European Investment Bank • European Investment Bank • European Investment Bank • European Investment Bank

# Innovation and productivity growth in the EU services sector

by Kristian Uppenberg and Hubert Strauss

July 2010

## About the authors

**Kristian Uppenberg** and **Hubert Strauss** are Senior Economists in the Economic and Financial Studies division of the EIB.

# Innovation and productivity growth in the EU services sector

by Kristian Uppenberg and Hubert Strauss

July 2010

# Innovation and productivity growth in the EU services sector

by Kristian Uppenberg and Hubert Strauss

## Executive summary

European countries continue to pride themselves on their rich industrial heritage and strong global position in high-end manufacturing. Yet the underlying reality is that manufacturing is playing a steadily diminishing role in both employment and output. In contrast, the services sector accounts for around two-thirds of total output in the EU, and for four-fifths of growth in recent years. In terms of employment growth, the dominance of services is even more striking. With few exceptions, manufacturing employment in the EU has contracted, total employment expansion thus being accounted for either by services or by construction.

Reflecting the emphasis on the services sector in the EU2020 strategy, this study highlights some key features of the services sector in the EU, including productivity and innovation in market services. One important observation is is that the services sector accounts for as much as three-quarters of cross-country differences in economic growth across individual EU countries. Relatively fast-growing countries have also typically had above-average productivity growth. Even though productivity growth is generally lower in the services sector than in manufacturing, it nevertheless accounts for a large share of aggregate growth in output per employee because of its large size. Countries with high aggregate productivity growth also tend to have relatively higher productivity growth in services.

But the services sector consists of a very disparate group of subsectors, with varying productivity performance and very different mechanisms for enhancing output per employee. The study points to three key ingredients in services sector productivity expansion.

The first is tangible fixed investment. On average, market services have as much fixed capital per employee as manufacturing, but this capital stock is more skewed towards buildings and information and communications technology. These investments have been shown to contribute substantially to productivity growth in several key services subsectors.

A second element is intangible capital. Services industries attain higher productivity by combining investment in fixed capital, new computer software and human capital so as to create new organisational structures and business models, and sometimes entirely new service products. But cross-country differences in the EU are substantial, in terms of both tangible and intangible investment.

A third element is that services sector innovation, in contrast to that in manufacturing, draws less on in-house knowledge creation in the form of R&D. Services industries tend to innovate in interaction with customers, suppliers and competitors. There is also substantial scope for productivity improvements by adopting best practice, both within and between certain service industries. The lower level of in-house knowledge creation partially reflects smaller average firm size in services industries. This greater reliance on external sourcing of new knowledge suggests that cluster formation fostering knowledge transfers and spillovers is an important element in supporting services sector innovation.

# 1. Introduction

The expansion of output and trade in manufactured goods constituted the engine of prosperity in Europe for much of the past century. Even today, European countries pride themselves on their manufacturing heritage and retain a global technological lead in many industries. But when we look more closely at economic growth in Europe, we see that manufacturing has long taken the back seat to services industries, in terms of both output and employment. Meanwhile, the manufacturing firms themselves have become increasingly service focused, partly as a means to remain competitive in a world economy where more and more commoditised goods are being produced in developing countries offering lower costs of production.

It is not unlikely that the economic crisis of recent years has speeded up this process of deindustrialisation in Europe, as a number of traditional sectors are confronted with overcapacity. Yet, the EU economy must find ways to expand faster in coming years in order both to replace the jobs lost during the crisis and to provide incomes with which excessive debt burdens are to be reduced. Given that the medium-term downtrend in manufacturing employment will not likely reverse, future growth in employment and incomes is likely to centre on services.

This study aims to explore some key features of the services sector. Chapter 2 takes stock of the role of services in economic growth and employment. Chapter 3 looks at fixed tangible investment in services, relative to other sectors. Chapter 4 provides a mapping of intangible investment across European countries. Chapter 5, finally, looks at the process of innovation in services. Since this study focuses on longer-term trends, and partly for reasons of data availability, the current economic downturn will not be addressed specifically. There are also other omitted elements, such as the functioning of labour, product and financial markets, regulation, competition, and firm demographics.

“Framework policies” targeting these elements are clearly important for innovation and growth in services, but they are not specific to services per se.

# 2. The role of services in EU economic growth

Total gross output in the economy (Gross Domestic Product, GDP) is the sum of gross value added in all its sectors. These comprise

- Agriculture
- Construction
- Manufacturing
- Services
- Utilities and other industry

This section sheds some light on the sectoral composition of economic growth in the EU and the US using primarily OECD data on sector value added and employment (“EU” is here represented by the EU-15 for reasons of data availability). We look at the last 10-year period for which disaggregated data is available for all countries, typically covering the decade up to 2005. The sectoral decomposition and time periods are slightly different for the EU aggregate and for the UK, for which only European Commission data are available.

## 2.1 The services sector has been a key engine of growth

At the aggregate as well as the sectoral level, growth in output (i.e. gross value added) is the sum of two components: growth in employment and growth in output per employee (also referred to here as labour productivity, although this is a slight simplification since output per employee is also affected by the average number of hours worked by each employee).

The sectoral perspective allows us to address several questions. Is economic growth at the national level broad-based or propelled by just a few sectors? Similarly, are cross-country differences in economic growth broad-based or concentrated to differences in certain sectors? Finally, does the composition of growth between employment and productivity differ across sectors?

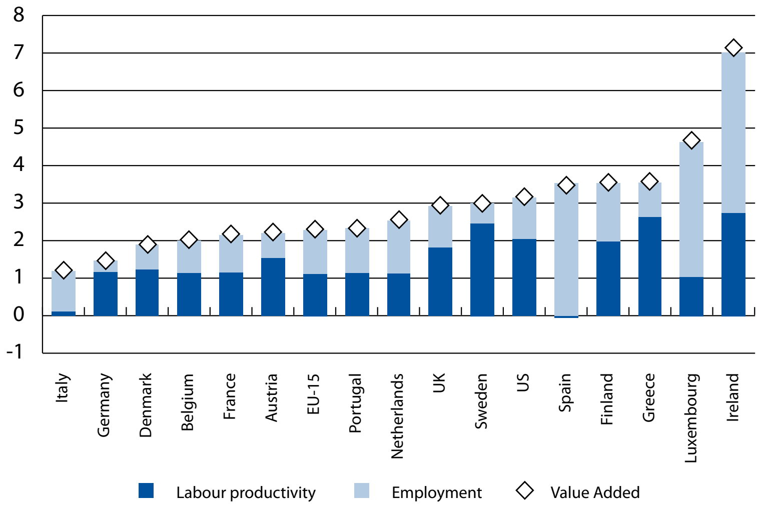
Starting with the aggregate picture, the services sector dominates the EU economy in both level and growth terms. The services sector accounts for around two-thirds of total value added and for four-fifths of real value added growth in the decade to 2005. The services sector also accounts for as much as three-quarters of cross-country differences in economic growth across individual EU countries. With a few exceptions, such as Sweden, Finland and Ireland, high-growth countries have mostly expanded on account of their services sectors, not manufacturing.

In terms of employment growth, the dominance of services is even more striking. With few exceptions, manufacturing employment has contracted. It should be noted here that the EU as a whole experienced relatively favourable conditions for employment growth during this period, Germany being an exception caused in part by the contraction in construction. Spain, Luxembourg and Ireland saw particularly strong employment growth in the services sector, augmented in the case of Ireland and Spain by rising employment in the construction sector. In retrospect, it is now clear that part of this construction-driven employment growth was linked to unsustainable real estate booms, and has contracted sharply during the recession.

## 2.2 In some sectors growth is propelled by employment, in others by productivity

A way to better understand the drivers of growth is to decompose it by growth in employment and growth in labour productivity (here proxied by gross value added per employee)[1] . On average in the EU as a whole, economic growth has been driven in equal shares by productivity and employment, as shown in Figure 1. While there is not a uniform pattern across countries, those with high output growth have typically also had above-average productivity growth. This is true for the US, and in the EU, for the UK, Sweden, Finland, Greece and Ireland. There are two notable exceptions: Output in Spain and Luxembourg has expanded largely due to rising employment, not productivity. Ireland, finally, has enjoyed high employment growth on top of its high productivity growth.

**Figure 1: Sources of economic growth (contribution to annual real value added growth, 1995-2005, percent)**



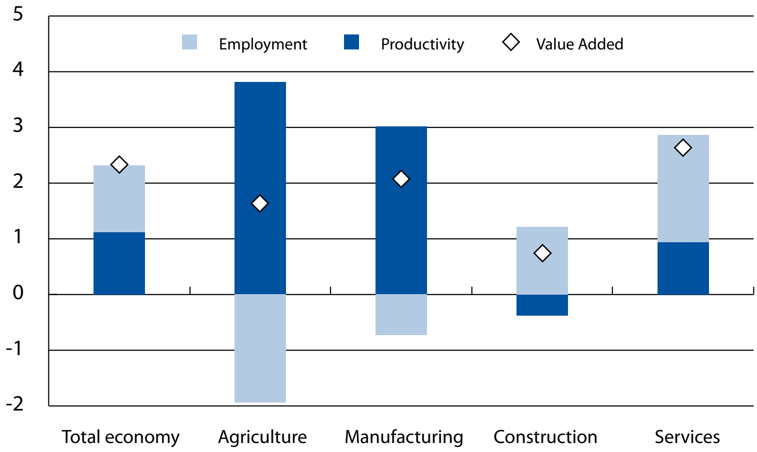

Source: OECD and European Commission
Note: UK and EU-15 data are from the European Commission, for 1994-2004

The relative growth contributions of productivity and employment differs markedly across different sectors of the economy. A shown in

1 Labour productivity is in turn a combination of capital deepening and total factor productivity growth (TFP).

Figure 2 for the EU-15 as a whole, in agriculture and manufacturing, large productivity gains have been accompanied by declining employment. In construction the situation is the reverse. In services, finally, output has been driven mostly by employment, but productivity growth has also been positive. As we will show later on, this productivity growth is in fact very important for aggregate growth performance.

