DOI: 10.1007/s10272-011-0387-2

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Intangible Capital: the Key to Growth in Europe

Intangibles and especially organisational capital are an important source of capital deepening in European countries, albeit with significant cross-country differences. The GDP in the EU27 area is 5.5% higher if certain categories of expenditure, which have until now been considered as current costs, are classified as investments in intangibles. Intangible capital investment markedly improves the profitability of companies, given the productivity-wage gap, and leads to increasing returns in intangible capital intensive countries.

Intangible capital is a major determinant of innovation and thus of enhancing the growth, employment and competitiveness of the European Union. The importance of R&D and innovation is explicitly recognised in the "Lisbon process" and in EU2020. However, our knowledge of the contributions of intangibles to economic performance remains incomplete. Undoubtedly, firms are at the centre of innovation and productivity growth, and INNODRIVE has analysed their activities empirically. Furthermore, at the macro level, the national accounts data on capital formation focus primarily on fixed investments. Investment in intangibles recorded in the system of accounts, such as software, mineral exploration and artistic creations, constitute only one seventh of all intangibles that we report in our studies in the EU27 area. The INNODRIVE research project has improved our understanding by providing new data on intangibles and new estimates of the capacity of intangible capital to generate growth. This research has thus explored uncharted territories in EU socio-economic research.

Growth accounting, which aims at explaining the growth of productivity, was initiated essentially by Denison in 1962.[1] When investigating the sources of growth in the United States from 1909 to 1958, he concluded that knowledge, labour and energy were important determinants of economic growth. Subsequent analysis by, notably, Jorgenson and Griliches have aimed by and large at identifying the contributions of various factors to the overall growth in productivity, in this context defined as the combined productivity of capital and labour, now more generally termed "multi-factor productivity".[2] As Denison himself recognised, growth accounting by definition cannot appropriately account for the interactions among determinants and does not involve a "controlled experiment". The underlying causal relationships, consequently, can only be approximated by detailed, careful classification of the contributors to the production function. In INNODRIVE a vital part of the analysis is the firm-level intangible capital evaluation using large panel datasets. This enables the analysis of interactions such as those between intangible and human capital and the use of important controls such as industrial composition and regional spillovers. INNODRIVE has also analysed the regional distribution of intangible capital within country borders, which is important as intangible capital tends to be concentrated in metropolitan areas.

The Innodrive website www.innodrive.org offers public national data of intangible capital in the EU27 and Norway covering the period 1995-2005 and private non-farm sector data of firm-level own account intangible capital in Finland, Norway, the UK, Germany, the Czech Republic and Slovenia 1995-2008 (years vary by country). In this paper we report the main results relevant for policy analysis, based on the analysis described in 20 Innodrive working papers and in the INNODRIVE manual.[3] We approach intangible capital evaluation using the now standard, national approaches, which aim to complement the system of national accounts data

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1 E.F. Denison: The Sources of Economic Growth in the United States and the Alternatives before Us, New York 1962, Committee for Economic Development, Supplementary paper No. 13; E.F. Denison: Why Growth Rates Differ: Postwar Experience in Nine Western Countries, 1967, Brookings Institution; E.F. Denison: Accounting for Slower Economic Growth: The United States in the 1970s, 1979, Brookings Institution.

2 J. Kendrick: Productivity Trends in the United States, 1961, Princeton Press; D. Jorgenson: Capital Theory and Investment Behaviour, in: American Economic Review, Papers and Proceedings of the Seventy-Fifth Annual Meeting of the American Economic Association, Vol. 53, No. 2, 1963, pp. 247-259; Z. Griliches: Research and Development, Patents and Productivity, 1984, Chicago University Press.

