LLEE Working Paper Series

SOURCES OF LABOR PRODUCTIVITY GROWTH IN THE EU AND THE US: THE ROLE OF INTANGIBLE AND ICT CAPITAL

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Working Paper No. 111
May 2014

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Sources of Labor Productivity Growth in the EU and the US: the Role of Intangible and ICT Capital[1] [2]

Massimiliano Iommi[3]

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Abstract: This paper provides a growth accounting analysis of the sources of labor productivity growth in the business sector of 13 EU Member States and the US in the years 1995-2009. The aim of the analysis is to provide new evidence on the role of intangible and ICT capital as drivers of economic growth. We adopt the approach first proposed by Corrado, Hulten and Sichel and we extend the standard growth accounting model treating a broad range of firm expenditures for intangibles as investments that create future value. Our main results are the following: Capitalizing intangibles increases labor productivity growth in the period 1995-2009 with respect to labor productivity growth estimated from current national accounts data; Capital deepening was the dominant source of growth in 11 out of the 14 countries included in the analysis and in the other three its contribution was very close to the contribution of multi factor productivity growth; The contribution of ICT capital and Intangible non-ICT capital to labor productivity growth was quite high in all countries that performed relatively well in terms of labor productivity growth; When focusing on the US and the EU15 countries, there is a positive relationship between the growth of ICT and Intangible non-ICT capital deepening and the growth of multifactor productivity.

Keywords: Productivity growth, Intangibles, ICT.

JEL reference: O47, E22,E01.

[1] This analysis have been produced within a contract with the European Union – DG CONNECT (request ARES (2012)931997) and this paper was delivered as European Policy Brief to DG CONNECT. The options expressed are those of the contractor only and do not represent the contracting authority's official position.

[2] The author is very grateful to Alain Stekke for helpful discussion on the topic, valuable comments on early drafts and his support during the preparation of the Policy Brief. The author retains sole responsibility for any remaining deficiencies. The views expressed in the Policy Brief are those of the author and do not involve the responsibility of the Italian Statistical Institute or the Luiss Lab of European Economics.

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Introduction

This Policy Brief is a growth accounting analysis of the sources of labor productivity growth in the business sector of 13 EU Member States[4] and the US in the years 1995-2009. The aim of the analysis is to provide new evidence on the role of intangible and ICT capital as drivers of economic growth. With the term intangibles we refer to firms expenditures in knowledge creation. Such expenditures are strategic investments in the long-run growth of individual companies and of the economy as a whole, but they are largely excluded from national accounts GDP and capital stock. We adopt the approach first proposed by Corrado, Hulten and Sichel[5] and we extend the standard growth accounting model treating a broad range of firm expenditures for intangibles as investments that create future value. Treating these expenses as investments means that they are included in GDP and that they are capitalized and added to the capital stock (intangible capital). Thus, the inclusion of intangibles in investment estimates changes the pattern of GDP and labor productivity growth and provides a different picture of the drivers of economic growth with respect to analysis that are based only on official national accounts data.

The analysis is based on the integration of two databases: EU KLEMS (the source of data on hours worked and ICT and non-ICT tangible assets consistent with current national accounts statistics) and INTAN-Invest (that provides harmonized business sector data on intangible assets and on output consistent with the extended definition of asset boundary for 1995-2009)[6]. EU KLEMS database provides data up to 2007. Estimates for 2008 and 2009 are author's own calculation based on national accounts estimates and WIOD database[7].

Intangible assets are classified under three main headings: Software, Innovative property (R&D, design, new product in financial services mineral explorations, entertainment and artistic originals), Economic competencies (market research and advertising, organizational structure, employer-provided training). Software, mineral explorations and entertainment and artistic originals are the only components that are considered investment in current national account data.

[4] EU Member States are: Austria, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, The Netherlands Slovenia, Spain, Sweden, the United Kingdom.

[5] Corrado, Carol, Charles Hulten and Daniel Sichel (2009), *Intangible Capital and US Economic Growth*. The Review of Income and Wealth 55: 3 (September), 661-685.

[6] INTAN-Invest estimates are the results of the joint work of Carol Corrado, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi and are the authors' own elaboration of work they previously conducted under three projects: two funded by the European Commission 7th Framework Program (COINVEST and INNODRIVE) and an ongoing effort of The Conference Board. The data are described in Corrado, Carol A., Jonathan Haskel, Cecilia Jona Lasinio and Massimiliano Iommi (2012), *Intangible Capital and Growth in Advanced Economies: Measurement and Comparative Results*. The working paper and the data are publicly available at http://www.intan-invest.net. The construction of EU-KLEMS database was funded by the EU Commission 6th Framework Program and the data are available at http://www.euklems.net.

[7] WIOD (World Input Output Database) is a project funded by the European Commission 7th Framework Program. The data are publicly available at http://www.wiod.org.

Box 1. The extended growth accounting model

Growth accounting provides a breakdown of observed labor productivity growth into components associated with changes in the composition of labor force, changes in capital deepening and a residual (called multifactor productivity) that reflects technological progress not embodied in production inputs and other elements as business cycle, spillovers, increasing return to scale (but also measurement errors).

Labor productivity growth = the sum of changes in:

Labor composition (skills)
Capital deepening (capital per hour worked):

Tangible
- Machinery and Equip.
- Transport Equipment
- Construction works

→ *Tangible non-ICT*

- Computing equipment
- Communication equip.

→ *ICT*

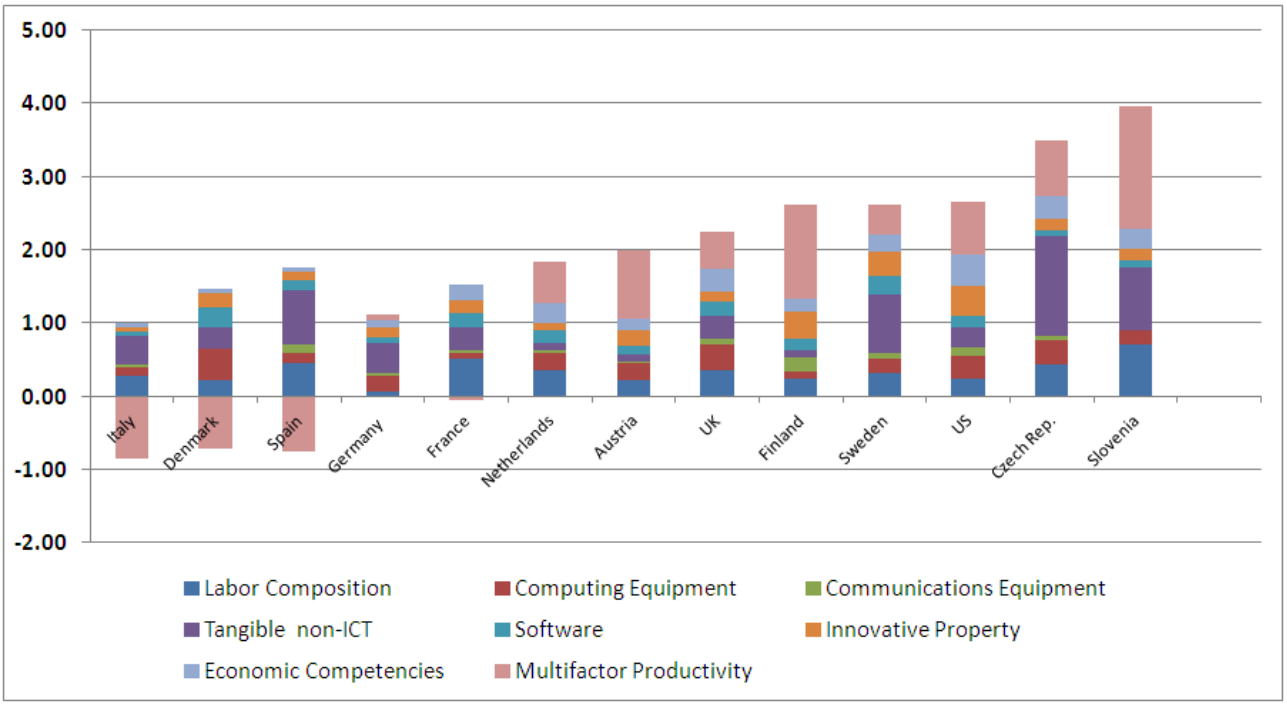
- Software

Intangible
- Innovative property
- Economic competencies

→ *Intangible non-ICT*
(almost completely excluded from national accounts GDP and capital stock)

