INNODRIVE

Intangible Capital and Innovations: Drivers of Growth and Location in the EU

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Intangible Capital and Innovations: Drivers of Growth and Location in the EU

Acronym: INNODRIVE

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State of the art in research on the economics of intangibles (Deliverable No. 12, WP2)

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Contents

Introduction

This general report concerns work package 2 of the INNODRIVE project, but also presents a background survey conducted for work package 1 and an essential part of the methodology to be applied in subsequent work, including

- general conceptual issues and scientific coordination (work package 1),
- data availability and the compilation of macro and micro data on intangibles (work package 2), and
- the methodology to be used in future work packages.

The general objective of work package 2 is to design a joint methodology for application in the performance-based analysis of intangible capital relying on linked employer–employee datasets (LEEDs). This methodology is to be used in work packages 3-8 and to develop the growth accounting methodology and cross-section methodology for the national-economy level in work package 9. The tasks involved are outlined below.

Task 1. Set up an estimation method for measuring intellectual assets at the macro level.

Task 2. Set up an estimation method for measuring intellectual assets at the micro level.

Task 3. Establish the methodology for measuring intangible capital as a determinant of growth and for adapting national accounts.

Once the core dataset has been constructed, we have to focus on two points:

i) the estimate of intangible gross fixed capital formation (GFCF), and

ii) the calculation of national accounts and firm-level variables consistent with the newly measured intangible GFCF.

The first step involves the following further methodological issues (to be discussed):

– What prices are to be used for the different categories of intangible assets?

– Or do we instead assume, as Corrado Hulten and Sichel (2005) did, the same price for all categories of intangibles?

Task 4. Growth accounting

Task 5. Establish the methodology for measuring intangible capital spillovers.

Task 6. Establish the methodology for measuring intangible capital as a determinant of growth in the micro approach.

Task 7. Estimating a central growth model (GDP per capita) through a panel (cross-section) analysis

1. Background: Towards a precise valuation of intangible capital (WP1)

Jorgen Mortensen (CEPS) and Hannu Piekkola (UNIVAASA)

1.1 General aims and approach

It is widely recognised that knowledge and intellectual capital are major determinants of the generation of innovation and thus the enhancement of growth, employment and competitiveness of the European Union. The importance of R&D and innovation is also explicitly recognised in the 'Lisbon process', aimed at improving the growth and employment performance of the EU. Yet, despite many 'credos', our knowledge of the contribution of intangibles to economic performance is still incomplete, to say the least. While firms undoubtedly are at the centre of innovation and productivity growth, their activities are hard to analyse empirically. Furthermore, at the macro level the national accounts data on capital formation focus primarily on fixed investment and have only recently attempted to measure investment in intangibles such as software, mineral exploration and artistic creations. Without ignoring the difficulties of this endeavour, the aim of this research project is to improve our understanding by providing new data on intangibles and new estimates of the capacity of intangible capital to generate growth.

INNODRIVE is designed to enhance our capacity for measuring the amount of capital embodied in intellectual assets (e.g. human capital, R&D, patents, software and organisational structures) and the potential for intangible capital accumulation in manufacturing, service industries and the rest of the economy.

At the micro level, the goal of the research is to improve our insight into the contributions of intangibles to the growth of firms, by exploiting the potential of recently established LEED data and 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. At the national-economy level, the task is to expand the traditional growth accounting framework by including, in capital formation, estimates of the investment in intangibles that have hitherto largely been counted as current expenditure in the conventional national accounts.

An essential hypothesis of the project is that knowledge-intensive and innovative firms cannot sensibly be considered separate from their socio-economic environments. The spatial dimension plays a crucial role in the project. We value the importance of geographical proximity, clustering and agglomeration for firm innovation and productivity, and integrate these factors as part of intangible economic assets. Efforts to foster the network properties of dense areas, i.e. cities or 'competitiveness centres', are thus viewed as an intangible investment and we also seek to study the effect of this aspect of intangibles on competitiveness and economic performance.

The unifying data and methodological approach of the project at the micro level brings together contributions from different EU countries: large and small countries, and old and new member states. The spatial dimension, with a separate focus on nations of different characteristics (and growth centres within countries), is required for political action and for a distinction between country-specific policies and more general factors in setting innovation policies. At the macro level, we cover all 27 member states subject to data availability.

1.2 Moving beyond the state of the art

Twenty years ago, economists in the field of business economics and accounting had already realised that conventional business accounts did not provide a credible assessment of results and added value. The main problem is that in business accounts a large share of spending on research and development, which in reality is an investment in intangibles, is counted as current costs and hence deducted from profits, and as such, it is not taken into account as investment.

On the other hand, an item called ‘goodwill’ has for a long time been recognised as an asset, which may be increased, for example, by the acquisition of another firm. In practice, this has in some cases resulted in a huge difference between the market capitalisation and the value of assets on the balance sheet of the firm (for example Microsoft, which has mainly grown through internal research). In other cases, where a firm has mainly grown by acquisition of other firms, the ‘goodwill’ may be recorded, resulting in a smaller difference between market capitalisation and the value of the firm on the balance sheet.

This problem has been recognised in the accounting profession and has been regularly discussed in both Europe and the US. The literature is abundant but the most important references (approximately in chronological order) are the following:

- a study prepared by the US Federal Reserve in the early 1990s;
- a CEPS task force report from 1997 (by Clark Eustace and Jørgen Mortensen);
- a study for DG ENT prepared by Clark Eustace and Jørgen Mortensen in 1998;
- programme notes and proceedings of an OECD/NL conference in 1999 on the measurement of intangible assets (Jørgen Mortensen and Wendi Bukowitz);
- a comprehensive study for DG ENT in 2004 by a team coordinated by Stefano Zambon of the University of Ferrara (IT) and with contributions from, notably, Baruch Lev (Stern School) and Anne Wyatt (Melbourne); and
- a more recent Melbourne University working paper by Laurie Hunter, Elizabeth Webster and Anne Wyatt.

Nearly all the contributions cited above address the issues related to *measurement* of intangible investment and assets at the level of the firm or corporation. Understandably, investors and business researchers have deployed huge efforts in order to enhance their insight into the ‘true’ rate of return on business capital and have, with still uncertain results, promoted a debate within the accounting profession with the aim of exploring the scope for showing intangible assets and investment more explicitly in business accounts.

The present research project starts from and builds on these contributions. But we do not go into the debate on reforming business and national accounting. Indeed, as demonstrated in two key references for this project proposal that have attracted considerable attention within the community of productivity research, it is actually possible on the basis of existing data beyond or on the fringe of business and national accounts to gain considerable insight into the share of intellectual capital in total capital and in total capital formation.[1]

The research is thus resolutely groundbreaking in two main areas:

- the introduction of new methodologies to explore intangible investment and its impact on innovative activity, and

[1] See Corrado, Hulten and Sichel (2006) and Giorgio Marrano and Haskel (2006).

- the evaluation of innovative growth at the firm level in a selection of old and new member states using the LEED data, and at the national level, the compilation of new estimates of the level of intangible capital and its contribution to the growth process in old and new member states (and for purposes of comparison, in the US).

One important milestone of INNODRIVE is a systematic and reliable analysis of the contribution of intangible capital to innovative growth at the level of the firm. This involves examining innovative growth (as distinct from imitation) and accounting for intangible capital in networks and spatial spillover. This allows an elucidation of the varying role that intangible capital plays in industrial sectors such as (traditional) manufacturing, technology-intensive sectors, the IT sector and services. Insight into this process is crucial for setting policy options for countries with fairly different industrial structures. LEED data form a unique disclosure of activities related to intangible investment at the firm level.

The second axis of our work programme comprises a top-down approach involving the generation of comparable expenditure-based estimates of intangible investment and capital at the national level. The resulting new growth accounting will then lead to new estimates of the rate of capital formation and of the rate of change of output per worker and of capital deepening. The study will therefore also lead to new estimates of the growth of multifactor productivity and of labour’s income share in the various countries included. In sum, this research will lead to

- estimating the level of intangible assets and the contribution of intangibles to the growth of output (at the macroeconomic level) for EU-27 countries, plus Norway and (for purposes of comparison) the US for recent years and for selected past years/periods;
- extending the basic research on adjusting national accounts data, by undertaking a cross-section analysis of the contribution of intangibles and human capital (including education) to economic growth among EU27 countries; and
- drawing broad conclusions with respect to the prospects for productivity growth in the EU and selected member states over the coming decades, taking account of potential investments in intangibles and human capital and the demographic projections as prepared by the Working Group on Ageing Populations of the EU’s Economic Policy Committee.

1.3 Methodology and associated work plan

We proceed in three steps, by

1. generating data on and analysing intangible capital at the firm and national levels;
2. analysing the social return on intangible capital with a view to assessing the role of the environment; and
3. analysing innovative growth and employment and the implications of this for national policies on fostering intellectual asset accumulation.

2. Building up and analysing data on intangible capital

2.1 General methodological approach

The firm-level approach involves analysing LEED data in six countries: the Czech Republic, Finland, Germany, Norway, Slovenia and the UK. The work programme involves heavy data exploration of special LEED data and of that at the European level through exploiting company accounts (notably the BACH database on corporate data run by DG ECFIN). LEED data as a tool for advancing understanding of labour markets is well established in parts of northern Europe. Longitudinal data track workers and their firms or workplaces over time, which is indeed necessary in order to separate the general human capital of workers and firm-specific (structural) capital. LEED data are particularly suited to linking firm and workplace fortunes (labour productivity, employment growth and survival) to market restructuring and worker flows (entry and exit) and worker progression (tenure and wages) within the firm.

In these databases, workers are characterised in a detailed way by occupation/kind of activity, education/skills, full-time/part-time, age, gender, wage, place of work, place of residence and any form of mobility. Firms (or establishments) are characterised by detailed sector, size, location and by features derived from the composition of employment and from payroll (R&D-intensive, high/low wage, etc.). The regional unit is a town or municipality and these are aggregated here to the NUTS 4 level. Other issues relevant to the regional competitiveness include measures of innovation at the regional level and accessibility. The examples gathered from the innovation surveys closely follow data used in the comparisons of competitiveness around the world (e.g. the Global Competitiveness Report 2004–05 from the World Economic Forum) and in a more recent study by Piekkola (2006).

The EU KLEMS database provides internationally harmonised and integrated annual data needed to perform standard, economic growth accounting using an industry breakdown (between 30 and 72) and provides comparable datasets for the US and Japan. The industry breakdown covers the whole economy, including a large number of service industries. Inputs of capital, labour, energy, material and service are comprehensively measured by distinguishing various components of each input, such as different kinds of labour (gender, age and skill level) and different kinds of capital (e.g. information and communications technology or ICT capital). To assess the contribution of intangibles to labour productivity, data in EU KLEMS will be integrated with information on intangible capital. Additional databases on R&D and other innovation measures, such as the OECD's ANBERD (on R&D) and the Community Innovation Survey (on innovation measures), and some further national sources are used.

In the existing national accounts, capital formation includes only a few kinds of intangible assets, namely software, entertainment, literary or artistic creations and mineral exploration. Other categories of expenditure, which are investment in nature (such as R&D and employer-provided training) are not treated as capital formation. This is corrected by Corrado, Hulten and Sichel (2005) who define capital investment as follows: *Any outlay that is intended to increase future rather than current consumption should be treated as investment, regardless its tangible or intangible nature*. They add intangible capital to the standard sources-of-growth framework and find that the inclusion of intangible assets makes a significant difference in the observed patterns of US economic growth. Corrado, Hulten and Sichel observe, in particular, a steep rise in investment in intangibles (as defined in their study) in proportion to traditional tangible investment, from about half in the 1950s to around 80% in the 1980s and to 136% in the years 2000–03.

They arrive at a higher rate of change of output per worker (productivity) than arrived at in the conventional national accounts, and capital deepening (but including intangible capital!) becomes the unambiguously dominant source of growth in labour productivity. The role of multifactor productivity (MFP) is correspondingly diminished and labour's income share is found to have decreased significantly over the second half of the 20th century.

Giorgio Marrano and Haskel, of Queen Mary, University of London, undertook a study aimed at applying the methodology of the former study using UK data in 2006. Their work arrives at broadly comparable results, albeit with investment in intangibles in the UK only at about the same level as investment in tangibles. Thus, for 2004 they estimate the level of investment in intangibles at 11% of GDP compared with 13% of US GDP according to Corrado, Hulten and Sichel (2005) for 1998–2000.

In the macro components of INNODRIVE we adapt intangible capital estimates synchronised with those established by Eurostat in their Second European Report on Science & Technology Indicators (1997) and Corrado, Hulten and Sichel (2005). In addition, we include intangible capital in a dynamic context as related to market restructuring. Recent studies have shown that up to half the growth of productivity is explained by the restructuring of firms. Simply put, high-productivity firms growing in size relative to low-productivity firms can be a more important source of growth than new inventions as such.

Besides the concept of *intangible capital*, INNODRIVE also applies a broader concept of *intellectual assets*, covering investment in higher education at the national level and returns to education at the firm level. These were also included in an evaluation of intellectual assets by OECD (2008). The broader definition of intellectual assets thus includes intangible capital (firm-specific, such as innovative activity, organisational capital and personnel with multiple skills) and assets that are general (human capital, spillovers from the innovation environment in the industry and in the region (urbanisation)). The unifying approach – to the extent possible – is shown in Table 1.

In the *micro approach*, an integral part of the performance-related analysis is to divide the intellectual assets engaged in manpower into the general capital of workers and the firm-specific capital – an exercise that is to a large extent only possible using LEED data. To match the national estimates, the firm-level measurement can be compared with national measures using those in Table 2. This table shows the main components of intangible capital in macro and micro approaches.

Table 1. Intellectual asset categories at the national and firm levels

	Valuation based on national expenditure data	**Valuation based on enterprise performance**
Intangible capital (firm-specific)		
Computer software	National accounts (NAs) output estimates	Returns to the use of computer personnel
Computerised databases	Special research	–
Scientific R&D	Special surveys, Eurostat Community Innovation Survey	R&D personnel
R&D in social sciences and humanities	Ad hoc estimate	Socio-economic classification 2-level: preparatory, design and research work other than R&D work
Firm-specific human capital (including training)	OECD and EUROSTAT surveys of training	Training expenditures (in ad hoc surveys)
Mineral exploration	NAs	Intangible capital in the mineral industry
Copyright and license costs	NAs	Regional patent data
New product development costs in the financial services industry	Ad hoc estimates based on input-output tables	Regional share of innovative firms (innovation survey)
New architectural and engineering design	NAs, share of turnover of the branch	Intangible capital in construction
Advertising expenditure	Special surveys of advertising associations, etc.	Advertising spending
Market research	Special surveys of market research firms and turnover	Marketing personnel
Purchased organisational structures	Examination of turnover and revenues of management consultant firms	Regional business services
Own account development of organisational structures	Ad hoc examination of national sources of information on employment and wages in executive functions	Organisational capital, performance-related pay
Intangible capital or intellectual assets (general)		
Human capital	Investment in higher education, experience	Education, experience human capital
Intangible capital creation through market restructuring	Firm entry and exit and worker mobility	Industry dynamics Worker mobility

Source: Corrado, Hulten and Sichel (2005) for valuation based on national expenditure data, Micro approach uses own evaluation..

Table 2. Intangible capital in the knowledge economy

Intangible capital in INNODRIVE	
Macro	Micro
Economic competencies	
1) Brand equity	1) Organisational capital
- Advertising	-Management
- Market research	- Marketing
2) Firm-specific resources	- Skilled administration
- Firm-specific human capital (e.g. training)	
- Organisational structure (e.g. management)	
Innovative property	
1) Scientific research & development	1) Research & development
2) Other research & development:	2) Innovative environment
- R&D in Social Science and Humanities	3) Macro: Other research & development
- Mineral exploration	
- New motion picture films and other forms of entertainment	
- New architectural and engineering design	
- New product development in the financial industry	
Digitalised information – ICT capital	
1) Software	1) ICT personnel assets
2) Database	2) Macro: software, database

Source: Corrado Hulten Sichel (2005) for the macro component.

The *macro approach* uses the categorisation of intangibles proposed by Corrado, Hulten and Sichel (2005). They identify three main categories of intangible assets: economic competencies, innovative property and computerised information. Economic competencies include spending on strategic planning, worker training, redesigning or reconfiguring existing products in existing markets, investment to retain or gain market share and investment in brand names. Innovative property refers to the innovative activity built on a scientific base of knowledge as well as to innovation and new product/process R&D more broadly defined. Computerised information basically coincides with computer software. Firm-level evaluation in the micro approach is also aggregated up to the national level. The idea is to use some of the macro results when firm-level information is not available as for software, databases and other research & development.

When aggregating firm-level estimates to the national level, we use weights by firm size and industry. For intangible items that cannot be assessed at the firm level, we simply use estimates obtained at the national level. Examples are the market research industry and training provided by firms.

Organisational capital can be obtained by identifying human resource practices at the firm and workplace levels or using information on entry wages and wage dispersion. In market restructuring, longitudinal LEED permits consideration of the extent to which productivity change is driven by behavioural change among continuing employees, compositional change in employees owing to migration and entry and exit, or a combination of these features. As emphasised repeatedly, information on innovation activity relies heavily on regional-level information. Data from the Community Innovation Survey is used at the most disaggregated level possible (NUTS 4 or NUTS 3).