**Figure 2: Sources of sectoral growth in the EU-15 (contribution to annual value added growth 1995-2005, %)**




Source: European Commission Economic Forecast database (AMECO)

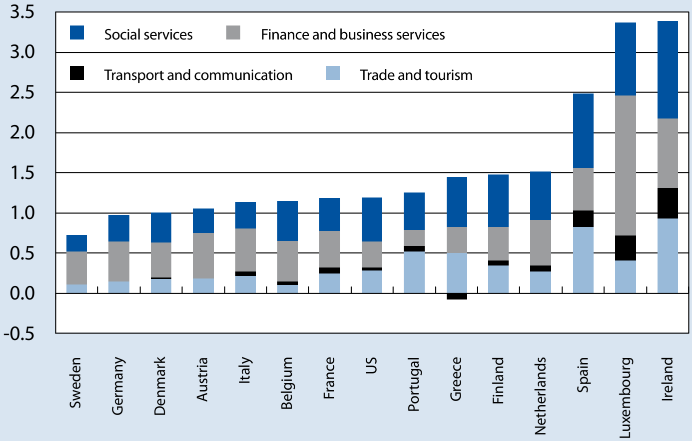
Zooming in on services, there are differences across countries. Sweden, Denmark, the Netherlands, Greece, Ireland and the UK have all seen notable gains in services sector productivity, as has the US. In a number of other countries, however, productivity growth in services has been negligible, and in the case of Spain negative.

While much of the public discourse on R&D has concentrated on the resources that countries invest in R&D on an annual basis, what actually matters for economic growth is the *stock* of knowledge, as represented

## Box 1. Output, employment and productivity in services: A closer look at selected subsectors

The services sector consists of a number of very different industries. For simplicity we have grouped these together into four major subsectors: Trade and tourism; Transport and communication; Finance and business services; and Social services. Figure 3 shows their respective contributions to total employment growth over the ten-year period, for a selection of OECD countries. Finance and business services have constituted a particularly strong growth engine in many countries, on average accounting for around half of total growth in services sector output, with a slightly smaller contribution to employment growth. The role of this sector has been particularly prominent in Luxembourg, France, Belgium, and in the US. Unfortunately, this OECD data set does not include data for the UK.

**Figure 3: Growth in service sector employment (sub-sectoral contributions to average annual growth, 1995-2005, percent)**




Source: OECD

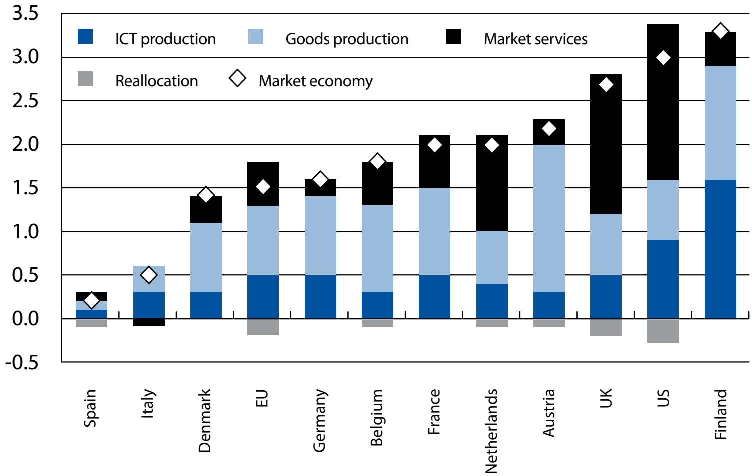
There are notable differences both across sub-sectors and across countries in terms of productivity growth in services (measured as the ratio of real output over employment by sub-sector). Productivity growth has typically been higher in trade and tourism and in transport and communication. In contrast, it has been mostly negative in social services. Finance and business services fall in-between. Ireland and the US have both experienced positive productivity growth in this subsector. The Netherlands, Sweden and Greece stand out as European leaders in aggregate services sector productivity growth, which in these cases has been propelled largely by trade and tourism, and to some degree also by transport and communication.

by the R&D capital stock. The R&D capital stock accumulates gradually as a result of many years of investment in R&D, but it also depreciates as older knowledge becomes obsolete. If Europe would suddenly raise its level of R&D investment to meet the Lisbon target of 3 percent of GDP, this alone would not have an immediate impact on its economic performance. What is needed is a sustained increase in the level of investment that would over time expand Europe's R&D capital stock.

Figure 4 shows the decomposition of productivity growth by sector. In three of the five economies with high productivity growth (UK, US and the Netherlands), services have contributed substantially to high aggregate productivity growth. The few countries that have attained high productivity growth despite small contributions from services are unlikely to serve as useful role models for Europe as a whole. Finland and Austria, along with Ireland and Sweden (not included here), have benefited from large contributions from their manufacturing sectors. But Finland and Sweden benefited during this period from enhanced competitiveness in the aftermath of their large devaluations in the early

1990s, which provided substantial boosts to their manufacturing exports. Ireland, similarly, benefited from massive FDI inflows, especially from the US. These small and exceptionally open economies thus provide rather untypical examples of manufacturing-led growth that the rest of Europe cannot easily replicate.

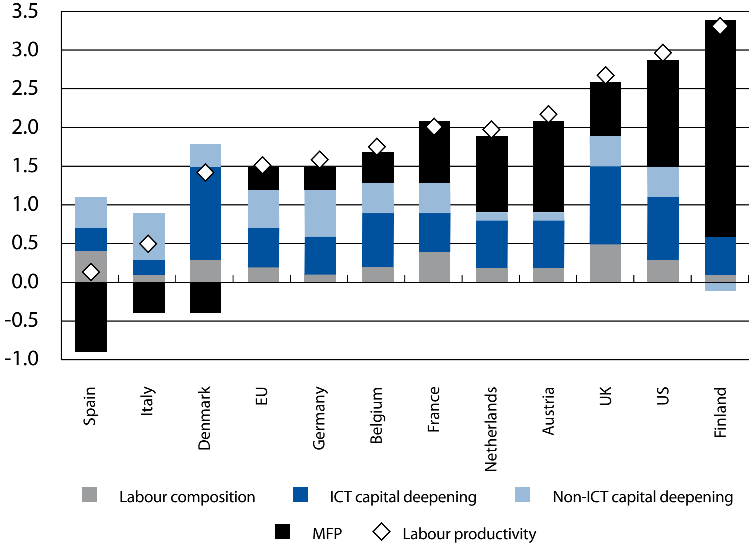
**Figure 4: Sector composition of labour productivity growth (annual average growth 1995-2004, percentage points)**




Source: van Ark *et al.* (2008)

Figure 5, also based on the work of van Ark *et al.*, shows a different decomposition of the same productivity growth. Instead of decomposing productivity by sector, it shows the contribution from different sources: capital deepening (i.e. equipping each worker with more productive capital); labour composition (i.e. changes in the quality of labour); and multifactor productivity (MFP), which is essentially efficiency gains and technological progress.

**Figure 5: The composition of labour productivity growth (all sectors, annual average growth 1995-2004, percentage points)**




Source van Ark *et al.* (2008)

Two conclusions emerge from this decomposition. First, the growth contribution from fixed capital deepening is substantial, at just over 1 percentage point for the EU and more so for the US. Second, while the growth contribution from capital deepening is relatively similar across countries, *differences* in growth performance across countries are largely driven by differences in MFP growth. Combined with the earlier observation that services are key to cross-country growth differentials, this suggests that efficiency gains in services may be an important driver of aggregate productivity growth.

## 2.3 Manufacturing firms become service providers

Mirroring the macroeconomic shift towards services, global rankings of leading firms, such as the Fortune 500, contain more service companies than in previous decades. In some cases, manufacturing firms have transformed themselves into predominantly service-providing companies. One prominent example is IBM, which now considers itself primarily a service business, although it still makes computers. The production of physical goods has become secondary to firms that instead focus on the provision of "business solutions". This transformation of manufacturing firms into service providers is part of a shift in the comparative advantage of advanced economies. As China and other lower cost producers move up the value added ladder in manufacturing, straight goods production has fallen under intense cost pressure. Many manufactured goods, for instance consumer electronics, have become commoditised. High income countries have lost competitiveness in such manufacturing. They have been able to stay competitive in part by shifting towards business solutions rather than the sale of products, as the price elasticity of demand for business solutions is lower than for hardware. This shift has been accompanied by a shift towards subscription pricing. Rather than receiving a single payment for a piece of manufactured equipment, many manufacturers are now receiving a revenue stream for ongoing contracts, which include a non-negligible service component. The management literature refers to this as the "servitisation of products". For a discussion, see for instance Vandermerwe and Rada (1988).

To conclude, this chapter sets the stage for the discussion that follows. With few exceptions, high-growth OECD countries have prospered on account of their expanding services sectors. But what are the drivers of productivity growth in services? Tangible and intangible capital deepening are key elements, but unlike the manufacturing sector, innovation in services does not primarily stem from scientific R&D.

We need to embrace a broader definition of investment to understand services sector innovation.

# 3. Fixed tangible investment is a key driver of productivity growth in services

We saw in the previous chapter that although employment growth was the key driver of services sector expansion, productivity growth has also played a large role. Labour productivity in the EU services sector has expanded by about 1 percent per year from 1995 to 2005. Combined with their large share in aggregate output and employment, services account for a substantial portion of aggregate productivity growth in the EU. Those EU countries with the fastest-growing service sectors have often had particularly high productivity performance.

This chapter sheds light on one of the key drivers of productivity growth: fixed tangible investment. The scope is somewhat narrower than that of the previous chapter, as it focuses on Market services, thus excluding the social services sub-sector. In addition to decomposing fixed investment by services sub-sector, we here also look at the composition of investment and capital stocks across asset types. The traditional split between non-residential construction and machinery & equipment is augmented with a further decomposition of the latter into ICT (information and communication technology) equipment, transport equipment, and other equipment. This further decomposition is important. Several studies have found that ICT-capital deepening has been a particularly important driver of productivity gains in services. Our findings support this view, but there are also notable differences across sub-sectors.