Multi factor productivity (technical progress but also business cycle, spillovers, imperfect competition, increasing return to scale, measurement errors)

Figure 1, Growth accounting decomposition of the sources of labor productivity growth, 1995-2009



Structure of the analysis

- Technical progress is what drives labor productivity and long-term economic growth. In the short-term, economic growth and productivity are very sensitive to the business cycle. The period covered by this analysis (1995-2009) is not only short to measure long term economic progress; it has also suffered major economic crisis (dotcom crash in 2000 and the 2007 financial crisis). Over the business cycle, labor productivity growth rather measure the degree of utilization of production capacities and the corresponding changes in worked hours. The outcome of this relationship is highly dependent on labor market regulations.

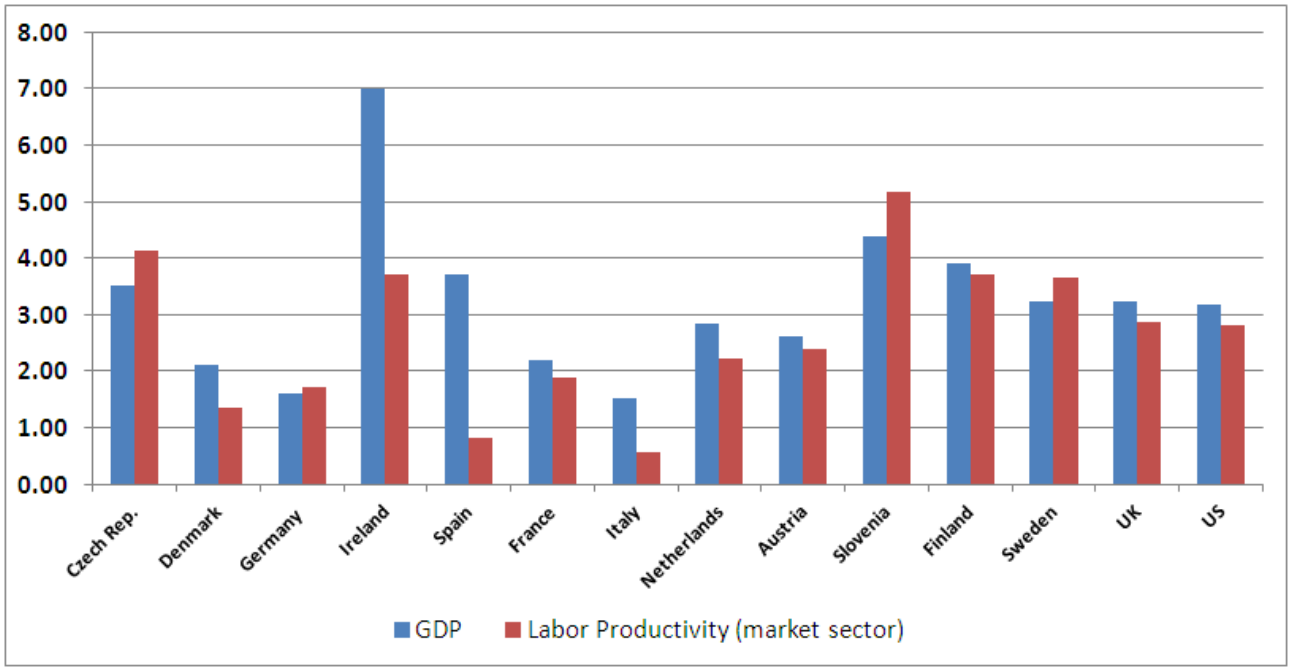
The analysis distinguishes between two periods: 1995-2009 and 2007-2009. .

- Some EU Member States are still in a catching up phase. Capital deepening, whether ICT or not, is the name of the game. Spain economic growth did not rely on productivity growth but rather on the catching up process and an important flow of immigrants where most resources were allocated to infrastructures and housing.

The analysis includes two catching up economies: Slovenia and the Czech Republic.

- Otherwise, economic growth and productivity growth are closely related even over such a short period of time (less clearly for Italy and Denmark)

Figure 2, GDP and Labor productivity growth, 1995-2007



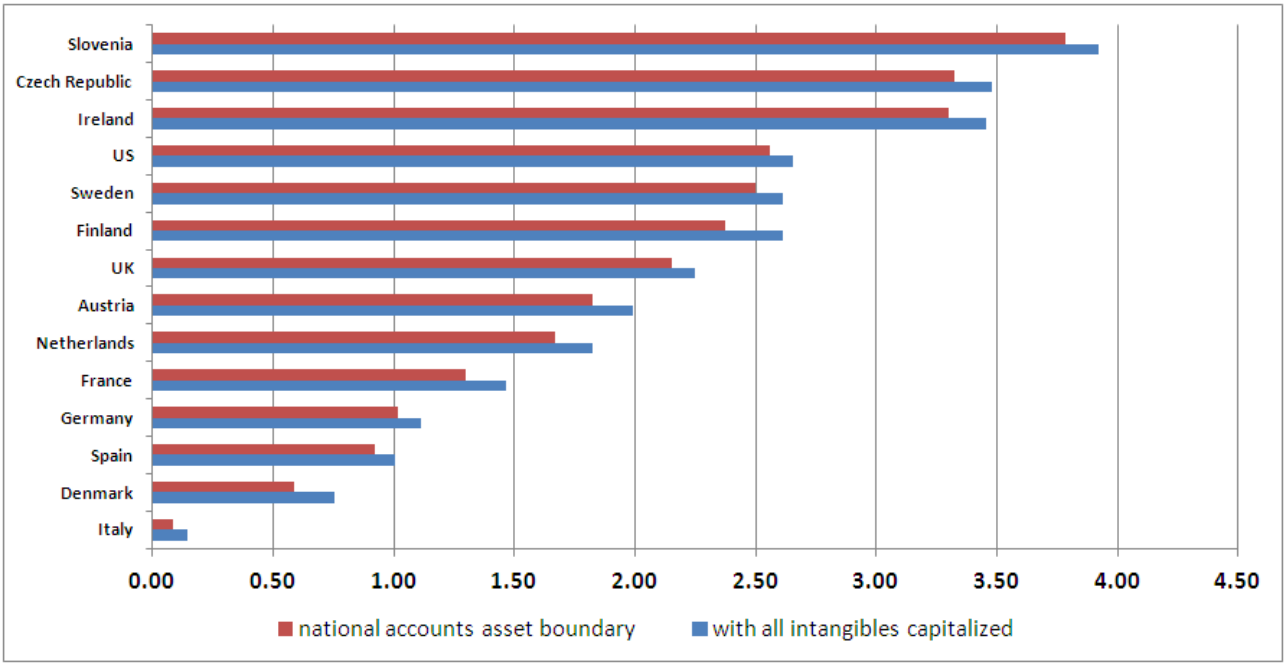
Analysis

1 THE WHOLE PERIOD: 1995-2009

Capitalizing intangibles increases labor productivity growth in the period 1995-2009 in all countries included in our analysis, although the impact is quite small (Figure 3).