The macro component involves reallocating the estimates of intangible investment in 16 categories, some of which are already shown in the conventional national accounts classified as contemporaneous inputs and thus deducted as such from the value added of the various branches, and in the aggregate, from GDP. Following the methodology of Corrado, Hulten and Sichel (2005), the production function model is therefore modified to include the stock of intangible assets and the estimate of GDP adjusted to include the flow of intangibles on the product side and the flow of services from the intangible stock on the income side.

In national estimates, the traditional Solow framework for analysing sources of growth is then expanded to include, on the input side, intangible capital in addition to labour and tangible capital. National growth accounting is a ‘representative-firm’ approach, but we take the aggregation problems seriously. This can be done by using country-level information on the quality of labour as is already done for the stock of fixed capital or output in standard approaches. In a panel (cross-section) analysis, we introduce an adjustment for the quality of labour in line with the Jorgenson framework (for example, the average level of educational attainment or a breakdown of labour input into categories). This feature is not included in the Corrado, Hulten and Sichel (2005) study, which only includes “firm-specific human capital”, but it can be of considerable added value in a cross-country comparison of sources of growth. The work programme thus involves two econometric studies:

- an analysis of the evolution through time (for selected years only) of the share of intangible investment and intangible assets in total capital formation and capital stock in the selected countries and an estimation of a production function as outlined above; and
- a cross-section analysis of the sources of growth, aiming at providing an overall econometric estimate of their contribution to growth, broadly following the approach in the seminal papers by Robert Barro.[2]

Finally, the work programme includes a forward-looking section, involving the preparation of scenarios for future productivity and output growth for the selected countries, as compared with the prospective analysis undertaken by Jorgenson, Mun and Stiroh (2004). This prospective analysis (undertaken in work packages 9 and 10) will, as indicated, involve the formulation of a view concerning the main inputs in the expanded production function and hence a projection of productivity.

2.2 Industrial clusters and spillover as an element of intangible capital

To the extent that geographical proximity, clustering and agglomeration contribute to innovation and productivity, the regional patterns of the economy may be seen as one of the strategic factors involved in promoting growth, employment and competitiveness of the EU. The ultimate question is whether the agglomeration of intangible capital is the solely appropriate spatial form of the knowledge economy in terms of productivity and competitiveness. We explore why this is not always the case, giving examples of industries and areas where small countries or regions with (specific) investment in intangible capital

[2] See Barro (1996) and Barro and Lee (1994).

have been able to generate innovative growth. Such an approach is impossible without giving due attention to the growth generated at the firm level and the networking of multinationals.

In the second and third steps, the analysis explores how intangible capital accumulates through knowledge spillovers and how this contributes to the social returns in productivity and employment growth at the firm level and across regions. The way intangible capital causes spillovers is broadly evaluated using the New Economic Geography theory to assess three mechanisms: *sharing, matching* or *learning* (see Combes, Duranton and Overman, 2005; Rosenthal and Strange, 2004).

Sharing mechanisms emphasise how fixed costs generate increasing returns because a larger local population allows every fixed cost to be spread over a larger number of customers. LEED data are particularly suited to the analysis of *matching* and linking firm and workplace fortunes (labour productivity, employment growth and survival) to worker flows (entry and exit) and worker progression (tenure and wages) within the firm. The approach identifies *learning* and thus intangible capital created through human capital and human resource practices, and the composition of this intangible capital in metropolitan and non-metropolitan areas.

3. Intangible capital: The macro approach methodology (WP2 Tasks 1-3)

Cecilia Jona-Lasinio (LUISS – LLEE), Massimiliano Iommi (LUISS – LLEE) and Felix Roth (CEPS)

3.1 Measuring intangible capital: The state of the art

There is extensive literature on intangible investment but most of it focuses solely on some assets (R&D capital, for example) leaving out other elements such as organisational capital or brand equity. Some of the most recent and general approaches to measuring intangibles in the economic literature can be identified (following Sichel, 2008) as financial market valuation, other performance measures and direct expenditure data.

The financial market valuation approach assumes that the value of intangible capital corresponds to the difference between the market value of firms and the value of tangible assets.

Brynjolfsson, Hitt and Yang followed this approach in some papers to analyse the link between intangible investments and investment in computers in the US (Brynjolfsson and Yang, 1999; Brynjolfsson, Hitt and Yang, 2000 and 2002). They used firm-level data and their main finding was that each dollar of installed computer capital in a firm was associated with between five and ten dollars of market value. According to them, this difference reveals the existence of a large stock of intangible assets that are complementary with computer investment.

Webster (2000) adopted a comparable approach with Australian data, assuming that any residual market value of the firm (stock market value plus liabilities) not explained by the balance sheet value of tangible assets must be due to intangible assets. He found that the ratio of intangible to all enterprise capital rose by 1.25% a year over the 50 years to 1998.

Along the same lines was the work done by the World Bank (2006) to measure intangible capital at the country rather than the firm level. The value of intangible capital was obtained as the residual after deducting natural capital and produced capital from total wealth (measured as the net present value of future sustainable consumption).

Another widely used method to estimate the value of intangible capital is the ‘other performance’ approach, concentrating mostly on measures such as productivity or earnings. Cummins (2005), for example, defined intangible capital in terms of adjustment costs and estimated these costs econometrically from US firm-level panel data. His idea was to create a proxy for the intrinsic value of the firm from the discounted value of expected profits based on analysts’ forecasts (which he suggested reflect the analysts’ valuation of intangibles) and to estimate the return on each type of capital (tangible and intangible). He found no appreciable intangibles associated with R&D or advertising but sizable intangibles (organisational capital) created by IT. In contrast to Cummins, Brynjolfsson, Hitt and Yang (2002) argue that most of the value springs not from adjustment costs but from the value of intangible assets materialising over a longer period, including factors such as business organisation, which are disproportionately high in IT-intensive firms. McGrattan and Prescott (2005) inferred the value of intangible capital from corporate profits, the returns to tangible assets and the assumption of equal after-tax returns to tangible and intangible assets. They calculated a range for the value of intangible capital from 31 to 76% of US GDP.

From a similar perspective, Lev and Radhakrishnan (2005) developed a firm-specific measure of organisational capital, modelling the effect on sales of organisational capital (proxied by reported ‘sales, general and administrative expenses’ as this includes expenditures that generate organisational capital). They found that the marginal productivity of organisational capital ranged between 0.4 and 0.6, and the mean organisational capital was 4% of average sales of their sample of US firms.

As stated in Cummins (2005), the first two approaches may be subject to considerable measurement error – for example, stock market values may reflect a mismeasurement to the extent that asset prices depart from their intrinsic values and analysts’ measures of earnings can be subject to mistakes and biases.

Yet the direct expenditure-based approach can also be subject to measurement error and data limitations – including whether the list of measures of intangibles is comprehensive and able to capture changes in the nature of intangibles over time.

This approach was adopted the first time by Nakamura (1999 and 2001), who measured gross investment in intangible assets by means of a range of measures including R&D expenditure, software, advertising and marketing expenditure, and the wages and salaries of managers and creative professionals. He found that in 2000, US investment in intangibles was $1 trillion (roughly equal to that in non-residential tangible assets), with an intangible capital stock of at least $5 trillion.

Starting from Nakamura’s work, Corrado, Hulten and Sichel (2005) developed expenditure-based measures of a larger range of intangibles for the US. They estimated that investment in intangibles averaged $1.1 trillion between 1998 and 2000 (1.2 times the tangible capital investment) or 12% of GDP. Then they developed a methodology for explicitly identifying the contribution of intangibles in the national accounts and growth accounting in Corrado, Hulten and Sichel (2006). They calculated that previously unmeasured intangible capital contributed 0.24 of a percentage point (18%) to conventionally measured MFP growth in the US between the mid-1990s and early 2000s. The Corrado, Hulten and Sichel methodology has been applied in a number of other country studies – with estimates of the contribution of previously unmeasured intangible capital to MFP growth, ranging from 14% in the UK (Giorgio Marrano, Haskel and Wallis, 2007) to 3% in Finland (Jalava, Aulin-Ahmavaara and Alanen, 2007) and 0% in the Netherlands (van Rooijen-Horsten et al., 2008), over a similar period. Other country studies simply estimated the contribution of *all* intangibles to MFP growth, with the results being -19% in Japan (Fukao et al., 2008), 19% in France, 18% in Germany, 9% in Spain and 0% in Italy (Hao, Manole and van Ark, 2008).[3]

This section provides an overview of the methodology adopted in the project to measure GFCF at the macroeconomic level and illustrates the main data sources used to estimate intangible GFCF for the EU-27 countries. In the framework of work package 2, the LUISS team has coordinated efforts to define the general estimation strategy for intangible variables at the macroeconomic level. LUISS and CEPS shared the responsibility for the estimates of the intangible variables as indicated in appendix 1.

3.2 Methodology: The INNODRIVE macro approach

The objectives of the work on the macro approach for the first 12 months of the project were the following:

- to identify some detailed criteria to screen the intangible variables (appendix 1) originally proposed by Corrado, Hulten and Sichel (2005) in order to select those to be capitalised;

[3] See Barnes and McClure (2009), for a comprehensive review of the empirical literature.

- to outline an INNODRIVE general estimation strategy;
- to screen the data sources available for each variable not currently included in GFCF and to define an estimation method; and
- to provide a first estimate of intangible assets for the EU-27.

Given the complex nature of intangible assets, there is no worldwide-accepted definition or single method to measure intangibles (Corrado, Haltiwanger and Sichel, 2005). Most of the literature simply identifies three critical attributes of intangibles: i) they are viewed as sources of probable future economic profits, ii) they lack physical substance, and iii) to some extent, they can be retained and traded by a firm (OECD, 2008). Yet, characteristics (i) and (iii) are also largely reflected in the more general definition of *economic assets* provided by the 1993 System of National Accounts (SNA) that classifies them (Harrison, 2006) as those entities

- over which ownership rights are enforced by institutional units, individually or collectively; and
- from which economic benefits may be derived by their owners by holding them or using them over a period of time.

On the other hand, Corrado, Hulten and Sichel (2005) 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". This implies that all types of capital should be treated symmetrically, thus leading to a very broad definition of capital – including for example intellectual and human capital as well as organisational assets (Schreyer, 2007).

Taking into consideration the above definitions, at this stage we have classified the expenditures as GFCF according to the following principles:

1. if the asset is identifiable – in other words, if it is separable (capable of being separated and sold, transferred, licensed, rented or exchanged, either individually or as part of a package);
2. if it is possible to identify the owner of the asset or who owns the intellectual property;
3. if the asset produces economic benefits for its owner; and
4. if the asset is used in the production process over several time periods. In particular, it is expected that the asset will provide capital services for over a year in the production of different products.

Our estimation strategy is based on the following criteria:

- *An expenditure-based approach*. We use expenditure data to develop direct measures of intangible GFCF and capital.
- *Exhaustiveness*. We estimate total expenditures for each type of intangible and how much each expenditure might be considered GFCF. Our estimates include both purchased and own-account components of expenditure on the intangible.
- *Consistency with national accounts*. The purchased component of expenditure on an intangible is already included in the production boundary of national accounts, while the own-account component is excluded. We want to guarantee that our estimates of the purchased component are consistent with national accounts production data. To this end, our estimation method is based (as much as possible) on variables expressed in per capita terms (per worker or per employee) or as a percentage of a national accounts variable (e.g. as a share of output or as a share of labour costs).

- *Reproducibility and international comparability*. To guarantee reproducibility and international comparability, wherever possible our estimates are based on official data sources that are homogeneous across countries (mainly Eurostat surveys, national accounts data, and supply and use tables).
- *Sectoral coverage*. Our estimates include only the non-agricultural business sector, defined as a grouping of all industries except agriculture (NACE Rev 1.1, category A), fishing (category B), 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). The exclusion of categories M, N, O and P in the definition of the business sector constitutes a pragmatic solution (the ideal approach would be to distinguish between establishments that are market producers and those that are not and then to define the business sector to include only market producers, but we do not have access to the data needed to implement such an approach). For some variables, the estimates that we have already produced do not refer exactly to the business sector as defined above; we plan to produce fully consistent estimates at a later stage.

Besides the general estimation strategy illustrated above, we also have to focus on three important implementation issues:

- *The estimate of intangible GFCF*. The first set of estimates of GFCF is based on the assumptions of Corrado, Hulten and Sichel (2005) of how much of each expenditure is assumed to be GFCF. This choice is dictated mainly by international comparability requirements (because most of the estimates of intangible GFCF available for European countries are based on the assumptions of Corrado, Hulten and Sichel). In a second stage, we will crosscheck their assumptions and verify whether it is feasible to produce alternative estimates of the proportion of expenditure that should be treated as investment.
- *The calculation of national accounts' value added consistent with the newly measured intangible GFCF*. For the business sector, the calculation of the revised value-added is quite straightforward: for market producers, value added simply increases with the newly measured intangible GFCF (both purchased and produced on own-account).
- *The exclusion any double counting of costs in the estimates of own-account components of capital formation*. Double counting can arise if costs are summed to obtain estimates of the own-account capital formation of one asset, while at the same time some or all of the same expenditures are also summed to obtain the own-account capital formation of some other asset.

  If the costs of production are used more than once to derive estimates of own-account capital formation in the same period, then the value asset production for that period will be over-estimated.

  This kind of double counting is likely to take place for R&D and software because of

  a) R&D undertaken in the course of producing software, or

  b) software produced in the course of undertaking R&D.

  Indeed, own-account software from the national accounts should include R&D connected to software development (the purchased R&D is included in the production costs as an intermediate input and the time spent by software personnel undertaking software R&D in-house is included in labour costs).

On the other hand, an R&D survey adhering to the Frascati Manual (the reference manual for R&D surveys) would record either some or all of the expenditure in case (a) and all of the expenditure in case (b) as expenditure on R&D.

The capitalisation of R&D based on data from R&D surveys may then lead to double counting, unless R&D connected to software development is subtracted from R&D data.

The double counting of costs may be present in all estimates based on the sum of costs (not only for R&D and software), so we need to be aware of the problem and put our estimates under scrutiny to be sure that no double counting is present.

3.3 Variable screening

The screening of the selected variables follows the classification scheme proposed by Corrado, Hulten and Sichel (2005) that grouped intangible assets into three main categories:

- computerised information,
- innovative property, and
- economic competencies.

In this section, we describe both the data sources and the measurement issues for each of the selected variables.

3.3.1 Computerised information

This category reflects knowledge embedded in computer programmes and computerised databases. The main component of computerised information is **computer software**, which is already included as a business fixed investment in the national accounts. At present, most countries do not provide official long time series of software investment, so our main data source is the EU KLEMS database. It provides both nominal and real software GFCF for the countries in Table 3.

Computerised databases are not identified as economic assets by themselves in the national accounting system. In some countries (the UK, the Netherlands and Finland), it is possible to gather data on database expenditures from IT surveys, but since they are usually captured by national account software measures (both purchased and own-account) we estimated them as a percentage of total software expenditure to avoid double-counting problems.

Table 3. Data availability: Software GFCF

Country	Time series length
Austria	1976–2005
Denmark	1970–2005
Italy	1970–2005
Finland	1970–2005
Germany	1991–2005
Czech Republic	1995–2005
Netherlands	1970–2005
Portugal	1995–2005
Slovenia	1995–2005
Sweden	1993–2005
UK	1970–2005

Source: EU KLEMS data base (March 2008 Release):

3.3.2 Innovative property

This category refers to the scientific knowledge embedded in patents, licenses and general know-how and the innovative and artistic content in commercial copyrights, licenses and designs (Corrado, Hulten and Sichel, 2005; van Rooijen-Horsten et al., 2008).

Scientific R&D

As one part of innovative property, Corrado, Hulten and Sichel (2005, 2006) include "firms' scientific and non-scientific R&D spending", with scientific R&D here reflecting the scientific knowledge embedded in patents, licenses and general know-how.

According to the 1993 SNA, expenditures on R&D are not treated as capital formation even though it is acknowledged that they are of an inherently investment nature. Paragraph 6.163 states that although R&D is aimed at future benefits, there are no clear criteria on how to distinguish R&D expenditures from those on other activities, to enable the identification and classification of the assets produced and therefore to know the rate at which these depreciate over time. As it is difficult to meet all these requirements, R&D outputs are treated as being consumed as intermediate inputs even though some of them may bring future benefits (Advisory Expert Group, 2005). Nevertheless, the revision of SNA 1993 (which was released in 2008) recommends that R&D expenditures be recorded as GFCF if they meet the general characteristics of a fixed asset. At the same time, the revised SNA 1993 also clarifies that there are substantial difficulties in implementing this recommendation and that the integration of technological assets will start by means of satellite accounts prior to a full consolidation in the SNA.

Foreseeing the revision of the 1993 SNA, Corrado, Hulten and Sichel (2005) consider scientific R&D as well as non-scientific R&D an investment in intangible capital. Referring to the vast amount of literature[4] on the capitalisation of R&D and taking into account criteria 1-4

[4] Anticipating the revision of the SNA, several national statistical institutes have already developed experimental satellite accounts for research and development. The accounts show how GDP and other measures would be affected if R&D spending were treated as GFCF rather than as a current expense.