3 H. Piekkola (ed.): Intangible Capital - Driver of Growth in Europe, 2011, Proceedings of the University of Vaasa: Reports, No. 167, pp. 20-60.

in a comparable manner. To complement the micro-level analysis, we use large linked employer-employee datasets that can also be aggregated to be representative of the non-farm private sector. Our use of two entirely difference sources of data, macro and micro, is shown to be important. Some of the surprising figures in national estimates are not entirely supported by the micro analysis of intangible capital in private sector firms. The major key messages are

- GDP in the EU27 area is 5.5% higher due to the classification of certain categories of expenditure, which were hitherto considered as current costs, as investments in intangibles.
- Intangibles are an important source of capital deepening in European countries, albeit with significant cross-country differences.
- Intangibles explain a substantial part of the market value of companies. This is only partially captured in standard economic analysis.[4]
- High-income countries with a comparatively low level of investment in tangible capital tend to invest more in intangible capital, confirming a transition towards the knowledge economy.
- Organisational capital investment is one of the key drivers of capital formation, accounting for three times more investment than in R&D at the national level, but also due to the narrow definition of R&D activity.
- Intangible capital is agglomerated in metropolitan areas in the private sector: the greater Helsinki area accounts for 48% of all intangibles in Finland and the London city-region for 41% of UK intangibles. In Germany, intangible capital is more dispersed, with the top ten regions accounting for 48.3% of the German total (Munich 7.5%, Stuttgart 7.2%, Frankfurt 6.4%, Düsseldorf 5.6%, Hamburg 5.2%, Berlin 4.7%, Cologne 3.9%, Duisburg/Essen 2.8%, Nuremberg 2.7% and Karlsruhe 2.3%).[5]
- Foreign direct investment is an important aspect of intangible growth in the EU8. Greenfield FDI brings with it more R&D and organisational capital.[6]

Intangible Capital and Growth

The national data used in our studies covers intangibles reported in national accounts (entertainment, literary and artistic originals, databases and software) and eight types of new intangible capital: architectural design, new financial products, own-account and purchased economic competence, firm-specific human capital (training), branding (advertising), market research and scientific R&D.

Intangibles are also evaluated at the firm level in six countries: Finland, Norway, the UK, Germany, the Czech Republic and Slovenia. At the micro level, the goal of the research was to improve our insight into the contributions of intangibles to the growth of firms by exploiting the potential of recently established linked employer–employee datasets (LEEDs) and also by implementing a performance-based methodology to analyse how firms use knowledge and human capital to increase their productivity and how mobile workers react to these processes.[7] Firm-level data from six countries for the period of 1995-2008 (years vary by country) cover three types of own-account intangible capital: organisational capital, R&D capital and information and communication technologies (ICT) capital. We have expanded the traditional growth accounting framework by including in capital formation estimates of investments in intangibles, which have until now been counted as current expenditures in the conventional national accounts.[8]

Given the complex nature of intangible assets, there is no definition or single method to measure intangibles that is accepted worldwide. Corrado, Hulten and Sichel, hereafter CHS, proposed the widest definition of intangibles, referring to a standard intertemporal framework that leads to the conclusion that "any use of resources that reduces current consumption in order to increase it in the future … qualifies as an investment".[9] This definition implies that all types of capital should be treated symmetrically, thus leading to a very broad definition of capital, including, for example, intellectual

4 H. Piekkola: Intangible Capital: Can It Explain the Unexplained? Innodrive Working Paper No. 2, 2010.

5 K. Geppert, A. Neumann: Regional patterns of intangible capital, agglomeration effects and localised spillovers in Germany, 2010, Innodrive Working Paper No. 9; R. Riley, C. Robinson: UK Economic Performance: How Far Do Intangibles Count?, 2011, Innodrive Working Paper No. 14; H. Piekkola: Intangible capital agglomeration and economic growth: An Analysis of Regions in Finland, 2010, Innodrive Working Paper No. 20.

6 S. Jurajda, J. Stancik: Organization and Firm Performance in the Czech Republic, 2010, Innodrive Working Paper No. 12.

7 B. Görzig, H. Piekkola, R. Riley: Production of intangible investment and growth: Methodology, 2010, Innodrive Working Paper No. 1.