The productivity growth rates in 1995-2009 were by far the highest for Ireland and the two new member states considered in the analysis, Czech Republic and, above all, Slovenia. Also the US, Finland and Sweden showed relatively fast productivity growth. Among the larger European countries, only the UK is close behind the US. France, Germany and Spain all showed positive rates of growth but well below the US, while productivity growth was sluggish in Italy. Productivity growth was relatively low also in Denmark, while Austria and the Netherlands were close behind the UK.

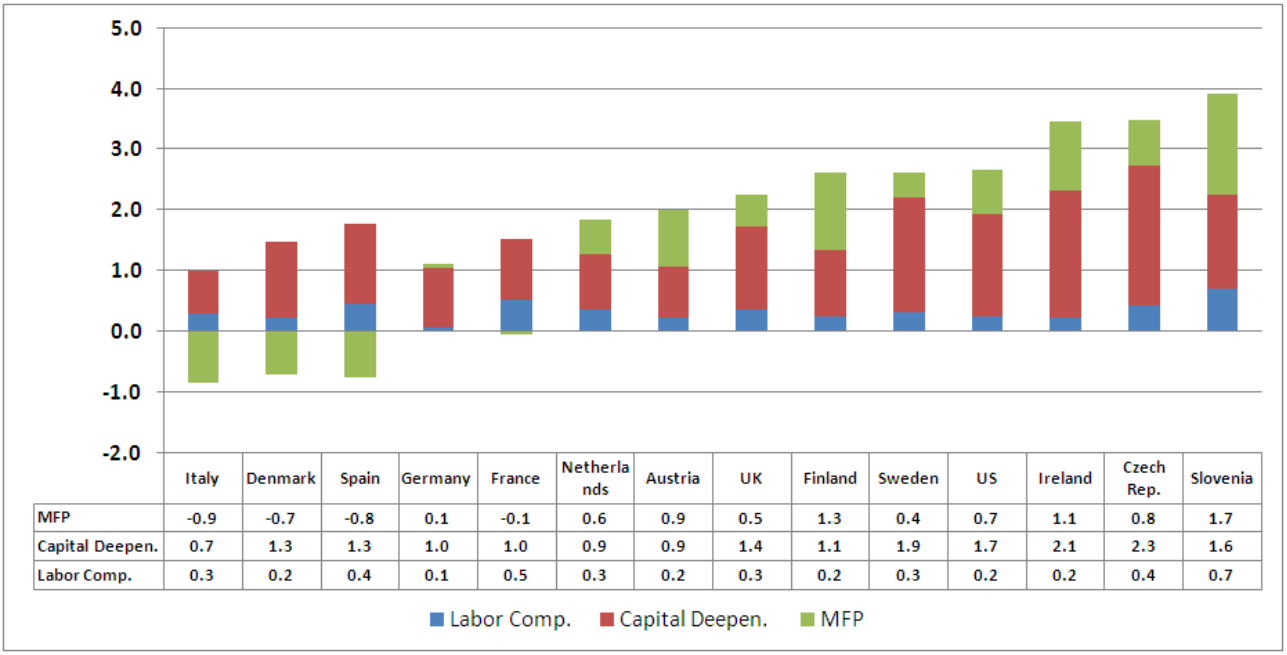
Figure 3, Labor Productivity (average growth 1995-2009)



In the period 1995-2009 capital deepening was the dominant source of growth in 11 out of 14 countries and in the other three (Austria, Slovenia and Finland) its contribution was very close to the contribution of multi factor productivity (MFP) growth (figure 4). Changes in labor composition were important sources of growth in France, Spain, Czech Republic and, above all, Slovenia.

The sluggish productivity growth in Italy was due to a combination of negative MFP growth and a positive but small contribution of capital deepening. Spain and Denmark showed negative MFP similar to Italy, but a higher contribution of capital deepening. A different picture holds for Germany, where the low productivity growth was due to a positive but negligible contribution of MFP and labor composition and a small contribution from capital deepening. France shared with Germany a sluggish MFP growth and a small contribution from capital deepening, but showed a slightly better productivity performance thanks to a relatively high contribution of changes in labor composition

Figure 4. Sources of labor productivity growth, 1995-2009

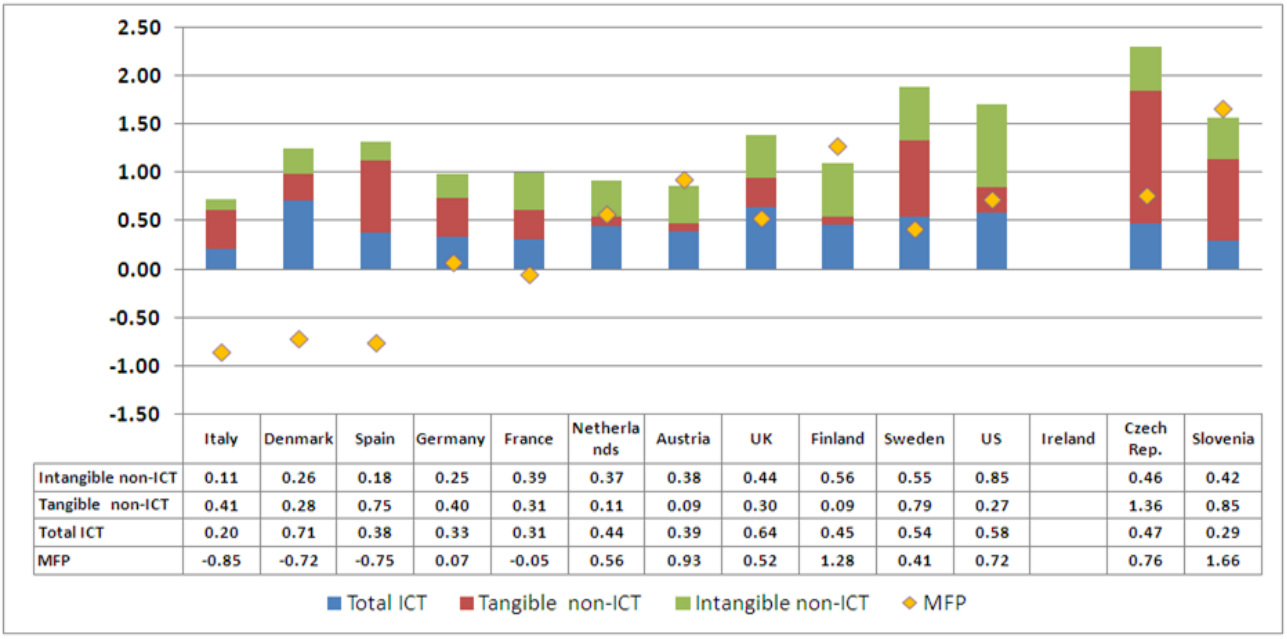


	Italy	Denmark	Spain	Germany	France	Netherlands	Austria	UK	Finland	Sweden	US	Ireland	Czech Rep.	Slovenia
MFP	-0.9	-0.7	-0.8	0.1	-0.1	0.6	0.9	0.5	1.3	0.4	0.7	1.1	0.8	1.7
Capital Deepen.	0.7	1.3	1.3	1.0	1.0	0.9	0.9	1.4	1.1	1.9	1.7	2.1	2.3	1.6
Labor Comp.	0.3	0.2	0.4	0.1	0.5	0.3	0.2	0.3	0.2	0.3	0.2	0.2	0.4	0.7

The contribution from capital accumulation in Slovenia and Czech Republic was due mainly to the contribution from tangible non-ICT capital deepening (although the role of ICT and intangible non-ICT is anything but negligible) (figure 5). When focusing the analysis on the US and EU15 countries, a clear pattern emerges: the contribution of ICT capital to labor productivity growth was quite high in all countries that performed relatively well in terms of labor productivity growth and it exceeded that of tangible non-ICT capital (with Sweden as the only exception, where the contribution of ICT were very high but the contribution from tangible non-ICT were even higher); on the other hand, the contribution of tangible non-ICT capital exceeded or was equal to that of ICT capital in all countries that performed relatively bad in terms of labor productivity growth , with the only exception of Denmark (that actually showed the highest contribution of ICT among the countries in included in our analysis).

