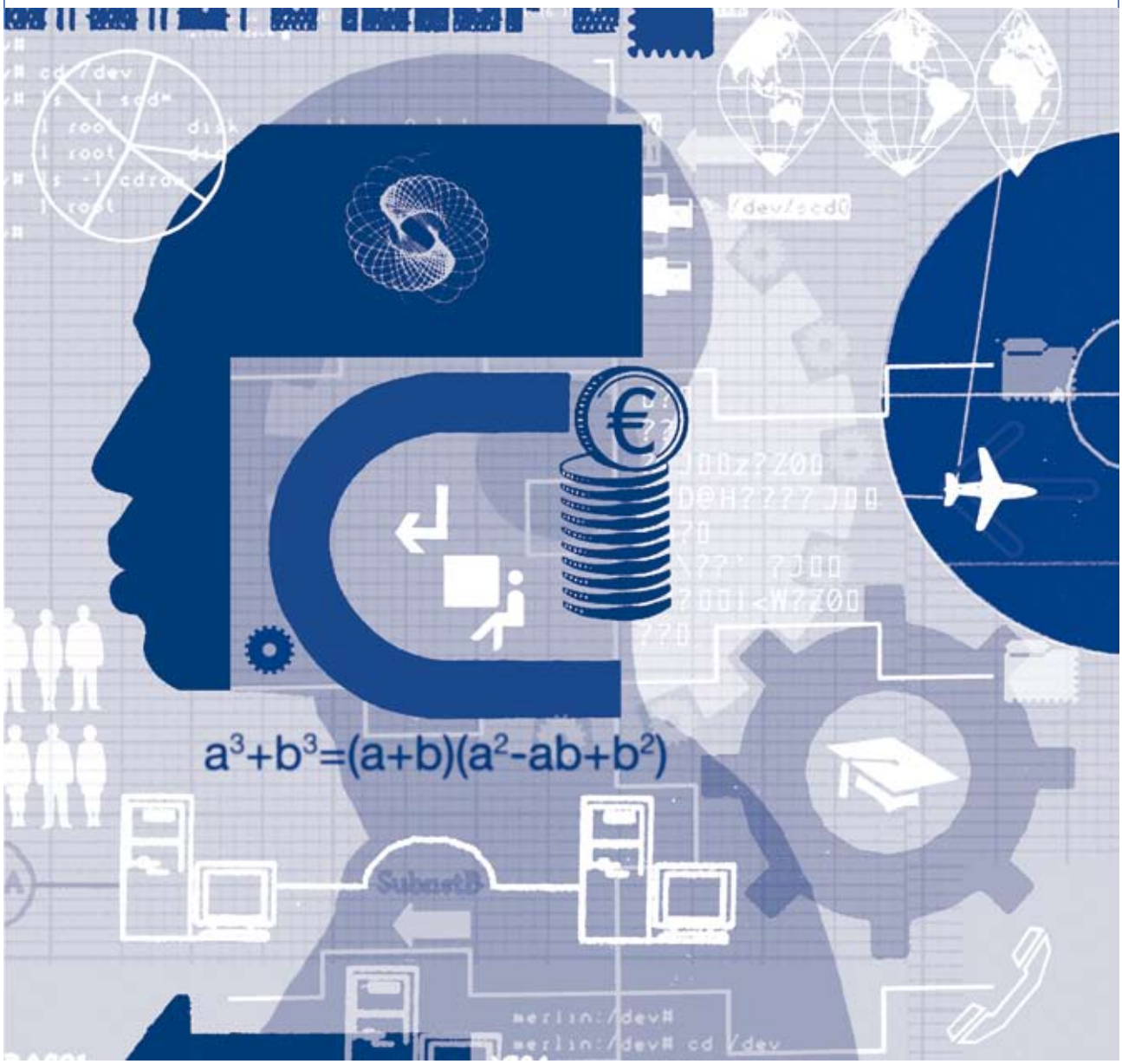
# The Knowledge Economy: How Knowledge is Reshaping the Economic Life of Nations

the work foundation

Ian Brinkley March 2008



## Sponsors


This report has drawn on some of the initial research work and discussions fromThe Work Foundation's three-year Knowledge Economy programme, to be completed in April 2009. However, the views set out here are entirely those of The Work Foundation and do not represent those of the sponsoring organisations.

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# Executive summary

**Overview**

The knowledge economy is driven by the demand for higher value added goods and services created by more sophisticated, more discerning, and better educated consumers and businesses. Technological development has primarily been a supply side enabler. Globalisation acts as an accelerator that has speeded up the process on both sides.
The defining features of a knowledge economy include:

- A fundamental shift in investment priorities towards the creation and exploitation of knowledge and other intangible assets such as R&D, software, design, development, human and organisational capital as the basis of competitive advantage;
- Processes that operate across all industries and all forms of economic activity – high and low tech, manufacturing and services, public and private, small and large;
- Cheap, powerful and pervasive general purpose information and communication technologies coupled with mass education to graduate level and beyond.

**Work and the knowledge economy**

- Knowledge based industries and knowledge related occupations have provided most of the new jobs in the UK over the past decade[1].
- Greater labour market polarisation in the UK associated with the 'hourglass economy'– more good knowledge economy jobs at the top, more bad poorly paid jobs at the bottom and fewer in the middle – has halted over the past decade.
- Much of the expansion in the knowledge workforce has come from women graduates. There has been some further job polarisation for men and male graduates but none for women and female graduates.
- The economy is absorbing the increased supply of graduate labour efficiently. The gaps in wages and employment prospects between graduates and non-graduates have remained stable, as has the share of less well paid jobs taken by graduates.
- The growth of knowledge work is not associated with new forms of flexible employment. Knowledge workers are just as likely to be in long term secure jobs as they were ten years ago.

[1] For this report we have used the OECD/Eurostat definitions of the knowledge based industries: high to medium tech manufacturing, high tech services, business services, financial services, health and education services (OECD) plus cultural and recreational services and international transport services(Eurostat). Knowledge workers are defined by proxy measures as either the top three standard statistical occupational codes (managers, professionals, associate professionals and technical) or graduate or higher levels of education. Details are given in Section One

- The distribution of market sector knowledge industry employment strongly favours parts of the South East, while the public sector based knowledge industries are more evenly distributed.