## 3.1 Capital deepening and productivity growth in Market services

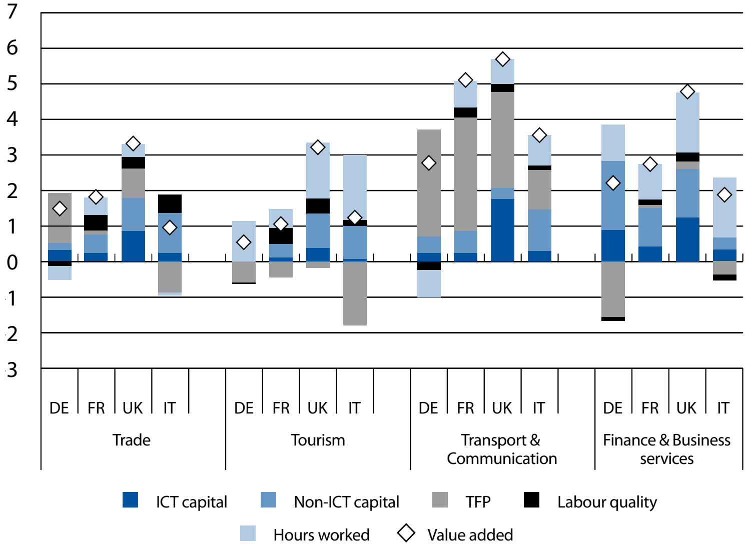
Tangible investment has played an important role in fostering productivity in Market services in the EU over the past decade. Figure 6 depicts the composition of average growth of real value added in Market services for the four largest EU countries, which represent about two thirds of the EU economy.[2] Value added is a measure of GDP at the sector level. The pattern of growth is quite different across the various sectors — "Trade" (Wholesale and retail trade and repair, NACE sector G), "Tourism" (Hotels and restaurants, NACE sector H), Transport & Communication (Transport, storage and communication, NACE sector I), Finance (NACE sector J) and Business services (NACE sector K). Financial and business services account for close to 60 percent of total value added in Market services.

Economic growth can be achieved either through a larger number of hours worked in the economy (through higher employment or an increased number of hours worked per employee) or by making each worker more productive. Higher labour productivity, in turn, can be achieved by equipping each worker with more and better machinery, or with more skills. But higher labour productivity can also be the result of making the economy more efficient in its use of all factors of production, i.e. both labour and capital. This is commonly known either as Total Factor Productivity (TFP) or Multifactor productivity (MFP).

Figure 6 shows the contribution to sectoral value added growth from these different elements. Capital deepening has in turn been decomposed into ICT and non-ICT capital.

2 This chapter is based on data from the EUKLEMS that provides detailed growth accounting results at the level of individual sectors for some 20 EU countries. Over and above the sector focus, it delivers improved growth analysis inter alia thanks to asset-specific capital inputs and by measuring labour in hours worked by skill groups. Due to lack of data for the EU as a whole, EU aggregates are based on own calculations.

**Figure 6: Growth composition in market services, 1995-2005 (average growth in value added, %)**




Source: EUKLEMS; own calculations

A first insight from the figure is that Transport & Communication grew most dynamically during this period, followed by Financial and business services, whereas Trade and tourism recorded a more moderate speed of growth. A second insight is that hours worked accounted for the bulk of growth in Tourism and for a substantial part of growth in Financial and business services. By contrast, growth in Trade as well as Transport & Communication was to a larger extent driven by productivity improvements. The latter fall into capital deepening, i.e. equipping each unit of labour with more ICT and non-ICT capital, and TFP. The third insight is that productivity growth was to a large extent propelled by capital deepening. While there are differences across sectors as to the relative importance of these two sources, the two largest sectors, Financial & business services on the one hand and Trade on the other, were characterized by capital-driven productivity advances.

Last but not least, the contributions from ICT capital deepening are impressive, especially in Financial & business services considering that back in 1995, the total stock of computers, communication equipment and software (ICT capital) represented only a small share in the total tangible capital stock. The other aspect that makes the growth contribution from ICT capital deepening peculiar is the large cross-country variation of this contribution. Among the four largest EU countries, the UK clearly stands out for having enjoyed the largest contribution across all sectors of Market services.

## 3.2 Productive investment in Market services

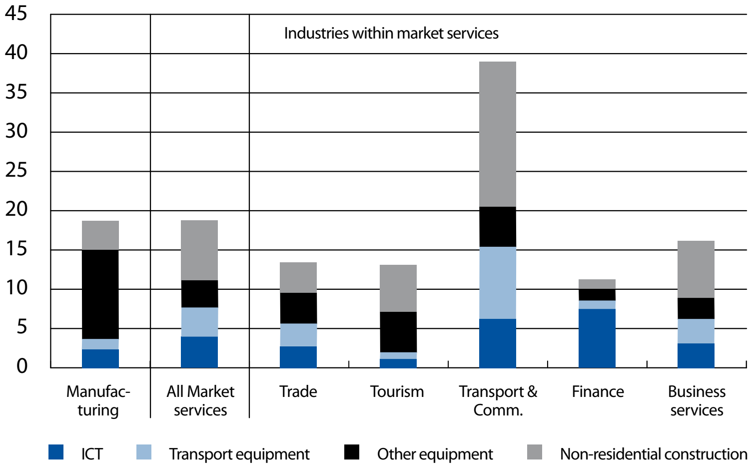
While employment has played an important role in propelling growth in Market services, at least in some sub-sectors, capital deepening has also been very influential. As Figure 7 below illustrates, investment in productive fixed capital is as high relative to value added in Market services as in Manufacturing.[3, 4]

Productive investment totalled 18 percent of value added for the economy as a whole. At close to 19 percent of value added, both Market services and Manufacturing were close to the whole-economy aggregate. In contrast, only 15 percent of output was invested in "Social services" (not shown).

3 For the remainder of this chapter, EU refers to those 11 EU countries for which EUKLEMS provides detailed sector-asset breakdowns for investment and capital stocks. These are Austria, Czech Republic, Denmark, Finland, Germany, Italy, Netherlands, Portugal, Slovenia, Sweden and the UK.

4 Tangible investment is known to be more pro-cyclical than output. Thus the share of investment in value added tends to be lower in recessions and higher in booms. In 2005, however, the output gap in the EU was closed according to the latest estimates by the EU Commission (AMECO) and, hence, overall capacity utilisation was normal. Therefore, the investment shares presented in the following are, by and large, representative.

**Figure 7: Productive investment in the EU by sector and asset, % of value added, 2005**




Source: EUKLEMS; own calculations

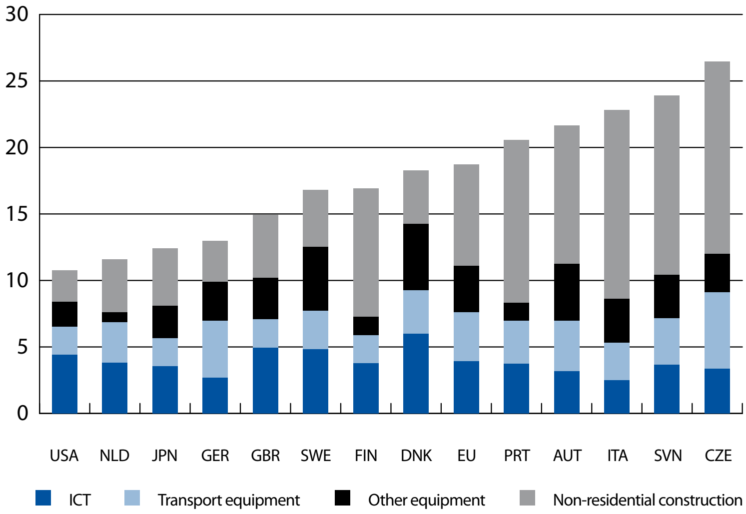
While the overall investment intensities of Manufacturing and Market services are very similar, the composition of investment is not. Some two-thirds of productive investment in manufacturing consists of "other equipment", while it is the smallest component in Market services. Instead, productive investment in Market services is dominated by non-residential construction, followed by ICT and Transport equipment.

Figure 7 also shows that both the level and the composition of investment differs notably across the different sub-sectors of Market services. This reflects the different characteristics of individual service industries. In terms of the asset composition of investment in individual Market services sectors, the example of the Transport and Communication sector is particularly intuitive. Half of the investment in this sector is devoted to non-residential construction (e.g. street, rail, port and airport infrastructure, warehouses, offices). Another quarter is used for transport equipment to renew fleets of trucks, plains, ships, rolling stock etc.

Moreover, at 6 percent the sector comes second only to Finance in the share of value added that is invested in ICT equipment even though ICT is allocated only a small fraction of the sector's large overall investment budget. By contrast, in Finance, two thirds of investment was devoted to ICT equipment.

Turning now to the geographic dimension, there are notable differences in the level of investment in Market services across countries. As shown in Figure 8, the US and Japan invested considerably less in Market services (11 percent and 12½ percent, respectively) than the EU. But also the variation across EU countries was large, with the productive-investment share ranging from 11½ percent in the Netherlands to some 25 percent in the economies in transition (Czech Republic and Slovenia). Italy, Austria and Portugal had above-average investment, too, mostly due to very high investment in non-residential construction.

**Figure 8: Productive investment by asset, Market services (percent of value added, 2005)**




Source: EUKLEMS; own calculations

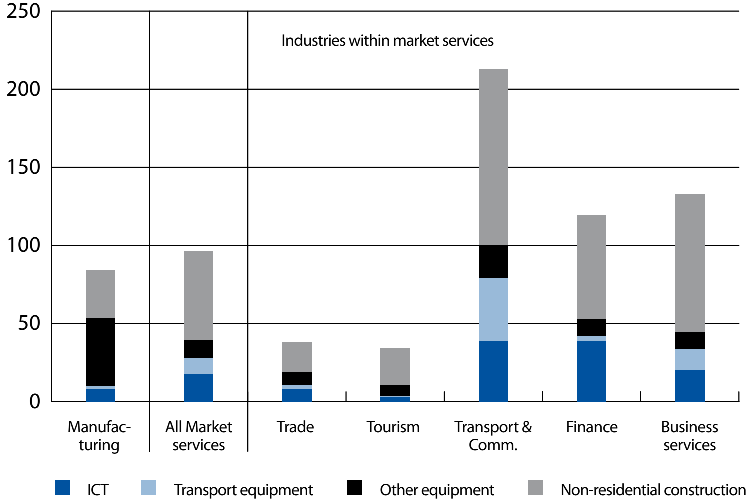
There are also interesting differences across countries in terms of the composition of investment by asset type. The well-known "ICT spenders" such as Denmark, Sweden, the UK and the US, devoted some 30-40 percent of fixed investment in Market services to ICT equipment, compared with just 20 percent for the EU as a whole. This is noteworthy, as these countries have also registered the largest growth contributions from ICT capital deepening for the economy as a whole, as discussed in the previous chapter. Moreover, in the UK and the US in particular, labour productivity in the service sector has grown substantially faster than in other countries. It is also worth noting that in all four countries overall investment relative to value added in Market services is well below the EU average.

