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Human Capital Formation and Continuous Training: Evidence for EU Countries

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Abstract

This paper links data on continuous training from the EU LFS to information on skill levels and earnings from the EU KLEMS growth and productivity accounts, to examine the relative magnitudes of continuous workforce training versus human capital formation through the general education system. The results suggest that in the EU 15 intangible investments in training represent a little under 2% of GDP but less than a third as large in the new member states. Failure to account for informal training leads to a significant underestimate of the impact of human capital on output growth in the EU as a whole.

1. Introduction

Having a highly skilled workforce is important for advanced countries to remain competitive in an increasingly globalised world. There are a number of routes through which countries build up their stock of human capital. Mostly this comes through the general education system but additions to human capital also come through the investment by both firms and individuals in training and continuous education once they leave general education. Moreover the extent to which individuals invest in continuing education will depend on the technology used in the workforce. In the face of rapidly changing technology (for example, changes arising from information and communications technology - ICT), it is imperative that skills are appropriate and up to date and this is often easier to achieve through workplace training than through the general education system.

There are two main approaches to estimating stocks of human capital. One is based on the stream of future earnings (e.g. Jorgenson and Fraumeni (1992a, 1992b), Wei (2004). Similarly methods exist to take account of human capital in investigations of sources of growth (e.g. Jorgenson, Gollop and Fraumeni (1987), Jorgenson and Ho (1999), Timmer et al. (2010). The data requirements for these exercises include numbers of pupils educated and/or proportions of the workforce with various levels of educational attainment plus market returns from education. An alternative method, going back to an earlier literature e.g. Kendrick (1976), treats expenditures on education as investments and cumulates these to estimate stocks of human capital, as for other assets.

Due to data constraints, neither approach works well when examining continuous education. Data exists on the proportion of workers trained in a number of countries in labour force surveys. Information is more sparse on expenditures – e.g. in the EU there is a periodic survey that covers expenditure on vocational training but this is only available for 1999 and 2006. There are some econometric estimates of the returns to training, e.g. Dearden et al. (2006) but again are not available systematically across time or countries.

This paper attempts to measures investment and stocks of continuing training borrowing from the literature on measuring intangible investments. This literature, which began with the seminal paper by Corrado, Hulten and Sichel (2005), treats training as an activity largely undertaken by firms who pay the direct costs of training programmes and indirect costs in terms of production output foregone. This paper employs their methodology using information on numbers of workers trained from the EU LFS, aggregated to industry level

and linked to earnings from the EU KLEMS growth and productivity accounts. This paper extends previous estimates by taking account of the characteristics of those being trained as well as including direct and opportunity costs of individuals who pay for their own training. Having constructed formation and stocks of continuous training capital, the paper then compares the impacts on growth relative to the measures currently employed in EU KLEMS, which only take account of qualifications achieved through formal educational attainment.

The next section reviews the main features of the primary data series employed from the EU LFS. It then sets out the methodologies for constructing investment series for continuous training. Section 4 discusses capital stock measurement and presents the main growth accounting results and section 5 concludes.

2. Workforce Training in the EU

This section examines the prevalence of workforce training across EU countries, using data from EU LFS. It presents an overview for the EU, both the quantity and quality of training provided and information on the characteristics of those trained. The estimates are derived from aggregating microdata from the quarterly surveys which allows cleaning of the data to remove outliers that appear to be reporting errors.[1]

2.1 Proportions of the workforce receiving training

Since 2003 the EU LFS has asked respondents if they 'attended any courses, seminars, etc. outside the regular education system'.[2] In 2007 in the EU as a whole approximately 10% of employees received some training in the 4 weeks prior to the quarterly survey (Table 1). Training proportions are significantly higher in the EU-15 than in the group of new member states.[3] The training proportion has been rising over time in the EU as a whole, but as Table 1 shows, this growth occurs mainly in the EU-15 group of countries.

[1] An example is the question on duration of education where some individuals report more hours than available in a four week period.
[2] Prior to 2003 the question was more general and included both regular education and continuous training. By restricting the sample to persons in employment we exclude all full time students. The earlier measure is only used to estimate growth over time.
[3] The list of countries included in these two groups are given in the Appendix Tables.

