identify prospective skill problems is slowly being rectified in the country in response to the emergence of shortages of highly skilled people in some areas and new tools are being developed to anticipate such problems. An 'observatory for competitiveness' was established in 2004, for example, to help government define policies for strengthening long-term competitiveness.

The Netherlands[32]

The Netherlands has a comprehensive system in place for anticipating skill shortages, coordinated by the Research Centre for Education and the Labour Market (ROA – *Researchcentrum voor Onderwijs an Arbeidsmarkt*) and involving Government Ministries, the Council for Higher Vocational Education, employment services, businesses, educational institutions and sector organizations. The approach is both top-down and bottom-up, the former entailing the compilation and analysis of labour market data and expected developments, the results of which are published every two years (in the form of *The labour market by education and occupation*) and used to design vocational education and training programmes.

The bottom-up approach focuses on specific parts of the labour market, such as individual sectors, occupations or regions, to complement this. It includes analyses of skills developments and of the associated trends in wages, productivity and returns on investment in training.

The social partners are actively involved in the process of anticipating skill needs and in defining new occupations and qualifications for inclusion in the national qualifications structure. In addition, the Expertise centres for vocational education, training and the labour market (COLO) work with ROA to make use of the available data, each expertise centre publishing the results of 'education and labour market research' studies on the expected demand for qualified personnel and the expected availability of training places for its own sector.

[32] Sources: European Centre for the Development of Vocational Training, Cedefop: fact sheet on the Netherlands:http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp; Corvers F., Early identification of skill needs in Europe – Initiatives and research on Early identification of skill needs in Europe at national level – Labour market forecasting in the Netherlands: a top-down approach, CEDEFOP, 2003, http://www.trainingvillage.gr/etv/Upload/Projects_Networks/Skillsnet/Publications/3029_15.pdf

Poland[33]

The Polish Central Statistical Office has been surveying demand for labour in large enterprises since 1995. In 1998, the survey was expanded to cover medium-sized enterprises. In 2005, the format of the survey was changed to comply with Eurostat requirements to harmonize the content and method with that in other EU Member States. The periodicity of the survey was also changed from every two years to quarterly, but at the same time the degree of detail was reduced in terms of sectors and occupations. The survey covers large and medium-sized enterprises (defined as those with 10 or more people employed) and reports on employment and vacancies in different occupations as well as newly created jobs, divided by the characteristics of work places – sector of activity, region, type of ownership and size of enterprise.

Portugal[34]

The Institute for Quality in Training (*Instituto para a Qualidade na Formação* – IQF) is responsible for producing sector-specific forecasts based on research into changes in qualifications and employment. These have a direct impact on policy-making by providing strategic guidance for improving curricula and training provision in general. More specifically, they serve as a the basis for discussions between employers' organizations , trade unions, training institutions and sectoral experts on their validity and on measures to match training provision with training needs.

Special bodies have been set up to implement sector-specific training systems, such as the Workforce Development Plan for the Tourism Industry (*Plano de Desenvolvimento dos Activos para a Indústria do Turismo*), which is responsible for detecting needs and for the development of reference frameworks for qualifications, certification and assessment.

Romania[35]

Romania does not have as yet a comprehensive system for anticipating skill needs. The first report on this, entitled *Evolution of Occupations in the Romanian Labour Market up to 2010*, was commissioned by the Ministry of Labour, Social solidarity and Family and financed by a World Bank loan was published in 2006. It was by the National Institute for Scientific Research on Labour and Social Protection and the Centre for Urban and Regional Sociology. The key message was that the labour market would dramatically change during the process of European integration process and that it was of vital importance to increase knowledge of labour market trends and training possibilities. The

[33] http://www.stat.gov.pl/english/dane_spolgosp/praca_ludnosc/popyt_na_prace/2005/index.php; http://www.nvf.cz/publikace/pdf_publikace/observator/eng/forecast_lessons.pdf (p. 153 ff.).

[34] European Centre for the Development of Vocational Training, Cedefop: fact sheet on Portugal: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp.

[35] Ministry of Labour, Social Solidarity and Family of Romania, 'Evolution of Occupations on Romanian Labour Market in 2010 perspective', 2006, available at: http://www.mmssf.ro/website/en/rapoarte_studii/230407studie.pdf.

report is based on the results of a detailed analysis of particular occupations, on a survey of a representative sample of companies and on an examination of the supply and demand for labour recorded at local employment offices over a two-week period.

The report recommends the establishment of an ongoing system for anticipating skill needs and annual surveys of firms to identify the demand for labour and training needs. It also recommends improved recording of job vacancies and of qualified workers requesting assistance from the County Employment Agencies – CEA, to facilitate better matching of labour demand and supply on local labour markets.