The Czech Republic and Germany, in turn, may be characterized as "Transport equipment spenders". Other equipment tends to make for a relatively large share of investment in the ICT-intensive market sectors of Denmark, Sweden and the UK. Finally, non-residential constructions were particularly dominant in Italy and Portugal (see above) but also in Finland.

## 3.3 Capital intensity in the service sector

Different types of capital assets have very different lifespans. High investment in short-lived asset types, such as ICT, translates into a smaller capital stock than would a corresponding level of investment in long-lived assets such as non-residential buildings. Because of the large differences in asset composition across sectors, we therefore need to look also at the *stock* of capital that each worker is equipped with, before deciding on whether a sector is fixed capital intensive or not.

**Figure 9: Productive capital per person employed in the EU, by sector (1000s of EUR, 2005)**

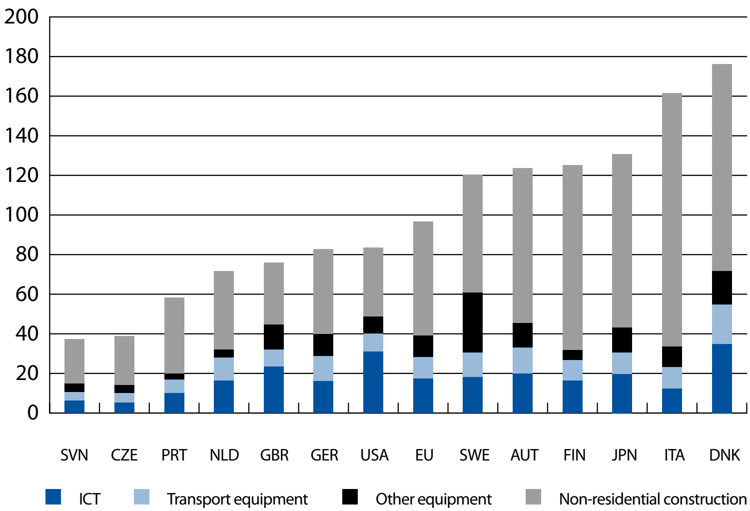



Source: EUKLEMS; own calculations

While broadly corresponding to the investment levels seen earlier, the capital stocks per employee shown in Figure 9 display some notable differences. First, as expected, the share of non-residential construction in the total capital stock is higher than its share in investment, as a result of its higher longevity relative to other assets. Second, the amount of capital per employee is higher in Market services than in Manufacturing, despite similar levels of total investment. This result follows directly from the higher share of construction in Market services investment. Among the sub-sectors within Market services, Transport & Communication stands out as the most capital-intensive sector, mirroring both its higher total level of investment and its large component of construction. To illustrate, each person working in that sector is equipped with approximately EUR 210,000 of productive tangible capital, compared with less than EUR 40,000 in Trade and Tourism.

Mirroring differences in investment intensity, the capital intensity of Market services differs markedly across countries. However, capital stocks per worker vary even more strongly across countries than investment. At close to EUR 180,000 per worker, Denmark's Market services are twice as capital intensive as the EU average and 4½ times as capital intensive as Market services in Slovenia. Second, unlike for investment, Japan is more capital intensive than the EU, and there is now only a small difference between the EU and the US. Third, there are striking cross-country differences in per-worker endowment with machinery and (transport) equipment, suggesting that within Market services, countries are specialised on different sectors requiring different asset types. Last but not least, endowment with ICT equipment greatly differs from one country to the next.

**Figure 10: Productive capital in EU Market services per person employed (1000s of EUR, 2005)**




Source: EUKLEMS; own calculations

## 3.4 Concluding remarks

Starting from the observation that tangible investment has made a substantial contribution to labour productivity in Market services since 1995, this chapter has analysed patterns of tangible investment and capital intensity in Market services. Among the main insights are that Market services are as capital intensive as Manufacturing and that Market services devote a larger share of resources to ICT capital than other segments of the economy. Business services, in particular, have seen a productivity-enhancing shift in capital structure towards more ICT and less “brick and mortar” without increasing the overall capital stock per worker. Those countries that have experienced rapid increases in labour productivity in Market services are characterized by a particularly large share of ICT equipment in overall tangible investment. But we also need to caution against overgeneralisations, since Market services include a rather heterogeneous set of activities. Transport & Communication, for example, is capital intensive, while Trade and Tourism is labour intensive.

# 4. Intangible capital and economic growth

The traditional concept of productive fixed capital includes tangible assets such as non-residential buildings and machinery and equipment. But from an economic point of view, this is a rather too narrow definition of productive fixed capital. In principle, capital expenditure should include any outlay that increases future output and income at the expense of current consumption. Investment in R&D for example gives rise to a productive capital stock similar to tangible fixed capital. The same argument can be made for investment in human capital, in the form of education and training. Human capital and R&D capital are key components of the economy’s “intangible capital”, but this concept can be broadened even further.

The exclusion of intangible capital from traditional measures of the fixed capital stock was to a large extent caused by a lack of reliable data. Intangible investment and capital tend to be more difficult to measure than tangible fixed capital. For much of the post-war period, this exclusion was not a great concern. Most advanced economies were manufacturing-based and tangible capital accounted for the bulk of the total productive capital stock. Over time, however, the exclusion of intangible capital from official statistics has led to a growing misrepresentation of the economic growth process. The reason is that many advanced economies have shifted away from traditional manufacturing towards services and towards economic activity that is increasingly knowledge-based. Growth in modern post-industrial countries has become increasingly dependent on investment in human capital, knowledge and other forms of intangible capital. It is estimated that intangible assets now account for between one third to half the market value of the US corporate sector. In Europe the share of intangible assets in the total assets of publicly-listed firms has more than tripled since the early 1990s, to around 30 percent. Even this figure understates the true share of intangible assets, however, because accounting standards do not allow for treating R&D as capital, and because only intangible assets which are actually on the balance sheet are measured. Hall *et al.* (2007) show, on the basis of just over 1000 publicly-listed European firms, that investment in R&D is a fundamental determinant of corporate financial value and competitive advantage. These findings are in line with other studies on US firms showing that investors view R&D as an asset rather than as an expense.

The growing role for intangibles is visible also at the macroeconomic level, which suggests that their exclusion from national accounts entails a growing misrepresentation of economic activity. Neither the system of national accounts (SNA) nor the financial accounting of firms have traditionally allowed for the capitalisation of intangibles, for both measurement and methodological reasons. Intangible capital such as the stock of R&D or human capital is often tacit, i.e. embedded in the skilled staff and researchers of firms. Also, such expenditures often contain a mix of genuine capital investment (which should be capitalised) and intermediate consumption (which should not be). Some fear that companies might be tempted to label almost any kind of expenditure a "capital expenditure" in order to improve their standing with investors. In contrast, conventional fixed investment and the capital stock it generates is relatively easy to distinguish.

Some steps have been taken towards the capitalisation of intangible investment in the SNA. Expenditures on computer software, for example, have already been counted as capital expenditure for a decade. Software benefits from relatively easy measurement and is relatively distinguishable as pure capital expenditure. It was also decided in 2008 to start counting R&D as investment, to be implemented in a few years time.

Given the limited coverage of intangibles in official SNA statistics, economic researchers have relied on a combination of private and public information sources to estimate such investment. Most have chosen the template created by Corrado, Hulten, and Sichel (2005, 2009), henceforth referred to as CHS. They include three types of intangible assets for the US economy:

- **Computerised information** (software and databases);
- **Scientific and creative property** (R&D, mineral exploration, copyright and license costs, other product development, design, and other research expenses);
- **Economic competencies** (brand equity, firm-specific human capital and organisational structure).

On this basis, they estimate total annual investment in intangible assets by US businesses in the late 1990s to have amounted to some USD 1.1 trillion, or 12 percent of GDP. This is a substantial figure, a similar order of magnitude as tangible investment. This is perhaps the single most important result of their exercise: Once the definition of capital is broadened to include all forms of expenditure that raise the future output potential of the economy, business sector investment is actually twice as large as that traditionally reported.

The data collected by CHS also suggest that US investment in intangibles has risen markedly over time. This gradual rise in intangible investment has been of the same order of magnitude as the decline in tangible investment, thus keeping the ratio of total investment to GDP relatively stable over time. Not all segments of intangible investment have contributed equally to this expansion however. Comparing the time period 1973–1995 with 1995–2003, CHS find that overall intangible investment grew from 9.4 percent of total national income to 13.9 percent. Computerised information rose the most, from 0.8 to 2.3 percent. Interestingly, while traditional scientific R&D remained flat at around 2½ percent, "non-scientific R&D" rose from 1 to 2.2 percent. Non-scientific R&D includes innovative and artistic content in the form of commercial copyrights, licenses, and designs, which are not counted in traditional R&D statistics. Investment in brand equity rose from 1.7 to 2 percent, while that in firm-specific resources increased from 3.5 to 5 percent. In other words, while scientific R&D is traditionally seen as the key element in knowledge creation, it has made a negligible contribution to the ascent of US intangible capital investment in recent decades.