**The globalised knowledge economy**

- The UK has emerged as a world leader in trade in knowledge services with the biggest trade surplus of the major OECD economies: however, this is unlikely to fully offset the trade deficits for manufacturing, energy and tourism.
- Although financial services and the City remain important generators of knowledge based services, just over two thirds come from business services, high tech services, and education and cultural services.
- UK manufacturing is now a significant generator of business and trade related knowledge service exports, as the boundaries between manufacturing and services blur due to globalisation and the shift towards intangible investment.
- Offshoring has had no measureable impact on knowledge economy jobs, and trade in knowledge services remains overwhelmingly with richer economies. However, trade related structural change will increase in some knowledge service industries.
- As knowledge services trade increases we expect to see increased flows of foreign direct investment, with increasing investment in economies like the UK from India and China as well as vice versa.

**Innovation in the knowledge economy**

- Innovation in the knowledge economy comes from both the successful exploitation of R&D undertaken in the UK and overseas and from wider forms of innovation – design and development, marketing and organisational change.
- R&D has not increased as a share of GDP, primarily because of big falls in medium tech manufacturing and cut-backs in government departmental spending, and has become more intensely concentrated within high tech manufacturing and high tech services.
- The high level of overseas funding for R&D makes the UK more vulnerable to the twin challenge from new lower cost locations for R&D and a relatively weak home market anchor that would otherwise keep R&D in the UK.

- The knowledge economy has seen strong employment growth in both SMEs and large firms across the knowledge based industries, but we know relatively little about the role of fast growing innovative 'gazelles'.

- Innovation in the public services has been primarily driven by the efficiency agenda and specific policy initiatives rather than continuous service improvement: there are substantial imbalances between risk and reward and the consequences of failure that constrain innovation.

**The policy agenda**

- We need to develop an overall strategic framework to ensure the UK retains a world leading knowledge economy, including a major review of the corporate tax and business support and enterprise support regimes to take account of the shift in business investment priorities.

- Public investment priorities need to be more closely aligned with the knowledge economy, especially in support of R&D, science and technology and higher education, and business and enterprise policies.

- Universities and the higher education sector more generally, have an extremely important potential role as economic actors at the national level, in attracting and retaining R&D, and as agents of regeneration at the local and regional levels.

- Open trade in services at both European and world level is a UK priority (together with liberal migration policies) to help sustain the growth of knowledge based industries such as business services, finance, IT, and health and education.

- An industry-specific focus on how general framework policies can be implemented and delivered most effectively should be strengthened and if necessary extended, building on the current initiatives across government in areas such as manufacturing, the creative economy, the City and the IT industry.

- The decline in the high tech manufacturing sector relative to other economies such as Germany, France and Sweden is of concern: the Manufacturing Forum should be asked to focus on why this is taking place, whether additional public intervention is justified and, if so, what form it might take.

- Underperforming regions and localities in both the North and the South will need to draw on their public sector knowledge base as part of a wider strategy to encourage private sector development.

- We welcome the recent improvements in official statistics and official interest in the role of intangibles: however, overall there is a remarkable lack of official statistics directly measuring and defining the knowledge economy.

**Next steps**

- We have undertaken a large scale survey of workers on the nature of knowledge work and knowledge workers based on what tasks people do at work.

- We will complete a series of studies on globalisation and the knowledge economy, including the role of global labour markets.

- We will bring together the existing strands of work on intangibles, including the macro-economic, accountancy, business school, corporate, market institutions and policy maker perspectives.

- We will develop further what the evolution of the knowledge economy means for business and for the future development of the policy agenda.

# Introduction

The knowledge economy is a story of how new general purpose technologies have combined with intellectual and knowledge assets – the 'intangibles' of research, design, development, creativity, education, science, brand equity and human capital – to transform our economy.

It is a universal process, operating across all sectors of the economy – manufacturing and services, high tech and low tech, domestic and internationally traded, public and private, large corporation and small enterprise. In doing so, the traditional boundaries between sectors such as manufacturing and services are disappearing and previously unnoticed industries – such as the creative sector – have emerged as major employers, generators of value-added, and exporters.

The change to a knowledge economy is happening on a global scale – a transformation taking place in all advanced industrialised economies and to which many developing economies aspire. And as a result, global markets in ideas and knowledge are being created which offer a new comparative advantage for advanced economies like the UK facing the challenges of competition from low wage economies.

The scale of this change is often under-estimated. We are fast approaching the point where nearly half of our national income, half of our employment, and a quarter of our exports are generated by the knowledge based industries. The share of knowledge workers defined either by the top three occupational groups or graduate level education is growing rapidly.

Even less widely realised is that Britain is further down this track than many other advanced economies. Our industrial and employment structures are more knowledge intensive than in much of the rest of the OECD. And we are unique among the major economies in successfully specialising in trade in knowledge services.

Why is this happening and what are the key drivers? The fuel that has driven the knowledge economy of today rests on a profound structural shift in consumer, collective, and business demand towards high value added, knowledge intensive goods and services. Technological development has acted on both the demand and supply side, but has primarily been a supply side enabler. Globalisation has speeded up the process on both sides.

This all sounds too good to be true. Does the knowledge economy have a dark-side? Is it reinforcing economic and social divides between a new working elite of knowledge workers at

the top and those at the bottom? Has the relentless expansion of higher education created more knowledge workers than there are knowledge jobs, so we have an overqualified, underutilised and increasingly disillusioned workforce? Is the knowledge economy about to be swept away by a tidal wave of offshoring creating a high skills-low wage economy?

Our work to date is broadly reassuring on all of these concerns. But there is no room for complacency. For example, the growth of the knowledge economy over the past decade may not have made the divides in the labour market any worse but it has done nothing to improve them either. Nor is our international lead in knowledge services trade assured.

The economic, industrial and social landscape is changing, often in ways that are poorly understood and documented. Many of our statistics and frameworks are still based on a world of accounting conventions where the only thing that really matters is machines and physical infrastructure.

These tangible assets are still vitally important, of course. But to explain how and why firms and organisations in the knowledge economy work and succeed, we need to recognise the importance of knowledge based investment and the close relationships and complementarities between them and more traditional forms of capital. Successful companies invest in new technologies but invest even more in organisational capital to ensure that investment pays off.

Understanding the knowledge economy goes much wider than constructing a better set of national accounts.