(outlined above), we can summarise the main reasons R&D should be recorded as GFCF as follows:

- Expenditure on R&D is identifiable, e.g. is capable of being separated and sold, transferred, licensed, rented or exchanged, either individually or as part of a package, as spending money on R&D activity usually leads to a patent or a license.
- It is possible to identify who owns the asset, as normally it is the cooperation or institution that performs the research and spends the money that is the owner of the asset. This could include a company, a government, a higher education institute or a private non-profit company.
- The asset produces economic benefits for its owner, as the money that is spent on R&D has the clear purpose of creating new products, patents or licenses and optimising the existing production processes to exploit them in the future by selling those licenses and increasing the production capacity by means of the innovative production processes.
- It is expected that the asset will provide capital services for over a year in the production of different products, as most often the profits from licenses and patents yield benefits that last far longer than one year. This is also true for innovative production processes.

Construction of the intangible capital variable 'scientific R&D'

As the INNODRIVE project is interested in constructing an intangible capital dataset that focuses on business expenditures, data on scientific R&D was collected; more concretely, data on Business Expenditure on Research and Development (BERD) was retrieved. Although the ANBERD dataset from the OECD provides data of higher quality, Eurostat was taken as a source since it also provides information for the 12 new member states. Eurostat provides such data under the category "Science and Technology", with the subheading "Research and Development".

For the relevant period from 1980 to 2005, the Eurostat BERD dataset only had a few missing observations; missing data were inter- and extrapolated.

To avoid the double counting of software investment (software investment is an own intangible capital variable) as pointed out by Marrano et al. (2006),data for "K72 – Computer and related activities" was collected. As the data were not balanced, imputation was applied.

To retrieve the investment in intangible capital, the R&D in K72 was subtracted from the total scientific R&D (here again, see Marrano et al., 2006). As the investment in scientific R&D should be considered a 100% investment in intangible capital, these subtracted figures provide us with the final intangible capital investment.

Among them are the US (BEA, 2007), the Netherlands (Statistics Netherlands, 2008) and Norway (Statistics Norway, 2008).

Non-scientific R&D (R&D in social sciences and humanities)

Non-scientific R&D reflects the innovative and artistic content in commercial copyrights, licenses and designs. The R&D expenditure on social sciences and humanities is one aspect of non-scientific R&D. As there are only very scarce data available for R&D in social sciences and humanities (NACE K73.2) and as the amounts are non-significant, the variable was neglected.

Mineral exploration

Expenditures on mineral exploration are already recorded as GFCF in national accounts. The rationale is that mineral exploration creates a stock of knowledge about the reserves that are used as input in future production activities. A fundamental question has been raised, however, as to whether such knowledge should be seen as independent of the stock of economically exploitable reserves or whether this leads to double counting when both discovered stocks of resources and stocks of exploration are capitalised.

The revised SNA indicates that a distinction will be maintained between the act of exploring for mineral deposits (treated as a produced asset) and the mineral deposits themselves (treated as non-produced assets).

Mineral exploration expenditures are estimated by means of the amount of exploratory drilling as well as data on the average costs of mining explorations. We gathered detailed data from the national accounts.

New architectural and engineering designs

At present, most of these expenditures are recorded as GFCF in the national accounts. They are included in the estimates of dwellings and of non-residential buildings[5] and are estimated as a percentage of the expenditures on the accompanying tangible capital.

We should nonetheless consider that most of the expenditures related to the development of an architectural (engineering) project might also be included among the R&D expenditures sustained by the architect or firm that effectively produces the design. Furthermore, a portion of the expenditures related to the development of the project is spending by the firm (architect) on behalf of their clients. In this case, the spending is an intermediate input of the firm and it is included in its output. But at the same time, it is also considered capital spending by its buyer. Thus, recording the expenditures sustained by the firm as capital spending would lead to double counting of these costs.

Another important point to consider is that generally an architectural (engineering) design is used to produce a single good that is not repeatedly used in the production process (see Aspden, 2007). Therefore, in this respect, it does not satisfy the fundamental criterion 4 necessary to be classified as an economic asset.

[5] The NACE Rev. 2 code of the corresponding economic activity is 74.20.

New product development costs in the financial services industry

Corrado, Hulten and Sichel (2005) include new product development costs in the financial services industry as a component of innovative property. In our opinion, the development of new financial products produces know-how that meets the criteria we have proposed to define an asset: the knowledge is identifiable, there is no doubt that it produces economic benefits for more than one year and the financial institution that has developed a new product is clearly the owner of the asset.

While the inclusion of new product development costs in financial services in the extended asset boundary is quite uncontroversial, the estimation is problematic. According to Corrado, Hulten and Sichel, in the US the R&D survey is designed to capture only innovative activity built on a scientific base of knowledge and it is likely that it does not fully capture R&D expenditures (broadly defined) in the financial services industry. On the other hand, the Frascati Manual explicitly gives examples of R&D in banking and insurance: “[m]athematical research relating to financial risk analysis and R&D related to new or significantly improved financial services (new concepts for accounts, loans, insurance and saving instruments)”. In principle, therefore, the R&D survey data should capture not only scientific R&D but also R&D in financial services (van Rooijen-Horsten et al., 2008). We think that more research is needed to clarify whether the R&D in banking and insurance as defined in the Frascati Manual (and measured in the R&D surveys) captures all expenditure to produce ‘innovative property’.

Estimation method

Following Corrado, Hulten and Sichel (2005), we have estimated new product development in financial services as 20% of total intermediate spending for intermediate inputs by the financial intermediation industry, which is defined as excluding insurance and pension funding (NACE J65).

Further improvements and refinements

- Estimate the variable as 20% of intermediate inputs by the financial services industry, which is defined as including insurance and pension funding (NACE J66).
- Compare with data on R&D.

3.3.3 Economic competencies

Corrado, Hulten and Sichel (2005) define the economic competencies category of intangibles as “the value of brand names and other knowledge embedded in firm-specific human and structural resources”. It comprises expenditures on advertising, market research, firm-specific human capital and organisational change.

Advertising expenditure

Expenditure on advertising is intended to create a perceived ‘image’ of the firm in the minds of potential consumers. As the consumer’s choice among the products of competing firms is often driven by a perception of reliability and trustworthiness, the development of this image or brand has to be considered key in the yield of future benefits.

Thus, in the light of this simple consideration, advertising expenditure (or at least part of it) should be viewed as an investment in intangible capital rather than simple short- or medium-term costs.

If we consider the criteria 1-4, we can argue that,

- advertising expenditure is identifiable, e.g. is capable of being separated and sold, transferred, licensed, rented or exchanged, either individually or as part of a package, as advertising activity is quite often outsourced to specialised firms;
- it is possible to identify who owns the asset, as the product of the firm or the firm's brand name, in general, is the object of the advertising and hence the firm is clearly the owner of the asset;
- the asset produces economic benefits for its owner, as the advertising expenditure contributes to the value of the brand and in this sense produces benefits for the owner; and
- it is expected that the asset will provide capital services for over a year in the production of different products, as advertising expenditure is the fundament on which the image or the brand name of the firm is built and thus its effects cannot be restricted to one year.

Construction of the intangible capital variable 'investment in advertising'

To construct the investment in advertising variable, data on the turnover (v12110) for "K74 – Other business activities" from Eurostat's Structural Business Survey were collected; the same source was taken for the subcategory "k744 – Advertising". Only data for the time period 1995–2005 was used.

After thorough analysis, however, it was concluded that the data were plagued with measurement errors. The time trends of Zenith Optimedia (ZO)[6] (a private data source) were therefore compared with the data from the Structural Business Surveys and the latter were altered accordingly.

In a next step, the spending of the public sector was subtracted from the data by considering public sector consumption as a percentage.

Subsequently, the shares between K74 and k744 were calculated and applied to the national accounts data on the output (P1) of K74 expressed in millions of national currency (including the 'euro fixed' series for the euro area countries).

Although it seems plausible to regard advertising expenditure as investment, it is not feasible to consider its total amount (100%) GFCF because a share of the expenditure in advertising is spent for short- or medium-term purposes, thus not providing economic benefits for more than one year. Landes and Rosenfield (1994) found that in the US, around 60% of advertising expenditure could be capitalised; therefore, Corrado, Hulten and Sichel (2005) recorded 60% of advertising expenditure as investment. This method of evaluating only 60% of spending was also replicated in the UK study by Giorgio Marrano and Haskel (2006), in the study for Japan by Fukao et al. (2007) and the study for the Netherlands by van Rooijen-Horsten et al. (2008). Consequently, the effective estimation of investment in intangible capital was performed by applying a share of 60%.

Construction of the intangible capital variable 'investment in advertising': Different data source (ZO)

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[6] The authors would like to thank Zenith Optimedia for making the data available to us.

In view of the deficiencies that emerged from the Structural Business Survey dataset and the fact that the data from these surveys are not able to capture own-account spending (see here Haskel et al., 2006), ZO data for the 1996–2005 period were also retrieved.

Since the actual expenditure is lower owing to methodological issues within the Zenith Optimedia report compared with the benchmark figures of Haskel et al. (2006) and Edquist (2009), a ratio was calculated and applied to the ZO data, taking the UK and Sweden as references.

As mentioned above, only 60% of the actual expenditure was considered investment.

As a final step, the 2005 Structural Business Survey data was compared with the ZO data. It emerges that the ZO data reports values twice as high; this is not unusual as only the ZO data is able to capture the own-account spending. One should now look at either applying the ratio to the Structural Business Survey data or retaining the ZO data.

Which dataset will be incorporated into the final estimation of the intangible capital stock is still to be decided.

Expenditure on market research

The intangible dimension of expenditure on market research constitutes, next to expenditure on advertising, an important part of the investment in brand equity. Up to now, national accounting frameworks have not recorded this kind of expenditure as business investment, but rather deemed it an intermediate cost that does not provide future benefits. Corrado, Hulten and Sichel (2005) instead proposed to include them in the asset boundary; this argumentation is based on the view that although the properties of markets tend to change consistently over time, it is reasonable to assume that the knowledge of certain market segments and consumer attitudes holds benefits for more than one year, as the information gathered tends to be valid for several years.

If we consider criteria 1-4, we can argue that,

- expenditure on market research is identifiable, e.g. is capable of being separated and sold, transferred, licensed, rented or exchanged, either individually or as part of a package, as the results, especially market data research, can easily be sold to other agents;
- it is possible to identify who owns the asset, as firms that spend money on market research own the data and the results, and they have more knowledge of the specific market structures;
- the asset produces economic benefits for its owner, as the expenditure on market research contributes to the value of the brand and in this sense produces benefits for the owner; and
- it is expected that the asset will provide capital services for over a year in the production of different products. Since some market segments only evolve slowly, knowledge of the specific market segment will hold benefits beyond one year.

Construction of the intangible capital variable ‘investment in market research’

Corrado, Hulten and Sichel (2005) took the data from the Census Bureau’s Services Annual Survey and used the “turnover of market research firms” as a proxy for the expenditure. This approach may draw some criticism: when measuring aggregated firm investment in intangible capital, it is crucial to analyse the *demand side* (aggregated expenditure) of market research activities and not the *supply side* (turnover of the market research industry). To give an example, if Nestlé, a Swiss corporation, invests in market research activities in one of the new EU member states, for instance Poland, the investment should be included in the accounting framework of Switzerland, as Nestlé has invested in its brand development. Yet, when taking the turnover of market research firms in a country as a proxy for the expenditure, Nestlé's expenditure would be included as an investment in intangible capital in Poland instead of Switzerland.

Although analytically weak, there is one clear pragmatic reason to use the turnover data: information on firms' expenditure on market research is not available. Representatives of Eurostat and ESOMAR (European Society for Opinion and Marketing Research) underlined that firms' expenditure data on market research are deemed sensitive and thus are not collected and made public.

Moreover, when comparing the data consistency of Eurostat and ESOMAR,[7] it can be observed that Eurostat turnover is systematically higher for all countries with the exceptions of Germany, France, Finland and Sweden. This could be because of different definitions of turnover or a diverse item included in the variable (such as data on public opinion). As a consequence, in order to construct the variable on investment in market research, the data on the turnover (v12110) for "k7413 – Market research" from the Structural Business Survey dataset was taken for the period 1995–2005.

Still, the Structural Business Survey dataset was affected by several measurement errors; the problem was successfully tackled by comparing the data on the turnover for k7413 with ESOMAR time trends and modifying the Structural Business Survey dataset accordingly.

In a next step, the spending of the public sector was subtracted from the data by considering public sector consumption as a percentage. Afterwards, the shares between K74 and k7413 were calculated and applied to the national accounts data on the output (P1) of K74 expressed in millions of national currency (including the euro fixed series for the euro area countries).

Finally, following the approach of Corrado, Hulten and Sichel, the prevalence of own-account market and consumer research was estimated by doubling the estimate of the data on market research.

Firm-specific human capital

Corrado, Hulten and Sichel (2005) include firm-specific human capital (FSHC) as a component of the broader category 'economic competencies', but they do not provide any rationale for including FSHC as a component of intangible capital.

It is virtually unquestionable that expenditure on training brings future benefits (as is also recognised by the 1993 SNA), and hence training expenditure should be recorded as GFCF.

On the other hand, it is not so clear who is the owner of the asset that is generated by training expenditures. Concerning the idea of capitalising FSHC, we can follow three different approaches:

- We can agree with the SNA and exclude training expenditures from our extended asset boundary because they "do not lead to the acquisition of assets that can be easily identified, quantified and valued for balance sheet purposes" (1993 SNA, paragraph 1.51);

[7] The authors would like to thank ESOMAR for making their data available to us.

- We can follow Corrado, Hulten and Sichel (as have all the papers that have replicated their analysis for other countries) and treat training expenditures as GFCF. For example, van Rooijen et al. (2008)) provide a rationale for including FSHC as a component of intangible capital. Here the main point is that it can be reasonably argued that a company would not pay for training unless it expects a return on its investment. They note that the extent to which a firm really exercises ownership rights over the new knowledge embodied in its personnel is questionable (e.g. a trained employee may choose at any point in time to leave the company for another job). But they conclude that the benefits of job training are expected to be largely captured by the employer (e.g. because firms may demand compensation from recently trained employees who leave shortly after being trained).
- We can assume that the asset belongs to the employee and not the employer. In other words, we can treat expenditure on employer-provided training as the production of human capital. This is what is proposed, for example by the PRISM initiative:[8]

  > Businesses can try to tie in skilled employees by offering long term contracts or inducements to prevent them leaving, in which case there may be scope for treating some knowledge assets as effectively 'belonging' to the business, at least for a time. In general, however, knowledge assets belong to individuals or households. They continue to exist and be valuable even if the businesses that make use of them cease to exist. Even if knowledge assets are recognised as intangible assets within the system, it is difficult to see how they can be attributed to the business sector.

  In their opinion, the benefits for the employer derive from the expectation of being able to retain the services of the employees and to continue to rent their special skills for a considerable length of time – not from becoming the owner of the asset (Hill and Youngman, 2002; Hill, 2003).

Our first estimates will be consistent with the approach by Corrado, Hulten and Sichel (2005). In a second stage, we will reconsider the three alternatives stated above and evaluate which one should be adopted.

Data sources

The main data source from which to estimate employer-provided training is the Eurostat Continuing Vocational Training Survey (CVTS). In our opinion, this source is to be preferred to national sources because it provides comparable statistical data on enterprise training across countries.

Survey description

- Years available from Eurostat's website: 1999 (CVTS2) and 2005 (CVTS3 is still preliminary and incomplete). The survey for 1993 (CVTS1) was of a pioneering nature and is no longer disseminated.
- Country coverage: The CVTS3 and CVTS2 cover the EU-27 member states and Norway (except Cyprus, Malta and Slovakia in CVTS2; in the case of Poland, only the Pomorskie region is in CVTS2). For the UK, however, the results from the two surveys are not comparable.

[8] See the website http://www.euintangibles.net.

- Industry coverage: Agriculture, fishery, education and health are not covered by the surveys.
- Industry detail: Data are available for 6 macro industries and 21 branches (CVTS3 is not yet available for 21 branches).
- Variable of interest for our estimates:. *Cost of CVT courses as a % of total labour cost (all enterprises).*

Estimation method

*Training expenditure = Cost of CVT courses as a % of total labour cost * Compensation of employees (from NA)*

We assume that 100% of spending is to be considered GFCF.

The estimation method for the years not covered by the survey

- We have held the share constant for the year before 1999 and we have (linearly) interpolated values for the years between 1999 and 2005.
- We have applied our estimation method at the industry level and then aggregated it to obtain national-level estimates, in order to reflect changes in industry composition.

Further improvements and refinements

Use more disaggregated results for CVTS3 when these are available.

Organisational structure

The literature dealing with the issue of intangibles' measurement and evaluation considers organisational capital one of the most important contributors to corporate performance and growth. The concept of organisational capital refers to "an agglomeration of technologies – business practices, processes and designs, and incentive and compensation systems – that together enable some firms to consistently and efficiently extract from a given level of physical and human resources a higher value of product than other firms find possible to attain" (Lev and Radhakrishnan, 2005). According to the short literature review in Lev and Radhakrishnan, some studies on organisational capital view this resource as embodied in employees (e.g. Jovanovic, 1979; Becker, 1993), while others view organisational capital as being beyond that embedded in people and define it as "a firm-specific capital good" (Arrow, 1962; Rosen, 1972; Tomer, 1987; Ericson and Pakes, 1995; and also Lev and Radhakrishnan, 2005).