8 C. Jona-Lasinio, M. Iommi, S. Manzocchi: Intangible Capital and Productivity Growth in European Countries, 2010, Innodrive Working Paper No. 10; and F. Roth, A.-E. Thum: Does Intangible Capital Affect Economic Growth, 2010, Innodrive Working Paper No 3.

9 C. Corrado, C. Hulten, D. Sichel: Measuring Capital and Technology: An Expanded Framework, in: C. Corrado, J. Haltiwanger, D. Sichel (eds.): Measuring Capital in the New Economy, Chicago 2005, National Bureau of Economic Research, Studies in Income and Wealth, Vol. 65, University of Chicago Press, pp. 11-45.

and human capital as well as organisational assets.[10] In the system of national accounts all consumption that does not take place within a year is also generally considered as investment. Our scope was narrowed to intangible capital that can in principle be owned by the firm, thus excluding human capital. Following this definition we established an estimation strategy for intangible capital based on the following five criteria:[11]

- *Expenditure- and performance-based approaches*. We use expenditure data to develop direct measures of intangible gross fixed capital formation (GFCF) and capital, but also apply a performance-based approach using micro data where firm-level performance is measurable.

- *Exhaustiveness*. We estimate total expenditures for each type of intangible and how much each type of expenditure might be considered as GFCF. Our estimates include both purchased and own-account components of expenditures on intangible assets, although it was impossible to disentangle the purchased component in the micro approach.

- *The macro approach aims at consistency with national accounts* and on many occasions the own-account component has to be estimated since it is not included in the production boundary of national accounts. The micro approach instead tends to rely on the own-account component and aggregates the large business sector sample data at national level using the firm-size distribution in one-digit industries as the key. However, the data is on average consistent only with respect to business sector output and not to GDP.

- *Reproducibility and international comparability*. To guarantee reproducibility and international comparability, macro estimates are, wherever possible, based on official data sources that are homogeneous across countries (mainly Eurostat surveys, national accounts data, and supply and use tables). Micro estimates use large linked employer-employee data which is reproducible given the applied consistent occupational classification of employees across the six countries.

- Our estimates cover the non-agricultural business sector, thus excluding public administration, defence and compulsory social security (category L), education (category M), health (category N), other community, social and personal service activities (category O) and private households (category P). In the micro data, establishments that are market producers are partly included in health and other community, social and personal service activities.

Macro Approach

In data covering the EU27 area an expenditure-based approach was necessary as the performance of any single nation is difficult to measure in any comparable way. Our main findings are as follows.[12] GDP in the EU27 area is 5.5% higher after including all intangible investments. In the national approach, the intangible capital investment share of GDP was 6.7% in the EU27 and Norway, whereas only 1.1% is recorded in the System of National Accounts. Organisational competence accounts for nearly half of this, at 3.1% of GDP. The intangible share of GDP increased during the latter half of the 1990s, whereas the GDP shares have stayed mostly constant in the 2000s. Figure 1 shows the evolution of new intangibles not currently recorded in national accounts as shares of GDP in a national approach in the EU27 and Norway.

The share of intangible investment has been constantly increasing, although its growth has somewhat diminished in the 2000s. Figure 1 shows that the shares are nearly the same in 1998 and 2005. An exception is the new member states that are catching up to the rest of Europe as regards both GDP levels and the intangible capital shares of GDP. Organisational capital investment (organisational competence) is one of the key drivers of capital formation, with training accounting for three times more investment than R&D investment at the national level. Overall, the level of intangible investment in Europe appears insufficient when compared with the USA, which is more likely to engage in all types of innovation activity more intensively.