A big gap in our understanding is also one of the most basic – who are knowledge workers and what do they do that distinguishes them from non-knowledge workers? None of the existing measures are satisfactory.

Our work has established that the knowledge economy has had remarkably little impact on the structure of employment. If new forms of labour market flexibilities and ways of working are emerging, we need to get into the workplace itself to map and understand them. We are conducting a major survey of workers to develop a robust definition of knowledge workers and knowledge work and shed more light on how firms organise and utilise knowledge workers.

We need to think through more than ever the role of knowledge institutions and the higher education sector as providers of human capital and drivers of innovation. Our project on the knowledge economy and the higher educations sector will report later in the year on the role of the higher education system in cities.

We need to establish the importance of place. Is the knowledge economy inevitably tied to big cities and the South East or does it offer the chance to address geographical divides? We are linking with our sister Work Foundation research programme on *Ideopolis* to address these issues in more detail.

As the programme has evolved we have gathered a solid body of evidence and started to answer some of the questions we started with. These are set out in the report below. But invariably new and complex questions have arisen. We will address these in our final year.

**The knowledge economy programme**

The Work Foundation's Knowledge Economy programme was established in December 2005 with the support from a mixture of major multi-national companies, Government Departments, and other public bodies. The three year programme is scheduled to end in April 2009. This interim report sets out the first eighteen months of The Work Foundation's Knowledge Economy Programme.

# 1. Drivers and definitions of the knowledge economy

Creating a knowledge economy is the stated ambition of economies as diverse as Uganda, Pakistan, Indonesia, and the Gulf States. Within the US every state and within the UK every region wants to transform itself into a knowledge based economy. The EU in 2001 in the Lisbon declaration set itself the ambition of making itself the most competitive knowledge economy in the world (although without saying what that was and how we would know if it had been achieved).

A plethora of articles, reports, speeches, and statements by policy makers, academics, think-thanks, business and across the media cite the knowledge economy.

The common factor across all these reports is the lack of definition and consistency. References to the knowledge economy range from a highly specific focus on innovation and science to investment in basic education systems to improve literacy and numeracy. Knowledge work similarly ranges from small groups of specialised IT and research jobs to almost the entire workforce with some form of recognisable skill or qualification.

In some ways the existing labels of knowledge economy and knowledge work are unhelpful, implying the knowledge economy is superior to the non-knowledge economy and that the latter therefore no longer matters; or that knowledge workers have a monopoly of skill, experience and knowledge about their job. Neither is true. As we show below, the knowledge economy describes a change in economic structures, and the way firms and people operate across all sectors potentially affecting a very wide range of occupations.

The lack of definition is not confined to more populist news stories. One recent study published in 2002 concluded:

> *the weakness or even complete absence of definition is actually pervasive in the literature... this is one of the many imprecisions that make the notion of the knowledge economy so rhetorical rather than useful'*[2]

Our first task under the programme was to start to develop more robust definitions to allow us to map how big the knowledge economy is, how fast it is growing and what the practical and policy implications for government, firms, society and individuals might be.

[2] Smith, Kevin, *What is the Knowledge Economy? Knowledge Intensity and Distributed Knowledge Bases*, Institute for New technologies Discussion Paper 2002/6, the UN University, June 2002

One of the central difficulties has been that the very concept of knowledge is difficult to pin down.

As one report concluded:

> *'the science of describing, understanding, and measuring knowledge will always be an imperfect one. The knowledge identified in this forum turned out to be capricious, sometimes sticky, often slippery, rarely tangible, frequently tacit and extremely heterogeneous'.*[3]

**Knowledge and information**

A further confusion is whether we are talking about information or knowledge. Indeed, the terms information society, information economy, or even information area have been used interchangeably with knowledge economy.

Information is an essential building-block for a knowledge based economy. The ability to generate, process and store huge flows of information at very low and sometimes negligible cost has been an essential prerequisite for the development of the modern knowledge economy. However, knowledge is required to transform that information into competitive advantage and organisational performance.

A key economic property frequently referred to in the literature is that knowledge does not diminish in value with repeated use a by a large number of actors, in contrast to physical resources. However, most information also shares this property.

What distinguishes knowledge from information is the way in which knowledge empowers actors with the capacity for intellectual or physical activity. Knowledge is a matter of cognitive capability. Information, by contrast, is passive and meaningless to those without suitable knowledge. Knowledge provides the means by which information is interpreted and brought to life.

A further distinction is between 'tacit' and 'codified' knowledge. The latter is written down in for example, in manuals, guides, instructions, statements and is easily reproduced. Tacit knowledge however resides with the individual in the form of expertise and experience that often cannot be written down and is expensive to transfer to others. In many respects, codified knowledge and information are indistinguishable. The significant difference is therefore between tacit knowledge and information.

[3] CERI, Washington Forum, June 1999

Some of the more useful general definitions of the knowledge economy from the DTI (as was) 1998 Competitiveness White Paper and more recently from the Economic and Social Research Council (ESRC) are summarised below.

**Definitions of the knowledge economy**

*'... one in which the generation and exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; it is also about the most effective use and exploitation of all types of knowledge in all manner of economic activity' .*
(DTI Competitiveness White Paper 1998)

*'economic success is increasingly based upon the effective utilisation of intangible assets such as knowledge, skills and innovative potential as the key resource for competitive advantage. The term "knowledge economy" is used to describe this emerging economic structure..*
(ESRC, 2005)

Distinctive features are the development of cheap, powerful and pervasive general purpose information and communication technologies coupled with mass education to graduate level and beyond and the emergence of mass consumer markets for high value added knowledge based services. In more prosaic terms, we can say the knowledge economy is based on the new general purpose technologies applied by well-educated 'knowledge workers' to create value within firms and organisations.

**Knowledge economy and the new economy**

Sceptics argue that economies have always been driven by innovation and knowledge and what we see today is not essentially different to past phases of technologically driven change. Others have argued that a 'new economy' was emerging that was fundamentally different from the past. One analysis suggested:

*'the possibility for economic growth which is potentially unbounded and of a nature that is different from that in sophisticated neo-classical growth or post neo-classical new endogenous growth theories'*[4].