Slovenia[36]

The Slovenian Employment Services (ESS) records labour market requirements systematically, collecting information about skill needs at both national and regional level. As regards the latter, assessments are only regularly carried out in the Podrevje region under the umbrella of the regional Human Resource Development Fund (HRDF). The ESS also publishes a database on vacancies, based on employers' announcements of needs, and undertakes periodic statistical reviews of labour demand by sector of activity.

The Slovenian Chamber of Commerce and Industry has developed a system for anticipating skill needs by sector and region, but the results are not widely published and are used mainly internally.

Spain[37]

Education and vocational training in Spain are largely the responsibility of the Autonomous Regions, which are charged with implementing and developing national standards. A number of the regions have developed their own observatories to identify emerging training needs. Accordingly, the system in place and the methods used to anticipate skill requirements differ across the country.

At the national level Spanish law provides for a national research programme to analyse labour market needs and a monitoring programme to examine developments. In 1999, a national observatory of skills needs (*Observatorio Profesiona – OBINCUAL*), was established as part of the National Institute for Qualifications (*Instituto Nacional de*

[36] European Centre for the Development of Vocational Training, Cedefop: fact sheet on Slovenia: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp; Employment services of Slovenia, http://www.ess.gov.si.

[37] Sources: National Institute for Qualifications (INCUAL): http://iceextranet.mec.es/iceextranet/accesoExtranetAction.do; Foundation for Continuing Training (FORCEM), http://www.fundaciontripartita.org; European Centre for the Development of Vocational Training, Cedefop: sheet fact about Spain: http://www.trainingvillage.gr/etv/Information_resources/NationalVet/Thematic/criteria_reply.asp. J. Planas, Early identification of skill needs in Europe. Developing prospective tools for the observation of skill requirements in Spain, 2003, http://www.trainingvillage.gr/etv/Upload/Projects_Networks/Skillsnet/Publications/3029_13.pdf.

Cualificaciones, Incual), charged with carrying out research on such needs in different sectors. This serves to coordinate the activities of the different regional observatories and has the aim of establishing a common framework of reference for skills.

More concretely, the concern of OBINCUAL is to analyse key areas of skills in the context of general economic developments. It is responsible for collecting information on trends and for forecasting future developments in different areas, based on the Delphi method of assembling a panel of experts to predict what will happen in different sectors and the implications for jobs and occupations. FORCEM (Foundation for Continuing Training), the body responsible for administering public funds for financing training in Spain, has also developed tools for monitoring skill requirements in different sectors, though it focuses on occupations only.

National bodies, therefore, act as platforms for gathering information and presenting forecasts of skill needs. There is no direct link to policy as such and no general overall analysis of labour market developments. Instead the focus is on particular sectors.

Sweden

Every year (in the autumn), each of the 325 local offices of the Swedish Public Employment Service makes an assessment of the balance between the supply and demand for labour in a large number of occupations, which is then transformed into an index ranging from excess supply to excess demand. The National Labour Market Board also carried out a major survey in 2004 (*Arbetsmarknadsstyrelsen*) covering some 3,000 Swedish firms in different sectors of industry, with the aim of identifying likely long-term future patterns of demand for skills and competencies.

The information available on skill needs is used as an input to the wide-ranging renewal of Swedish secondary education and vocational training that is currently being undertaken by central, regional and local government authorities in cooperation with the social partners, and which is designed to address general problems of labour market mismatch and lack of general competencies, and well as specific problems of skill shortage.

UK

Over the past few years, the UK Department for Education and Skills has published three policy White Papers relating to workplace skills:

- 21st Century Skills – Realizing Our Potential (2003)
- Skills: getting on in business, getting on at work (2005)
- Further Education Reform: Raising Skills, Improving Life Chances (2006).

The UK Finance Ministry – HM Treasury – has also produced a Review of long-term skill needs (the *Leitch Report* 2006). These initiatives are aimed at changing the way in which vocational education and training is managed, delivered and funded in the UK, with the stated aim being to ensure that it meets the needs of individuals and employers.

The agencies created include:

- A Learning and Skills Council, with 47 local Learning and Skills Councils, created in 2001 as the new funding and planning body for all post-16 education and training (except higher education)
- A UK-wide Skills for Business Network, consisting of 25 employer-led Sector Skills Councils, overseen by the Sector Skills Development Agency
- Regional Skills Partnerships, announced in the 2003 White Paper, aimed at improving the link between the supply and demand for skills by integrating the work of regional development and other agencies

In addition, the Department of Trade and Industry has produced a *Review of the Government's Manufacturing Strategy – Competing in the Global Economy,* and *The Manufacturing Strategy Two Years On* (2004). The employers' body, the Engineering Employers Federation has also produced a report *Learning to Change: Why the UK skills system must do better* (2006).

In terms of monitoring skill shortages, the main source is the annual *National Employer Skills Survey* produced by the Learning and Skills Council, in association with the Department of Education and Skills, and the Sector Skills Development Agency. The latest report, published in 2006, covering 2005, is based on interviews with 74,500 employers. It contains detailed information by sector and occupation and records skill shortages, in the sense of a deficiency of skills among the existing work force as well as hard to fill vacancies.