Corrado, Hulten and Sichel (2005) include investment in organisational change and development in their definition of economic competencies. They follow the firm-embodied concept of organisational capital, but with a very important peculiarity. Most of the literature assumes that organisational capital is acquired by endogenous learning-by-doing (e.g. it is jointly produced with measured output) or through other externalities deriving from IT or R&D management, for example. Instead, externalities are excluded by the Corrado, Hulten and Sichel expenditure-based approach (so that their approach is consistent with the SNA).

Corrado, Hulten and Sichel define investments in organisational change and development as the sum of two components: the purchased component (represented by management consultant fees) and the own-account component (represented by the value of executive time spent on improving the effectiveness of business organisations, i.e. the time spent on developing business models and corporate cultures). Therefore, the Corrado, Hulten and

Sichel investment in organisational structure can be thought of as a subset of organisational capital as it is usually referred to in the literature.

In our opinion, the Corrado, Hulten and Sichel definition of organisational structure meets the definition of an asset. It is rather obvious that it produces economic benefits for more than one year. Moreover, it also meets the ownership criterion as it can be retained by the firm. In other words, following the categorisation proposed by the European Commission through the MERITUM project, it is a form of structural capital, as it stays with the firm 'after the staff leaves at night' (and it is not a form of knowledge that employees 'take with them when they leave at night').

Data sources and estimation method for the own-account component

Data sources

In order to preserve cross-country comparability and consistency with national accounts data, we propose to base our estimates on the Structure of Earnings Survey (SES) and the Labour Force Survey (LFS).

1) Structure of Earnings Survey

SES represents EU-wide, harmonised structural data on gross earnings, hours paid and annual days of paid holiday leave that are collected every four years. It gives detailed and comparable information on the relationships between the level of remuneration, individual characteristics of employees (gender, age, occupation, length of service, highest educational level attained, etc.) and their employer (economic activity, size and location of the enterprise).

Survey description

- Years available from Eurostat's website: The Eurostat website provides data only for the 2002 survey. In the near future, the results for the year 2006 will also be available.
- Country coverage: The 2002 SES covers all EU member states as well as the candidate countries Bulgaria and Romania, and the European Economic Area countries Iceland and Norway.
- Industry coverage: The statistics of the 2002 SES refer to enterprises with at least 10 employees in the areas of economic activity defined by sections C-K of NACE Rev. 1.1. The inclusion of sections L-O is optional for 2002, as is the inclusion of enterprises with fewer than 10 employees. Yet several countries (Cyprus, Germany, Estonia, Finland, Hungary, Ireland, Lithuania, Latvia, the Netherlands, Norway, Poland, Slovenia, Slovak Republic and the UK) covered all.
- Variable of interest for our estimates: *Mean annual earnings by profession*.

Industry detail: NACE one-digit level but the variable of interest for our estimates (*Mean annual earnings by profession*) from the Eurostat website is only available at the aggregate level.2) Labour Force Survey

The EU LFS is a quarterly household sample survey carried out in the EU member states, candidate and European Free Trade Association (EFTA) countries (except for Liechtenstein). It is the main source of information about the situation and trends in the labour market in the EU. It provides data on employment, unemployment and inactivity together with breakdowns by age, gender, educational attainment, temporary employment, full-time/part-time distinctions and many other dimensions. The survey's target population is all persons in private households aged 15 years or older.

Survey description

- Years available and country coverage: Data for all member states are mostly available from 1999 or 2000 onwards. Data relating to the former EU-15 are available from 1995 onwards. Data relating to the former EU-12 are available from 1987 onwards. Results for the candidate countries date back to 2002 and for the EFTA countries to 1995.
- Variable of interest for our estimates: *Number of employees by occupation*.

Estimation method

- Estimate the *gross earnings of managers* and *gross earnings of all employees* by multiplying the mean annual earnings (from the SES) for the number of employees (from the LFS).
- Calculate the share of gross earnings of managers as

manager_comp_share = Gross earnings of managers / Gross earnings of all employees.

- Estimate the total expenditure for management compensation consistent with national accounts data by applying the share of gross earnings of managers to the total compensation of employees:

*manager_comp = manager_comp_share * Compensation of employees (from NA).*

- Make an assumption about what proportion of spending is to be considered investment (*inv_share*). Following Corrado, Hulten and Sichel (2005), we have assumed *inv_share*=20%.
- Estimate the value of own-account investment in the organisational structure (*own_organiz_structure*) by applying the investment share to the total manager's compensation:

*own_organiz_structure= manager_comp * inv_share.*

Estimation method for the years not covered by the survey

Since for the time being only the 2002 SES is available, we have held *manager_comp_share* constant to the value for the year 2002.

Further improvements and refinements

- When the SES for the year 2006 is available, we can interpolate in order to obtain a time-varying share.
- Apply the proposed method at the industry level and then aggregate to obtain national-level estimates, so as to reflect changes in industry composition.

The Eurostat website does not provide data cross-classified by industry and category of occupation. Possible sources of more disaggregated data are below.

- We can ask national statistical institutes if they can disseminate the data cross-classified by industry and category of occupation.
- The Eurostat website notes that at present, access to the SES microdata is only possible through the SAFE Centre at the premises of Eurostat in Luxembourg. The confidential

microdata of (in principle) 15 countries are covered,[9] depending on the authorisation of use by these countries.

- An additional source is LEED data.

Possible bias in the results

The share of legislators, senior officials and managers (ISCO1) of the total number of employees in the LFS shows a high degree of variation across countries (e.g. about 14% in the UK and about 3% in Italy and Germany). It may be that this variation stems from a lack of comparability of results across countries, but it requires further investigation.

Data sources and estimation method for the purchased component

The purchased component can be computed using the nominal gross output or turnover of the NACE 2002 version of industry "7414 – Business and management consultancy activities".

Data sources

The data sources are annual, detailed enterprise statistics on services from the Structural Business Statistics (Annex 1), with the following caveats:

- Eurostat or OECD website data at the four-digit level of disaggregation for NACE 7414 are only available for Italy, Germany and Ireland; and
- for many countries, only a long time series is available.

Concerning the Structural Business Statistics on Business Services (available from the Eurostat website),

- the turnover of NACE 7414 is available, and
- data are available only for some selected countries and some selected years (see Table 4).

A further source is the FEACO Survey of the European Management Consultancy Market[10]Table 5 reports the data source that is used for each country.

[9] These are Cyprus, the Czech Republic, France, Hungary, Ireland, Lithuania, Latvia, Luxembourg, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia and Norway.

[10] FEACO is the European Federation of Management Consultancies Associations, the European umbrella organisaton for 20 national management consultancies associations and it is the sole European federation representing and promoting the management consulting sector.

Table 4. Structural Business Statistics on Business Services

(millions of euros)

Structural Business Statistics on Business Services

nace 7410 - Turnover

	2001	2002	2003	2004	2005
Austria	-	-	-	-	-
Belgium	-	-	-	-	-
Bulgaria	-	-	-	-	-
Cyprus	-	-	-	-	-
Czech Republic	-	-	-	-	-
Denmark	1,648	-	1,185	1,509	1,746
Estonia	-	-	-	-	-
Finland	1,102	-	-	1,172	-
France	15,031	-	-	-	-
Germany	-	-	-	16,327	-
Greece	-	-	764	762	-
Hungary	-	-	-	-	-
Ireland	-	-	-	-	-
Italy	-	-	-	-	-
Latvia	-	-	31	57	-
Lithuania	-	-	-	91	-
Luxembourg	-	-	178	-	-
Malta	-	-	-	52	-
Netherlands	-	-	-	-	-
Poland	-	-	1,871	-	-
Portugal	1,379	-	-	2,181	3,794
Romania	-	-	-	691	863
Slovakia	-	-	-	107	-
Slovenia	-	-	475	343	391
Spain	2,630	-	3,059	3,029	3,552
Sweden	5,262	-	4,399	4,511	4,940
United Kingdom	31,862	-	28,224	30,211	-
Norway	-	-	-	1,048	1,248

Table 5. Main Data Source for Purchased Organisational Structure

Country	Source
Austria	feaco
Belgium	feaco
Bulgaria	feaco
Cyprus	business surveys
Czech Republic	feaco
Denmark	business surveys
Estonia	business surveys
Finland	business surveys
France	business surveys
Germany	business surveys
Greece	business surveys
Hungary	feaco
Ireland	business surveys
Italy	business surveys
Latvia	business surveys
Lithuania	business surveys
Luxembourg	business surveys
Malta	feaco
Netherlands	feaco
Poland	business surveys
Portugal	business surveys
Romania	business surveys
Slovakia	business surveys
Slovenia	business surveys
Spain	business surveys
Sweden	business surveys
United Kingdom	business surveys
Norway	business surveys

Preferred estimation method (based on business survey data)

1. Calculate the share of turnover of industry 7414 in the turnover of industry 74 from survey data (Structural Business Statistics):

   NACE7414_share = NACE7414_turnover / NACE74_turnover.

2. Estimate the gross output of NACE 7414 consistent with the national accounts by applying the share to gross output of industry 74 from the national accounts:

   *NACE7414_output = NACE7414_share * NACE74_output.*

3. Estimate the share of turnover of NACE 7414 purchased by the business sector (*NACE7110_enterprise_share*) from the data disaggregated by client type (information available from both the Structural Business Statistics on Business Services and the FEACO survey).
4. Estimate the business sector expenditure on organisational structure as

   organiz_structure_expenditure = NACE7110_enterprise_share NACE7414_output.*

5. Make an assumption about what proportion of spending is to be considered investment (*inv_share*). Following Corrado, Hulten and Sichel, we have assumed *inv_share=80%.*
6. Estimate the value of investment in organisational structure (*purch_organiz_structure*) by applying the investment share to the total manager's compensation:

   *purch_organiz_structure= organiz_structure_expenditure * inv_share.*

Alternative estimation method (based on the FEACO survey)

- Assume that *NACE7414_output = Total Turnover in Management Consulting from the FEACO Survey.*
- Replicate points 3-6 from the preferred estimation method above.

Estimation method for the years not covered by the survey

We have held *NACE7414_share* constant.

Further improvements and refinements

- Extend the country coverage and the time span of the data on turnover of NACE 7414 from the Structural Business Survey. Possible sources of more disaggregated data are national statistical institutes and Eurostat.
- Estimate investment in purchased organisational structure using a commodity flow approach, e.g. as output + imports – exports. Data on imports and exports of services are available from balance of payments statistics, but further investigation is needed to check if the data are available at the level of disaggregation required for our estimates.
- Revise the assumption about *inv_share* on the basis of information on the type of management consultancy service provided (this information is available from both the Structural Business Statistics on Business Services and FEACO).

4. Estimates of intangible capital: The micro approach (WP2 Tasks 1-3)

Hannu Piekkola (UNIVAASA)

Traditional accounting considers intangible expenditure a cost and not an investment. Yet, the binding factor for maintaining a global network of production and marketing is intangible capital. It can be viewed as including organisation-related code, which makes it tacit and not directly transferable to other firms (Evenson et al., 1995). Economies are facing a second wave of globalisation, characterised by specialisation in tasks and inter-industry trade (Baldwin, 2006). Workforces vary in skills and investment in managerial competence, marketing and ICT, and not only with respect to R&D in creating valued added over a longer period. Such intangible capital creates future profits and the capitalisation rate should be positive, i.e. intangible capital should be treated at least partly as an investment. Intangible capital should first be interlinked with managerial resources. Prescott and Visscher (1980) first introduced "organisational capital" as the management-related abilities of measuring the performance of the firm's personnel in improving matches between employees and jobs, working in teams and the human capital of the firm's employees. This broad definition emphasises organisational capital in people. Harvey and Novicevic (2005) also emphasised the managerial competencies appropriate for competing in a global context. Employees in marketing are similarly at the core of organisational capital as evidenced by Miyagawa and Kim (2008). Marketing can be divided into that provided by the firm and that purchased from advertising agencies, where the former can be more strategic in nature.[11]

The organisational work related to top management, marketing and administration has become among the most rewarded work, but influences book values predominantly only in mergers. In the Anglo-American type of operation-based accounts, selling, general and administrative (SGA) expenditures not only include these but also R&D expenses, employee training, ICT and the set-up of Internet-based supply and distribution channels. Ito and Krueger (1996) and Bresnahan and Greenstein (1999) suggest that organisational capital complements ICT investments and typically exceeds the direct financial costs of the ICT investments themselves. Brynjolfson, Hitt and Yang (2002) argue that their reported large returns on ICT investments are largely explained by a relationship between the use of IT and skilled workers and human resource management (with a greater decentralisation of certain decision rights and team-oriented production). R&D expenditures have been the first recognised type of intangible capital to be included in the satellite accounting of GDP by the OECD.

In all intangibles, employee compensation forms the majority of expenses. The micro approach aims at valuing intangible capital using this information. We first build our estimate by valuing organisational capital such as the contribution of management by measuring its productivity relative to other kinds of work. ICT personnel assets and R&D assets are instead calculated using traditional measures evaluating the contribution of workers (relative to capital) and using predetermined depreciation rates. The estimation strategy for valuing organisational capital proceeds as follows:

1. modelling the firm's output as a function of physical capital, labour input, organisational work augmenting labour input and R&D assets (representing innovative activities);

[11] Where it occurs at the national level.

2. in explaining asset (resource) productivities, measuring the relative productivity of organisational work or using compensation for organisational work as an instrument in explaining sales growth in yearly industry-level estimates using two-stage least squares (2SLS);
3. explaining organisational capital and ICT personnel assets using variables that are known to be correlated with it – proxies for globalisation (activity abroad, multiplant) and human resource management; and
4. evaluating how measured intangible capital explains the market value over book value of the firms listed on the Helsinki stock exchange.

Estimation method

We apply a constant returns to scale production function (see Lev and Radhakrishnan, 2003, 2005; Hall, 2000):[12]

$$SALE_{it} = b_{0it}(Q_{it}L_{it})^{b1}RND_{it}^{\ b2}PPE_{it}^{\ b3}e_{it} \quad (1)$$

where $SALE_{it}$ is the revenues of firm *i* in year *t*, $Q_{it}L_{it}$ is labour quality input (L is total work hours), RND_{it} is plant-specific R&D capital, PPE_{it} is net plant, property and equipment, and *eit* is an error term. Note that the specification imposes higher returns to an additional investment in R&D capital at low levels of it (although the elasticity of output with respect to intangible assets is constant). It is therefore appropriate to have a wide definition of R&D occupations. The labour L_{it} is measured by total hours including overtime hours for production workers and using regular weekly working hours for non-production workers and those in services. We separate the labour input of organisational workers. Hellerstein, Neumark and Troske (1999) and Ilmakunnas and Maliranta (2005) analyse skill-adjusted labour input when the education and work experience of employees are perfect substitutes, but with differing marginal productivities. We divide workers into two categories, with the labour input of other-than-organisational-capital workers as the reference.

$$\begin{aligned} Q_{it}L_{it} &= a\,w_{it}^{OC}OC_{it} + w_{it}(L_{it} - OC_{it}) \\ &= w_{it}L_{it}\left[1 + \left(a\frac{w_{it}^{OC}}{w_{it}} - 1\right)\frac{OC_{it}}{L_{it}}\right], \end{aligned} \quad (2)$$

where OC_{it} is the total hours of organisational workers in the plant and w_{it}^{OC} and w_{it} are hourly wages for organisational workers and other workers, respectively. Compensation for occupations OC_{it} relate to management, administration and marketing. Here we allow for the productivity of organisational workers to differ from the rest by factor a. In log form, we can approximate $\log\left[1 + \left(a\frac{w_{it}^{OC}}{w_{it}} - 1\right)\frac{OC_{it}}{L_{it}}\right] \approx \left(a\frac{w_{it}^{OC}}{w_{it}} - 1\right)\frac{OC_{it}}{L_{it}}$ since organisational workers are

[12] Caves and Barton (1990) and Jorgenson, Griliches and Intriligator (1986) give details on estimating firm production functions with fixed effects. Hulten (2000) provides a review of the theoretical foundations of the Solow residual and Divisia Index.

16% of total workers and we are measuring relative productivity (also so that the first term in squared brackets is not too far from zero). Hence, the production function can be written as

$$\ln SALE_{it} = b_0 + b_1 \ln w_{it} + b_1 \ln L_{it} + b_4 \frac{OC_{it}}{L_{it}} + b_2 RND_{it} + b_3 PPE_{it} + \ln e_{it} \quad (3)$$

where $b_4 = b_1[a(w_{it}^{OC} / w_{it}) - 1]$. Thus, the additional productivity of organisational capital can be written as $a = (w_{it} / w_{it}^{OC})(b_4 / b_1 + 1)$. Our measure of organisational capital is

$$ORG_{it} = a w_{it}^{OC} OC_{it} = w_{it} OC_{it} [b_4 / b_1 + 1] \ . \quad (4)$$

Alternatively, we substitute SGA expenditures divided by the average hourly compensation as another measure of the share of workers engaged in intangible capital creation in general. The value of SGA is the wage bill multiplied by this share and relative productivity.