However, in this report we argue that the truth lies somewhere between the hype of a 'new economy' and just more of the same economy. The emergence of the knowledge economy is not a sharp break from the past, but a sea change or as David and Foray described it a 'soft

[4] Quah, D *Growth and the Increasingly Weightless Economies*, Paper for DTI Conference, January 1999

discontinuity'.[5] The knowledge economy offers a new economy in the way defined by Sushil Wadhwani [6] :

> *'A New Economy is defined to be one where structural changes like a significant fall in the equilibrium rate of unemployment and/or a significant increase in the potential growth rate of the economy might have occurred'.*

**Key drivers of the knowledge economy**

We see the key drivers of the knowledge economy as market demand from consumers, new technologies and globalisation.

- *Consumer demand*: over the past forty years the composition of demand has shifted decisively towards consumption of services and especially services generated by the knowledge based industries.
- *Technology*: acts on both the demand and the supply side, but primarily as a supply side enabler. The internet and very powerful cheap computers have created the global information networks that make much of the knowledge economy possible and have found their way into most aspects of the production process, reducing transaction and investment costs substantially. New technologies have also allowed niche markets to be exploited.
- *Globalisation*: opening up of markets and the internationalisation of trade in knowledge sectors exposed to international competition; global labour markets for highly skilled workers, the provision of investment capital and access to new technology, information, ideas and knowledge flows from around the world have accelerated the transition to a knowledge economy.

The link between demand and the rise in the knowledge economy – and especially knowledge-based services takes place through three inter-related channels:

- Market or individual consumption: growing affluence and the nature of consumption among households and in particular the individual consumer.
- Collective consumption: the collective funding of public services such as health and education, supported by growing demand for such services across OECD economies[7].

[5] David and Foray, *Economic Fundamentals and the Knowledge Economy*, 2002
[6] Wahdwani S, *Do we Have a New Economy?* Bank of England Speech, September 2001
[7] OECD estimates suggest total spending on health (public and private) increased from just over 13 per cent of GDP in the US in 1995 to just over 15 per cent in 2004; Japan increased spending from just under 7 per cent to 8 per cent of GDP; France from just over 9 per cent to just over 10 per cent. The UK share increased from just over 7 per cent to just over 8 per cent of GDP

- Business demand: business to business services is a rapidly growing area; as noted above, the manufacturing industry is both an increasing consumer and provider of services.

The consumer market has become more powerful, more sophisticated and more diverse. A shift is occurring away from segmented markets determined by corporate strategies, towards more personalised markets more strongly influenced by consumers. The same trends are observable in the demand from citizens for public based services. The increase in affluence is underpinned by an increasing demand for novelty; not least in the application of new technologies to ever more sophisticated consumer products.

Some of the shift can be explained by a combination of falling prices and inelastic demand for household basics, so that as households have become wealthier, they have been able to shift an increasing share of their income to buying more sophisticated goods and services. This has been encouraged further over the past decade by the rapid fall in prices for some electronic goods, notably computers and some internationally traded services such as telecommunications. The latter would have been even more dramatic if quality improvements are taken into account.

The IFS estimates that between 1975 and 1999 the share of expenditure by households required meeting 'bread and butter' items declined from 40 per cent to 27 per cent of household non-housing spending. Meanwhile, overall household spending by volume in current prices on communication services has increased nine fold comparing 1971 and 2004 and nearly seven fold on recreation and culture. This compares with an overall increase of 2.5 times for spending on all items by households.

Some studies have identified the 'death of the middle' with consumers increasingly spending more at both the top and bottom ends of the market, but disproportionately at the top. One study suggested that consumers will spend up to 200 per cent more for what are described as new luxury goods or 'high quality, emotionally rich' goods[8]. Much of the hard evidence comes from the US where it is claimed the middle market for cars, televisions, and washers has all fallen. The same study suggests the high market was worth $600 billion, the middle market $1,500 billion and the low market $1,200 trillion. Both the top and bottom are expected to grow, with the top growing roughly twice as fast as the bottom.

[8] Silverstein and Butman, *Treasure Hunt: Inside the Mind of the New Consumer*, 2006

A related change has been the explosive growth in the diversity of goods and services. One US study[9] for example found that the number of packaged consumer goods had grown from less than 5,000 in 1980 to nearly 25,000 by the late 1990s. Similar trends were evident across a wide range of products and services from cars to magazine titles, to amusement parks to airports. Moreover, the average time taken to bring new products and services to market has fallen, so more choice is being delivered at an increasingly fast rate and the lifespan of existing products is shortening.

However, explaining why and how the nature of consumer demand has changed are less well charted, partly because consumer behaviour is difficult to unpack and involves abstract concepts that are often hard to quantify or address through conventional economic analysis and statistical measures.

Theoretical perspectives are offered by Maslow and Inglehart. Maslow[10] distinguished between individuals satisfying lower physiological and safety needs or material needs first, before moving on to higher cognitive, aesthetic and moral needs (described as self-actualisation needs). As societies and individuals become wealthier, individuals are able to divert a growing share of their income to higher needs once material needs have been satisfied. Ingelhart[11] links this shift to rising security and economic prosperity across the OECD and sees an accompanying move towards societies that are both more secular and place a higher value on material goods. Ingelhart suggests there is nothing new about quality of life concerns, but mass prosperity has allowed them to be expressed in practical terms through increased consumption.

A similar recurring theme is the importance of the expression of individualism. One argument is that people are more inclined to express themselves and establish their identity through personal consumption rather than through collective and social organisations. The explosive growth in the diversity of products and services available noted above and the speed of novelty is both a response and a driver. Professor Avner Offer[12] has argued that social conventions of self-restraint have been outpaced and undermined because technological advance and falling prices provide an unprecedented choice of goods and services that offer instant gratification.

**Knowledge and intellectual assets**

The shift from investment in physical assets towards intangibles as the basis of economic activity is central to the knowledge economy story. As firms and organisations rely increasingly on the exploitation of knowledge to secure competitive advantage and better performance, so

[9] Federal Reserve Bank of Dallas
[10] Abraham Maslow, *Motivation and Personality*, 1954
[11] Inglehart *The Silent Revolution in Europe American Political Science Review*, 1971; Modernisation and Postmodernisation, 1997
[12] Offer, 2006 *The Challenge of Affluence: Self-control and Well Being in the United States and Britain since 1950*

they invest more in knowledge based and intellectual assets – in R&D, software, design new process innovation and human and organisational capital.