Table 1. Percent of the workforce receiving training in the past four weeks.[1]

	EU-24[2]	EU-15	EU-9[2]
1995	7.8	8.5	3.6
1996	8.0	8.7	3.6
1997	8.1	8.9	3.7
1998	8.1	8.9	3.7
1999	8.3	9.1	3.7
2000	8.6	9.3	3.7
2001	8.7	9.5	3.7
2002	8.7	9.4	4.1
2003	10.0	10.9	4.0
2004	11.3	12.3	4.3
2005	11.1	12.2	3.8
2006	11.0	12.1	3.8
2007	10.2	11.2	3.9

Notes: 1. From 2003 this is based on the variable 'COURATT' which ask respondents 'did you attend any courses, seminars, conferences or received private lessons or instructions outside the regular education system in the past 4 weeks. Time series are constructed by linking in an overlapping year to the variable 'EDUC4WN' – education or training received during the previous 4 weeks.

The figures for the EU aggregates hide large variation across countries. The proportions are very high in the Scandinavian countries, the Netherlands and the UK, but are considerably lower in the large continental EU-15 countries of France, Germany, Spain and Italy. Some EU-15 countries (Portugal, Greece) have as low training densities as some of the smaller new member states (NMS) – see Appendix Table A1.

Dividing by industry group shows that the percent of workers receiving training is generally higher in service sectors than in production industries and is highest for non-market services (Table 2). The underlying data suggest that training proportions are very high in financial services and the distribution across industries is similar in the EU15 and the NMS, except perhaps in financial services where the EU9 proportion is closer to the EU15 than is the case for other sectors (see Carmichael et al., 2009, for proportions by detailed industry).

Table 2. Percent of the workforce receiving training in the past four weeks.

	EU-24[1]	EU-15	EU-9[1]
By Industry group (2007)			
Production[2]	**6.0**	**7.0**	**2.3**
Market Services[3]	**9.3**	**10.1**	**3.9**
Non-market services[4]	**14.9**	**16.2**	**6.7**
By skill group (2007)			
High[5]	**17.0**	**18.3**	**9.0**
Intermediate[6]	**7.9**	**9.5**	**2.9**
Low[7]	**5.0**	**5.2**	**1.0**
By gender (2007)			
Male	**8.7**	**9.7**	**3.2**
Female	**11.5**	**12.8**	**4.7**
By age group (2007)			
15-29	**11.7**	**13.1**	**4.3**
30-49	**9.9**	**11.0**	**4.1**
50+	**8.4**	**9.4**	**3.1**

Notes: 1. Excluding Malta.
2. Agriculture, Forestry & Fishing; Mining; Manufacturing; Electricity, Gas & Water and Construction;
3.Distribution; Hotels & Catering; Transport and Communications; Financial Services; Business Services; Other Personal Services;
4. Public Administration; Education; Health and Social Services.
5. Educational attainment at ISCED levels 5-6, University degree or equivalent;
6. Educational attainment at ISCED levels 3-4, Academic and vocational qualifications above intermediate secondary;
7. Educational attainment at ISCED levels 1-2, secondary qualifications at age 16 or below.
Source EU LFS

Training is also likely to vary by worker characteristic. The figures in Table 2 suggest that females are more likely to receive training than males, training proportion decline with age and rise with skill level. The division by skill group is particularly pronounced – in fact in the EU-15 the share of all workers receiving training who have 'high' qualification levels was much higher (44%) than this group's share of the total workforce (15%). These results are consistent with findings in the literature. Blundell et al (1996) find that more educated people have higher chances of receiving training. Vignoles et al. (2004) find that male workers in their mid career (age 33-42) experience the highest wage growth from training and that the firms often train the workers who are more able in the first place. O'Mahony and Peng (2008), using UK data, presented evidence that the propensity to receive training decreased with age and increased with skill level, with males slightly less likely to receive training on average than females.

2.2 Quality of Training

This section considers a number of measures that yield information on the quality of training received. These include purpose of training, duration of training and whether training occurs during working hours. These questions were only asked since 2003 or 2004, depending on the country and the response rate was relatively low in some cases so the numbers presented below are all based on average values over the period 2003-2007. EU LFS respondents were asked if the purpose of the training was mainly professional or mainly personal/social. In the EU as a whole 84% said the training was mainly professional. There was some small variation by type of worker – the most salient being that the low skilled were more likely to say the training was for personal reasons (25%) against only 14% for the highest skill group. The percent of workers saying training was for professional reasons was similar across gender and across age groups. There were also some differences across country and industry but in general the response rate on this question was quite low so these differences are unlikely to be significant.