In R&D investment we find it relevant to emphasise the historical values, as the returns from R&D work emerge in the long run. ICT personnel assets and R&D assets may be more homogeneous than organisational capital so a common depreciation rate is applied over the industries. R&D assets are calculated assuming 20% deprecation and using information on related wage compensation multiplied by 1.25 (assuming that employee compensation for R&D work is 80% of total expenses in R&D). An R&D asset is based on observed figures over three years.

$$R\&D\,Asset_{it} = 1.25*\{RND_{emp,it} + (1\text{-}\delta)RND_{emp,it-1} + (1\text{-}\delta^2)RND_{emp,it-2} + (1\text{-}\delta^3)\overline{RND}_{emp,it-3} \frac{1}{1-(1-\delta-g)}\} , \quad (5)$$

where δ is the depreciation rate, g is the growth of R&D investment and $\overline{RND}_{emp,it-3emp,it-3} = (RD_{emp,it} + RND_{emp,it-1} + RND_{emp,it-2}) / 3$ is the average compensation for R&D work over the last three periods. The latter is used to decrease randomness when calculating past values. The short time span of the data allow information on R&D for two lags and the value of R&D stock from period *t*-3 backwards is evaluated assuming R&D compensation in period *t*-3 to be an average observed in periods *t*, *t*-1 and *t*-2. We set the depreciation rate to 20% following the literature and R&D growth, $g = 0.03$, follows the sample average growth rate of 3%. R&D compensation is deflated by capital investment and wage indices with equal weight, while the R&D asset is then transformed back to nominal value.

The distribution of R&D assets is highly skewed, but still two-thirds of firms have R&D assets in comparison with one-third in Lev and Radhakrishnan (2003). Therefore, we examine all firms and do not separate the production function of R&D-intensive firms. ICT personnel assets are calculated directly from employee compensation, and assuming a 33% depreciation rate (Corrado, Hulten and Sichel, 2005, have 36% depreciation rate for software).

The estimation is done separately for nine to eleven industries. In services and the manufacturing of non-durables (such as food, textiles and leather) firms may more easily adapt their organisational capital for the business cycle. The adapted industry classification, which is grounded on Fama and French (1988) and (1997). For the sample of firms with operation-based accounts, SGA expenditures are used to evaluate the number of organisational workers.

The alternative measure of organisational capital evaluates sales growth and uses 2SLS as proposed by Lev and Radhakrishnan (2005). Growth estimates are done using an annual growth equation, i.e. log differencing the model, using as an instrument occupational compensation OC_{it} so that

$$\begin{aligned}\log(SALE_{ijt} / SALE_{ij,t\text{-}1}) \;=\; & c_{0jt} \;+\; g_{0jt}\log(OC_{ijt} / OC_{ij,t\text{-}1}) \\ & + c_{1jt}\log(PPE_{ijt} / PPE_{ij,t\text{-}1}) \;+\; c_{2jt}\log(EMP_{ijt} / EMP_{ij,t\text{-}1}) \\ & + c_{3jt}\log(RND_{ijt} / RND_{ij,t\text{-}1}) + \log(e_{ijt} / e_{ij,t\text{-}1})\end{aligned} \tag{6}$$

$$\begin{aligned}\log(OC_{ijt} / OC_{ij,t\text{-}1}) \;=\; & b_{0jt} \;+\; b_{1jt}\log(OC_{ij,t-1} / OC_{ij,t\text{-}2}) + b_{2jt}\log(SALE_{ij,t-1} / SALE_{ij,t\text{-}2}) \\ & + b_{3jt}\log(PPE_{ijt} / PPE_{ij,t\text{-}1}) \;+\; b_{4jt}\log(EMP_{ijt} / EMP_{ij,t\text{-}1}) \\ & + b_{5jt}\log(RND_{ijt} / RND_{ij,t\text{-}1}) + \log(u_{ijt} / u_{ij,t\text{-}1})\end{aligned} \tag{7}$$

and again using a cross-sectional estimation for nine or eleven industries j for years $t = 1998,\ldots,2006$. The Hicks-neutral contribution of organisational capital b_{0it} includes common organisational capital (often narrowed to define output-augmenting technical change) c_{0it} and the returns to firm-specific organisational capital $g_{0t}\log(OC_{it})$:

$$\log(b_{0it}) \;=\; c_{0t} \;+\; g_{0t}\log(OC_{it}) \;. \tag{8}$$

The production function is estimated by industry 2SLS from

$$\begin{aligned}\log(SALE_{ijt}) &= c_{0jt} + g_{0jt}\log(X_{ijt}) \\ &\quad + c_{1jt}\log(PPE_{ijt}) + c_{2jt}\log(EMP_{ijt}) \\ &\quad + c_{3jt}\log(RND_{ijt}) + \log(e_{ijt})\end{aligned} \tag{9}$$

$$\begin{aligned}\log(X_{ijt}) &= b_{0jt} + b_{1jt}\log(X_{ij,t-1}) + b_{2jt}\log(SALE_{ij,t-1}) \\ &\quad + b_{3jt}\log(PPE_{ijt}) + b_{4jt}\log(EMP_{ijt}) \\ &\quad + b_{5jt}\log(RND_{ij,t}) + \log(u_{ij,t})\end{aligned} \tag{10}$$

using a cross-sectional estimation in nine industries j for years $t = 1998,\ldots,2006$. Organisational capital expenditures are here tied to the firm's past commitments (the lagged value of organisational capital instrument) and are a proportion of past activity levels (sales). The estimation uses the 2SLS for each sample year (1998–2006). Growth effects are evaluated following Lev and Radhakrishnan (2005) by comparing the expected output (sales) computed with and without the common and firm-specific organisational capital. The expected output of firm *i* in year *t* with organisational capital is given by

$$\begin{aligned}SALE_{it}^{*} &= SALE_{i,t-1}\{\exp\{c_{0t}^{*} + g_{0t}^{*}\log(OC_{it}/OC_{i,t\text{-}1}) \\ &\quad + c_{1t}^{*}\log(PPE_{it}/PPE_{i,t\text{-}1}) + c_{2t}^{*}\log(EMP_{it}/EMP_{i,t\text{-}1}) \\ &\quad + c_{3t}^{*}\log(RND_{it}/RND_{i,t\text{-}1}) + \log(e_{it}/e_{i,t\text{-}1})\} \quad ,\end{aligned} \tag{11a}$$

and the expected output of firm *i* without the effect of organisational capital is

$$\begin{aligned}SALE_{it}^{**} &= SALE_{i,t-1}\{c_{1t}^{*}(PPE_{it}/PPE_{i,t-1}) + c_{2t}^{*}(EMP_{it}/EMP_{i,t-1}) \\ &\quad + c_{3t}^{*}(RND_{it}/RND_{i,t-1})\} \quad .\end{aligned} \tag{11b}$$

The instrument-based estimate of organisational capital using occupational compensation (*OC*) is the difference between expected sales *with* and *without* organisational capital, given by

$$ORG_{it}^{Growth} \equiv SALE_{it}^{*} - SALE_{it}^{**} \ , \tag{12}$$

where $SALE_{it}^{*}$ and $SALE_{it}^{**}$ are given by (11a) and (11b), respectively. The quantity ORG_{it}^{Growth} is the inflated nominal value using the general price deflator. Accumulating organisational capital over time is considered later when assessing its impact on market value.

5. Establishing the methodology for undertaking the growth accounting exercise (Task 4)

Cecilia Jona-Lasinio (LUISS – LLEE), Massimiliano Iommi (LUISS – LLEE)

At the national-economy level, we will expand the traditional growth accounting framework by including, in capital formation, estimates of the investment in intangibles that hitherto have been counted as current expenditure in the conventional national accounts. The resulting new growth accounting will then lead to new estimates of the rate of capital formation and of the rate of change of output per worker and of capital deepening.

Corrado, Hulten and Sichel (2006) expand the growth accounting model to incorporate their definition of capital expenditures and apply their model to the US economy. Their main findings are that the inclusion of intangible investment in the real output of the non-farm business sector increases the estimated growth rate of output per hour by 10 to 20% relative to the baseline case, which completely ignores intangibles. Thus, the inclusion of intangibles matters for labour productivity growth, although it had little effect on the acceleration of productivity in the 1990s. On the input side, since 1995, intangible and tangible assets have provided equivalent contributions to economic growth, and when they are combined, capital deepening supplants MFP as the principal source of growth. Moreover, the majority of the contribution of intangibles comes from the non-traditional categories of intangibles identified in this report. We will therefore be better able to explain the slow productivity growth compared with the US, as this is likely to be related to ICT expenditures and to institutional factors associated with human resource hiring and management. We expect performance-based micro-level estimates to yield high returns to computer usage and also to be the most dynamic component of ICT investment. Investment in software has generally contributed more to labour productivity than other ICT investments, such as communication and IT equipment.

The consortium augments the former EU KLEMS project by integrating growth accounting practices into a micro-level approach. As for the macro approach, we will consider the possibility of introducing an adjustment for the quality of labour in line with the Jorgenson framework (for example, an average level of educational attainment or a breakdown of labour input into categories). This feature is not included in the Corrado, Hulten and Sichel study (2005), which only includes "firm-specific human capital", but it can be of considerable added value in a cross-country comparison of sources of growth.

Methodology

Intangibles are treated symmetrically as the tangibles are treated in the standard growth accounting framework.

The extended growth accounting equation is

$$g_Q(t) = v_L(t)g_L(t) + v_T(t)g_T(t) + v_I(t)g_I(t) + g_A(t) \quad (13)$$

where $g_X(T)$ denotes the logarithmic rate of growth of variable X and $v_Y(t)$ denotes the share of input Y in total output (more precisely the average of the shares at time t and at time t-1). L, T and I are, respectively, the input of labour, tangible capital and intangible capital and $g_A(t)$ denotes the growth rate of multifactor productivity.

Corrado, Hulten and Sichel (year?) show that the extended growth accounting framework involves i) a different definition of final output (as illustrated above), ii) a restatement of input shares, and iii) the inclusion of the rate of growth of intangible capital input in the growth accounting equation.

Capital input and income shares

Theoretical model

In the standard growth accounting framework, the volume growth of capital input is obtained by aggregating the growth rates of the productive stock of the various assets using cost-share weights for each asset type:

$$g_K(t) = \sum_{i=1}^{ni} 0.5\left(v_t^i + v_{t-1}^i\right)\ln\left(S^i{}_t / S^i{}_{t-1}\right) \quad (14)$$

where S^i_t is the productive stock of asset *i*,

$$v_t^i = u_t^i S_t^i / \sum_{i=1}^{n} u_t^i S_t^i \quad (15)$$

is the cost-share of asset *i* in period *t*, u^i_t is its user cost and *n* is the number of asset types (both tangibles and intangibles).

The standard framework outlined above is modified to evaluate the impact of intangible assets on the aggregate growth of capital services, by computing volume indices of the flow of capital services from both tangible and intangible assets. The volume indices of the flow of intangible capital services are obtained by aggregating across productive stocks of intangible capital goods with weights equal to the share of each asset in the value of the total cost for intangible capital services.

If there are *nz* intangible-type assets, then the index of intangible capital services is

$$g_I(t) = \sum_{i=1}^{nz} 0.5\left(vi_t^i + vi_{t-1}^i\right)\ln\left(SI^i{}_t / SI^i{}_{t-1}\right) \quad (16)$$

where

$$vi_t^i = u_t^i SI_t^i / \sum_{i=1}^{ni} u_t^i SI_t^i \quad (17)$$

is the share of intangible asset *i* in the value of the total cost for intangible capital services and SI^i_t is the productive stock of intangible asset *i* .

The index of the flow of capital services from tangible assets is defined symmetrically.

Implementation issues

The first step to calculate the flow of capital services is therefore the estimate of productive capital stock. In this respect, we propose to adopt the following simplifying assumptions:

i) geometric pattern [$S^i_t=(1-d^i)S^i_{t-1}+I_t$],

ii) constant depreciation rates through time, and

iii) the depreciation rate for each type of asset is the same for all countries.

The first assumption eases the calculations because it implies that the rate of efficiency decay is identical to the rate of economic depreciation (put differently, age-efficiency and age-price profiles coincide). Furthermore, since each type of asset (e.g machinery and equipment, office machinery and so on) is an aggregate of many different individual assets that are quite heterogeneous in terms of their service life, it is necessary to find a proxy for an average profile. The geometric depreciation is the best approximation of the average profile, even if each of the asset components in the group follows a different pattern (Hulten, 1990; Schreyer, Diewert and Harrison, 2005).

The depreciation rates of tangible assets will be gathered from EU KLEMS, while those for the intangibles will be obtained as in Corrado, Hulten and Sichel (2005).

The second step of the estimate of capital services is the calculation of the user cost of the capital necessary to obtain the cost share of each asset.

Given an asset *i*, the corresponding user cost u_i is the following:

$$u^i_t = q^i_t\,(r_t + d^i_t - g^i_t) \tag{18}$$

where q^i_t is the investment deflator for asset *i* (i.e. the same price index that is used to deflate nominal expenditure), r_t is the net rate of return common to all assets (both tangibles and intangibles) in year *t*, d^i_t is the economic depreciation rate of asset *i*, and g^i_t measures expected capital-gains losses on asset *i*.

The depreciation rate '*d*' is the same used to calculate the capital stock of asset *i*, while the asset revaluation term can be derived from the investment price index (e.g. it can be defined as a moving average of the rates of changes in the asset price in the three years priors to *t*).

With respect to the nominal net rate of return, we propose to follow Corrado, Hulten and Sichel (2005) and to estimate it as an internal rate. This option is based on the assumption that the total value of the remuneration of capital services (for both tangible and intangible capital) exhausts total non-labour income:

$$P_Q Q - P_L L = P_K K = \sum_{i=1}^{n} u^i_t S^i_t \tag{19}$$

where the summation runs over all the assets (tangibles and intangibles).

Thus, once we obtain total capital income, productive capital stock and the other components of the user cost for each asset, we can solve the expression above determining the value of *r(t)* that causes the identity to hold.

The following step concerns the calculation of the labour income $P_L L$. In this respect, we propose to obtain $P_L L$ as the sum of the labour compensation of employees and of an imputation of the labour compensation of the self-employed (with the imputation made by assuming that the average compensation of the self-employed is equal to the average compensation of employees).

Then remunerations of intangible and tangible capital are

$$P_I I = \sum_{i=1}^{nz} u_t^i SI_t^i \text{ and } P_T T = \sum_{j=1}^{nt} u_t^j ST_t^j \quad (20)$$

where SI^i_t is the productive stock of intangible asset *i*, and ST^j_t is the productive stock of tangible asset *j*, with $P_I I + P_T T = P_K K$ and $n=nt+nz$.

Finally, the income share of each input is obtained by dividing its remuneration by the value of the output:

$$v_L = P_L L / P_Q Q; \; v_I = P_I I / P_Q Q; \; v_T = P_T T / P_Q Q. \quad (21)$$

6. Establishing the methodology for measuring intangible capital spillovers (Task 5)

Kurt Geppert (DIW), Hannu Piekkola (UNIVAASA) and Rebecca Riley (NIESR)

Another of our priorities is to offer a region-oriented analysis of how intangible capital is agglomerated in metropolises and large cities. It is also of interest to know more about the regional distribution of various kinds of intangible capital: organisational capital, ICT personnel assets and R&D assets. The principal task here has been to establish the methodology for considering knowledge-intensive and innovative economic activities as part of their socio-economic environments and to produce spillover measures to capture the fact that productivity and wages are substantially higher in dense areas than in non-agglomerated regions.

The comparison between agglomerated and non-agglomerated areas within a country is only possible in the micro approach. We collect information on the share of innovative firms by NUTS 4 regions or the equivalent. The Community Innovation Survey also used separate indicators of innovations by type: process, product, organisation and marketing. The regions are chosen appropriately in each of the six countries examined in the study. The initial objective of INNODRIVE was to construct innovation indicators at the NUTS 4 level. Our analysis suggests the quality of the Community Innovation Survey data at this level of disaggregation is inappropriate (based on an assessment of the coefficients of variation of the main data items). Separately, for the UK, NUTS 4 is an administrative geography with little meaning in economic terms. For these reasons, we will proceed to collect local area data at a higher level of geographical aggregation. For the UK, we are considering the use of 45 self-contained UK city-regions, accounting for just under 80% of total UK employment, which tend to overlap with the commuting patterns of managers and professionals. Thus, they potentially delineate both the labour markets for high-level skills and the geographical boundaries within which extensive face-to-face business interactions and knowledge exchange and transfer may take place. In other examples, in Slovenia the number of relevant regions may well be below 10, while in Finland these exceed 50 (there are around 80 NUTS 4 regions in Finland).

Spillovers and regional characteristics

Theory and empirical evidence suggest that regional (and spatial) factors are important determinants of worker income and firm productivity. Wages and productivity are substantially higher in dense areas than in non-agglomerated regions (e.g. Glaeser and Maré, 2001; Combes, Duranton and Gobillon, 2004; Head and Mayer, 2004; Rosenthal and Strange, 2004). Agglomeration economies can be categorised as the result of *sharing*, *matching* and *learning* processes (Combes, Duranton and Overman, 2005). The learning channel in the transmission of agglomeration effects is important because intellectual assets are not the exclusive property of their original holders; rather they partly spill over to other – nearby – firms and workers. This leads to increasing returns of intellectual assets at regional and national levels. To the extent that geographical proximity, clustering and agglomeration contribute to innovation and productivity, the locational patterns of the economy may be seen as one of the strategic factors promoting the growth, employment and competitiveness of the EU. In this sense, agglomeration is itself part of the intangible capital of an economy.