**Box 2: The neo-classical growth model and growth accounting**

The most common method used to empirically investigate the composition of economic growth is called growth accounting, drawing on the neo-classical model of the economy developed simultaneously by Solow (1956) and Swan (1956). In the neoclassical production function gross output is a simple function of only two factors of production: capital and labour. These two are smoothly but imperfectly substitutable, as can be exemplified by the standard Cobb-Douglas production function:

(1) $Y = AK^{\alpha}L^{1-\alpha}$

What this function says is that aggregate output can be expanded either by increasing the amount of labour (*L*) or fixed capital (*K*) used in production, or through an expansion of the stock of knowledge (*A*). The function above has constant returns to scale. This means that a doubling of both capital and labour also leads to a doubling of output. At the same time there are diminishing returns to individual inputs (i.e. $\alpha<1$). Because of diminishing marginal returns to capital, the marginal contribution to growth from steadily increasing the capital stock for each worker will be smaller and smaller. Consequently, the only way for the neoclassical economy to keep growing on a per capita basis is by continuously expanding the stock of knowledge.

The seminal contribution of Solow was his pioneering empirical work on growth accounting. Applying his model to US data from the first half of the 20th century, Solow (1957) could calculate the shares of growth that stemmed directly from the expansion of labour and fixed capital[#]. Whatever portion of growth that cannot be directly explained as the result of increased factor inputs must, according to the neo-classical model, be the result of an expanding stock of knowledge. Solow's startling discovery was that, indeed, some nine-tenths of US growth could *not* be explained by the expansion of labour and capital, but was captured by the residual *A*. While knowledge is certainly one key element of this residual, this interpretation may in fact be a bit too narrow, since empirically the residual captures all efficiency gains in the use of factors of production. The residual captures all increases in output for a given combination of factor inputs. Hence it is nowadays often referred to simply as "total factor productivity", or TFP.

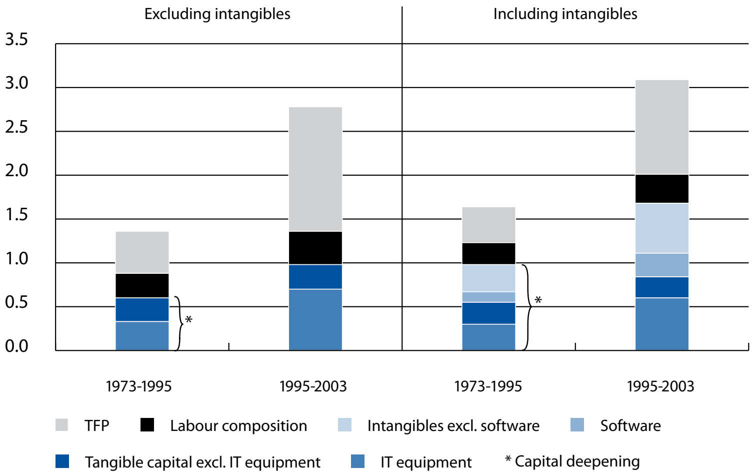
Modern growth research has found that one reason the TFP residual accounted for such a large portion of growth in Solow's calculations was that early measures of fixed capital were rather too narrow. By broadening the concept and measurement of capital, the unexplained TFP residual can be reduced*.

# In order to do this using the relatively simple neo-classical production function and the limited set of data at his disposal, Solow had to make a few simplifying assumptions. First, he assumed that the US economy was on its equilibrium growth path, not unreasonably given its long history of having a relatively free market economy. This allowed him to draw on some generalised properties of the production function that are only true in equilibrium and under the additional assumption of perfect competition. Under these circumstances, the wage rate equals the marginal productivity of labour and the rate of return on capital equals the marginal productivity of capital. The income shares reflect the output elasticity of each input. Assuming constant returns to scale, they add up to one. These are the $\alpha$ and $1-\alpha$ shown in equation (1). Consequently, while the output elasticities are not directly observable, one can simply calculate the contribution of an input to output growth as the growth rate of each input (capital and labour) multiplied by its own income share, which is observable.

* A more comprehensive review of the modern growth literature is provided in Uppenberg (2009).

Based on their estimates of intangible investment, CHS estimate the size of the intangible capital stock, which is then incorporated into the standard growth accounting framework first developed by Solow (see Box 2). As illustrated by Figure 11, productivity growth is higher in the presence of intangible capital. The reason is that spending on intangibles, which grew faster than other segments of the economy, is now included in measured output. It was not when viewed merely as intermediate consumption. Another consequence of treating intangibles as capital expenditure is that it dramatically changes the observed sources of economic growth. Capital deepening – increases in the stock of capital per hour worked – now becomes the dominant source of growth. For the period 1995-2003, intangible and tangible capital investment account for broadly equal shares of growth in US output per worker.

**Figure 11: Contributions to US output growth per hour worked (percentage points)**



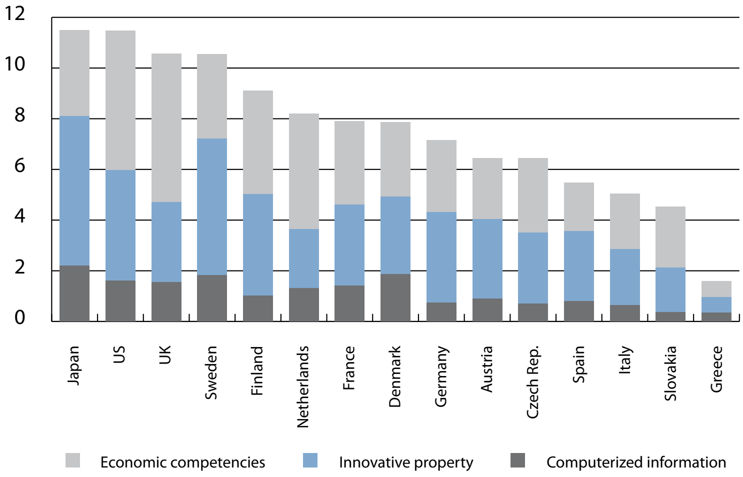

Source: Corrado *et al.* (2009)

With capital deepening explaining a larger share of growth, the contribution from the TFP residual becomes correspondingly smaller, falling from around half to one-third for the post-1995 period when intangibles are included. The Solow residual also accounts for a smaller portion of the post-1995 *acceleration* in US growth. When intangibles are excluded, some two-thirds of the increase in growth is accounted for by

TFP. Its share drops to just over one-third when intangibles are included. On balance, this research is suggestive of the very substantial role that investment in intangibles has played in US economic growth.

The CHS methodology was consequently applied by Giorgio Marrano and Haskel (2007) for the UK, by Fukao *et al*. (2009) for Japan, by Jalava *et al*. (2007) for Finland and by Edquist (2009) for Sweden. In all of these cases, total investment in intangible capital stood at around 10 percent of GDP, i.e. a similar order of magnitude as in the US. However, when this methodology has been applied to a larger number of continental European countries, a wider range of results has emerged.

**Figure 12: Intangible investment in the market sector (percent of GDP, 2006)**

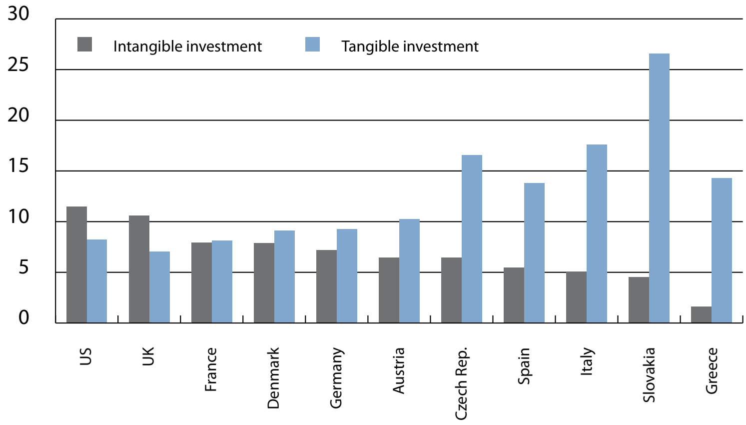



Source: van Ark *et al.* (2009); Edquist (2009); Fukao *et al.* (2009); Jalava *et al.* (2007); Van Rooijen-Horsten *et al.* (2008)

In the EU, with the exception of the countries mentioned above, both the resources devoted to intangible investment and their contribution to productivity growth have typically been of a smaller magnitude. This is one of the key findings of van Ark *et al*. (2009). Building on existing estimates of intangible capital for the US and several European countries, van Ark and his co-authors extend the estimates of intangible investment and capital to five additional European countries: Austria, the Czech Republic, Denmark, Greece and Slovakia. The concept of intangible capital follows the template of CHS for the US. Figure 12 provides a comparison of intangible investment in the US, Japan and a number of European countries, drawing on the results of van Ark *et al*. and other studies using the CHS methodology.

We see here that the ratio of intangible investment to GDP varies markedly across countries, not least within the EU. Also the composition of intangible investment varies across countries. Economic competencies account for as much as half of total intangible investment in the US, UK and the Netherlands, while innovative property such as copyrights and licenses tend to dominate in Japan and a large number of continental EU countries.

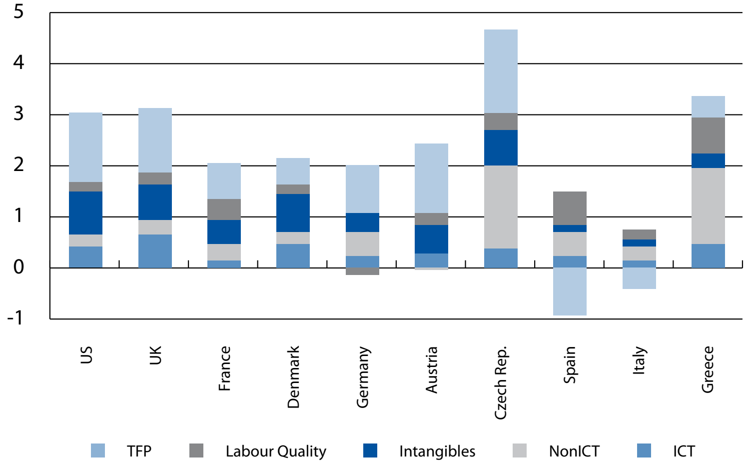
**Figure 13: Intangible and tangible investment in the market sector (percent of GDP, 2006)**




Source: van Ark *et al.* (2009)

Figure 13 above compares the size of intangible investment with tangible investment across a selection of countries. As seen earlier for the US, intangible investment is of a similar order of magnitude as tangible investment in the Nordic countries and in the three biggest EU economies. In many other EU economies, however, investment in intangibles remains far below tangible investment.