Moreover, this change means that understanding the role of knowledge based assets in business and organisational performance is increasingly vital to understanding how modern economies work. Increasingly, the conventional measures based on the exploitation of physical assets are giving misleading signals about the size, speed, and scale of investment, productivity, and economic growth. Indeed, a key driver of the increasing focus on intangibles is because conventional accounting based measures of physical assets were having an increasingly difficult time in explaining both productivity and investment growth. This problem was recognised by the OECD a decade ago:

> *'In general, our understanding of what is happening in the knowledge-based economy is constrained by the extent and quality of the available knowledge-related indicators. Traditional national accounts frameworks are not offering convincing explanations of trends in economic growth, productivity and employment.'*[13]

Investment in intangibles is sometimes referred to as investment in knowledge assets. A recent paper by Australian academics Hunter, Webster and Hyatt defines intangible assets as follows:

> *'all forms of capital not embodied in matter, that is, all assets that do not have a tangible form. While it includes enterprise level intellectual capital and registered intellectual capital, it also embraces access to distribution networks and markets, systems to optimise the rate of innovation and structures and procedures that improve workplace and enterprise efficiency. As a subset, intellectual capital refers to the stored knowledge and cognitive abilities of the workforce. This includes investment in both the skills and knowledge of a firm's workforce and the invention and development of new products and processes*[14]*.'*

However, until recently measuring intangibles has proved frustrating. Most studies have looked at intangibles for which statistical time series exist, such as R&D, ICT related spending, and higher education. Others have simply assumed that the value of intangibles represents the difference between the book value of firms and their stock market value. Yet another approach has been to define certain occupations as being associated with the production of knowledge based assets and using the share of employment in those occupations as a proxy for the growth in intangibles.

[13] OECD (1996) *The Knowledge-Based Economy*. Paris
[14] Hunter, Webster and Wyatt (October 2005) Measuring Intangible Investment, Melbourne Institute Working Paper No 15/05

In 2005 economists at the US Federal Reserve published estimates of total business investment in a wide range of intangible assets based on measures of actual business spending. The intention was to try and answer the puzzle as to why US business investment was not increasing as a share of GDP despite highly favourable conditions – strong domestic demand, low inflation, high profitability.

They found a profound shift in business investment behaviour had taken place from the early 1980s onwards. US firms were investing heavily, but not in those assets such as machines and buildings that have been conventionally defined as investment. Firms were investing instead in knowledge based assets – R&D, software, design and development, brand equity,

The Fed's work has since been replicated in the UK by academics at Queen Mary College and the Office for National Statistics with the support of HMT and BERR[15]. They show exactly the same trend with exactly the same date for the change in business behaviour.

The latest results were published in a Treasury Economic Working Paper with the Autumn 2007 Pre Budget Report. The results showed that business investment in intangibles were worth about 40 per cent of business investment in tangibles in 1980, but by 2004 business investment in intangibles was worth over 120 per cent of business investment in tangibles.

Not all intangibles are excluded from the present national accounts definitions of investment – for example, investment in computerised information (software and databases) and spending on mineral exploration and copyright and licence fees are included. In 2004 these items constituted just over 20 per cent of spending on intangibles. However, this still leaves 80 per cent of spending on intangibles as defined by the Treasury not included as investment for national accounts purposes.

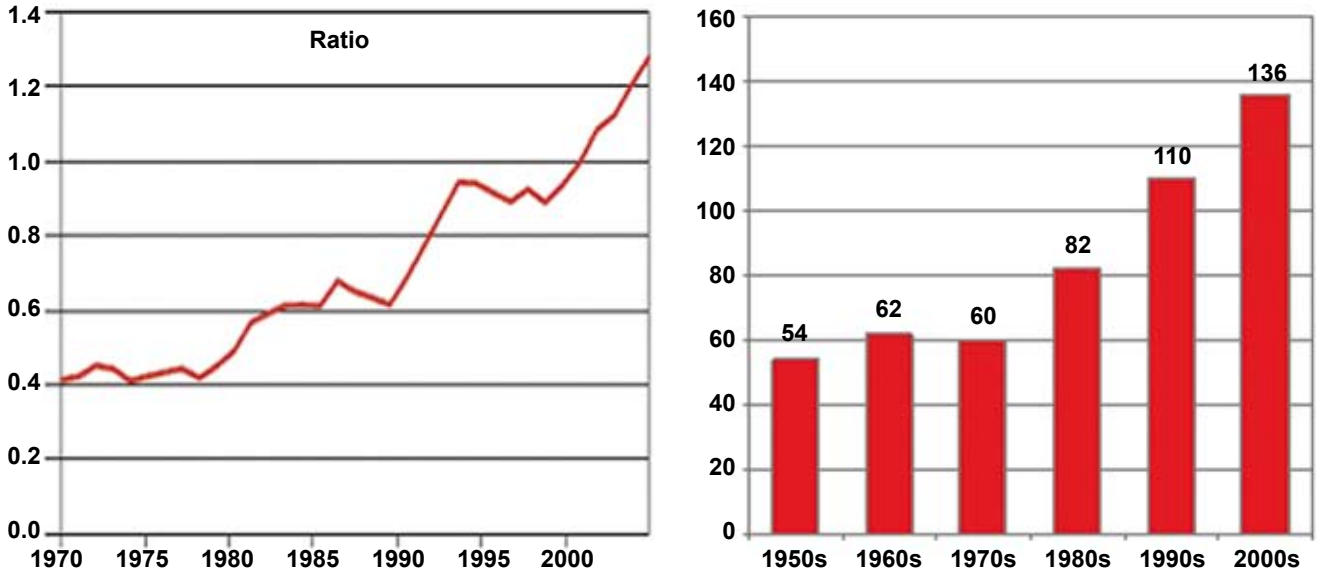
The chart on the next page summarises the US and UK results, showing the ratio between investment in intangibles and tangibles.

**Impact on growth, productivity and investment**

Both groups of researchers looked at what would happen to measures of economic growth and productivity if intangibles were factored back into the national accounts as investment rather than current spending. The results are broadly similar for both economies, so we concentrate on the UK. The results are expressed as a share of gross value added produced by the market sector or MGVA.