The growth accounting framework allows us to decompose GDP growth into its labour, capital and total factor productivity (TFP) components. The reference model for evaluating the contribution of intangibles to economic growth is the CHS model. In this model, intangibles are treated symmetrically as tangibles in the standard growth accounting framework. The explicit inclusion of intangible capital within a growth accounting framework can affect both the input and output sides of the model, thus also influencing the residual TFP growth.[13]

An analysis of the results obtained for the above definitions provides a picture of the impact of intangibles on measured

10 P. Schreyer: Old and New Asset Boundaries: A Review Article on Measuring Capital in the New Economy, in: International Productivity Monitor, 2007, No. 15, pp. 77-82.

11 See C. Jona-Lasinio, M. Iommi, F. Roth: National Measures of Intangible Capital in the EU27 and Norway, in: H. Piekkola: Intangible Capital – Driver of Growth in Europe, op. cit.

12 See also Innodrive Policy Brief February 2011, www.innodrive.org.

13 For a detailed description of the effects of capitalising intangibles, see P. Barnes, A. McClure: Investments in Intangible Assets and Australia's Productivity Growth, Canberra 2009, Productivity Commission Staff Working Paper.

Figure 1
Investment in Intangibles as Share of GDP (%) in 1998 and 2005: EU27 Countries and Norway

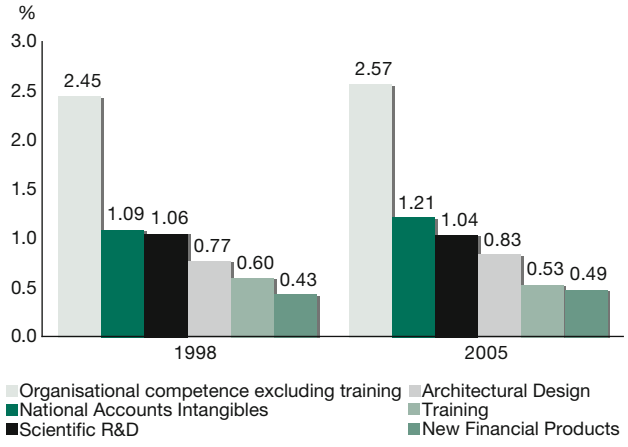


Table 1
Growth Accounting Results
(Extended Asset Boundary, 1995-2005)

	Contributions to Labour Productivity Growth				Estimated Impact		
	LPG	NA CD	NI CD	TFPG	LPG	CD	TFPG
Austria	2.05	0.72	0.34	0.97	0.18	0.29	-0.11
Denmark	1.61	0.50	0.27	0.83	0.06	0.22	-0.16
Finland	3.07	0.25	0.37	2.43	0.09	0.34	-0.26
France	2.07	0.36	0.23	1.47	0.06	0.20	-0.14
Germany	1.69	0.74	0.27	0.68	0.11	0.21	-0.11
Italy	0.26	0.51	0.09	-0.35	0.09	0.06	0.02
Netherlands	2.25	0.62	0.31	1.31	0.05	0.24	-0.20
Portugal	1.94	1.72	0.24	-0.03	0.13	0.14	-0.02
Spain	0.24	0.50	0.03	-0.29	0.04	0.01	0.03
Sweden	3.69	1.01	0.44	2.20	-0.04	0.32	-0.37
United Kingdom	2.71	0.95	0.34	1.39	0.09	0.24	-0.15

Notes: LPG stands for labour productivity growth; CD is capital deepening, distinguished between national account (NA) and new intangible (NI); TFPG is total factor productivity growth. The estimated impact shows the impact of an extended asset boundary in comparison with the results obtained by growth accounting without new intangibles.