Intangible non-ICT (the component of capital input that is almost entirely unrecorded in current national accounts) emerges as an important source of growth in almost all countries. At least two results are worth to be noticed: 1) the contributions from intangible non-ICT is relatively low (both in absolute value and as proportion of total capital deepening contribution) in the countries that showed the more modest productivity growth (in the catching up countries its contribution is modest as proportion of total capital deepening, but quite high as absolute values); 2) as for ICT capital, when focusing on the US and the EU15 countries, the contribution of intangible non-ICT exceeded that of tangible non-ICT capital in all countries that performed relatively well in terms of labor productivity growth (again, with the only exception of Sweden, where the contribution of intangible non-ICT was among the highest ones but the contribution from tangible non-ICT were even higher) and was lower or equal to that of tangible non-ICT capital in all the bad performers.

Figure 5. Contributions of subcomponent of capital deepening, 1995-2009

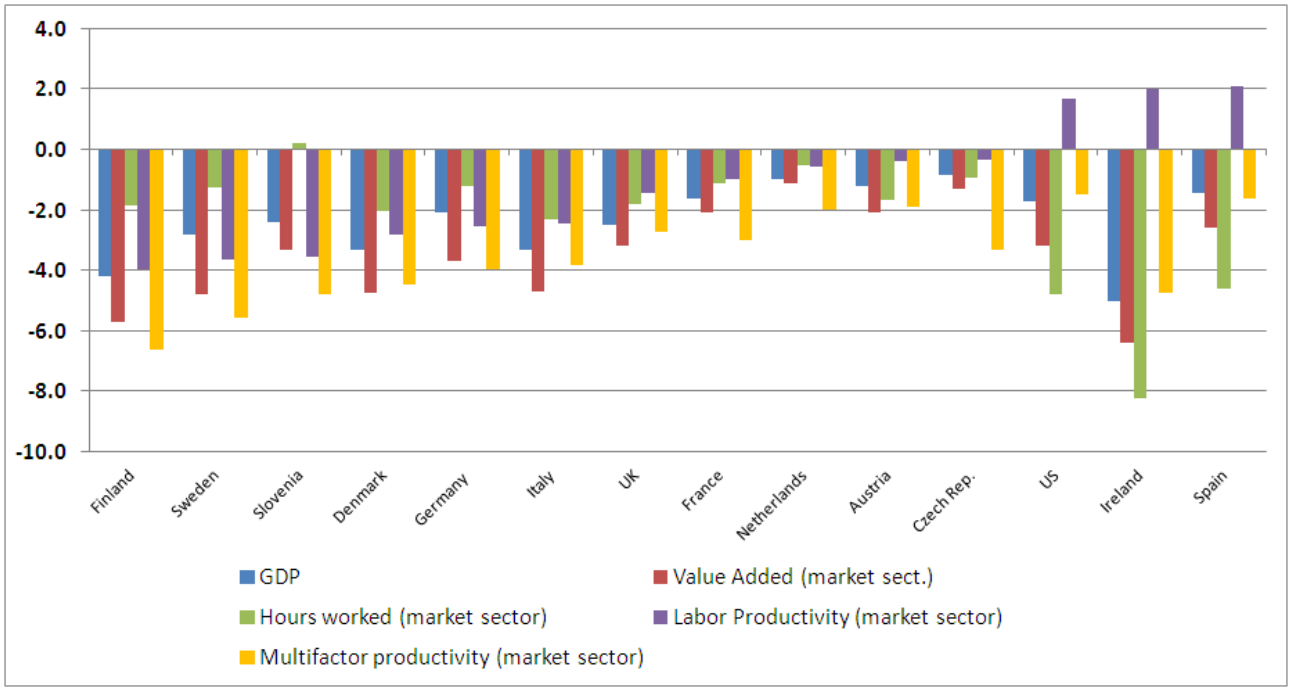


	Italy	Denmark	Spain	Germany	France	Netherlands	Austria	UK	Finland	Sweden	US	Ireland	Czech Rep.	Slovenia
Intangible non-ICT	0.11	0.26	0.18	0.25	0.39	0.37	0.38	0.44	0.56	0.55	0.85		0.46	0.42
Tangible non-ICT	0.41	0.28	0.75	0.40	0.31	0.11	0.09	0.30	0.09	0.79	0.27		1.36	0.85
Total ICT	0.20	0.71	0.38	0.33	0.31	0.44	0.39	0.64	0.45	0.54	0.58		0.47	0.29
MFP	-0.85	-0.72	-0.75	0.07	-0.05	0.56	0.93	0.52	1.28	0.41	0.72		0.76	1.66

2 THE CRISIS:2007-2009

The fall in real GDP in 2008-2009 was somewhat uneven, but all countries were affected (figure 6). The value added of the market sector decreased more than GDP in all countries. The strong negative growth in value added lead to a fall also in labor productivity in all countries excluding the US, Ireland and Spain (where the fall in hours worked was higher than the fall in output and labor productivity then increased). The decline was very strong in some of the countries that had showed the fastest growth in the previous period (Finland, Sweden and Slovenia) but also in some of the slow growing countries (Italy and Denmark). Also Germany experienced strong negative growth of labor productivity.

Figure 6, GDP and market sector value added, labor productivity and multifactor productivity, 2007-2009



At full employment of capital and labor input, TFP measures technical progress not embodied in the inputs, also referred to as the level of technology of an economy. Unfortunately, economies are rarely operating at full-employment and certainly not during 2007-2009. In this case the measured contributions of capital and labor are distorted by swings in the rate of capital utilization and effort that are not captured by the available measures of capital stocks and hours worked. Consequently TFP is no longer measuring technical progress but mainly the change in labor productivity due to the fact that firms cannot reduce instantaneously their inputs (labor market regulations, installed equipment) according to changes in output. Actually, TFP is measuring the impact on productivity of changes in the rate of utilization of inputs.

For this reason, the analysis distinguishes clearly the 1995-2007 period from the 2007-2009 period and the most detailed analysis focuses on the period before the beginning of the recession (to 2007).

In the period 2007-2009 MFP growth was negative in all countries, including US, Ireland and Spain where labor productivity growth was positive (see background slide n. 6). Measured capital deepening was instead positive and it was the predominant source of growth in all countries but France (where the highest contribution come from changes in the composition of the labor force) and Slovenia (where capital deepening and labor composition gave almost the same contribution).

3 THE 1995-2007 PERIOD

Cross-country comparison of average productivity growth rates in the period 1995-2007 is largely similar to the picture of the period 1995-2009 (see background slide n. 8). The productivity growth rates in 1995-2007 were by far the highest for Slovenia, followed by Czech Republic with Finland, Ireland and Sweden close behind. Also the UK and US performed relatively well. At the lower end of productivity rank there are Denmark and, above all, Spain and Italy.