**Figure 14: Contribution of inputs to labour productivity growth (annual average in percent, 1995-2006)**




Source: van Ark *et al.* (2009)

Just as the level of intangible investment varies across countries, so does its impact on economic growth. As shown in Figure 14, intangible capital deepening (i.e. more intangible capital per unit of labour) contributed 0.7-0.8 percentage points to labour productivity growth in the US, UK, Denmark and the Czech Republic in 1995-2006. In Germany, France and Austria the growth contribution was slightly smaller, ranging between 0.4 and 0.6 percentage points. The smallest contributions to productivity growth were found in Italy, Spain and Greece, where it averaged only

0.1-0.2 percentage points during this period. The figure also illustrates how non-ICT capital deepening has been delegated to a minor role in growth during this period, with the notable exceptions of the Czech Republic and Greece.

To sum up, this literature shows that the exclusion of intangible investment generates a growing misrepresentation of growth in economies specialising in knowledge-intensive production. The more complete accounting of intangibles undertaken in recent research has demonstrated that the business sector sets aside a much larger share of their total resources to investment than conventional capital measures would have us believe. This modification, in turn, has substantially affected our perception of the drivers of economic growth. It makes both the accumulation of knowledge and its contribution to economic growth more explicit. Indeed, the inclusion of intangibles in aggregate investment shows that a substantial portion of growth can be accounted for by such investment.

But the diversity of intangible investment levels across countries is also indicative of the highly varying speeds at which different countries are making the transition to knowledge-based economies. Although a sectoral breakdown is not available for these data, intangible investment has tended to be particularly high in those countries where the services sector has made a large contribution to productivity growth. Notable examples are the UK, the US, the Netherlands and some of the Nordic countries. The positive correlation between the level of intangible investment and the role of services as a growth engine suggests that high aggregate productivity growth will be difficult to achieve in countries with low intangible investment and stagnant productivity in the services sector. This is an important observation to consider if Europe as a whole is to succeed in its ambition to catch up with US productivity growth in coming years. The next chapter will take a closer look at the nature of innovation in the business services sector, and how public policy can be tailored to support innovation in services specifically.

# 5. Innovation in the services sector

We have earlier presented evidence that the services sector is becoming increasingly important for economic growth, in terms of both employment and productivity. It also accounts for a substantial portion of the outperformance of fast-growing advanced countries in recent years, disregarding for now any repositioning that the economic downturn may cause. A better understanding of the drivers of productivity growth in services is therefore important if Europe as a whole is to improve its productivity performance. We have seen above that investment in both tangible and intangible capital plays a role. Investment in ICT, in particular, is instrumental in facilitating productivity enhancing innovation in services. But there is also strong evidence in the economics literature that these productivity gains arise only when the new ICT hardware and software is accompanied by organisational changes. In a recent study of the US economy, Oliner *et al.* (2007) observe that ICT and intangible capital deepening accounted for a large share of US productivity growth in the second half of the 1990s. But they also show that this influence diminished in the first half of the 2000s in favour of total factor productivity (TFP), i.e. the increased efficiency with which factor inputs are used. This shift is consistent with the view that productivity enhancing organisational changes may lag the investments that enable them. Hence there is more to innovation -- not least in services -- than installing more and better machinery. This chapter therefore takes a closer look at how the services sector innovates.

## 5.1 Innovation has recently been redefined to better fit its role in services

Analysis on innovation has always tended to centre on manufacturing. Both statistical services and economic research have historically underplayed the role of innovation in services. The realisation that services play a substantial role in growth makes this stance untenable, however. Efforts have recently been made to better account for innovation in services.

One prominent example of this is the third edition of the "Oslo Manual" (OECD, 2005) which provides a revised definition of innovation which is better tailored to its role in service industries. Specifically, it has been obvious for some time that innovation in services is more geared towards organisational changes than towards the development of new products and processes. Indeed, it is an inherent feature of services that the final product is difficult to distinguish from the organisation that provides it, or from the manner in which it is provided.

To account for this, the revised Oslo Manual broadens the definition of innovation to mean "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations."

This implicitly identifies the following four types:

- **Product innovation**: the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses.
- **Process innovation**: the implementation of a new or significantly improved production or delivery method.
- **Marketing innovation**: the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
- **Organisational innovation**: the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations.

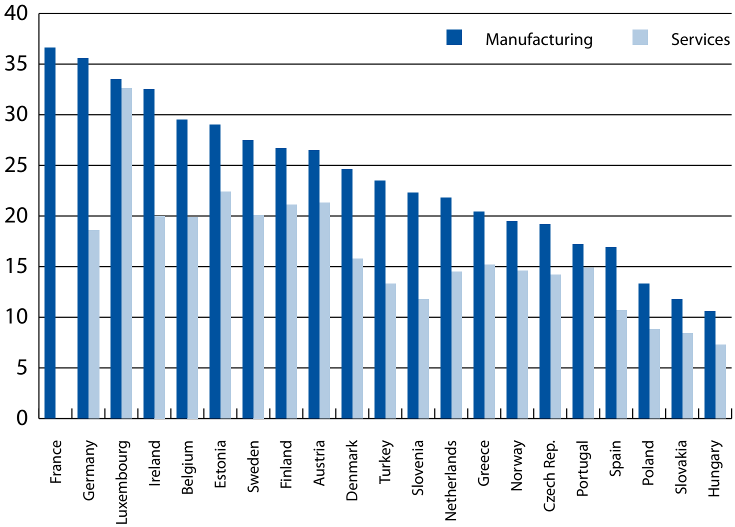
The first two are traditionally more closely related to technological innovation. The last two are non-technological in nature. These are new additions to the third edition of the Oslo Manual.

## 5.2 Manufacturing and services focus on different types of innovation

The revised definition of innovation has been applied in recent surveys, providing improved measurement of innovation in services. The latest Community Innovation Survey (CIS-2006, conducted by Eurostat on behalf of the European Commission) shows clearly that a too narrow definition of innovation (limited to technological innovation) would underestimate the occurrence of innovation in services.

The survey identifies "in-house" innovation as that which is mainly developed within the firm. On this score, the number of firms engaged in in-house ***product innovation*** (products that are new to both the firm and the market) is on average around one-third lower in services than in manufacturing, as shown in Figure 15.

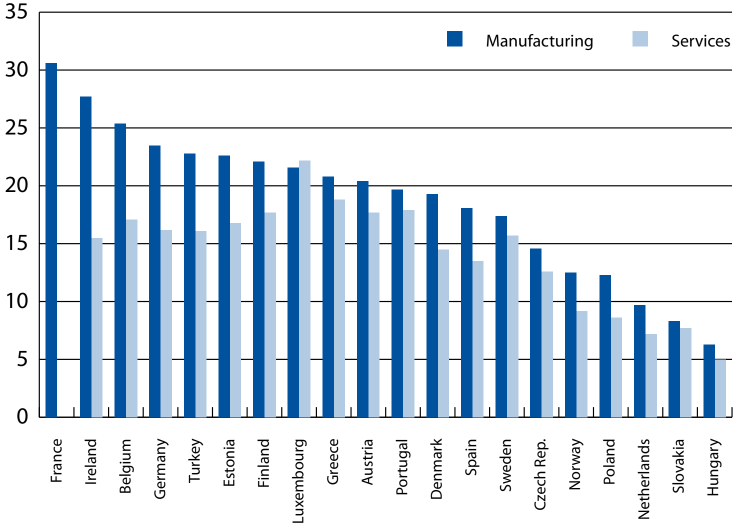
**Figure 15: In-house product innovators by sector (as a percentage of all firms, 2004-06)**




Source: OECD STI Scoreboard 2009

The gap between services and manufacturing is somewhat smaller (one-quarter) as regards the percentage of firms engaged in ***process innovation*** (Figure 16).

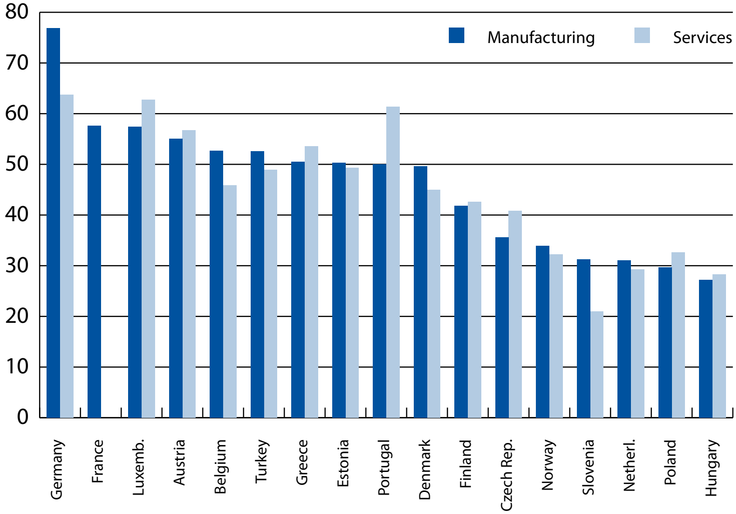
**Figure 16: In-house process innovators by sector (as a percentage of all firms, 2004-06)**




Source: OECD STI Scoreboard 2009

The gap between manufacturing and services virtually disappears, finally, in the percentage of firms that engage in ***non-technological innovation*** such as a marketing or organisational innovation (chart 17 below). Note that the percentage of firms involved in such innovation is also much higher across the board than in the case of product or process innovation.