Source: C. Jona-Lasinio, M. Iommi, S. Manzocchi: Intangible capital and Productivity Growth in European Countries, 2011, Innodrive Working Paper No. 10.

productivity growth and the extent to which national accounts are affected by omitting some intangible assets. Table 1 is based on a report by Jona-Lasino, Iommi and Manzocchi showing the relative contributions of tangible capital deepening (NA CD), new intangible capital deepening (NI CD) and TFP to labour productivity growth compared to the labour productivity growth and capital deepening in the current asset boundary without the inclusion of intangible capital.[14] NA CD and NI CD are thus, respectively, the capital deepening of national account assets (which include software, mineral exploration and artistic, literary and entertainment originals) and the capital deepening of the eight types of new intangible assets not currently included in national accounts: architectural design, new financial products, own-account and purchased economic competence, firm-specific human capital (training), branding (advertising), market research and scientific R&D.

The last column in Table 1 shows that, as could be expected, the inclusion of intangible capital significantly reduces the contribution of TFP growth. In other words, the inclusion of intangible capital increases the rate of capital deepening by more than it increases the rate of labour productivity growth (with the exception of Italy and Spain). While TFP growth becomes less important, physical capital turns out to be strongly complementary to intangible capital. Intangible capital deepening has been considerable and the contribution of total capital deepening increased from 0.28 to 0.62 percentage points per year in Finland (the increase of 0.34 percentage points in the second last-column), from 1.14 to 1.45 percentage points per year in Sweden (an increase of 0.32 percentage points) and from 0.78 to 1.06 percentage points in Austria (an increase of 0.3 percentage points).

Labour productivity growth is also higher when intangibles are included in the capital stock in all of the sample countries with the exception of Sweden. The greatest impact is seen in Austria, where labour productivity increases by 0.18 percentage points, followed by Portugal, with an increase of 0.13 percentage points, and Germany, with 0.11 percentage points. However, among these countries, only Austria is an intangible-intensive country (Germany's intangible intensity also appears higher in the micro approach), while Austria, Portugal and Germany were all fast-growing economies in the second half of the 1990s.

Roth and Thum applied panel regressions across countries to explain labour productivity growth.[15] The positive effect on labour productivity growth is shown to be cross-sectional so that countries that have invested more in intangible capital have been growing faster in the period 1995 to 2005. This result is robust to a range of alterations. Other elements of intangible capital in addition to R&D matter for economic growth, a finding confirmed in the micro approach. The pan-

14 C. Jona-Lasinio, M. Iommi, S. Manzocchi: Intangible capital and Productivity Growth in European Countries, 2011, Innodrive Working Paper No. 10.

15 F. Roth, A.-E. Thum, op. cit.; and F. Roth: Measuring Innovation – Intangible Capital in the EU. In: Blind et al., 2010, Drivers and Impediments for Innovation in Europe, Intereconomics 45: 273-77.

el regressions also find that intangible capital investment is able to explain a significant portion of the unexplained international variance in labour productivity growth and thus diminishes the unexplained part of labour productivity growth and, hence, the extent of our ignorance about its sources.

Micro Approach

An integral part of the micro analysis is to divide the intangible capital of firms into amounts related to organisational work, ICT and R&D. The micro approach concentrates on own account production of intangibles of the following types:

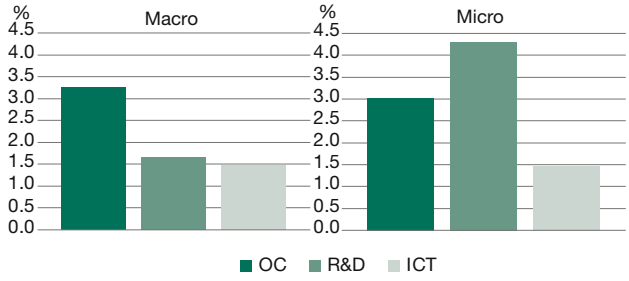
- information and communications technology (ICT)
- research and development (R&D)
- organisational capital (OC).