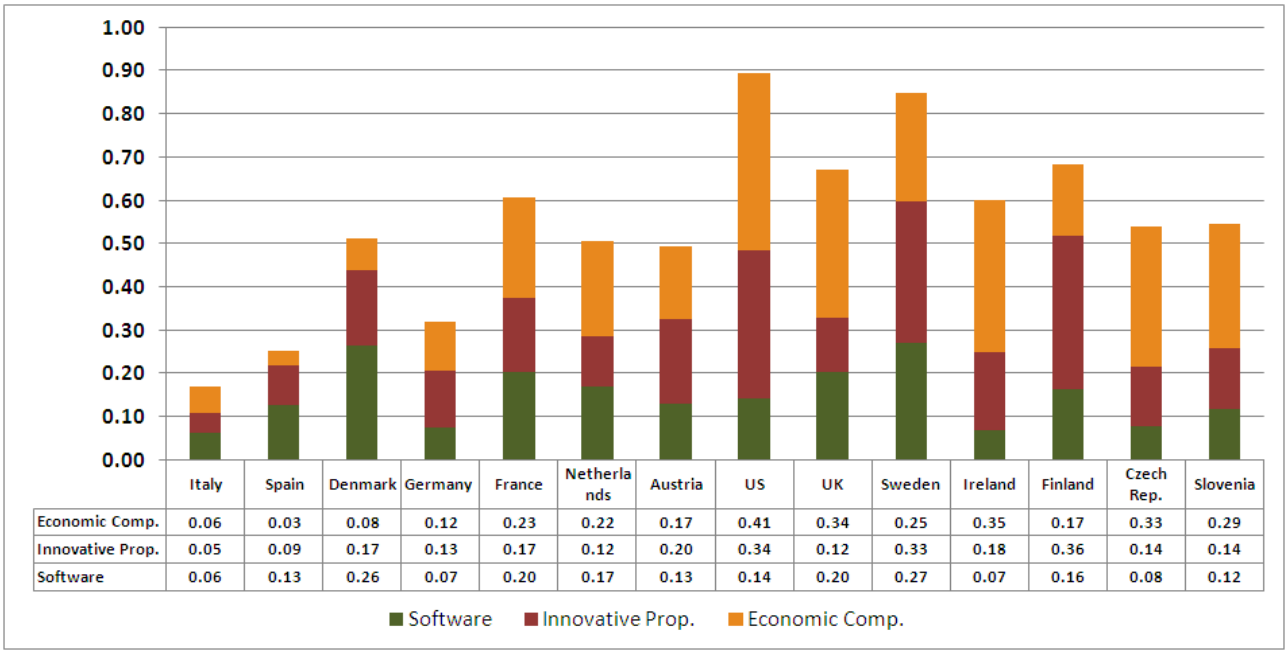
Also in the period 1995-2007 capital deepening was the dominant source of growth in most of the countries, although excluding the crisis period increases the contribution of MFP in all countries (see background slide n. 9). MFP is the dominant source of growth only in Austria, Finland, Ireland and Slovenia, while in the Netherlands its contribution is only slightly higher than the contribution of capital deepening. The slow growing countries (Italy, Spain and, to a lesser extent, Denmark) all showed negative MFP growth rates. Capital deepening is the main source of growth not only in the countries that performed relatively bad in terms of MFP growth but also in countries that showed relatively high labor and multifactor productivity growth (like Czech Republic, Sweden, US and UK). Changes in labor composition were important sources of growth in France, Spain and, above all, Slovenia.

Excluding the crisis years from the analysis and focusing on the period 1995-2007 leaves the overall picture on the role of ICT, tangible non-ICT and intangible non-ICT almost unchanged (see background slide n. 10): 1) The contribution from capital accumulation in Slovenia and Czech Republic was due mainly to the contribution from tangible non-ICT capital deepening (although the role of ICT and intangible non-ICT is anything but negligible); 2) the contributions from intangible non-ICT is relatively low (both in absolute value and as proportion of total capital deepening contribution) in the countries that showed the more modest productivity growth; 3) when focusing on the US and the EU15 countries, the contribution of ICT and of intangible non-ICT exceeded that of tangible non-ICT capital in all countries that performed relatively well in terms of labor productivity growth (again, with the only exception of Sweden, where the contribution of intangible non-ICT was among the highest ones but the contribution from tangible non-ICT was even higher) and it was lower or equal to that of tangible non-ICT capital in all the bad performer (again with the only exception of Denmark , that actually, together with the UK, showed the highest contribution of ICT among the countries included in our analysis).

Capital deepening contribution come both from tangible and intangible assets, although with many differences across countries (see background slide n.11). The contribution from capital accumulation in Slovenia and Czech Republic was due mainly to the contribution from tangible capital deepening but the contribution from intangible capital deepening was quite important too. Intangible capital accumulation was an important source of growth in all the other countries that experienced high labor productivity growth rates (yet more important than tangible capital in Finland, the UK and the US). Austria, France and Netherland showed significant contributions from intangible capital (higher than the contribution from tangible) against the backdrop of smaller growth rates of labor productivity. Italy and Spain both show small absolute contributions from intangible assets (and much smaller than contribution from tangibles) coupled with negative MFP growth rates. Germany and Denmark showed a peculiar experience: Germany shares with Italy and Spain a small contribution from intangibles, but coupled with a positive MFP growth rates. Denmark is the opposite: high contribution from intangible and negative MFP growth rates.

There are also significant differences in the accumulation of intangibles by broad type across countries (figure 7). Among the countries that showed high contribution from intangibles and rapid productivity growth, the US and the UK were more based on economic competencies while Finland and Sweden relied more on the accumulation of innovative property. On the other hand, the countries that had the smaller contribution from intangibles (Italy, Spain and, to a lesser extent, Germany), showed a small contribution from all the three components.

Figure 7. Contributions of subcomponent of intangible capital deepening, 1995-2007

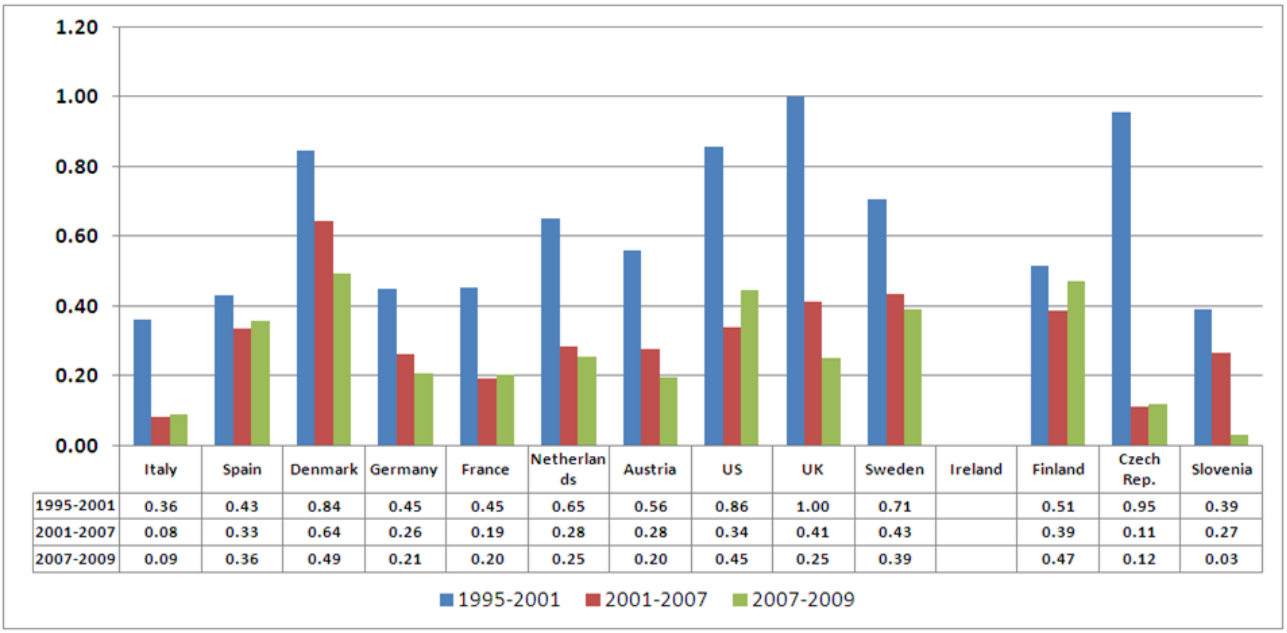


	Italy	Spain	Denmark	Germany	France	Netherlands	Austria	US	UK	Sweden	Ireland	Finland	Czech Rep.	Slovenia
Economic Comp.	0.06	0.03	0.08	0.12	0.23	0.22	0.17	0.41	0.34	0.25	0.35	0.17	0.33	0.29
Innovative Prop.	0.05	0.09	0.17	0.13	0.17	0.12	0.20	0.34	0.12	0.33	0.18	0.36	0.14	0.14
Software	0.06	0.13	0.26	0.07	0.20	0.17	0.13	0.14	0.20	0.27	0.07	0.16	0.08	0.12