A more revealing quality dimension is the average length of training, shown in Table 3. On average workers who receive training in the past 4 weeks are trained for about 15 hours in the EU as a whole. This is a significant length of time suggesting a reasonable quality of training. Table 3 shows that the number of hours is highest in the production industries and lowest in non-market services, the reverse of the pattern for training proportions. There is also variation across country with hours generally larger in new member states than in the EU15, and high in some countries where training propensities are relatively low, e.g.France and Greece.

Table 3. Average duration of training (hours),average 2003-07

	Total		Production	Market Services	Non-market Services
EU24*	**15.3**		25.6	14.5	11.6
EU15	**15.2**		25.9	14.5	11.6
EU9*	**15.3**		21.7	15.5	11.7

Source EU LFS, * excluding Malta

Examination of figures on duration of training by worker characteristic suggests that females receive less hours training on average than males and that duration of training falls marginally with skill level for the youngest age group, compensating to some extent for the

reverse findings for proportions of workers trained in these two dimensions. However duration of training falls with age, reinforcing the findings on training proportions for this group above so that both the quantity and quality of training appears to be lower for older age groups (see Carmichael et al. (2009) for details.

Another quality dimension is the extent to which training occurs during normal working hours. The EU LFS asks respondents if the training occurred always or mostly during working hours. In the EU countries for which data were available, about 67% of respondents said training occurred wholly or mostly during working hours. In Finland, France and the UK more than 75% of training occurred during working hours; in Belgium, Ireland, Italy, the Netherlands and Poland the proportion was about 50% whereas in many new member states and Greece the proportion was under 40%. However it should be noted that this variable was not reported for many countries including Germany and Spain. In this paper we include all training regardless of whether it occurs during working hours or not, including the opportunity costs to individuals. In an analysis of links between training and the use of information technology, O'Mahony and Peng (2010) employ the information on whether training occurred during working hours to adjust the estimates of intangible investments to those paid for by firms. This is an important indicator of the commitment of firms to training and of the cost to firms.

3. Training Investments

Much of the recent literature on the productivity effects of new technologies emphasises the need to invest in organisational changes and other firm specific changes in production processes in order to reap the benefits. These changes required firms to expend some resources, which collectively are termed intangible investments. The literature frequently referred to these intangible investments as the 'missing input' that potentially could explain the apparent rise in MFP growth some time after the introduction of technologies such as ICT. As intangibles are difficult to observe and measure by definition, their impact was mainly captured by the MFP component in analyses of sources of growth.

This section analyses training as an intangible investment, using the information on proportions of workers trained and the duration of training.[4] It first sets out a brief description of the methodology employed – further details and sensitivity analysis are given in

[44] In these calculations we restrict attention to training of those in employment and do not take account of training of the unemployed or inactive persons. This is due to problems with the underlying data that only allow us to distinguish continuous from formal education by restricting the sample to those in work. Ideally human capital calculations would include all persons and not just those currently in employment.

Carmichael et al. (2009). This is followed by a description of the importance of these intangible investments as shares of outputs.

Estimating intangible investments requires a monetary valuation of the number of hours of training received by workers. To achieve this hours trained, calculated as numbers of workers trained times average duration of training, are multiplied by the average hourly cost of this training. Hence intangible investments in training in industry i, country j and time period t are calculated by:

$$(1) \qquad TI_{i,j,t} = HTR_{i,j,t} C_{i,j,t}$$

Where TI = nominal expenditures on investments in training, HTR = total hours spent training per worker and C is the cost of an hour's training. Since average durations are reported for the previous 4 weeks, this is converted to an annual basis, allowing for time lost due to holidays and other forms of absence.