**Figure 17: Non-technological innovators (as a percentage of all firms, 2004-06)**




Source: OECD STI Scoreboard 2009

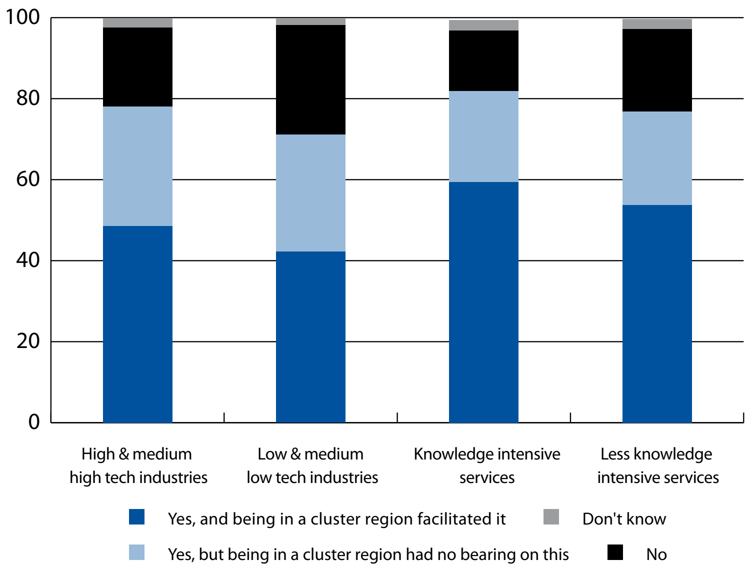
## 5.3 Average firm size in services is smaller, and they benefit from clustering

The CIS-2006 also shows that a lower percentage of SMEs engage in innovation than do large firms. This should be born in mind when assessing the lower incidence of innovation in services. Most firms in the services sector are relatively small. On average in the EU-27, around three-quarters of service sector value added are generated by firms with less than 250 employees (i.e. SMEs and micro-sized firms). In manufacturing, the SME/micro share of total value added is only around one-half.

Smaller firms tend to devote less resources to in-house innovation, whether in the form of scientific R&D or other types of intangible investment. Typically lacking the resources for substantial internal innovation, they are more dependent on externally generated innovation and technology, for example off-the-shelf software and IT hardware. They also benefit from sharing the costs of innovation and infrastructure with other similar firms, which suggests that they are prone to clustering.

The European Cluster Observatory (financed by the Commission in the framework of its Europe INNOVA initiative) has shown that clustering in services is highly correlated with GDP per capita. This is most evident for clusters in business services, financial services and information technology. Evidence for positive effects from clustering in services is indicative of what "eco-systems" allow innovative services to flourish. Figure 18 illustrates this point. The 2006 Innobarometer survey showed that a larger portion of services sector firms gave their cluster credit for their own innovation (dark blue) than did industrial firms.

**Figure 18: Clustering helps services innovate**

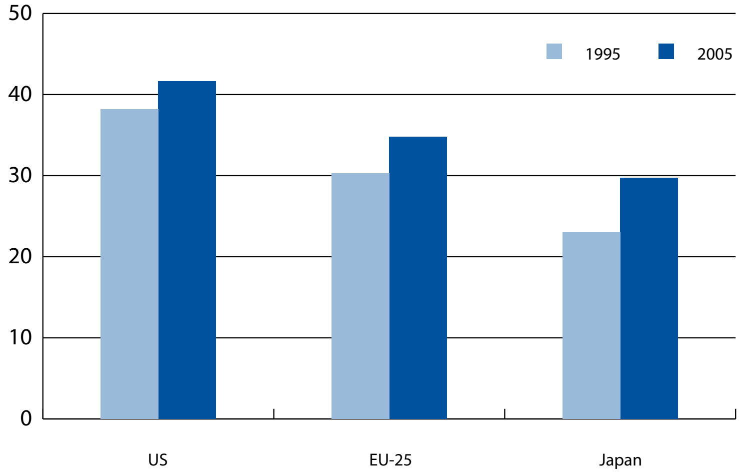



Source: European Commission (2006), Innobarometer

## 5.4 Some services are more innovative than others

One problem with assessing innovation in services is that it includes a very heterogeneous group of activities. Some types of services are particularly uninnovative, which pulls down the average. Services with high levels of technological opportunity, such as computer services, telecommunications, transport and R&D and engineering services stand at the core of what Eurostat calls “Knowledge Intensive Services” (KIS). Eurostat’s definition of KIS is relatively broad, which has the effect that it covers around half of total service sector employment and one-third of total employment in the EU (Figure 19).

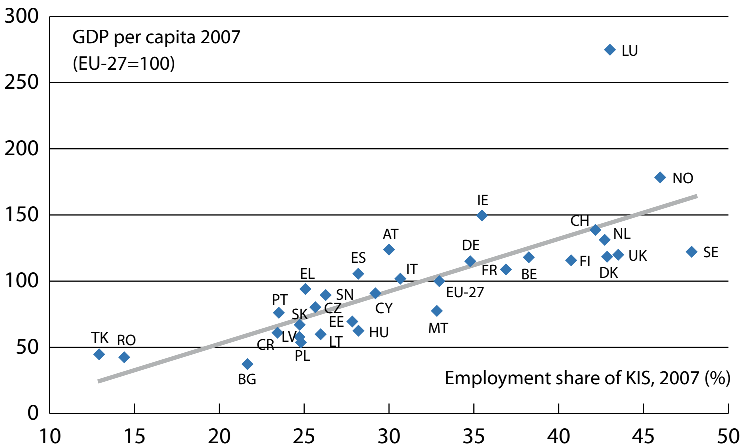
**Figure 19: Employment in knowledge-intensive service sectors (share of total employment, percent)**




Source: PRO INNO Europe paper No. 12, 2009

Unlike the services sector as a whole, the KIS segment is not that different from manufacturing in terms of R&D intensity or the share of output that comes from new products. The KIS segment is important for aggregate productivity growth, and there is a strong positive correlation between the employment share of the KIS and GDP per capita, as shown in Figure 20. The causality here likely goes in both directions, i.e. rich countries may have higher aggregate demand for KIS services. However, we have seen earlier that services contribute very differently to aggregate productivity growth across countries, and the employment share of KIS is also strongly correlated with overall innovation scores. This suggests that knowledge intensive services do play a non-negligible part in overall services sector innovation, and in its contribution to aggregate productivity growth.

**Figure 20: Employment share in knowledge-intensive services vs. GDP per capita**




Source: Eurostat and European Commission (AMECO database)

## 5.5 How do service sector firms innovate? Results from the NESTA innovation survey

Because of the heterogeneity of service industries, it is difficult to generalise too much about their innovative process. We therefore now turn to take a closer look at how a sample of individual service industries conduct their innovation. This section draws on a UK survey, which usefully distinguishes between different stages of the “innovation value chain”, from the formation of knowledge all the way through to commercial applications and value creation, which in turn is the basis for measuring productivity. This is helpful, as different industries with similar overall levels of innovation may focus on different stages of the value chain.

That innovation should be reflected in value creation was first suggested by Joseph Schumpeter, who argued that innovation is not just a new idea or invention, but the increased productivity that stems from its application. Innovation is thus inseparable from the economic value that it generates. This is a very serviceable definition of innovation, since it makes it measurable in quantitative/monetary terms. By any other measure, how could one possibly compare two different inventions?

The study, by the UK National Endowment for Science, Technology and the Arts (NESTA, 2009), draws on a survey of 1500 UK companies. It covers nine sectors, selected to provide a representative cross-section of the economy. These include both industries that are believed ex ante to be knowledge-intensive and those that are not.
The nine sectors included in the survey are:

- Automotive sector
- Specialist design
- Construction
- Energy production
- Accountancy services
- Architectural services
- Consultancy services
- Legal services
- Software & IT services

Of these, the last five are in services (shown in blue in the list).

Sectors innovate differently, emphasising different stages of the innovation value chain. The NESTA survey identifies three distinct phases:

- **Accessing knowledge** (through in-house investment in knowledge, collaboration with other organisations, or acquisition of external knowledge);
- **Building innovation capacity** (as firms translate their knowledge investments into innovation outputs);
- **Commercialisation/value creation** (as firms seek to exploit their innovations in the market place).

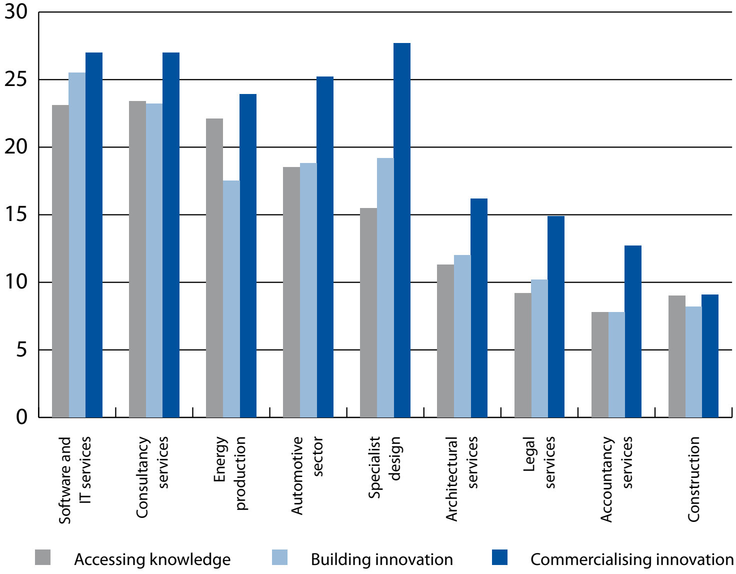
In order to measure the innovative capabilities of each sector, in each of the three stages, the survey identifies a number of metrics assessed at firm level. In order to measure each sector's innovativeness through the innovation value chain, the survey covers the 16 firm-level metrics. Many of these elements are particular to each of the three stages. For example, the *Accessing Knowledge* stage includes metrics reflecting the firm's internal R&D and design expenditure. *Building Innovation* includes spending on process change and the extent of new products and services in total sales. *Commercialising Innovation* includes metrics relevant to successfully taking an innovation to market, such as the nature of involvement with customers and the use of IP protection. Then there are also metrics that are common across all three stages. For example, the use of different internal skill groups and the use of external partners are not limited to a specific stage.

In a second step, the firm-level metrics are weighed and translated into sectoral innovation indices, as shown in Figure 21. These are constructed with the aim of allowing for a comparison of the level and variability of innovativeness *across* sectors, and across the three stages of the innovation value chain. In addition, the *variation* of firms in each sector is used as a measure of the scope for knowledge transfer *within* sectors.

These results are then used as an indication of the potential for productivity gains through the adoption of best practice, either within or across sectors.