It is assumed that the firm exclusively directs the production of these types of good towards its own uses so that purchased intangible capital is by and large excluded from the analysis. If the goods produced are not used in the current year, these types of good can be classified as intangible capital investments which hitherto have not been included in capital stocks in the national accounts. To produce these types of capital good, firms apply resources supplied by different factors of production: labour, intermediate and capital services. In six countries with firm-level data on intangibles, the share of workers engaged in intangible capital-type work was around 18%, and the type of work differs from one country to another. The typical use of intermediate input and capital is assessed from input and output tables in industries that are intensive in R&D, organisational capital and ICT (Nace-codes 73, 74, and 72, respectively).[16]

Figure 2 shows macro and micro aggregates using data from the six countries mentioned above. (Finland, Norway, the UK, Germany, the Czech Republic and Slovenia). The figures aim to be representative of the entire EU area by using different weights depending on the GDP shares of total EU27 GDP. Firm-level analysis in the six countries is aggregated to be representative of the EU27 and Norway, using as weights 30% for the UK, 40% for Germany and 7.5% for Finland, Norway (to approximate the Scandinavian impact), the Czech Republic and Slovenia (the latter being the only Mediterranean country). The figures are thus tentative, also because variables are not directly comparable between the micro and macro approaches.

The aggregates show that R&D capital intensity can vary quite a lot in the micro analysis with an almost 4.5% share of business value added as compared with the 1.6% share in the macro analysis. The reason is the broader definition of

Figure 2
Macro and Micro Data Aggregates on Intangible Shares of Business Value Added in EU27 in 2003
(using weight multipliers for the six countries)[1]



[1] Finland, Norway, the UK, Germany, the Czech Republic and Slovenia.

R&D workers compared with the macro approach which uses data on gross domestic expenditure on R&D (GERD). Organisational capital investment is also sensitive to the data used. For example, the share of management employees in Germany increases to 8% of all employees in the occupational classification used in the micro approach, compared with the 3% share reported in Labour Force surveys by EUROSTAT and used in the macro approach. Own-account organisational capital almost matches the level of total organisational competence in the macro analysis, which also includes purchased organisational investment and market research.

In the micro approach an even greater share of intangible capital from value added is obtained using a performance-based methodology. Here, the estimated productivity of intangible-type work is used to replace the wage expenditure costs of input.[17] Organisational capital from management and marketing work is then typically 3-4% of the company value added or 4-5% of the company value added in the UK. This share has not increased much over the years. The results highlight, in particular, the importance of organisational capital (management and marketing) as a major form of intangible capital, exceeding even R&D investment in importance in many European countries. In fact, in nearly all EU27 countries except Finland and Sweden, the share of economic competence (including training and purchased components) in value added exceeded the R&D share in the macro approach. Second, the very narrow concept used in macro analysis does not represent R&D activity well in a service intensive country like the UK. In the UK in 2003, R&D intangible capital is 3.7% of value added in the micro analysis and 1.8% in the macro approach. Countries are also specialised in different types of intangible capital, with the share of R&D investment being highest in Nordic countries.

In an analysis of regional effects in Germany, Finland and the UK, company-level productivity is also shown to be strongly

16 See B. Görzig, H. Piekkola, R. Riley, op. cit.

17 For methodology, see ibid.

related to firms' own intangible capital and to regional intangible capital, suggesting positive localised spillovers. Productivity is highest in firms that also have considerable human capital. There is a need to be clear about the distinction between human capital and intangibles; intangibles enhance the profitability of economic activity, whereas human capital is owned by the employee and capitalised in wages. Organisational capital, i.e. the competence of management and marketing workers, appears to be the form of intangible capital that is most clearly related to profitability and productivity growth.