Hourly costs C will have two elements, the direct costs of training (costs of running courses or external fees) and the opportunity costs of the production or leisure time foregone due to time spent training. Both time away from production and leisure are valued at the market wage, as in Jorgenson and Fraumeni (1992b). In this analysis hourly costs were estimated as:

$$(2) \qquad C_{i,j,t} = DR + \overline{wadj}$$

Information on hourly direct costs (DR) was taken from the Eurostat Continuous Vocational Training Surveys (CVTS) surveys, which were carried out in 1999 and 2005. We used the variable 'the ratio of direct to opportunity costs (wages)' in these surveys. This variable is available by country and industry. Examination of the data suggests that these ratios vary significantly across time and industry, possibly due to small sample sizes. Therefore we average across the two survey years, using the same number for all time periods, and calculate just two ratios for each country, dividing into production industries (NACE C to F) and market services (NACE G to K and O). Non-market services are not covered by the CVT survey so we assume the ratios for these sectors are equal to those for market services. In the EU25 direct costs are estimated to be about 30% higher than wage costs in production industries and 26% higher in services, but there is large variation across countries, e.g. in the UK the ratio for the whole economy is close to two. The first component in (2) was estimated as the average labour compensation of employees, taken from EU KLEMS, multiplied by the ratio of direct to opportunity costs.

The second term in the hourly costs equation is the opportunity cost. This is set equal to the average wage but adjusting for the composition of those being trained; data are again taken from EU KLEMS. Due to small samples we estimate proportions trained by skil, age and gender groups for just three industry groups, production industries, market services and non-market services and apply the average proportion for 2003-2007 to all years. In most countries the proportions of workers with university degrees or equivalent is higher for those trained than for employment so this adjustment is positive. The one exception appears to be Italy. When dividing by broad industry, however, the adjustments are positive for production industries and market services but allowing for composition lowers the average wage in non-market services due a predominance of females in those sectors. On average wages are adjusted upwards by 10%-15% for EU15 countries and by closer to 25% for new member states.

Table 4 presents intangible investments as a share of value added, averaged across the years 2003-2007. In the EU 15 intangible investments in training represent 1.8 of GDP but less than a third as large in the new member states. These investments represent a lower share of production industry value added than in the total economy and is highest in the non-market sectors, where the much higher training propensity more than compensates for the lower duration and lower opportunity cost.

Results for individual countries are shown in Appendix Table A.1. It shows the UK as the country most willing to spend on training followed by Denmark and Finland. The shares in Table A.1 are somewhat higher than those of other authors, e.g. for the UK, 2.45% in 2004 estimated by Giorgio-Marrano and Haskel (2006) and Finland, 1.5% in 2005 estimated by Jalava, Aulin-Amhavarra and Alanen (2007). These differences largely reflect the higher opportunity costs calculated in this paper arising from the composition adjustment, but also reflect some differences in source data. In general intangible investment in training is a lower share of GDP in smaller countries and in new member states. However the share is much smaller for Italy than other large EU-15 countries and the figure for Slovenia, a small new member state, is larger than Austria, Belgium or Spain.

Table 4. Intangible investments in Training as a % of GDP, average 2003-07

	Total	*Production Industries*	*Market Services*	*Non-market services*
EU24*	1.63	1.06	1.52	2.81
EU15	1.81	1.21	1.68	3.01
EU9*	0.52	0.27	0.46	1.28

*Excluding Malta.

It is useful to compare these figures with expenditure on general education as a percent of GDP. Table 5 summarises this information for the EU with country values shown in Appendix Table A3. Comparing Tables 4 and 5 shows that continuous training is about a third as large as spending on general education. It represents a higher share of GDP than either primary or tertiary education, although to be strictly comparable the latter should also account for the time students spend on their studies. Failure to take account of continuous training is likely to seriously understate the magnitude of human capital accumulation and its impact on growth. We now to an analysis of the sources of growth to gain additional insight into the impact of this understatement.

Table 5. Education as % of GDP, average 2007

	Total*	*Primary*	*Secondary*	*Tertiary*
EU25	4.98	1.16	2.21	1.12
EU15	5.01	1.16	2.23	1.13
EU10	4.75	1.22	1.98	0.99

Source: Eurostat. * includes pre-primary education

4. Training Capital and Growth Accounting

In order to estimate the impact of these investments on productivity it is necessary to convert investment values to volumes and construct capital stocks. The convention in the literature set by Corrado, Hulten and Sichel (2005) is to use the GDP deflator to construct volume measures. However in this paper we employed an earnings deflator instead, to ensure that cross country differences are not driven by changes in real earnings; sensitivity of the estimates to this assumption are considered further below.