To capture agglomeration effects in our analysis, we use a variety of indicators of regional size and density:

- GDP
- employment
- GDP per sq km
- employment per sq km.

These indicators are readily available for all EU regions. In addition, we characterise the way regions are agglomerated by an index of specialisation/diversification, in order to explore whether spillovers essentially are industry-specific or extend over the whole regional economy. These indicators have to be constructed from the micro datasets for the respective countries.

Yet agglomeration is not the only regional feature that affects wages and firm productivity. Rather, there are other potential drivers of productivity and growth – region-specific intangibles – that are not necessarily correlated with size and agglomeration. To capture these factors, we use regional data on

- education (educational attainment of the workforce);
- innovation (expenditure and employment in R&D, patents);
- share of innovative firms (product, process, organisation and marketing from the Community Innovation Survey);
- organisational capital, ICT personnel assets and R&D assets; and
- availability of knowledge-intensive business services (measures by regional employment in these industries).

These indicators can either be calculated on the basis of aggregate statistics or be constructed from the micro datasets for the different countries. From a theoretical perspective, it would be desirable to account for some other potentially relevant regional characteristics:

- regional networking, and
- regional governance and business promotion.

Information on these components of region-specific intangibles is very scant, however.

The analysis based on agglomeration and regional characteristics will follow the results of the micro estimations. Data availability and empirical evidence on the geographical range of spillovers lead us to choose larger, socio-economically integrated spatial units for this step of the analysis.

7. Establishing the methodology for measuring intangible capital as a determinant of growth in the micro approach (Task 6)

Hannu Piekkola (UNIVAASA)

We model domestic multifactor productivity for a sample of six EU countries following the conventional methodology (see Benhabib and Spiegel, 2005 and the country-level study by Khan and Luintel, 2006): i) performance-based estimates from alternative sources of intangible capital, ii) cross-industry heterogeneity in productivity relationships, and iii) endogeneity, and we specify a fixed-effect dynamic (autoregressive) equation to explain growth:

$$d\ln A_{j,t} = b + \beta_1 \ln I_{x,j,t} + \beta_2 \ln\left(\frac{R\&D_{p99,t}}{R\&D_{j,t}}\right) - \beta_3 \ln I_{x,j,t}\left(\ln\left(\frac{R\&D_{p99,t}}{R\&D_{j,t}}\right) - 1\right) + \beta_4 \ln\left(\frac{A_{M,t}}{A_{j,t}}\right) + \beta_5 I_{x,j,t} + \mu_T + \mu_I + \varepsilon_j \tag{22}$$

where β_1 and β_3 are the coefficients for the component of multifactor productivity $A_{j,t}$ that depends on the level of intangible assets $I_{x,j,t}$ of type *x* in firm *j* at period *t* and interacting with distance to the industry's top innovative activity; β_2 is the coefficient for this innovation gap $\ln(R\&D_{P99,t} / R\&D_{j,t})$; β_4 is the coefficient for catching up with the leader firm M in the industry in productivity; β_5 is the coefficient for controls; and μ_I is industry- and region-specific effects and μ_T is time-specific effects. $\ln(R\&D_{P99,t} / R\&D_{j,t})$ shows the innovation gap with respect to the top innovative firm. Top innovative activity is measured by the R&D personnel share of non-production workers in the top 99 decile in each industry. A small difference in relation to top innovative activity can indicate an opportunity to imitate the top innovative firm in the industry. The intellectual assets listed in Table 1 are considered in three groups: intangible capital other than R&D, general intellectual assets (education human capital) and the social return from the environment. The last part may also contain various measures of agglomeration, such as the share of innovative firms. The role of these assets in the performance of the firm is used to evaluate their value for the nation as a whole. The valuation method is uniform and therefore enables benchmark estimates by pooling the results from six countries.

From the viewpoint of methodology, we also correct for the time-varying firm fixed effects. Here also new estimation methods, such as those of Olley and Pakes (1996), are used.

8. Estimating a central growth model (GDP per capita) through a panel (cross-section) analysis (Task 7)

***Felix Roth* (CEPS)**

Once the construction of the intangible capital data set is finished and the new GDP is calculated, a cross-section estimation will be performed estimating the following model:

$$G_i = \beta_0 + \beta_1 Y_i + \beta_2 X_i + \beta_3 H_i + \beta_4 Z_i + u_i \qquad (23)$$

where i represents each country, β_0 is the intercept and u_i is the error term, and Y, X, H and Z are income, intangible capital, human capital and important control variables.

If panel data are available, the central growth model (GDP per capita) that will be estimated, following an approach of Khan and Luintel (2006), is the following:

$$G_{i,t} = \alpha_i + \beta Y_{i,t-1} + \gamma X_{i,t-1} + \mu H_{i,t-1} + \psi Z_{i,t-1} + v_t + w_{i,t}, \qquad (24)$$

where i represents each country and t represents each time period; $G_{i,t}$ is the average annual growth for country i during period t; $Y_{i,t-1}$, $X_{i,t-1}$, $H_{i,t-1}$ and $Z_{i,t-1}$ are respectively income, intangible capital, human capital and important control variables for country i during period $t-1$; α_i represents a group-specific constant term, v_t represents a time-specific constant term and $w_{i,t}$ is the error term.

The country sample to be analysed will consist of 27 EU member states. Panel data will be collected. Next to the cross-section, pooled panel, fixed- and random effects estimation, an attempt will be made to apply the estimation of differenced and system GMM, as well as a heterogeneous panel model.

9. Synthesis of the findings on data availability and comparability

Hannu Piekkola (UNIVAASA)

In the micro estimation, the first preliminary results have been obtained. These include the overall description of data in each country. The preliminary summary tables in appendix 3 reveal that the micro data are strictly comparable, although they require some more fine-tuning. It appears that in each country the shares of organisational capital workers from among all workers are roughly the same, at about 15%. The deviations from this may be attributed to data misspecifications, which are to be corrected. The relative compensation for management, marketing, IT and R&D work is also roughly comparable across countries. Management receives the highest wages followed by ICT workers or R&D workers. The data so far indicate that we have been successful in building up our micro data in a coherent manner. This has required the classification of occupations in 41 categories, which has been achieved by using ISCO occupation codes as the benchmark.

In the micro data, intangibles consist of organisational capital, ICT personnel assets and R&D assets. Our preliminary study indicates that organisational capital is equivalent in value to around 6% of sales, while the value of ICT assets is twice lower. R&D assets exceed the other two in magnitude. Intangible assets are hence around 20% of sales. Thus, the micro data have produced a level of intangible that may well be comparable to that obtained in the macro approach. It should be noted that these figures exclude software and database expenditures, while they include personnel investment in ICT. The figures also exclude the value added of the market research sector and training expenditures.

In the macro estimation, the first comprehensive final version data have been obtained. We have been able tentatively to evaluate a synthesis of the micro and macro analysis. We are also satisfied with the comparability of data across countries and between the micro and macro approaches. Our first results are described in separate reports: the *Report on Data Gathering and Estimations in INNODRIVE using firm-level data (LEED data in the micro* *approach)* and *Report on Data Gathering and Estimations in INNODRIVE in the macro approach* (national estimates).

Glossary of Abbreviations

2SLS	Two-stage least squares
ANBERD	Analytical Business Enterprise R&D Database
BERD	Business Expenditure on Research and Development
CVTS	Continuing Vocational Training Survey
ESOMAR	European Society for Opinion and Marketing Research
FEACO	European Federation of Management Consultancy Associations
FSHC	Firm-specific human capital
GDP	Gross domestic product
GFCF	Gross fixed capital formation
ICT	Information and communications technology
ISCO	International Standard Classification of Occupations
LEED	Linked employer–employee dataset
LFS	Labour Force Survey
MFP	Multi Factor Productivity
NA	National accounts
NACE	General industrial classification of economic activities
NUTS	Classification/nomenclature of territorial units for statistics
OECD	Organisation for Economic Cooperation and Development
R&D	Research and development
SGA	Selling, general and administrative
SES	Structure of Earnings Survey
SNA	System of National Accounts
WP	Work package
ZO	Zenith Optimedia

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Appendix 1. List of variables in the macro approach

Variables already included in gross fixed capital formation from national accounts

1. Computer software (LUISS)	National accounts
2. Computerised databases (LUISS)	Special research
3. Mineral exploration (LUISS)	National accounts; expenditure on prospecting for new oil wells in the expectation of future returns
4. Copyright and license costs (LUISS)	National accounts

Variables for which official well-known sources are available

5. Scientific R&D (CEPS)	BERD (Business Expenditure on Research and Development) ANBERD, Community Innovation Survey, national accounts
6. Firm-specific human capital (LUISS)	OECD and Eurostat surveys on training

Variables for which we need to find ad hoc sources or estimation methods

7. New product development costs in the financial industry (LUISS)	National accounts
8. New architectural and engineering designs (LUISS)	National accounts
9. Market research (CEPS)	Special survey
10. Advertising expenditure (CEPS)	Special survey
11. Own account development of organisational structures (LUISS)	Ad hoc examination of national resources
12. Purchased organisational structures (LUISS)	Examination of revenues
13. R&D in social science and humanities (CEPS)	Ad hoc research
14. Intangible capital creation through market restructuring (LUISS)	LEED data

Appendix 2. Industry coverage

Industry coverage	
c_to_k_o	***All NACE branches covered by CVTS (Continuing Vocational Training)***
c_e_f_h_i	**Mining and quarrying; electricity, gas and water supply; construction; hotels and restaurants; transport, storage and communication**
c	Mining and quarrying
d	**Manufacturing**
da	Manufacture of food products; beverages and tobacco
db_dc	Manufacture of textiles and textile products; manufacture of leather and leather products
dd_dn	Manufacture of wood and wood products; manufacturing n.e.c.
de	Manufacture of pulp, paper and paper products; publishing and printing
df_to_di	Manufacture of coke, refined petroleum products and nuclear fuel; chemicals, chemical products and man-made fibres; rubber and plastic products; other non-
dj	Manufacture of basic metals and fabricated metal products
dk_dl	Manufacture of machinery and equipment n.e.c.; manufacture of electrical and optical equipment
dm	Manufacture of transport equipment
e	Electricity, gas and water supply
f	Construction
g	**Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods**
g50	Sale, maintenance and repair of motor vehicles
g51	Wholesale trade and commission trade, except of motor vehicles and motorcycles
g52	Retail trade, except of motor vehicles, motorcycles; repair of personal and household goods
h	Hotels and restaurants
i60_to_i63	Land transport; transport via pipelines; water transport; air transport; supporting and auxiliary transport activities; activities of travel agencies
i64	Post and telecommunications
j	**Financial intermediation**
j65_j66	Financial intermediation, except insurance and pension funding; insurance and pension funding, except compulsory social security
j67	Activities auxiliary to financial intermediation
k_o	**Real estate, renting and business activities; other community, social, personal service activities**
k	Real estate, renting and business activities
o	Other community, social, personal service activities

Appendix 3. Preliminary summary tables in the INNODRIVE micro approach

Combined Preliminary Summary Table for all INNODRIVE Micro Partner Countries

OVERALL		Short Name		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
											FIN CR NOR	FIN CR NOR	FIN CR NOR	FIN CR NOR	FIN CR NOR
Occupation Compensations: salaries+social security tax socsec				FIN				FIN GER	FIN GER	FIN GER CR					
Social Security Tax (e.g. 0.30 in Finland)				0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
All Sectors	(1+socsec)*Annual Comp Per Employee		**year**	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Organization	Compensation	**ocw**	**ocw**	15.26	15.40	14.73	14.83	23.54	18.28	18.46	19.67	22.35	22.25	22.22	24.30
R&D Work	Compensation	**rndw**	**rndw**	15.64	15.75	14.95	15.13	28.75	21.53	20.90	19.95	22.65	22.76	23.07	24.13
IT Work	Compensation	**itw**	**itw**	16.51	16.66	16.04	15.91	25.11	18.70	19.37	22.35	24.73	24.76	24.76	25.83
Production Worker	Compensation	**ain1w**	**ain1w**	4.32	10.73	10.55	10.65	19.79	15.60	15.24	13.14	15.32	15.33	15.22	16.39
Other Non-Production Worker	Compensation	**ain2w**	**ain2w**	17.27	17.50	16.65	17.34	24.98	18.97	19.43	24.88	24.99	25.31	24.03	23.23
Other Services	Compensation	**ain3w**	**ain3w**	9.78	9.91	9.43	9.29	16.46	13.24	13.43	11.21	14.65	14.47	14.63	15.94
Management	Compensation	**managew**	**managew**	18.36	18.41	17.57	17.57	30.29	22.25	22.57	22.52	25.63	25.29	25.30	27.45
Marketing	Compensation	**marketingw**	**marketingw**	17.09	17.06	16.26	16.72	24.63	17.89	18.18	23.93	25.81	25.82	25.52	26.89
Administration	Compensation	**adminw**	**adminw**	13.26	13.31	12.74	12.86	21.90	16.35	16.82	15.35	17.93	18.01	17.91	19.14
			obswyear	220843	352383	420192	451423	476934	472933	485619	484108	483573	481795	482359	472536
Organization	Hourly Wage	**och**	**och**	6.83	6.81	6.47	6.38	32.90	23.28	24.78	9.07	11.18	11.13	11.41	12.98
R&D Work	Hourly Wage	**rndh**	**rndh**	7.85	7.92	7.46	7.41	48.10	34.44	36.16	9.77	12.15	12.02	12.39	12.97
IT Work	Hourly Wage	**ith**	**ith**	8.37	8.40	8.01	7.82	35.77	25.36	27.09	10.86	14.32	12.30	12.40	13.68
Production Worker	Hourly Wage	**ain1h**	**ain1h**	1.97	5.01	4.77	4.70	32.94	24.81	26.02	5.92	8.01	7.79	7.61	8.38
Other Non-Production Worker	Hourly Wage	**ain2h**	**ain2h**	8.41	8.61	8.18	8.19	31.19	23.43	24.08	12.67	14.02	13.12	12.66	11.90
Other Services	Hourly Wage	**ain3h**	**ain3h**	5.26	5.39	5.13	5.02	27.31	20.21	20.84	5.90	8.76	8.28	8.35	9.31
Management	Hourly Wage	**manageh**	**manageh**	9.24	9.29	8.79	8.62	46.48	31.73	34.36	10.87	13.00	12.78	13.14	14.31
Marketing	Hourly Wage	**marketingh**	**marketingh**	8.46	8.49	7.97	8.11	31.72	21.60	23.15	11.51	13.24	13.81	13.22	14.03
Administration	Hourly Wage	**adminh**	**adminh**	6.75	6.79	6.46	6.42	34.70	24.68	26.16	7.68	9.72	9.50	9.60	10.94
Organization	Share of workers	**oc**	**ocs**	11.1 %	9.3 %	9.3 %	10.5 %	16.1 %	16.2 %	16.6 %	12.5 %	12.3 %	12.5 %	12.5 %	12.2 %
R&D Work	Share of workers	**rnds**	**rnds**	6.7 %	5.5 %	5.9 %	5.6 %	7.3 %	7.3 %	7.1 %	6.1 %	6.4 %	6.7 %	6.3 %	6.2 %
IT Work	Share of workers	**its**	**its**	1.2 %	1.0 %	1.4 %	1.3 %	4.3 %	3.7 %	3.9 %	2.0 %	2.5 %	2.5 %	2.5 %	2.6 %
Production Worker	Share of workers	**ain1s**	**ain1s**	12.7 %	24.1 %	23.4 %	22.9 %	36.6 %	38.3 %	37.8 %	24.4 %	24.4 %	23.9 %	23.6 %	21.4 %
Other Non-Production Worker	Share of workers	**ain2s**	**ain2s**	3.2 %	2.0 %	2.0 %	2.2 %	3.4 %	2.8 %	3.0 %	1.8 %	2.4 %	2.4 %	2.3 %	2.7 %
Other Services	Share of workers	**ain3s**	**ain3s**	30.2 %	23.2 %	23.2 %	22.8 %	35.1 %	33.1 %	33.2 %	32.4 %	34.8 %	34.8 %	35.6 %	34.8 %
Management	Share of workers	**manages**	**manages**	3.3 %	2.5 %	2.6 %	3.2 %	4.3 %	5.1 %	5.0 %	4.8 %	4.7 %	4.9 %	4.9 %	4.9 %
Marketing	Share of workers	**marketings**	**marketings**	2.0 %	1.8 %	1.8 %	1.8 %	4.3 %	3.1 %	3.1 %	1.6 %	1.8 %	1.7 %	1.8 %	2.1 %
Administration	Share of workers	**admins**	**admins**	5.9 %	5.0 %	5.0 %	5.5 %	8.0 %	8.2 %	8.7 %	6.1 %	5.8 %	5.8 %	5.7 %	5.1 %
			ainall	220843	352383	420192	451423	476934	236468	242811	242056	241788	240899	241181	236272
Organization	Standard Deviation	**stdsga**	**stdocw**	709.63	737.13	667.48	672.48	718.04	538.06	514.26	487.67	371.63	358.68	363.34	9.86
R&D Work	Standard Deviation	**stdrnd**	**stdrndw**	519.07	524.31	461.31	462.19	482.26	386.64	395.28	391.11	305.60	311.04	316.82	7.81
IT Work	Standard Deviation	**stdit**	**stditw**	552.49	600.57	544.07	542.75	584.69	471.83	465.16	487.61	373.08	374.75	383.55	7.46
Production Worker	Standard Deviation	**stdain1**	**stdain1w**	484.63	336.76	293.71	293.40	310.56	236.54	231.61	204.13	169.01	168.96	177.01	6.27
Other Non-Production Worker	Standard Deviation	**stdain2**	**stdain2w**	807.28	845.10	862.82	909.61	984.51	768.30	800.01	804.65	590.41	609.55	675.69	6.67
Other Services	Standard Deviation	**stdain3**	**stdain3w**	493.45	511.58	446.48	452.02	476.91	371.39	367.04	348.08	265.65	265.54	273.31	10.04
Management	Standard Deviation	**stdmanage**	**stdmanagew**	1032.56	1090.42	984.00	1003.16	1027.84	775.26	738.66	706.79	502.36	457.58	464.63	11.94
Marketing	Standard Deviation	**stdmarketing**	**stdmarketingw**	1228.76	1211.25	1103.20	1168.22	1317.46	956.38	950.46	891.91	690.68	675.03	680.28	11.75
Administration	Standard Deviation	**stdadmin**	**stdadminw**	592.82	604.07	555.78	599.42	644.14	469.28	464.68	443.71	349.27	344.75	356.95	8.15