Intangible Capital Factor Shares: a Case Study of Finland

It is of considerable interest to reassess the conventional production function when accounting for intangible capital. We have done this for Finland although growth accounting using micro data applies a similar method for all countries. In evaluating the share parameters for the intangible capital items, we consider the associated user cost.[18] Following convention, own account production of capital goods is valued at production cost. The main components of capital costs are depreciation and the return of capital.[19]

We apply an external rate of return of 4% in calculating the return of capital and apply the depreciation rates 25% for OC capital, 20% for R&D capital and 33% for ICT capital used in INNODRIVE. Thus we estimate:

$$\alpha_{IC} = (RR + \delta_{IC})\, K_{IC} / \hat{Y}$$

where value added $\hat{Y}$ is adjusted for intangible investment, δ_{IC} is depreciation and *RR* is the external rate of return. Intangible capital K_{ICt} is broken down into contributions from three types of factor shares: organisational capital (OC), R&D capital (R&D) and information technology (ICT), where a performance-based approach is used to estimate the productivity of organisational work. The labour cost share is straightforward to obtain while tangible capital shares are calculated first at firm level using information on interest on debt and depreciation of fixed capital (here including residential buildings).[20]

In comparison to the Jorgenson-Griliches procedure, our approach may underestimate the contribution of intangible capital to labour productivity growth.[21] This is because internal rates of return typically exceed external rates of return for the industries, countries and time periods we consider.[22] Table 2 shows the results in four major private sector non-farm industries.

It is seen that factor shares sum up to nearly 110%, indicating increasing returns to scale. Organisational and R&D capital have equal shares and account for 12% of all factor inputs, while ICT capital has a much lower share of 1% (performance-based estimates have been applied here for organisational capital only). Intangibles thus explain the increasing returns. Abstracting from intangible capital yields considerable undervaluation of factor shares. This is strikingly so in business services, where intangible capital is 30% of all factor input and with noticeable ICT capital 5% of value added. The only sector with constant returns to scales is trade and consumer services. Increasing returns rather than Cobb-Douglas constant returns to scale generally apply at the firm level. It is noteworthy that we have measured mainly own account intangible capital. Intangible capital factor shares should be even higher including purchased intangible capital and externalities generated at the national level. Since Finland belongs to intangible capital intensive countries, the results may be less striking in Europe on average.

Conclusions

Intangible capital, from a broader perspective, describes the main innovation activities of private companies and is the source of future growth. The key messages have already been listed above. Management activity encouraging longer-term productivity growth has been difficult to define, but our message is clear: it is the most significant part of intangibles. Our performance-based estimates clearly show that the traditional expenditure-level estimates of organisational activity (mainly management and marketing) are lower bounds for the true value of organisational investments. The productivity of these types of activity usually exceeds the corresponding wage expenditures; the combination of labour, intermediates and capital in the production of intangible capital increases value added by more than the costs of related expenditures. An important consequence of this relation is that intangible capital investment also improves markedly the profitability of the firm given the productivity-wage gap and can lead to increasing

18 See D. Jorgenson, op. cit.; D. Jorgenson, Z.Griliches: The Explanation of Productivity Change, in: Review of Economic Studies, Vol. 34, July 1967, pp. 349-83.

19 We do not include changes in the prices of investment goods, because due to the lack of data there is no firm-level variation in this variable.

20 The average interest on debt of 3.6% is close to the external rate applied to intangibles but with an upper limit of 9% in 10% of the observations and a lower limit of 2% in nearly half of the observations. The average depreciation is 14% with a 7% standard deviation due to the varying composition of fixed assets.

21 This approach differs from the Jorgenson-Griliches procedure for estimating the rate of return cited by CHS. This would imply a common rate of return to both tangibles and intangibles, assuming that businesses arbitrage their investments across all types of capital, investing in each type until the rate of return for all assets is equal. This would be the case if we apply the internal rate of return, as used in the EU KLEMS project.

22 See EU KLEMS data; for Germany see B. Görzig, M. Gornig: Intangibles, Can They Explain the Dispersion in Return Rates?, DIW Discussion Paper, No. 1018, Berlin 2010.