4 TRENDS IN ICT CONTRIBUTIONS

The contribution to labor productivity growth of ICT in 2001-2007 declined with respect to the contribution in 1995-2001 in all countries (figure 8). Notwithstanding the decline with respect to the previous period, in the 2001-2007 the contribution of ICT to labor productivity growth was still relevant (although less impressive than in 1995-2001) in all countries but Italy and Czech Republic.

Figure 8. Contribution of ICT to labor productivity growth over selected intervals, 1995-2009



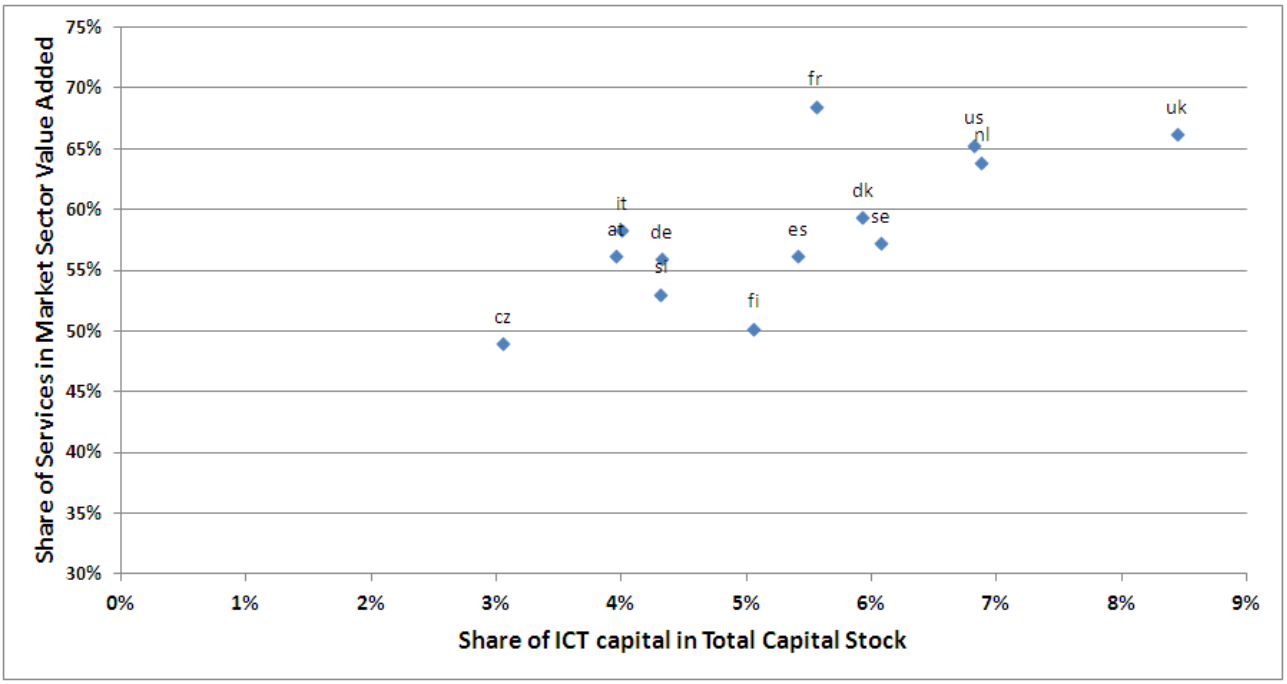
	Italy	Spain	Denmark	Germany	France	Netherlands	Austria	US	UK	Sweden	Ireland	Finland	Czech Rep.	Slovenia
1995-2001	0.36	0.43	0.84	0.45	0.45	0.65	0.56	0.86	1.00	0.71		0.51	0.95	0.39
2001-2007	0.08	0.33	0.64	0.26	0.19	0.28	0.28	0.34	0.41	0.43		0.39	0.11	0.27
2007-2009	0.09	0.36	0.49	0.21	0.20	0.25	0.20	0.45	0.25	0.39		0.47	0.12	0.03

The decline in the contribution to labor productivity growth of Software in 2001-207 with respect to 1995-2001 was lower than the decline of the contribution of total ICT (see background slide n. 14). In Finland and Spain it actually increased and in Denmark and Slovenia it had only marginally declined. In 2007-2009 the contribution increased with respect to 2001-2007 in Denmark, the US, the UK and Ireland while it decreased in Finland and Slovenia. It remained almost constant in all the other countries. Consequently the part of ICT contribution to labor productivity growth due to software increased (see background slide n. 14). In 2001-2007 it was between 30% and 50% in all countries excluding Germany (22%) and France (70%). In 2007-2009 it further increased in all countries but Finland.

5. ECONOMIC STRUCTURE AND CAPITAL STOCK

Countries where the share of services is higher are also the countries where the shares of ICT and intangible non-ICT in total capital stock are higher (figure 9 and background slide n. 25). On the other hand, there is no evident correlation between growth of capital deepening and economic structure (both for ICT and intangible non-ICT) (see background slides n. 26 and n. 27). A better cross-country understanding of the role of intangible in promoting labor productivity growth and of the complementarities between non-ICT intangible and ICT capital (see point 5 below) could be obtained if differentials in the propensity to invest in intangible could be traced to industry specific developments. Unfortunately no harmonized data on intangibles assets at the industry level are available and the lack of industry level data is hampering research on the main determinants of economic growth.

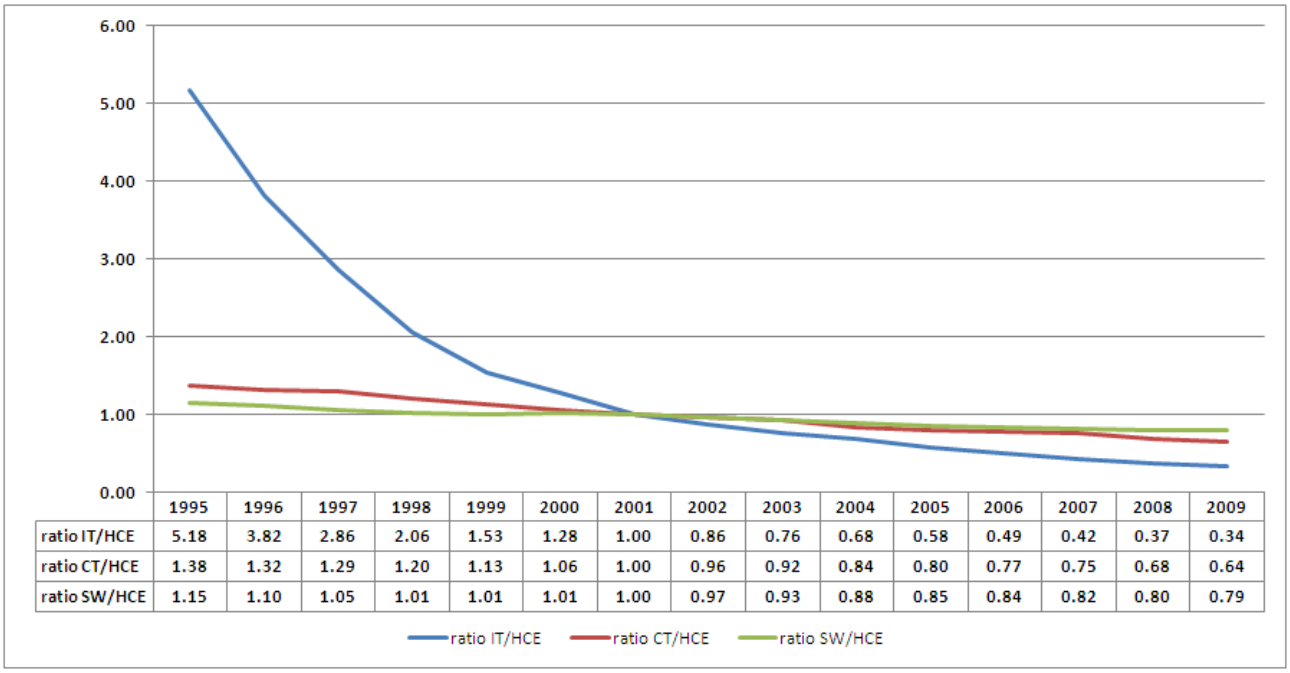
Figure 9. ICT share in capital stock and Services share in value added, 2007