In all such exercises the perpetual inventory method that cumulates investments and deducts depreciation is employed to convert to stocks. The most common assumption employed in the literature on the form of the depreciation function is geometric decay

(Jorgenson, Gollop and Fraumeni, 1987) – this is largely due to the relative simple calculations this entails. If we let I denote investment and K capital, geometric decay allows capital at time t to be estimated as:

(3) $K_t = K_{t-1}(1- d) + I_t$

Where d is the depreciation rate. Geometric decay implies that proportionally more of the asset is depreciated early in its use. It is common in the intangibles literature to employ relatively high depreciation rates to take account of the idea that many of these investments are associated with new technologies that change rapidly. In this study we employ a 25% depreciation rate, instead of the 40% rate employed in other studies, to take account of the fact that not all training is associated with new technology. Again the sensitivity of the estimates to this assumption is discussed below.

The estimates of capital stocks derived in (3) can be combined in a growth accounting equation to estimate the impact of intangible training capital on output growth. The growth accounting methodology assumes the existence of a value added production function for country j at time t, given by:

(4) $$Y_{jt} = f_j\left(K_{jt}, L_{jt}, X_{jt}, T\right)$$

where *Y* is output, *K* is an index of tangible capital service flows, *L* is an index of labour service flows and *X* is an index of intangible capital flows. Under the assumptions of competitive factor markets, full input utilization and constant returns to scale, the growth of output can be expressed as the cost-share weighted growth of inputs and technological change (A^Y), using the translog functional form common in such analyses:

(5) $$\Delta \ln Y_{jt} = \bar{v}^K_{jt} \Delta \ln K_{jt} + \bar{v}^L_{jt} \Delta \ln L_{jt} + \bar{v}^X_{jt} \Delta \ln X_{jt} + \Delta \ln A^Y_{jt}$$

where $\bar{v}^i$ denotes the two-period average share of input *i* in nominal output defined as follows:

(6) $$v^L_{jt} = \frac{P^L_{jt} L_{jt}}{P^Y_{jt} Y_{jt}}; \quad v^K_{jt} = \frac{P^K_{jt} K_{jt}}{P^Y_{jt} Y_{jt}} \quad v^X_{jt} = \frac{P^X_{jt} X_{jt}}{P^Y_{jt} Y_{jt}};$$

and $\bar{v}^L + \bar{v}^K + \bar{v}^X = 1$. Each element on the right-hand side of (5) indicates the proportion of output growth accounted for by growth in capital services, labour services, intangible capital services and technical change as measured by multifactor productivity (MFP), respectively. If inputs are further disaggregated by type (e.g. assets or workers with

different marginal productivities) an expanded version of equation (5) can be used to estimate the impacts on output growth of both changes in input volumes and input composition.

The analysis in this section makes use of the EU KLEMS database, which provides a breakdown of output into conventional capital inputs (with a division into ICT- and non-ICT assets), labour input (divided into labour hours and labour composition) and derived variables such as MFP at industry level (O'Mahony and Timmer 2009). To this we add intangible training capital, with weights $\bar{v}^x$ as nominal investment expenditures divided by value added. The latter (and constant price value added) were adjusted upwards by the amount of the investments in training since these expenditures would have been previously classified to intermediate expenditures.[5]

Table 6 shows growth in training intangible capital stocks and its contribution to value added growth. The results suggest that intangible capital growth from on the job training was very high in the period since 2001 in the EU15. To place this in perspective the growth rate of real tangible physical capital in the EU15 was only 2.6% per annum in the same period, with ICT capital growing at 7.3% per annum.[6] The contribution of intangible training capital in the EU15ex at 0.09 is more than half the contribution from labour composition, 0.15, which in turn is mainly driven by up-skilling of the workforce arising from general education. In a number of countries, namely, Denmark, Spain, Finland, France, the Netherlands, Slovenia and the UK these high growth rates translate into small but significant contributions to value added growth – see Appendix Table A4. In contrast, in many countries where labour composition changes are very high, e.g. the Czech Republic, Ireland and Hungary, the contribution of training capital is small.