Table 2
Factor Shares at Firm Level Aggregated at Industry and National Levels in the Finnish Business Sector
(1998-2007, in %)

	Factor shares	Manu-facturing	Construction other[1]	Business services[2]	Trade and consumer services
All factors	109.8	110.6	111.7	117.6	102.3
Labour inputs	63.9	54.4	70.1	54.1	72.1
Capital	32.6	45.2	27.0	34.1	26.3
Organi-sational capital	5.7	4.6	6.2	10.4	3.1
R&D capital	6.3	5.8	7.4	14.1	0.3
ICT capital	1.3	0.7	0.9	5.0	0.5

Notes: [1] "Construction other" includes transportation, building materials and mining. [2] "Business services" includes telecommunication.

returns in intangible capital intensive countries. It should be noted, though, that intangible capital also has a positive impact on hourly wage growth, but the improvement in efficiency allows a decrease in overall wage expenditures over time. We have not analysed labour utilisation rates, but it may well be that good performance induced by intangible investment also increases overall demand for employment.

Innovative growth requires investment in intangibles, most of which are imprecisely valued in any balance of accounts. There is a clear need for a broad view of intangible capital type work that includes managerial and marketing work. More and more of the expenditures on marketing and organisational investment need to be recognised as intangible investments that increase productivity over a longer period. Organisational capital is also more clearly firm-specific and owned by the firm than are other types of intangibles.

We have also shown clearly that intangible investment in general, and not only R&D investment, drives productivity growth. Our project has shown that R&D investments constitute only part of total intangible activity. In comparison across countries, it is also likely that overall intangible capital can even be calculated more precisely, representing the innovation potential of a country better than any individual type of intangible investment, such as R&D capital.

Organisational and ICT work are close complements, but they may also work as substitutes in resource allocation for R&D work activity. Policies for promoting R&D activity alone may hence not be appropriate because such policies may crowd out other intangible investments. The EU2020 programme aims at smart, sustainable and inclusive growth, with the clear objective of investing 3% of the EU's GDP in R&D. Because Europe has an average R&D investment level below those of other developed countries, including the USA, this target is well founded, but in the future, targeting should also cover a wider set of intangible capital assets. On the other hand, the way R&D activity is measured may not work well in service-oriented countries like the UK, so the true R&D activity is likely to be higher.

Our findings support the importance of organisational capital. Firm-level analysis is also able to show some numerical estimates of the growth effect of organisational capital. In Finland and Germany, the doubling of organisational investment, corresponding to less than 2% of business value added, increases productivity growth by 0.2% in a three-year period.[23] Growth effects are missing or even negative for R&D investment. Nordic countries and Germany, which already engage in intensive R&D activity, should focus more on organisational investment. Many non-R&D-intensive countries (the UK, Belgium, the Czech Republic, the Netherlands and Hungary) also have innovation models that emphasise organisational competence.

Our results emphasise intangible investment as tacit knowledge that is less bound to regional borders. Stable economic conditions without extensive market reallocation are typical for high-performing regions. Regional policies can also be targeted in subsidising innovative activity outside of metropolitan areas. Regional policies should also be targeted for providing *sufficient* educational skills, because intangible capital and human capital are clear complements at the firm level. Most of the intangible capital spillovers, indeed all of them in the UK and Finland, also accrue for organisational capital. Businesses, in their location decisions, are interested in profitability rather than in productivity, where the tacit knowledge within the firm plays the most significant role.

The PIGS countries have recently suffered from the burden of financing sovereign debt. The investment policies in these countries rely more on tangible than on intangible investment, and therefore, they have suffered relatively more from the shifting of production outside of Europe, especially to Asia. Intangible capital investment in the future is likely to yield more solid growth. Intangible GDP shares in 2005 were 4.5% in Italy, 4.1% in Spain and Portugal and 2.0% in Greece, all below the average EU27 value and Norway's share of 6.7%. At the same time, the diversity of intangible capital should be emphasised so that policies do not promote R&D investment alone. Our research does not examine public intangible investment, which should also have far-reaching implications.

23 H. Piekkola: Intangible capital agglomeration and economic growth: An Analysis of Regions in Finland, 2010, Innodrive Working Paper No. 20.