Other periodic surveys – notably for manufacturing – include the Survey of Professional Qualifications by the Engineering Technology Board (2003), A Statistical Guide to Labour Supply and Demand in Engineering and Technology (ETB 2005), a Labour Market Survey of the Engineering Industry in Britain (EMTA 2002).

5.3 Improving data on skill shortages at EU level – extending vacancy statistics

As is evident from the above review of Member States, the extent of data available at national level to assess and monitor skill problems varies considerably across the EU, from being collected on an annual basis and complemented by periodic in-depth analyses of particular sectors and occupations as well as projections of prospective developments to being non-existent.

Regular surveys of employers, however, are carried out at present in the EU in all Member States on a reasonably comparable basis, but these are for the purpose of collecting information on vacancies, rather than on skill shortages as such, and are used primarily by the European Central Bank to give an indication of the overall pressure of demand for labour. Although in principle they should record the number of vacancies in occupations within sectors and at a regional as well as national level, at least on an annual basis, such data, in practice, are available only for the new Member States. In most EU15 countries at present, they cover only sectors and not occupations and at most record vacancies in broad regions – in the western and eastern parts of Germany, in particular.

Nevertheless, these data could potentially be expanded to serve as a means of identifying and monitoring skill problems across the EU on a consistent and comparable basis. They would, however, need to cover sectors in more detail than at present – at NACE 2-digit level instead of at NACE 1-digit level, since the need is to distinguish the situation in industries within manufacturing and not simply manufacturing as a whole. They would also need to provide more detail on occupations (ISCO 2-digit instead of ISCO 1-digit), which is essential for identifying the types of qualification which people need to do the job, so providing the link with the supply side of the labour market, as well as with the education and training system.

Moreover, they would equally need to report in more detail on the nature of vacancies, in the sense of indicating the degree of difficulty involved in recruiting suitable people to fill them or the length of time the vacancy has been unfilled, since the mere existence of a vacancy does not necessarily indicate recruitment difficulties as such. In addition, the data would ideally need to be capable of being subdivided by the size of enterprise, since the evidence suggests that the problems faced by small firms differ both in scale and nature from those experienced by larger firms in this regard. This does not entail the collection of more information, but ensuring that the selection of the sample of enterprises to be surveyed is such that it is representative of firms of different sizes as well as of firms overall[38].

The amount of additional detail required to make additional effective use of the vacancy statistics is, therefore, not substantial[39]. Furthermore, such details would need only to be collected at most once a year and perhaps even every other year, since the main purpose is not to identify short-term recruitment problems which could be the result of cyclical fluctuations in the demand for labour (which is a major concern of the ECB), but to

[38] The unit of observation for the collection of the vacancy statistics is in fact the establishment rather than the enterprise but, in practice, the data are collected on an enterprise ratther than an establishment basis by national statistical offices.

[39] Indeed, data on vacancies in Poland before 2005 used to be collected on a more detailed basis, distinguishing between occupations and sectors of activity at a more disaggregated level, if at less regular intervals. In effect, complying with Eurostat requirements for the quarterly provision of vacancy statistics has led to a trade-off between the frequency of data collection and the degree of detail.

distinguish longer-term skill shortages which may be exacerbated by a cyclical upturn but which are not caused by it. The aim, therefore, is to identify problems of labour market imbalance which have to do with a 'structural' mismatch between the supply of labour skills and the demand for them and which have potential implications for education and training system, in terms of the number of people acquiring qualifications in particular areas.

It should be emphasized, as illustrated by the case studies summarized below, that surveys of employers of this kind, even with the degree of detail suggested, do not necessarily imply that there is a need for more people with the skills identified as being in short supply to be educated and trained. Even if due allowance is made for possible cyclical effects on the findings – by, for example, focusing on the relative rather than absolute level of long-term, or 'hard-to-fill', vacancies – the data collected represent only the starting-point of consideration of skill shortages for particular occupations in particular sectors and the underlying reasons for these.

They are, however, an essential starting-point without which it is difficult if not impossible to identify the skill problems affecting different industries and to devise appropriate policies for tackling them. These polices might include expanding the training programmes which prepare people for performing particular jobs or with certain qualifications – which may involve the provision of short-term courses to teach specific skills or the addition of modules to existing programmes – but it also might include encouraging people to take up particular education paths or career choices, taking action to increase labour mobility, or eliminating restrictions on the entry to certain occupations or professions or which limit the wages that can be paid for particular jobs.

The policies might equally include, of course, taking no action at all to alleviate the shortages identified, on the grounds that any action is likely either to be ineffective – or less effective than leaving employers to resolve the problem themselves – or counterproductive, in the sense of relieving problems in one industry but having an adverse effect on the economy as a whole, such as, for example, by slowing down the shift of labour into expanding sectors.

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