Appendix 3. Cont'd. - Preliminary Summary Table for Finland

Firm-Level and Nuts IV level		Organ_CapitaldataCountry/TABLE CALCULATIONS/outsheet using "$orgcapdata\Compensationsyear.out"													
COUNTRY		**Short Name**		**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Occupation Compensations: salaries+social security tax socsec															
Social Security Tax (e.g. 0.30 in Finland)				0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
All Sectors	(1+socsec)*Annual Comp Per Employee		**year**	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Organization	Compensation	**ocw**	**ocw**	32.07	31.97	31.44	31.59	31.94	31.74	32.02	31.76	32.47	32.46	32.52	32.53
R&D Work	Compensation	**rndw**	**rndw**	32.80	32.52	31.85	32.24	32.46	32.48	32.34	32.33	32.09	31.70	31.55	31.76
IT Work	Compensation	**itw**	**itw**	36.16	35.87	35.12	34.55	35.01	35.01	35.31	35.04	34.32	34.50	34.14	34.08
Production Worker	Compensation	**ain1w**	**ain1w**		23.11	23.74	24.11	24.11	24.12	23.69	23.42	23.42	23.66	23.46	23.95
Other Non-Production Worker	Compensation	**ain2w**	**ain2w**	31.52	31.28	30.97	31.10	30.97	31.18	30.92	30.32	30.18	29.94	30.18	30.39
Other Services	Compensation	**ain3w**	**ain3w**	19.32	19.25	19.03	18.51	18.44	18.32	18.36	18.30	18.32	18.24	18.29	18.45
Management	Compensation	**managew**	**managew**	36.87	36.25	35.97	35.95	36.62	36.59	37.04	36.42	36.72	36.87	36.90	37.03
Marketing	Compensation	**marketingw**	**marketingw**	32.86	32.43	31.77	32.76	32.84	32.22	32.46	32.13	31.90	31.88	31.50	31.47
Administration	Compensation	**adminw**	**adminw**	27.12	27.00	26.68	26.93	26.86	27.05	27.02	26.88	27.69	27.86	28.00	28.18
			obswyear	220843	352383	420192	451423	476934	472933	485619	484108	483573	481795	482359	472536
Organization	Hourly Wage	**och**	**och**	17.21	17.10	16.58	16.42	16.41	15.79	15.50	15.20	15.45	15.41	15.21	14.95
R&D Work	Hourly Wage	**rndh**	**rndh**	17.28	16.99	16.44	16.36	16.29	15.75	15.28	15.08	14.82	14.62	14.38	14.20
IT Work	Hourly Wage	**ith**	**ith**	19.08	18.80	18.17	17.64	17.69	17.08	16.79	16.44	16.01	16.04	15.73	15.39
Production Worker	Hourly Wage	**ain1h**	**ain1h**		10.82	10.60	10.44	10.41	10.14	9.84	9.63	9.46	9.39	9.29	9.21
Other Non-Production Worker	Hourly Wage	**ain2h**	**ain2h**	16.55	16.31	15.94	15.75	15.48	15.09	14.57	14.05	13.87	13.72	13.68	13.52
Other Services	Hourly Wage	**ain3h**	**ain3h**	11.20	11.20	10.95	10.71	10.58	10.24	9.99	9.75	9.70	9.63	9.57	9.45
Management	Hourly Wage	**manageh**	**manageh**	19.62	19.20	18.77	18.41	18.59	17.89	17.66	17.20	17.20	17.18	16.98	16.72
Marketing	Hourly Wage	**marketingh**	**marketingh**	17.17	16.81	16.27	16.68	16.58	15.72	15.46	15.12	14.88	14.84	14.51	14.22
Administration	Hourly Wage	**adminh**	**adminh**	14.55	14.47	14.10	14.03	13.80	13.49	13.11	12.87	13.24	13.32	13.14	13.03
Organization	Share of workers	**oc**	**ocs**	19.8 %	14.4 %	14.6 %	18.2 %	19.0 %	18.7 %	18.5 %	17.1 %	16.4 %	16.6 %	16.5 %	16.4 %
R&D Work	Share of workers	**rnds**	**rnds**	11.3 %	7.8 %	9.0 %	8.2 %	8.5 %	7.0 %	7.3 %	7.5 %	7.6 %	9.9 %	7.6 %	7.6 %
IT Work	Share of workers	**its**	**its**	2.3 %	1.7 %	3.0 %	2.4 %	2.5 %	2.7 %	2.9 %	3.0 %	3.3 %	3.3 %	3.5 %	3.5 %
Production Worker	Share of workers	**ain1s**	**ain1s**	0.0 %	35.0 %	33.2 %	32.4 %	30.7 %	31.5 %	30.2 %	29.9 %	28.2 %	27.3 %	26.1 %	25.1 %
Other Non-Production Worker	Share of workers	**ain2s**	**ain2s**	9.5 %	5.9 %	5.9 %	6.6 %	7.6 %	7.8 %	8.5 %	7.9 %	8.1 %	8.0 %	7.9 %	7.7 %
Other Services	Share of workers	**ain3s**	**ain3s**	57.1 %	35.1 %	34.3 %	32.2 %	31.7 %	32.4 %	32.7 %	34.5 %	36.4 %	34.8 %	38.5 %	39.6 %
Management	Share of workers	**manages**	**manages**	6.8 %	4.3 %	4.3 %	5.9 %	6.4 %	6.4 %	6.7 %	6.4 %	6.7 %	6.9 %	6.7 %	6.7 %
Marketing	Share of workers	**marketings**	**marketings**	5.5 %	4.9 %	4.8 %	5.0 %	5.1 %	5.0 %	4.9 %	4.9 %	4.9 %	4.5 %	4.9 %	4.9 %
Administration	Share of workers	**admins**	**admins**	7.6 %	5.3 %	5.4 %	7.2 %	7.6 %	7.3 %	6.9 %	5.9 %	4.9 %	5.2 %	4.8 %	4.9 %
			ainall	220843	352383	420192	451423	476934	472933	485619	484108	483573	481795	482359	472536
Organization	Standard Deviation	**stdsga**	**stdocw**	8.67	8.53	8.53	8.84	9.44	9.10	9.54	9.06	9.20	9.43	9.29	9.31
R&D Work	Standard Deviation	**stdrnd**	**stdrndw**	7.07	6.71	7.34	7.28	7.86	7.92	8.02	8.47	7.88	8.16	7.72	7.92
IT Work	Standard Deviation	**stdit**	**stditw**	9.38	9.50	8.94	8.82	9.76	9.20	9.45	9.31	9.10	9.12	9.40	9.13
Production Worker	Standard Deviation	**stdain1**	**stdain1w**		6.92	6.89	6.62	6.78	6.77	6.91	6.56	6.60	6.53	6.35	6.51
Other Non-Production Worker	Standard Deviation	**stdain2**	**stdain2w**	6.52	6.24	6.10	6.42	6.49	6.81	6.74	6.23	5.92	5.86	6.03	5.99
Other Services	Standard Deviation	**stdain3**	**stdain3w**	5.27	5.57	5.49	5.53	5.83	5.81	5.90	5.82	5.76	5.80	5.87	5.82
Management	Standard Deviation	**stdmanage**	**stdmanagew**	10.55	9.72	9.79	10.66	11.50	11.18	11.45	10.89	11.04	11.30	11.70	11.36
Marketing	Standard Deviation	**stdmarketing**	**stdmarketingw**	9.23	9.23	9.25	10.00	10.44	9.75	10.69	10.33	10.30	10.38	9.96	9.97
Administration	Standard Deviation	**stdadmin**	**stdadminw**	6.73	7.01	6.89	7.01	7.00	7.20	7.03	6.85	7.62	8.08	7.75	8.21

Appendix 3. Cont'd. - Preliminary Summary Table for the Czech Republic

Firm-Level and Nuts IV level		Organ_CapitaldataCountry/TABLE CALCULATIONS/outsheet using "$orgcapdata\Compensationsyear.out"														
COUNTRY		**Short Name**		**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Occupation Compensations: salaries+social security tax socsec			**CZK/EUR**						**35.6075**	34.081	30.815	31.840	31.900	29.779	28.340	27.764
Social Security Tax (e.g. 0.35 in CR)									**0.35**	0.35	0.35	0.35	0.35	0.35	0.35	0.35
All Sectors	(1+socsec)*Annual Comp Per Employee		**year**						**2000**	2001	2002	2003	2004	2005	2006	2007
Organization	Compensation	**ocw**	**ocw**						6.36	6.38	6.97	7.46	7.38	7.68	7.60	7.07
R&D Work	Compensation	**rndw**	**rndw**						4.14	4.41	5.34	5.33	6.17	6.35	3.71	5.30
IT Work	Compensation	**itw**	**itw**						2.08	4.44	5.05	4.57	5.27	5.87	2.73	3.80
Production Worker	Compensation	**ain1w**	**ain1w**						3.14	4.06	4.13	4.36	4.71	4.87	2.98	3.84
Other Non-Production Worker	Compensation	**ain2w**	**ain2w**						1.68	3.12	3.45	3.66	4.71	5.09	2.24	3.45
Other Services	Compensation	**ain3w**	**ain3w**						4.97	5.30	6.13	5.87	6.10	6.30	5.98	6.44
Management	Compensation	**managew**	**managew**						7.46	8.55	9.09	9.37	9.76	9.91	8.21	7.64
Marketing	Compensation	**marketingw**	**marketingw**						1.76	2.45	2.99	2.66	3.22	3.78	1.98	2.66
Administration	Compensation	**adminw**	**adminw**						3.05	4.19	4.43	4.71	5.33	5.36	4.07	4.63
			obswyear						555807.00	652 728	684 531	678 627	741 083	770 786	771 533	740 416
Organization	Hourly Wage	**och**	**och**						2.63	2.66	2.91	3.11	3.03	3.20	3.09	2.90
R&D Work	Hourly Wage	**rndh**	**rndh**						1.71	1.82	2.23	2.31	2.51	2.62	1.49	2.12
IT Work	Hourly Wage	**ith**	**ith**						0.86	1.84	2.06	1.89	2.14	2.43	1.10	1.53
Production Worker	Hourly Wage	**ain1h**	**ain1h**						1.37	1.75	1.82	1.89	1.94	2.08	1.24	1.61
Other Non-Production Worker	Hourly Wage	**ain2h**	**ain2h**						0.70	1.29	1.42	1.56	1.89	2.13	0.90	1.39
Other Services	Hourly Wage	**ain3h**	**ain3h**						2.10	2.26	2.60	2.55	2.53	2.67	2.48	2.66
Management	Hourly Wage	**manageh**	**manageh**						3.07	3.54	3.73	3.87	3.97	4.09	3.29	3.12
Marketing	Hourly Wage	**marketingh**	**marketingh**						0.74	1.04	1.27	1.12	1.34	1.58	0.81	1.10
Administration	Hourly Wage	**adminh**	**adminh**						1.27	1.75	1.88	2.00	2.19	2.25	1.65	1.91
Organization	Share of workers	**oc**	**ocs**						0.18	0.200	0.184	0.179	0.184	0.182	0.180	0.177
R&D Work	Share of workers	**rnds**	**rnds**						0.10	0.093	0.095	0.103	0.098	0.097	0.094	0.093
IT Work	Share of workers	**its**	**its**						0.02	0.025	0.020	0.028	0.026	0.025	0.026	0.032
Production Worker	Share of workers	**ain1s**	**ain1s**						0.41	0.394	0.416	0.412	0.414	0.414	0.414	0.429
Other Non-Production Worker	Share of workers	**ain2s**	**ain2s**						0.01	0.007	0.006	0.007	0.007	0.007	0.007	0.008
Other Services	Share of workers	**ain3s**	**ain3s**						0.28	0.283	0.278	0.271	0.271	0.274	0.278	0.261
Management	Share of workers	**manages**	**manages**						0.08	0.069	0.071	0.070	0.068	0.065	0.068	0.068
Marketing	Share of workers	**marketings**	**marketings**						0.01	0.006	0.007	0.006	0.007	0.008	0.009	0.009
Administration	Share of workers	**admins**	**admins**						0.09	0.125	0.106	0.103	0.109	0.110	0.102	0.099
Organization	Standard Deviation	**stdsga**	**stdocw**						3.62	2.96	4.07	3.92	3.74	3.96	7.89	4.78
R&D Work	Standard Deviation	**stdrnd**	**stdrndw**						3.30	3.89	4.29	3.81	3.76	4.09	4.80	5.75
IT Work	Standard Deviation	**stdit**	**stditw**						3.78	4.84	5.52	5.14	5.53	6.10	5.26	5.94
Production Worker	Standard Deviation	**stdain1**	**stdain1w**						2.02	2.41	3.00	2.70	2.90	2.73	3.20	3.27
Other Non-Production Worker	Standard Deviation	**stdain2**	**stdain2w**						3.15	4.40	5.44	5.40	6.10	6.64	5.44	6.87
Other Services	Standard Deviation	**stdain3**	**stdain3w**						8.60	2.89	5.00	3.52	3.58	4.25	4.06	4.33
Management	Standard Deviation	**stdmanage**	**stdmanagew**						5.47	4.93	6.07	5.81	5.62	5.72	9.64	7.01
Marketing	Standard Deviation	**stdmarketing**	**stdmarketingw**						3.68	4.19	4.32	5.24	5.74	6.87	4.43	6.00

Appendix 3. Cont'd. - Preliminary Summary Table for Norway

Firm-Level and Nuts IV level		"$data/wagesyearleed.out"			###	###	###	###	###	###	1.110	1.151	1.204	1.250	1.310
COUNTRY	Norway	**Short Name**		**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Occupation Compensations: salaries+social security tax socsec															
Social Security Tax (e.g. 0.30 in Finland)															
All Sectors	(1+socsec)*Annual Comp Per Employee		**year**												
Organization	Compensation	**ocw**	**ocw**									39.42	38.86	39.40	39.36
R&D Work	Compensation	**rndw**	**rndw**									41.77	41.57	41.81	41.85
IT Work	Compensation	**itw**	**itw**									43.15	42.27	42.68	42.38
Production Worker	Compensation	**ain1w**	**ain1w**									30.52	30.51	30.67	30.23
Other Non-Production Worker	Compensation	**ain2w**	**ain2w**									32.80	32.41	32.85	32.75
Other Services	Compensation	**ain3w**	**ain3w**									35.41	35.10	35.48	35.87
Management	Compensation	**managew**	**managew**									45.74	44.87	45.93	46.34
Marketing	Compensation	**marketingw**	**marketingw**									43.76	43.00	43.20	43.10
Administration	Compensation	**adminw**	**adminw**									34.01	33.69	34.34	34.45
			obswyear									410525.52	403945.55	398666.77	387597.41
Organization	Hourly Wage	**och**	**och**									24.17	24.60	25.90	24.79
R&D Work	Hourly Wage	**rndh**	**rndh**									25.56	24.46	25.23	24.13
IT Work	Hourly Wage	**ith**	**ith**									34.80	22.96	23.13	25.77
Production Worker	Hourly Wage	**ain1h**	**ain1h**									20.29	19.05	18.01	18.51
Other Non-Production Worker	Hourly Wage	**ain2h**	**ain2h**									24.54	19.60	18.56	19.45
Other Services	Hourly Wage	**ain3h**	**ain3h**									24.70	22.21	22.27	22.90
Management	Hourly Wage	**manageh**	**manageh**									26.47	26.02	27.67	27.53
Marketing	Hourly Wage	**marketingh**	**marketingh**									26.35	31.37	27.62	26.55
Administration	Hourly Wage	**adminh**	**adminh**									21.89	20.08	20.82	23.87
Organization	Share of workers	**oc**	**ocs**									12.8 %	12.4 %	12.6 %	12.5 %
R&D Work	Share of workers	**rnds**	**rnds**									7.8 %	8.3 %	8.2 %	8.3 %
IT Work	Share of workers	**its**	**its**									4.2 %	4.1 %	4.1 %	4.2 %
Production Worker	Share of workers	**ain1s**	**ain1s**									27.9 %	27.9 %	28.3 %	28.5 %
Other Non-Production Worker	Share of workers	**ain2s**	**ain2s**									5.0 %	5.0 %	5.0 %	4.9 %
Other Services	Share of workers	**ain3s**	**ain3s**									42.2 %	42.2 %	41.8 %	41.6 %
Management	Share of workers	**manages**	**manages**									4.0 %	3.9 %	4.0 %	4.1 %
Marketing	Share of workers	**marketings**	**marketings**									2.5 %	2.5 %	2.6 %	2.6 %
Administration	Share of workers	**admins**	**admins**									6.3 %	6.0 %	6.0 %	5.8 %
			obsw												
Organization	Standard Deviation	**stdocw**	**stdocw**									19.33	20.52	22.90	25.33
R&D Work	Standard Deviation	**stdrnd**	**stdrndw**									15.06	15.89	15.71	18.06
IT Work	Standard Deviation	**stdit**	**stditw**									15.43	15.60	16.12	17.51
Production Worker	Standard Deviation	**stdain1**	**stdain1w**									11.71	11.97	12.42	13.13
Other Non-Production Worker	Standard Deviation	**stdain2**	**stdain2w**									17.89	14.64	15.40	16.65
Other Services	Standard Deviation	**stdain3**	**stdain3w**									18.36	19.42	21.76	24.70
Management	Standard Deviation	**stdmanage**	**stdmanagew**									20.47	22.32	24.20	31.98
Marketing	Standard Deviation	**stdmarketing**	**stdmarketingw**									25.33	26.38	29.07	31.84
Administration	Standard Deviation	**stdadmin**	**stdadminw**									14.47	14.76	16.47	19.17

Notes:

a. Hourly wages calculated for each job as annual earnings divided by normal (contracted) hours (excl. overtime) for the duration of the job within the year.

b. All amounts in 1000 current EURO (current Norwegian kroner divided by average exchange Nkr/Eur 2003-2006 = 8.1084).