[5] The case for adjusting upwards by the opportunity costs element is less straightforward than direct costs as firms who lose working time to training may hire additional labour to compensate and these payments will be already part of value added. Adjustments to value added that exclude the opportunity costs make little difference to the estimates.

[6] This number, derived from EU KLEMS data, includes some intangible capital in the form of software; see O'Mahony and Timmer (2009) for more details of capital growth rates in the EU.

Table 6. Intangible Training capital and output growth, 2001-2007.

	Growth in intangible training capital (% p.a.)					Contribution of intangible training capital to value added growth[1]			
	Total	**Production Industries**	**Market Services**	**non-market services**		**Total**	**Production Industries**	**Market Services**	**non-market services**
EU24	5.29	3.58	6.35	5.12		0.07	0.03	0.08	0.12
EU15	5.37	3.66	6.45	5.20		0.08	0.04	0.09	0.13
EU15ex[2]	5.58	3.91	6.65	5.38		0.09	0.04	0.10	0.14
EU9	2.15	0.46	2.75	2.50		0.01	0.00	0.01	0.03

Notes: 1.Growth in intangible capital times share in value added. 2; aggregate across EU-15 countries for which full growth accounts are reported, i.e. Austria, Belgium, Denmark, Spain, Finland, France, Germany, Italy, Netherlands and the UK. This aggregate is employed further in the analysis below.

Table 6 and Appendix Table A4 also show growth in intangible training capital and contributions to output growth by broad sector. Training capital is most important in non-market sectors - in the EU aggregates and almost all individual countries the contributions are greater in non-market services than in the total economies. The Tables also show that contributions are significantly higher in market services than manufacturing in the EU and in most individual countries. Growth rates of intangible training capital and contributions to value added in individual sectors (not shown) indicate that the contributions are highest in the health sector, with intangible training capital also important in financial services, business services and wholesale and retail trade.

The estimates above may be sensitive to the assumptions underlying the estimation methods including measuring real investments and on the assumptions employed to capitalise these assets. When the GDP deflator is employed to convert nominal investments to volumes then growth in intangible capital is a little higher in the EU-15 and its contribution to growth is about 0.01 percentage points higher. The assumption of a 40% depreciation rate, on the other hand leads to lower capital growth and about 0.015 percentage point lower contribution. The largest impact is in the group of new member states where a 40% depreciation rate implies negative growth in intangible training capital and so a small negative contribution to growth. In general though the two assumption employed

Finally in this section we examine the contribution to output growth of the measures presented in Table 6 relative to other inputs. Table 7 presents output growth and contributions of the knowledge economy for the EU15ex group of countries for which

estimates of ICT capital are available in EU KLEMS. When looking at the contributions of the components of output growth, the impact of labour composition is generally relatively small and lower than 'knowledge' inputs such as ICT capital. Table 7 shows that the combined contribution of labour composition and training is much closer to that for ICT capital. Therefore failure to include training investments underestimates the impact of changes to the average skill level of the labour force.

Table 7. Contributions of inputs to output growth, EU15ex. (percentage points per annum, 2001-2007)

	Value added		Hours worked	Non-ICT Capital	ICT Capital	Labour composition	Training	MFP
Growth rate	**1.98**		0.71	2.00	7.29	0.19	5.58	0.35
Percentage point contribution to value added growth			0.47	0.61	0.32	0.14	0.09	0.35

Source: EU KLEMS with adjustments to value added to include investments in intangible training.

5. Conclusions

This paper linked the microdata underlying the EU LFS to industry data from EU KLEMS to estimate investment in continuous training and their importance as sources of growth in the European Union. Modelling training activities as intangible investments allows us to compare the extent of these investments across countries and compare with impacts of human capital formation acquired through the general education system.

In the EU-15 and a number of individual countries, intangible capital from investing in training is a significant contributor to output growth. The results suggest that ignoring continuous training leads to a significant understatement of the contribution of human capital to growth. Van Ark, O'Mahony and Timmer (2008) define knowledge economy contributions to output growth as the sum of the contributions of ICT capital, labour composition (mostly due to up-skilling of the labour force), and MFP. The inclusion of training capital suggests that about 25% of the contributions of knowledge inputs are directly related to increases in the level of human capital in the workforce. In a companion paper O'Mahony and Peng (2010), using an industry panel dataset for EU countries, show that continuous training linked with ICT is an important determinant of growth. In conclusion understanding the knowledge economy requires more attention to human capital than earlier growth accounting estimates suggest.