While some sectors have an evenly high level of innovative capacity across all three stages (most notably IT and Consultancy services), others are more uneven (Automotive and Specialist design, along with several service industries).

**Figure 21: Sectoral innovation indices**




Source: NESTA (2009)

## 5.6 Improving innovative capabilities by learning from best practice

The guiding principle of the NESTA survey was that the innovation capability of individual sectors can be enhanced by learning from best practice, whether residing inside the sector or in other sectors. If such learning does not occur spontaneously, there may be a role for the government to serve as a facilitator. The approach taken by NESTA is consistent with the view that technological innovation plays a secondary role in services sector innovation, as implied by the CIS results discussed earlier. If true, the allocation of resources (whether public or private) to the creation of new scientific knowledge is likely less effective in the context of fostering services sector innovation than the dissemination of best practice and knowledge spillovers, for instance through cluster formation.

In the NESTA framework, the scope for *intersectoral learning* is proxied by the gap of each sector and stage relative to that with the highest score, which is assumed to represent economy-wide best practice for each stage of the innovation value chain. The scope for learning from best practice *within* each sector is represented by the standard deviation of firm scores within each sector. is mapping provides a guide to sector-specific strategies for lifting innovative capacity through the adoption of best practice.

On this basis, four sectors stand out as having rather extreme profiles. Accountancy and construction display very large inter-sectoral gaps for each stage of the innovation value chain, suggesting greater scope for inter-sectoral learning of innovation best practice. At the same time, however, accountancy and construction firms have relatively low intra-sector variability, which implies limited scope for learning from other firms in their own sectors. At the other extreme, consultancy and software/IT services have small or non-existent gaps to best practice for each element of the value chain. Consultancy firms also have relatively low intra-sector variability, which implies limited scope also for intra-sector learning. Firms in the software and IT services sector, on the other hand, display a greater degree of intra-sector variability in their innovation capability. Here there is greater scope for learning from best practice within the software and IT services sector itself. Other sectors fall in between these extremes. Architectural services display low variability within the sector but a relatively large inter-sectoral gap. If this sector is to improve its innovative capabilities, it would have to draw on best practice in other sectors, for instance consultancy and specialist design. The latter stands to gain relatively more from intra-sector learning, on account of its greater intra-sector variation.

One key observation made in the NESTA study is that the need to learn from and adopt best innovation practice is not always equal across all three stages of the innovation value chain. Relatively few sectors have large gaps to best practice in the first and third stages of the innovative value chain. In the second stage, however ("Building Innovation Capacity"), only two sectors have small gaps to best practice. This suggests that particular policy attention is needed in improving the ability of firms to build on their knowledge investments to generate more commercially viable innovative products and services.

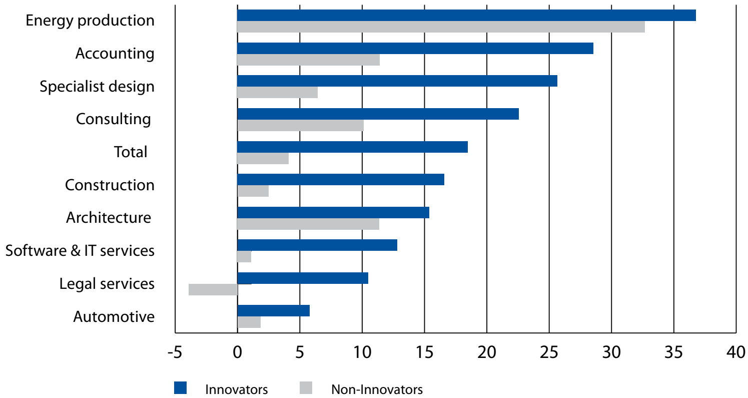
## 5.7 Innovative firms grow faster

One final finding of the NESTA survey is that firms with high innovative capacity expanded substantially faster on average than non-innovative firms (Figure 22). The gap is also visible in services (except in architecture, where the innovative lead is relatively small). To the extent that the UK can serve as a role model for the rest of Europe, this suggests that broadening the innovative capability of firms in the services sector holds the key to faster service sector-led growth.

Possible methodological shortcomings notwithstanding, the NESTA study does provide a telling illustration of how individual service industries differ, not only in their overall innovative capacity, but also in their focus on the different stages of the innovation value chain. One lesson here is for instance that sectors suffering from structural weaknesses in the commercialisation of knowledge would enjoy limited benefits from increased investment in the *creation* of new knowledge.

These results point to an alternative role for public policy in the context of service sector innovation, as a facilitator of learning from best practice, as opposed to supporting investment in R&D and in-house generation of new knowledge.

**Figure 22: Sales growth for UK innovators and non-innovators, by sector (annual percent growth, 2006-2009)**




Source: NESTA (2009)

# 6. Conclusions

The various sections of this survey paper have individually made some striking observations. Services account for a non-negligible portion of the productivity lead of highly innovative economies, most notably the US (Chapter 2). While Europe on average does not lag behind in terms of fixed tangible investment in the services sector, the shift towards ICT equipment has been even more pronounced in the US than in Europe (Chapter 3). Europe does lag the US with respect to intangible investment, and especially in economic competencies (Chapter 4). Given the large role that intangible investment has played in US productivity growth in the past decade-and-a-half, this imbalance needs to be addressed if the transatlantic productivity gap is to be narrowed. The academic literature points to strong synergies between tangible fixed capital, investment in knowledge and in human and organisational capital. An imbalance in the resources allocated to tangible vs. intangible capital may therefore hamper the final productivity-payoff. But innovation in services is not just about the resources allocated to ICT and intangible investment. In order to boost productivity, service industries must draw on these investments to reshape the way they conduct business, and to invent entirely new services. For such innovation to occur, appropriate framework conditions must be in place, including product and labour market flexibility, competition, and free trade of services across borders. In services as in other industries, survival and the ambition to outrun the competition is the most powerful incentive to innovate.

A final conclusion that emerges from the literature and data surveyed above is that the nature of knowledge formation itself is different in services. Although some service industries do invest substantial amounts in scientific R&D, many do not. Average firm size in most service industries is small and the resources devoted to in-house knowledge creation are limited. Instead, surveys show that services rely extensively on external sources for new knowledge, most notably through their ties with customers and other firms. Yet the widespread lack of patenting of non-technological innovations tends to limit the dissemination of such knowledge. As discussed in Chapter 5, many service industries would stand to gain substantially from learning from best practice in other firms and even in other sectors, yet many are relatively closed to information sharing and cooperation, partly for competitive reasons. The lack of effective IP protection for non-technological innovation raises the risk of suboptimal levels of knowledge transfers and wasteful duplication of innovative efforts, protected by secrecy. In light of these observations, public support for the dissemination of best practice and the formation of knowledge intensive service clusters are attractive complements to traditional R&D subsidies in fostering more innovation in the services sector.

# 7. References

Corrado, C.A., Hulten, C.R. and Sichel, D.E. (2005). "Measuring capital and technology: An expanded framework", in Corrado, C.A., Haltiwanger, J. and Sichel, D.E. (eds.), Measuring capital in the new economy. *NBER Studies in Income and Wealth*, (65), University of Chicago Press, Chicago, USA.

Corrado, C.A., Hulten, C.R. and Sichel, D.E. (2009). "Intangible capital and US economic growth". *The Review of Income and Wealth*, (55:3), pp. 661-685.

Edquist, H. (2009). "How much does Sweden invest in intangible assets?" Research Institute of Industrial Economics Working Paper No. 785.

Fukao, K., Hamagata, S., Miyagawa, T. and Tonogi, K. (2009). "Intangible investment in Japan: Measurement and contribution to economic growth". *The Review of Income and Wealth*, (55:3), pp. 717-736.

Giorgio Marrano, M. and Haskel, J. (2007). "How much does the UK invest in intangible assets?". CEPR Discussion Paper No. 6287.

Hall, B.H., Thoma, G. and Torrisi, S. (2007). "The market value of patents and R&D: Evidence from European firms". NBER Working Paper No. 13426.

Jalava, J., Aulin-Ahmavaara, P. and Alanen, A. (2007). "Intangible capital in the Finnish business sector 1975-2005". Discussion Papers 1103, The Research Institute of the Finnish Economy.

OECD (2005). "The measurement of scientific and technological activities: Proposed guidelines for collecting and interpreting technological innovation data", OECD, Paris.

Oliner, S., Sichel, D.E., Stiroh, K.J. (2007). "Explaining a productive decade". *Brookings Papers on Economic Activity*, 2007/1.

NESTA (2009). *Measuring sectoral innovation capability in nine areas of the UK economy*. Report for NESTA Innovation Index project. November 2009.

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

Solow, R.M. (1957). "Technical change and the aggregate production function". *Review of Economics and Statistics*, (39), pp. 312-320.

Swan, T.W. (1956). "Economic growth and capital accumulation". *Economic Record*, (32:2), p.334-61.

Uppenberg, K. (2009). "Innovation and economic growth". *EIB Papers*, (14:1), pp. 10-35.

van Ark, B., O'Mahony, M. and Timmer, M. (2008). "The productivity gap between Europe and the U.S.: Trends and causes", *Journal of Economic Perspectives*, 22 (1), pp. 25-44.

van Ark, B., Hao, J.X., Corrado, C., and Hulten, C. (2009). "Measuring intangible capital and its contribution to economic growth in Europe". *EIB Papers*, (14:1), pp. 62-93.

Vandermerwe, S. and Rada, J. (1988) "Servitization of business: Adding value by adding services", *European Management Journal*, vol. 6, no. 4, 1988.

van Rooijen-Horsten, M., van den Bergen, D., de Haan, M., Klinkers, A. and Tanriseven, M. (2008). "Intangible capital in the Netherlands: Measurement and contribution to economic growth", Discussion Paper No. 08016, Statistics Netherlands, The Hague.

European Investment Bank • European Investment Bank • European Investment Bank • European Investment Bank

**European Investment Bank**
Economic and Financial Studies
98-100, boulevard Konrad Adenauer
L-2950 Luxembourg
infoefs@eib.org
(+352) 43 79-82154
(+352) 43 79-68895
www.eib.org/efs

ISBN 978-92-861-1254-6


QH-31-10-501-EN-C