6. TECHNICAL PROGRESS

The decline in the relative price of all the three ICT components with respect to the price of Final Consumption Expenditure of Households (figure 19) can be interpreted as a measure of the dynamic in their technical progress. The rate of technical progress of Computing Equipment in the 2000's was very high (13 per cent per year on average) but much lower than in the second part of the 1990's (a striking 23 per cent per year on average!). The rate of technical progress in Communications Equipment (4 per cent in both periods on average) and Software (2 per cent in 1995-2001 and 3 percent in 2001-2009 on average) was lower than the rate of technical progress in Computing Equipment but anything but negligible.

Figure 10. Ratio of ICT and Final Consumption Expenditure of Household deflators in the US, 2001=1



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ratio IT/HCE	5.18	3.82	2.86	2.06	1.53	1.28	1.00	0.86	0.76	0.68	0.58	0.49	0.42	0.37	0.34
ratio CT/HCE	1.38	1.32	1.29	1.20	1.13	1.06	1.00	0.96	0.92	0.84	0.80	0.77	0.75	0.68	0.64
ratio SW/HCE	1.15	1.10	1.05	1.01	1.01	1.01	1.00	0.97	0.93	0.88	0.85	0.84	0.82	0.80	0.79

7.SPILLOVERS AND COMPLEMENTARITIES

In the US and the EU15 countries included in our analysis, there is a positive correlation between ICT capital deepening and MFP growth (with the exception of Denmark) (figure 11) and a positive correlation between intangible non-ICT capital deepening and MFP growth (figure 12). On the other hand appears a negative correlation between tangible non-ICT and MFP growth (with the exception of Sweden) (see background slide n. 34). Moreover there is a positive correlation between intangible non-ICT and ICT capital deepening growth (with only Denmark partially as an outlier)(figure 13). These results are consistent with the existence of spillovers from both ICT and Intangible non-ICT capital accumulation (i.e. their overall contribution to labor productivity growth is higher than the direct effect measured by the growth accounting analysis) and with the existence of complementarities between the two type of assets (i.e. there are productivity gains when investment in ICT is realized in combination with investment in knowledge creation).