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Appendix Table A.1. Proportions of the workforce receiving training (TR) and Intangible investments in Training as a % of GDP (ITRG), average 2003-07

	Total Economy			***Production Industries***			***Market Services***			***Non-market services***	
	TR	ITRG		TR	ITRG		TR	ITRG		TR	ITRG
Austria (AT)	11.2	2.1		7.9	1.3		9.8	1.8		17.7	4.4
Belgium (BE)	7.2	0.9		5.3	0.8		6.4	0.7		9.6	1.5
Germany (DE)	5.7	1.3		3.8	0.9		4.8	1.1		9.6	2.3
Denmark (DK)	24.0	4.2		18.0	3.1		23.4	3.9		29.2	6.0
Spain (ES)	15.0	1.3		4.9	0.9		22.9	1.1		13.8	2.8
Finland (FI)	19.2	2.2		14.0	1.2		17.0	2.0		27.0	4.3
France (FR)	8.3	1.5		6.8	1.5		7.8	1.3		10.4	2.1
Greece (GR)	1.6	0.2		0.6	0.1		1.6	0.1		2.5	0.6
Ireland (IE)	5.0	0.6		3.1	0.2		4.4	0.6		8.1	1.6
Italy (IT)	3.7	0.3		1.9	0.2		2.9	0.2		7.9	0.9
Luxembourg (LU)	7.7	1.2		4.4	0.8		8.2	1.1		10.7	1.9
Netherlands (NL)	10.5	2.5		8.6	1.4		10.2	2.8		12.4	3.4
Portugal (PT)	1.5	0.4		0.9	0.2		1.4	0.3		2.7	0.8
Sweden (SE)	20.7	1.5		15.6	1.1		19.1	1.3		26.3	3.1
United Kingdom (UK)	27.6	4.4		21.2	3.1		25.5	4.1		36.2	7.1
Cyprus (CY)	7.2	0.8		3.3	0.4		6.8	0.6		12.7	1.7
Czech Republic (CZ)	5.1	0.5		3.3	0.3		5.4	0.4		8.5	1.1
Estonia (EE)	3.8	0.7		1.6	0.2		3.4	0.6		8.2	2.2
Hungary (HU)	1.9	0.4		1.2	0.2		2.2	0.4		2.6	0.6
Lithuania (LT)	3.2	0.4		1.1	0.1		2.9	0.4		6.3	1.4
Latvia (LV)	4.6	1.1		2.0	0.4		4.4	0.8		9.1	2.9
Poland (PL)	3.5	0.5		1.9	0.2		3.2	0.3		6.1	1.4
Slovenia (SI)	10.8	1.5		6.7	1.1		10.7	1.3		19.3	3.1
Slovakia (SK)	4.4	0.6		2.5	0.3		5.2	0.8		5.6	1.1

Source: Based on data from EU LFS, EU KLEMS and Eurostat CVTS. For methods see text.

Table A.2. Average duration of training (hours),average 2003-07

	Hours
EU24*	**15.3**
EU15	**15.2**
EU9*	**15.3**
Austria (AT)	16.1
Belgium (BE)	14.9
Germany (DE)	16.9
Denmark (DK)	15.3
Spain (ES)	22.9
Finland (FI)	11.3
France (FR)	18.5
Greece (GR)	22.3
Ireland (IE)	13.0
Italy (IT)	14.5
Luxembourg (LU)	15.8
Netherlands (NL)	16.0
Portugal (PT)	19.2
Sweden (SE)	9.8
United Kingdom (UK)	11.9
Cyprus (CY)	13.4
Czech Republic (CZ)	11.5
Estonia (EE)	15.4
Hungary (HU)	22.2
Lithuania (LT)	15.9
Latvia (LV)	15.8
Poland (PL)	16.4
Slovenia (SI)	15.4
Slovakia (SK)	15.1