Appendix 3. Cont'd. - Preliminary Summary Table for Slovenia

Firm-Level and Nuts IV level		Organ_CapitaldataCountry/TABLE CALCULATIONS/outsheet using "$orgcapdata\Compensationsyear.out"													
COUNTRY		**Short Name**			**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Social Security Tax					0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161
Payrol Tax (Progressive scale 0%, 3.8%, 7.8% and 14.8% - time variant classes)				**in million tolars; constant 2000 wages (wpi used) in euros (average 2000 exchange rate of the Bank of Slovenia used)**											
All Sectors	(1+socsec)*Annual Comp Per Employee (1000€)														
Organization	Compensation	**ocw**	**ocw**	**in 1000 EUR**	13.70	14.22	12.74	12.90	13.30	13.72	13.34	12.39	12.10	11.97	12.05
R&D Work	Compensation	**rndw**	**rndw**		14.11	14.73	12.99	13.15	13.51	14.31	14.34	13.65	13.54	13.66	13.81
IT Work	Compensation	**itw**	**itw**		13.38	14.10	13.01	13.17	13.40	14.09	14.18	14.29	14.29	14.48	14.72
Production Worker	Compensation	**ain1w**	**ain1w**		8.64	9.07	7.91	7.83	8.05	8.44	8.36	7.61	7.63	7.67	7.82
Other Non-	Compensation	**ain2w**	**ain2w**		20.29	21.22	18.98	20.91	21.98	21.95	22.94	22.79	22.32	23.26	24.52
Other Services	Compensation	**ain3w**	**ain3w**		10.02	10.47	9.26	9.35	9.61	9.99	9.84	8.97	8.85	8.71	8.86
Management	Compensation	**managew**	**managew**		18.20	18.98	16.73	16.76	16.98	17.33	16.49	15.52	14.87	13.93	14.04
Marketing	Compensation	**marketingw**	**marketingw**		18.41	18.76	17.00	17.40	18.55	18.80	18.28	17.56	16.94	17.46	17.28
Administration	Compensation	**adminw**	**adminw**		12.65	12.95	11.53	11.64	11.91	12.37	12.31	11.31	11.04	11.06	11.06
			obswyear		419472	436066	437222	426339	425916	398344	423309	455064	461263	466763	468583
Organization	Hourly Wage	**och**	**och**	**in EUR**	3.28	3.33	2.83	2.72	2.65	2.56	2.46	2.47	2.40	1.97	2.00
R&D Work	Hourly Wage	**rndh**	**rndh**		6.27	6.77	5.93	5.86	5.94	6.06	6.14	5.84	5.88	5.99	6.04
IT Work	Hourly Wage	**ith**	**ith**		6.04	6.39	5.85	5.83	5.81	6.22	6.25	6.22	6.29	6.27	6.37
Production Worker	Hourly Wage	**ain1h**	**ain1h**		3.94	4.22	3.72	3.65	3.72	3.77	3.79	3.38	3.43	3.48	3.54
Other Non-	Hourly Wage	**ain2h**	**ain2h**		8.67	9.52	8.60	8.83	9.70	10.94	10.41	10.04	9.75	10.08	10.96
Other Services	Hourly Wage	**ain3h**	**ain3h**		4.58	4.96	4.44	4.35	4.41	4.43	4.40	4.01	3.97	3.97	4.11
Management	Hourly Wage	**manageh**	**manageh**		8.12	8.67	7.59	7.44	7.34	7.25	7.05	6.65	6.53	5.98	6.10
Marketing	Hourly Wage	**marketingh**	**marketingh**		8.21	8.64	7.65	7.65	8.21	7.91	7.78	7.44	7.47	7.62	7.66
Administration	Hourly Wage	**adminh**	**adminh**		5.71	5.89	5.27	5.22	5.26	5.34	5.32	4.89	4.82	4.86	4.95
Organization	Share of workers	**oc**	**ocs**		13.6%	13.5%	13.4%	13.4%	13.5%	13.5%	13.6%	13.1%	13.2%	14.1%	14.1%
R&D Work	Share of workers	**rnds**	**rnds**		8.9%	8.7%	8.6%	8.5%	8.4%	8.5%	8.1%	7.5%	6.9%	6.8%	6.7%
IT Work	Share of workers	**its**	**its**		1.2%	1.2%	1.3%	1.3%	1.4%	1.7%	1.9%	2.0%	2.0%	2.1%	2.2%
Production Worker	Share of workers	**ain1s**	**ain1s**		38.0%	37.4%	36.9%	36.1%	35.7%	35.3%	34.8%	35.0%	34.8%	34.0%	33.5%
Other Non-	Share of workers	**ain2s**	**ain2s**		0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Other Services	Share of workers	**ain3s**	**ain3s**		33.7%	34.6%	35.2%	36.2%	36.6%	36.8%	37.6%	38.3%	39.1%	39.1%	39.7%
Management	Share of workers	**manages**	**manages**		3.1%	3.2%	3.3%	3.6%	3.8%	3.9%	4.2%	4.0%	4.2%	5.2%	5.4%
Marketing	Share of workers	**marketings**	**marketings**		0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%
Administration	Share of workers	**admins**	**admins**		10.0%	9.8%	9.6%	9.3%	9.2%	9.0%	8.8%	8.6%	8.4%	8.3%	8.1%
			ainall		439878	456960	457774	445940	444816	415626	440782	473864	479801	484722	486105
Organization	Standard Deviation	**stdsga**	**stdocw**		2120	2203	1994	2009	2106	2106	2006	1937	1826	1760	1780
R&D Work	Standard Deviation	**stdrnd**	**stdrndw**		1550	1566	1377	1379	1415	1509	1543	1550	1500	1526	1555
IT Work	Standard Deviation	**stdit**	**stditw**		1648	**1792**	1623	1619	1706	1841	1812	1938	1838	1846	1889
Production Worker	Standard Deviation	**stdain1**	**stdain1w**		969	1003	874	874	893	907	884	805	821	820	860
Other Non-	Standard Deviation	**stdain2**	**stdain2w**		2415	2529	2582	2722	2914	3025	3157	3207	2925	3024	3353
Other Services	Standard Deviation	**stdain3**	**stdain3w**		1475	1529	1334	1351	1392	1443	1425	1380	1298	1297	1333
Management	Standard Deviation	**stdmanage**	**stdmanagew**		3087	3262	2942	2999	3038	3051	2904	2812	2475	2249	2280
Marketing	Standard Deviation	**stdmarketing**	**stdmarketingw**		3677	3625	3300	3495	**3903**	3780	3751	3552	3413	3333	3357
Administration	Standard Deviation	**stdadmin**	**stdadminw**		1772	1805	1660	1791	1890	1834	1813	1763	1720	1696	1755

Appendix 3. Cont'd. - Preliminary Summary Table for Germany (Average of Braunschweig, Ostfriesland and Stuttgart)

Firm-Level and Nuts IV level		"$data/wagesyearleed.out"													
COUNTRY		**Short Name**		**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Occupation Compensations: salaries+social security tax socsec															
Social Security Tax (e.g. 0.30 in Finland)															
All Sectors			**year**												
Organization	Compensation	**ocw**	**ocw**					25.63	21.52	22.34					
R&D Work	Compensation	**rndw**	**rndw**					40.69	35.54	32.84					
IT Work	Compensation	**itw**	**itw**					27.19	23.87	23.79					
Production Worker	Compensation	**ain1w**	**ain1w**					27.48	26.96	25.08					
Other Non-Production	Compensation	**ain2w**	**ain2w**					22.24	21.27	20.97					
Other Services	Compensation	**ain3w**	**ain3w**					21.56	19.89	20.43					
Management	Compensation	**managew**	**managew**					37.63	27.89	28.50					
Marketing	Compensation	**marketingw**	**marketingw**					22.72	18.97	19.73					
Administration	Compensation	**adminw**	**adminw**					27.20	23.15	24.01					
			obswyear												
Organization	DAILY Wage	**och**	**och**					80.46	72.86	79.28					
R&D Work	DAILY Wage	**rndh**	**rndh**					123.30	115.40	122.64					
IT Work	DAILY Wage	**ith**	**ith**					84.65	78.06	84.31					
Production Worker	DAILY Wage	**ain1h**	**ain1h**					85.53	84.81	89.59					
Other Non-Production	DAILY Wage	**ain2h**	**ain2h**					69.08	67.65	70.73					
Other Services	DAILY Wage	**ain3h**	**ain3h**					67.64	64.72	67.38					
Management	DAILY Wage	**manageh**	**manageh**					114.66	99.72	110.29					
Marketing	DAILY Wage	**marketingh**	**marketingh**					71.07	62.66	69.00					
Administration	DAILY Wage	**adminh**	**adminh**					85.90	79.40	85.31					
Organization	Share of workers	**oc**	**ocs**					16.1 %	14.6 %	14.4 %					
R&D Work	Share of workers	**rnds**	**rnds**					5.2 %	3.3 %	4.0 %					
IT Work	Share of workers	**its**	**its**					9.2 %	8.1 %	8.5 %					
Production Worker	Share of workers	**ain1s**	**ain1s**					43.8 %	46.4 %	47.5 %					
Other Non-Production	Share of workers	**ain2s**	**ain2s**					2.6 %	2.6 %	2.6 %					
Other Services	Share of workers	**ain3s**	**ain3s**					37.5 %	35.9 %	34.6 %					
Management	Share of workers	**manages**	**manages**					2.9 %	1.8 %	2.3 %					
Marketing	Share of workers	**marketings**	**marketings**					7.3 %	6.5 %	6.4 %					
Administration	Share of workers	**admins**	**admins**					7.4 %	6.9 %	6.7 %					
			obsw												
Organization	Standard Deviation DAILY	**stdocw**	**stdocw**					38.66	34.24	37.49					
R&D Work	Standard Deviation DAILY	**stdrnd**	**stdrndw**					24.57	25.71	25.74					
IT Work	Standard Deviation DAILY	**stdit**	**stditw**					38.31	35.33	37.15					
Production Worker	Standard Deviation DAILY	**stdain1**	**stdain1w**					31.95	29.89	31.23					
Other Non-Production	Standard Deviation DAILY	**stdain2**	**stdain2w**					33.43	32.92	33.63					
Other Services	Standard Deviation DAILY	**stdain3**	**stdain3w**					33.35	31.51	32.70					
Management	Standard Deviation DAILY	**stdmanage**	**stdmanagew**					34.60	35.99	35.68					
Marketing	Standard Deviation DAILY	**stdmarketin**	**stdmarketingw**					38.95	32.56	36.83					
Administration	Standard Deviation DAILY	**stdadmin**	**stdadminw**					36.16	32.66	35.19					

Notes:

a. Compensation is yearly income, in 1.000 Euro

Appendix 3. Cont'd. - Preliminary Summary Table for the UK

Firm-Level and Nuts IV level		"$data/wagesyearleed.out"													
COUNTRY		**Short Name**		**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Occupation Compensations: salaries+social security tax		**socsec**	**€/£**								1.59	1.45	1.47	1.46	1.47
Social Security Tax (e.g. 0.30 in Finland)															
All Sectors			**year**												
Organization	Compensation	**ocw**	**ocw**								47.2	42.6	42.9	41.6	42.0
R&D Work	Compensation	**rndw**	**rndw**								48.4	43.2	43.5	44.9	43.3
IT Work	Compensation	**itw**	**itw**								57.4	52.0	52.0	51.2	50.0
Production Worker	Compensation	**ain1w**	**ain1w**								30.5	26.0	25.4	24.5	24.8
Other Non-Production Worker	Compensation	**ain2w**	**ain2w**								67.8	61.0	61.6	51.6	50.7
Other Services	Compensation	**ain3w**	**ain3w**								22.7	19.4	18.7	18.8	19.4
Management	Compensation	**managew**	**managew**								51.6	47.1	46.3	45.0	45.7
Marketing	Compensation	**marketingw**	**marketingw**								67.0	59.6	59.3	57.4	57.9
Administration	Compensation	**adminw**	**adminw**								34.1	30.2	30.1	28.7	29.0
			obswyear												
Organization	DAILY Wage	**och**	**och**								24.8	22.0	21.8	22.1	22.1
R&D Work	DAILY Wage	**rndh**	**rndh**								25.7	24.4	24.5	26.1	25.0
IT Work	DAILY Wage	**ith**	**ith**								29.6	26.9	26.4	26.8	26.1
Production Worker	DAILY Wage	**ain1h**	**ain1h**								14.8	13.0	12.9	12.7	12.9
Other Non-Production Worker	DAILY Wage	**ain2h**	**ain2h**								37.8	34.4	33.4	30.6	25.6
Other Services	DAILY Wage	**ain3h**	**ain3h**								13.2	11.6	11.4	11.5	11.7
Management	DAILY Wage	**manageh**	**manageh**								26.8	24.0	23.5	24.0	24.0
Marketing	DAILY Wage	**marketingh**	**marketingh**								33.7	29.6	27.7	27.9	28.6
Administration	DAILY Wage	**adminh**	**adminh**								18.8	16.4	16.5	16.4	16.1
Organization	Share of workers	**oc**	**ocs**								13.9%	13.6%	13.7%	13.3%	13.9%
R&D Work	Share of workers	**rnds**	**rnds**								5.8%	5.4%	5.6%	5.7%	5.9%
IT Work	Share of workers	**its**	**its**								2.7%	2.5%	2.5%	2.4%	2.6%
Production Worker	Share of workers	**ain1s**	**ain1s**								15.6%	14.1%	12.7%	12.3%	12.2%
Other Non-Production Worker	Share of workers	**ain2s**	**ain2s**								0.5%	0.4%	0.3%	0.3%	0.3%
Other Services	Share of workers	**ain3s**	**ain3s**								61.5%	63.9%	65.2%	66.0%	65.1%
Management	Share of workers	**manages**	**manages**								6.4%	6.4%	6.8%	6.8%	7.1%
Marketing	Share of workers	**marketings**	**marketings**								2.1%	2.1%	2.2%	2.2%	2.2%
Administration	Share of workers	**admins**	**admins**								5.3%	5.1%	4.7%	4.4%	4.7%
			obsw												
Organization	Standard Deviation	**stdocw**	**stdocw**												
R&D Work	Standard Deviation	**stdrnd**	**stdrndw**												
IT Work	Standard Deviation	**stdit**	**stditw**												
Production Worker	Standard Deviation	**stdain1**	**stdain1w**												
Other Non-Production Worker	Standard Deviation	**stdain2**	**stdain2w**												
Other Services	Standard Deviation	**stdain3**	**stdain3w**												
Management	Standard Deviation	**stdmanage**	**stdmanagew**												
Marketing	Standard Deviation	**stdmarketing**	**stdmarketingw**												
Administration	Standard Deviation	**stdadmin**	**stdadminw**												

Notes:
a. Compensation is yearly income, in 1.000 Euro
b. Hourly wage not available, therefore daily wages