[15] Marrano and Haskell (2006) How much does the UK invest in Intangible Assets

**Figure 1: How business investment priorities change in a knowledge based economy**




*Source: HMT, 2007 and US Fed, 2006*

**Note:** Ratio between business investment in intangible and tangible assets for UK (left hand graph) and US (right hand graph). Tangibles are machines and building, intangibles are R&D, software, design and new product development, workshop skills, managerial competence and brand equity.

- Business investment has been increasing to stand at around 25 per cent of MGVA if intangibles are included, compared with a falling trend towards 12 per cent of MGVA if intangibles are excluded.
- The market sector of the economy is roughly 13 per cent bigger today measured by MGVA if intangibles are included.
- Productivity growth is faster, with no slowdown in productivity in the second half of the 1990s (although productivity still slows after 2000 regardless of whether intangibles are included or not);

As the Treasury conclude: *'The results suggest that traditional measures of investment may not be capturing the dynamic changes in the economy that are taking place as knowledge-intensive industries increase in importance'*.

The authors of the Federal Reserve research make a similar point:

> *'the fraction of output growth per hour attributable to the old 'bricks and mortar' forms of capital investment is very small, accounting for less that 8 percent of the total growth in the period While it is inappropriate to automatically attribute the other 92 percent to 'knowledge capital' or 'the knowledge economy,' it is equally inappropriate to ignore the association between innovation, human capital, and knowledge acquisition, on the one hand, and investments in intangibles, IT capital, labor quality change, and multifactor productivity, on the other'.*

**Measuring intangibles**

The authors of these studies would, however, be the first to admit that the measures require development. The Treasury paper estimated that about 60 per cent of the intangibles measured by value could be derived from official data or survey evidence, and 40 per cent were proxy measures where the researchers had had to make assumptions. The lack of time series data in some areas has also required assumptions to be made of past trends, taking into account changes in industrial structure.

In 2004 total business investment in intangibles was worth £130 billion. The biggest spending item was firm specific human capital (investment in workforce skills and managerial time spent on organisational change), totalling together nearly 40 per cent of total intangibles investment. This was – along with investment in computerised information – also one of the fastest growing.

Investment in firm specific human capital is made up of two components. One component – employer provided training – is supported by direct survey evidence, although time-series data is limited. The other – 'organisational capital' – is a more problematic measure of managerial investment in organisational change rather than the day to day running of the business. This is proxied by assuming executives spend a certain amount of time on these tasks, an estimate in turn derived from the US Fed estimates. It also includes spending on external management consultants.

The second largest item of spending is on software (computerised information) at £22 billion or 17 per cent of intangibles spending. This is relatively straight-forward as a measure and has recently been incorporated into the national accounts as investment.

Another more problematic measure is brand equity – a measure of the 'strategic value' of advertising expenditure. In the UK work this is proxied by the total spending on advertising (less expenditure on classified advertisements) and expenditure on market research. This accounts for about 15 per cent of total intangibles investment.

Interestingly, this is one of the few components of intangibles that have not grown as a share of market gross value added since 1970. This is surprising given the growth of the advertising industry and expansion of market research, the perceived importance of 'brands', and increased competition following market liberalisation.

Under the broad heading 'innovative property' the measure includes R&D spending by the OECD definition: this is well documented, and totalled about £12 billion in 2004. The intangibles measure introduces (in the Treasury paper) the concept of 'non-scientific R&D' which is significantly more at £22 billion. This includes measures of spending on new design in architecture and engineering, new product development in financial services, spending on social science research, and mineral exploration and copyright and licence fee costs.

The details of intangible investment as defined and measured in the Treasury paper are set out in the chart on the next page.

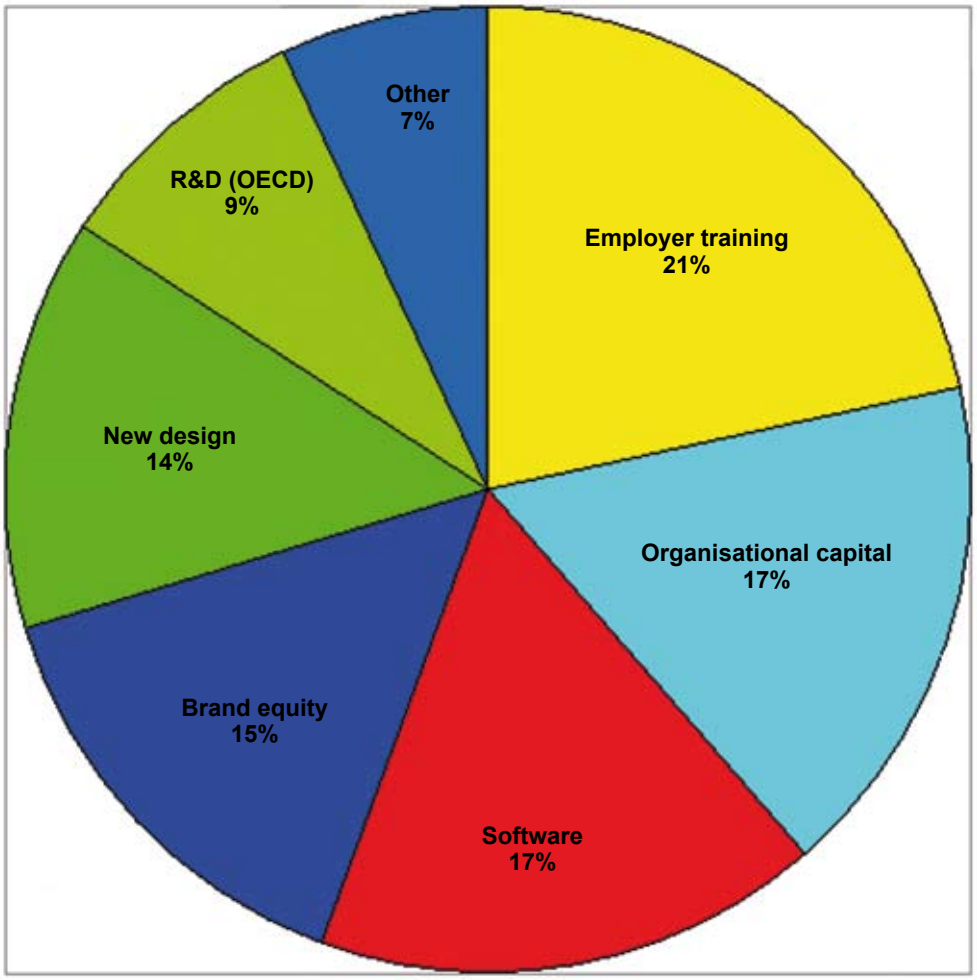
**Intangibles, firms and stock markets**

Non-financial indicators and framework can, in theory, play a useful role in helping firms and investors understand better the role and value of intangibles investment within the firm. It has been argued, for example, that markets under-value firms that invest in R&D and human capital.