Source EU LFS, * excluding Malta

Table A.3. Education expenditures as a percent of GDP

	Total**		primary	secondary	tertiary
Austria (AT)	5.40		0.97	2.52	1.5
Belgium (BE)	6.02		1.42	2.58	1.31
Germany (DE)	4.50		0.63	2.25	1.14
Denmark (DK)	7.83		1.86	2.80	2.29
Spain (ES)	4.35		1.10	1.66	0.99
Finland (FI)	5.91		1.20	2.52	1.85
France (FR)	5.59		1.17	2.55	1.23
Greece (GR)	4.00		1.14	1.42	1.44
Ireland (IE)	4.90		1.72	2.03	1.14
Italy (IT)	4.29		1.08	1.98	0.76
Luxembourg (LU)	3.15		1.69	1.46	na
Netherlands (NL)	5.32		1.32	2.16	1.45
Portugal (PT)	5.30		1.48	2.09	1.2
Sweden (SE)	6.69		1.68	2.64	1.77
United Kingdom (UK)	5.39		1.65	2.45	0.94
Cyprus (CY)	6.93		1.95	3.03	1.61
Czech Republic (CZ)	4.20		0.58	2.03	1.07
Estonia (EE)	4.85		1.13	2.25	1.07
Hungary (HU)	5.20		0.99	2.29	1.03
Lithuania (LT)	4.67		0.67	2.41	1.01
Latvia (LV)	5.00		1.24	2.11	0.93
Poland (PL)	4.91		1.59	1.89	0.93
Slovenia (SI)	5.19		2.26	1.16	1.21
Slovakia (SK)	3.62		0.67	1.69	0.79

Source: Eurostat. ** includes pre-primary education

Table A.4. Intangible Training capital and output growth, 2001-2007, sector

	Growth in intangible training capital (% p.a.)					Contribution of intangible training capital to value added growth			
	Total	**Production Industries**	**Market Services**	**non-market services**		**Total**	**Production Industries**	**Market Services**	**non-market services**
Austria (AT)	3.03	0.62	3.48	4.11		0.06	0.01	0.06	0.16
Belgium (BE)	2.98	0.47	3.00	4.90		0.02	0.00	0.02	0.05
Germany (DE)	4.30	2.68	5.68	3.99		0.05	0.02	0.05	0.08
Denmark (DK)	5.95	4.50	7.37	5.36		0.21	0.13	0.25	0.27
Spain (ES)	13.49	14.43	13.47	12.95		0.17	0.12	0.15	0.34
Finland (FI)	6.21	5.25	6.47	6.52		0.12	0.06	0.11	0.24
France (FR)	7.44	6.61	8.59	6.82		0.09	0.08	0.09	0.11
Greece (GR)	5.32	2.33	2.54	8.19		0.01	0.00	0.00	0.03
Ireland (IE)	3.63	-1.06	4.50	5.05		0.02	0.00	0.03	0.08
Italy (IT)	5.87	3.01	6.84	6.97		0.02	0.01	0.01	0.05
Luxembourg (LU)	9.33	6.28	10.12	9.07		0.09	0.04	0.09	0.15
Netherlands (NL)	12.47	9.38	11.74	16.07		0.27	0.11	0.28	0.44
Portugal (PT)	-0.86	-4.34	-2.89	1.95		0.00	-0.01	-0.01	0.02
Sweden (SE)	1.39	-0.68	2.28	1.69		0.01	0.00	0.02	0.03
United Kingdom (UK)	3.20	1.19	4.21	3.01		0.12	0.03	0.14	0.18
Cyprus (CY)	10.07	8.80	7.17	13.50		0.06	0.02	0.04	0.17
Czech Republic (CZ)	-0.86	-0.69	-0.90	-0.93		0.00	0.00	0.00	-0.01
Estonia (EE)	1.53	-0.06	3.88	0.05		0.01	0.00	0.02	0.00
Hungary (HU)	0.72	-1.60	1.47	1.17		0.00	0.00	0.00	0.00
Lithuania (LT)	3.19	2.81	7.84	0.39		0.01	0.00	0.02	0.01
Latvia (LV)	3.07	1.12	3.84	2.86		0.03	0.01	0.03	0.08
Poland (PL)	1.70	-1.28	2.80	2.34		0.01	0.00	0.01	0.03
Slovenia (SI)	10.45	10.37	9.61	11.42		0.12	0.08	0.09	0.25
Slovakia (SK)	0.66	1.78	0.93	-0.69		0.00	0.00	0.01	-0.01