Figure 11. ICT Capital deepening and MFP growth, 1995-2007

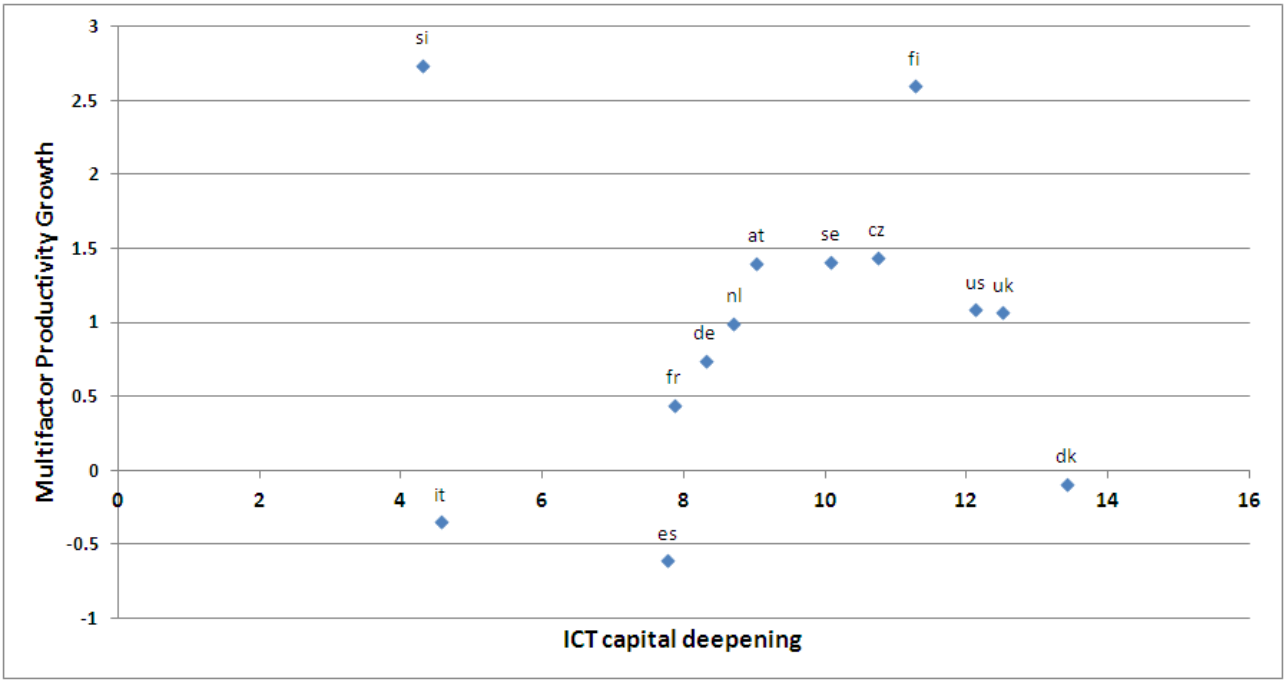


Figure 12. Intangible non- ICT Capital deepening and MFP growth, 1995-2007

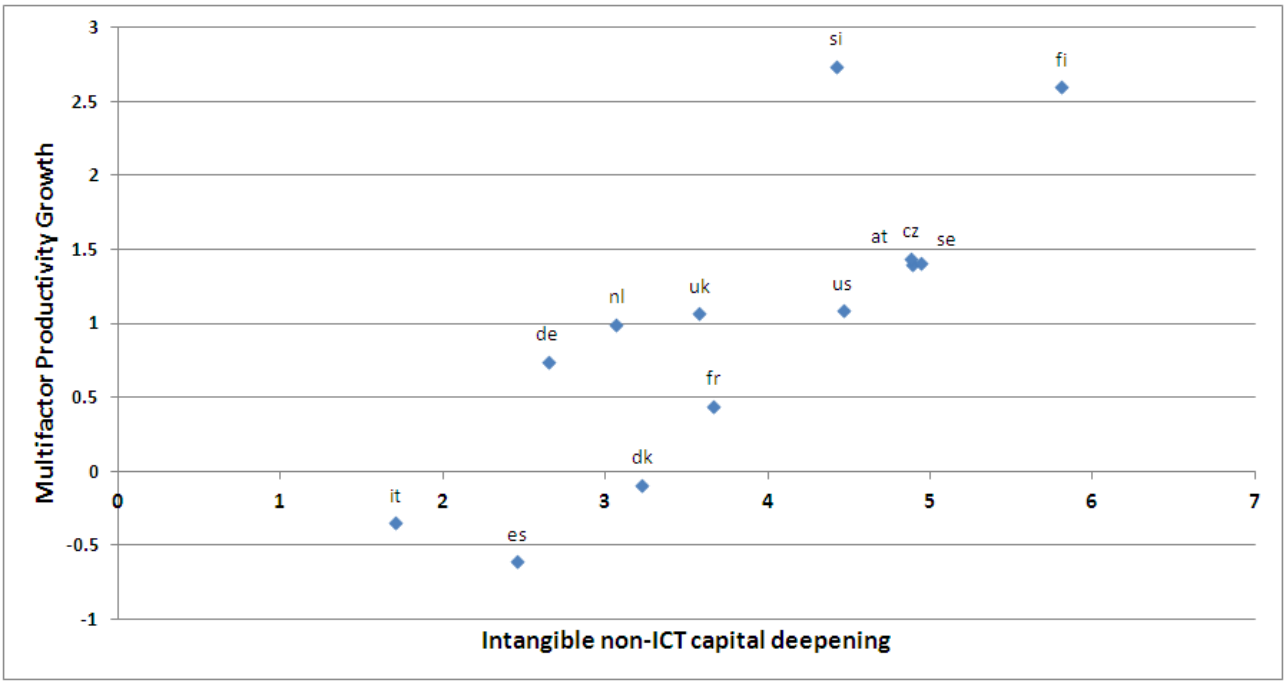
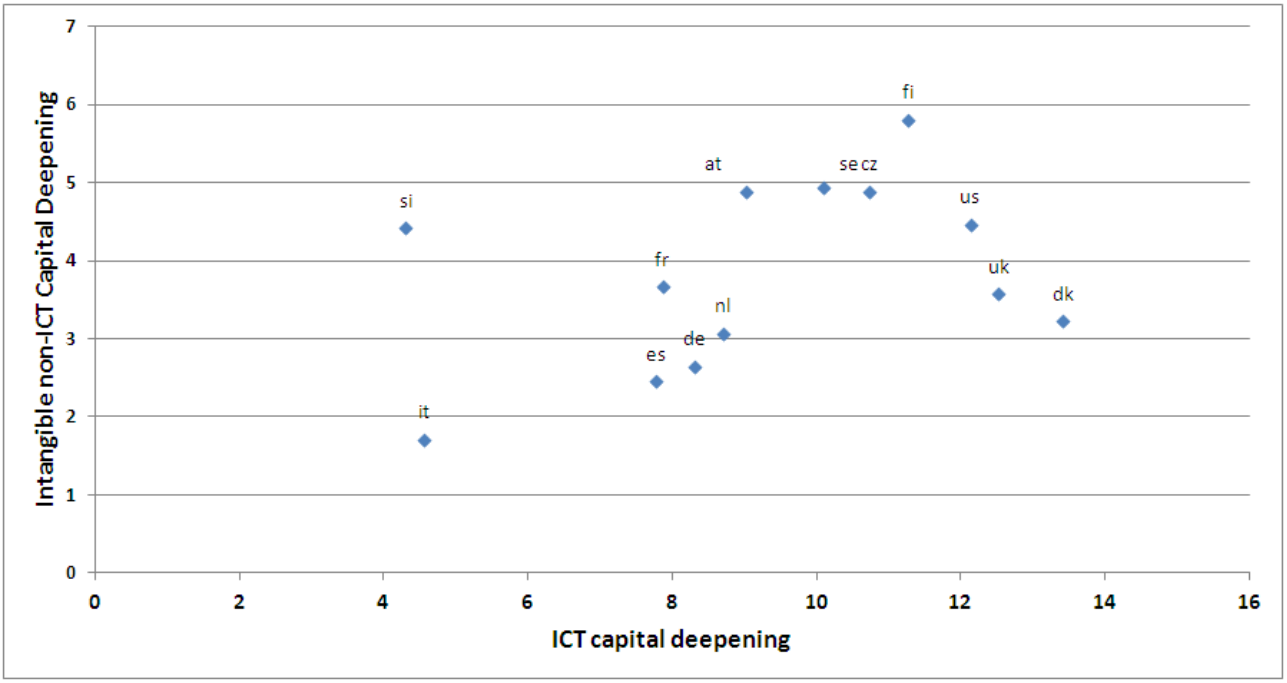


Figure 13. ICT and Intangible non-ICT Capital deepening, 1995-2007



Main findings of the analysis

1. Capitalizing intangibles increases labor productivity growth in the period 1995-2009 in all countries included in our analysis with respect to labor productivity growth estimated from current national accounts data.
2. In the period 1995-2009 capital deepening was the dominant source of growth in 11 out of the 14 countries included in the analysis and in the other three (Austria, Slovenia and Finland) its contribution was very close to the contribution of multi factor productivity (MFP) growth.
3. The contribution of ICT capital to labor productivity growth was quite high in all countries that performed relatively well in terms of labor productivity growth and it exceeded that of tangible non-ICT capital (with Sweden as the only exception), while the contribution of tangible non-ICT capital exceeded or was equal to that of ICT capital in all countries that performed relatively bad in terms of labor productivity growth , with the only exception of Denmark (that actually showed the highest contribution of ICT among the countries in included in our analysis).
4. Intangible non-ICT (the component of capital input that is almost entirely unrecorded in current national accounts estimates of GDP/Value Added and capital stocks) emerges as a significant source of growth in almost all countries and it was very important in all countries that performed relatively well in terms of labor productivity growth (more important than tangible non-ICT capital with the exception of Sweden).
5. There are significant differences in the accumulation of intangibles by broad type across countries. Among the countries that showed high contribution from intangibles and rapid productivity growth, the US and the UK were more based on economic competencies while Finland and Sweden relied more on the accumulation of innovative property. A policy implication is that policies aimed at removing barriers and increasing incentives for firm to invest in knowledge creation should not be focused only on R&D.

6. The above results holds with only minor changes also when excluding the year of the crisis (2008 and 2009) from the analysis.
7. The contribution to labor productivity growth of ICT in 2001-2007 declined with respect to the contribution in 1995-2001 in all countries but it was still relevant (although less impressive than in the previous period) in all countries but Italy and Czech Republic. Moreover, in 2001-2007 the component of ICT contribution due to Software increased in all countries.
8. Countries where the share of services is higher are also the countries where the shares of ICT and intangible non-ICT in total capital stock are higher. On the other hand, there is no evident correlation between growth of capital deepening and economic structure (both for ICT and intangible non-ICT). A better cross-country understanding of the role of intangible in promoting labor productivity growth and of the complementarities between non-ICT intangible and ICT capital (see point 10 below) could be obtained if industry level data on intangible were available.
9. There is technical progress in ICT equipment and infrastructure but also in Software, although the rate of technical progress of Computing Equipment in the 2000's is much lower than in the second part of the 1990's.
10. There appears to be other channels through which ICT and intangible non-ICT capital can affect labor productivity growth, beyond their direct impact as measured by growth accounting analysis. When focusing on the US and the EU15 countries, there is a positive relationship between the growth of ICT and Intangible non-ICT capital deepening and the growth of multifactor productivity (with only Denmark as outlier); moreover, ICT and Intangible non-ICT capital deepening growth are positively correlated each other. These results are consistent with the existence of spillovers from both ICT and Intangible non-ICT capital accumulation (i.e. their overall contribution to labor productivity growth is higher than the direct effect measured by the growth accounting analysis) and with the existence of complementarities between the two type of assets (i.e. there are productivity gains when investment in ICT is realized in combination with investment knowledge creation).