However, according to the study by Hunter, Webster and Hyatt there has been little agreement on which indicators should be used, partly because there is little convergence on the questions they are trying to answer and many are highly industry specific so cannot be easily transferred. Often there is little direct linkage between the measures and justifiable business models. Moreover, causal relationships tend to be assumed rather than justified by evidence. The authors conclude:

> *'If our object is to measure investment and analyse value creation, these indicators are a superfluous step for they clearly neither reflect inputs into the intangible investment process or outputs. If they do not enable us to either know the quantum of returns to a given expenditure on resources or to comprehend why we achieved a certain profit result in a given period, then the cost of collecting them can hardly be justified'* (p21).

**Figure 2: Business investment in intangibles in 2004**




*Source: HMT, 2007*

Not surprisingly, given the measurement problems, the accountancy profession has been reluctant to suggest moving away from the standard presentation of company accounts and the current definitions of assets. There has been significant debate on how best to provide investors with information through other channels, notably through company reports, what sort of information should be provided and whether it should be a legal requirement.

There has also been a substantial increase in wider benchmark indicators by government Departments, notably the R&D and Value-Added Scoreboards produced by BERR (formerly

part of the DTI); and efforts at the European level through the EU funded MERITUM project to develop a common framework approach.

The net effect of all these efforts has been to improve the knowledge available to investors about intangibles. However as a series of seminars held at The Work Foundation and a review of the debate in The Work Foundation's Knowledge Economy paper *Intangibles and the Knowledge Economy*[16] have shown, we seem little closer to getting widespread agreement on the best way forward.

**Knowledge industries**

Both the OECD and Eurostat have developed definitions of technology and knowledge based industries. The current definitions include high to medium technology manufacturing industries, high tech services, business services, telecommunications, financial services, and health and education.

The two definitions are however not entirely consistent and measure different things. In addition to the sectors listed above, Eurostat also includes some international transport services and the recreational and cultural industries. Eurostat publishes only employment estimates; the OECD publishes only output estimates. At the time of writing, Eurostat figures were available up to 2005. The OECD estimates are for 2004 (market sector) and 2002 (whole economy).

These international industrial level definitions are the only source of official statistics on output and employment in the knowledge economy.

The selection of these industries is strongly influenced by investment and use of new technologies, in that they include the R&D intensive manufacturing sectors and the ICT intensive using industries. However the primary drawback of an industry based definition is that the shift to economic activity is taking place across all sectors of the economy. We can expect firms and organisations in all sectors to be investing more in intangibles and new technologies, including sectors such as retail and energy.

An OECD study of large global retail firms suggested that the key to their success was the combination of high performance workplace practice and the intelligent use of ICT.[17] Innovative firms in sectors classified as low tech are just as much part of the knowledge economy as the

[16] *What you see is not what you get: Intangibles in the knowledge economy*, Mahdon, Rudiger, Coats and Brinkley, WF 2007

[17] *Case Studies of Successful Companies in the Services Sector and Lessons for Public Policy,* STI Working Paper 2005/7, OECD

'knowledge industries'. A recent study[18] prepared for the EU Commission concluded that such firms were:

> *'intensive creators and users of practical knowledge and high grade design skills. They use engineering and scientific knowledge and are closely integrated with science and technology infrastructure. The mere fact that they do not do much internal R&D says nothing about knowledge intensity or their contribution to the knowledge economy.'*

The term 'knowledge industry' can confuse by implying that all the people who work in such sectors are knowledge workers. Knowledge based industries are graduate intensive and employ an above average share of people in the top three occupational categories. However, knowledge workers as conventionally defined, still constitute less than half the workforce in knowledge industries, on average, even among the more innovation intensive firms. Knowledge industries also employ many non-graduates and people in other occupational groups. The expansion of the knowledge industries is creating jobs throughout the skills chain and not just for those classified as knowledge workers.

**Knowledge trade**

As the knowledge economy expands, an increasing share of the UK's international trade is now accounted for by technology and knowledge based services. We report our initial findings later in this report.

There are no official definitions of trade in knowledge goods and services. The international trade statistics do not match exactly national account industrial definitions. However, there is a close enough match so that we can distinguish between knowledge and non-knowledge services using the knowledge industry definitions as a guide.

The OECD definition excludes transport services, Eurostat includes air and sea transport as a knowledge industry. We have followed the OECD definition and also the work of UK economists Bob Rowthorne and Ken Coutts and excluded international transport services.

We have also excluded construction services, postal services, and government services (primarily spending by embassies and military establishments). However, we include personal spending on education and health services (mainly fees paid by foreign students at UK educational institutions).

[18] Hirsch-Kriensen et al, EU PILOT project, *Low Tech Industries and the Knowledge Economy* August 2003

**Table 1: International knowledge industry definitions**

| OECD (output measure) | NACE | EU (employment measure) | NACE |
|---|---|---|---|
| **High tech manufacturing** | | **High tech manufacturing** | |
| Pharmaceuticals | 24.4 | Pharmaceuticals | 24.4 |
| Aerospace | 353 | Aerospace | 353 |
| Computers, office machinery | 30 | Computers, office machinery | 30 |
| Electronic communications | 32 | Electronic communications | 32 |
| Scientific instruments | 33 | Scientific instruments | 33 |
| | | | |
| **Medium-high tech manufacturing** | | **Medium-high tech manufacturing** | |
| Chemicals (less pharmaceuticals) | 29 | Chemicals (less pharmaceuticals) | 29 |
| Non-electrical machinery | 31 | Non-electrical machinery | 31 |
| Motors | 34 | Motors | 34 |
| Other transport equipment* | 35 | Other transport equipment | 35 |
| | | | |
| **Knowledge services** | | **Knowledge services*** | |
| Post and telecommunications | 64 | Post and telecommunications | 64 |
| Business services (ex real estate) | 71-74 | Business services (inc real estate) | 70-74 |
| Finance and insurance | 65-67 | Finance and insurance | 65-67 |
| Education | 80 | Education | 80 |
| Health | 85 | Health | 85 |
| | | Water and air transport | 61-62 |
| | | Recreational and cultural (less sport) | 92 |

*Source: OECD and Eurostat*

**Note:** *The EU Commission divides knowledge services into high tech services (information services, computer services, R&D services); market services (other business services, telecommunications, transport); financial services; and other services (health, education, recreational and cultural).

The international trade statistics in the Pink Book (and at EU level) identify recreational and cultural services as primarily trade in audio-visual industries. However the wider definition used by the DCMS for the cultural and creative industries as a whole record a much higher level of exports. A related potential problem is that while tourism is not classified as a knowledge industry by the DCMS, some EU definitions include what is called 'heritage tourism' as a cultural industry.

**Table 2: The Work Foundation definitions of knowledge service trade**
(National accounts, Pink Book categories)

| Knowledge based service exports | Other service exports |
|---|---|
| Other business services | Transport services |
| Legal and accountancy | Travel (business and tourist spending) |
| Consultancy | Construction services |
| Advertising | Post services |
| R&D services | Government services |
| Technical services | |
| Insurance and financial | |
| Royalties and fees | |
| Computer, information, telecommunications | |
| Education and heath spending by foreigners | |
| Creative and recreational* | |

*Source: Pink Book, The Work Foundation*

**Note:** * National account definition of sector, primarily trade in audio-visual services. The DCMS definition of the creative industries includes significant business service industries and some forms of publishing. telecommunications, transport); financial services; and other services (health, education, recreational and cultural).

**Knowledge work and knowledge workers**

There are no official definitions of either knowledge work or knowledge workers. The two most widely used proxies are the top three occupational groups (managers, professionals and associate professionals) or graduates and those with an equivalent educational qualification. However, many studies and surveys have used other definitions – ranging from most of the

workforce to narrow definitions of IT workers and R&D researchers – to some who offer no formal definition and treat 'knowledge work' as self-evident.

**Table 3: Definitions of knowledge workers**

| | |
|---|---|
| Top three groups in Standard Occupational Classification (managers, professionals and associate professionals and technicians) | Studies and surveys |
| Graduate or equivalent educational level | Studies and surveys |
| Occupations with expert thinking (researchers and other professionals) and complex communication skills (teachers, salespeople, some managers) | Academic US study<br>Adapted in some surveys |
| Direct producers of knowledge assets (teachers, trainers, sales and marketing, consultants, R&D workers, financial advisors, social scientists, actuaries, librarians); indirect producers (supervisors, natural scientists, social professionals, technicians, nurses) | Australian study of intangibles investment |

The occupational approach has the big advantage of being able to use readily available national statistics and allows comparisons with previous studies. There are also some comparable international statistics available for the EU, but these no not easily correspond to those used by the statistical authorities in the US. Indeed, the OECD does not publish occupational data for the 'managerial' occupational group because of differences in interpretation and classification.

The other approach taken has been to proxy knowledge workers as having at least a graduate level education. This is consistent with our broad definition of the knowledge economy as one based on graduate intensive employment. Investment in higher education is also one of the OECD's indicators of an economy's investment in knowledge assets. However, educational qualification is also open to the charge of arbitrariness and the possibly unjustified assumption that graduate level education automatically means that all individuals will undertake 'knowledge work'.

The Australian study cited above offers a variant of the occupation based approach for classifying the workforce by the degree of their involvement in producing intangible assets. This is a potentially interesting approach. However, there will inevitably be a degree of arbitrary selection in which occupations are assumed to be central to intangible assets, especially as the latter are not always well documented. For example, social scientists are classified as directly producing knowledge assets and natural scientists as indirectly supporting knowledge assets.

The occupational and qualification based approaches both show that the share of knowledge workers in the economy is growing, but there is little consistency between the two measures. Significant numbers of people in the top three groups are not graduates, while graduate employment in occupations not traditionally associated with educational qualifications at this level is growing. Overall, there is at least a ten percentage point gap between the two measures – in 2006 the occupational measures suggested 42 per cent of the workforce were knowledge workers while the qualification measure suggested 31 per cent were knowledge workers.

Our initial work confirmed that the occupational definition is unsatisfactory, particularly around the managerial occupation classification. The managerial definition includes many who would not reasonably be regarded as knowledge workers such as managers of small shops and hospitality outlets. As a result, sectors such as retail and hospitality appear to have unexpectedly high shares of knowledge workers.

Although we have had to use graduate or occupational proxies in this report for lack of anything better, we clearly need a better understanding of the limitation of the data so we can interpret and qualify our analysis. We have started work on a large scale survey of the UK workforce derived from the more sophisticated approach that has been adopted by US economists Autor, Levy and Murname[19] who analysed US labour force data using five categories determined by the nature of tasks performed and the degree to which computers could substitute for people. The categories included:

- Expert thinking: solving problems for which rules do not exist, computers assist by providing information: examples include researchers and other professionals;
- Complex communication: interacting with other people to acquire or convey information and persuade others – examples include teachers, salespeople, some managers;
- Routine cognitive: mental tasks closely prescribed by rules such as routine processing and verification and vulnerable to substitution by computers;
- Routine manual: physical tasks closely prescribed by rules such as assembly line and packaging work, can be substituted for by computers and mechanisation in some circumstances;
- Non-routine manual tasks: physical tasks hard to define by rules requiring optical or fine muscle control such as truck-driving or cleaning and unlikely to be replaced or assisted by computers.

[19] Autor, Levy and Murane, 2003. *The Skill Content of Recent Technology Change*. Quarterly Journal of Economics

The first two categories – expert thinking and complex communication – can be regarded as 'knowledge workers'. The authors applied these descriptions to the detailed occupational codes in the US equivalent of the Labour Force Survey and found that the knowledge worker category increased significantly over the period 1969 to 1998 whereas the share of all other categories decreased. The main disadvantage of the Autor et al study is that it is not easy to update without a significant investment in time and effort to undertake the complex re-coding of the occupational categories, and hence it is not readily comparable with other studies and surveys.

The Economist Intelligence Unit (EIU)[20] used a similar approach in a survey of top managers and CEOs asking them to identify which skill sets would be most valuable in terms of competitive advantage in the year 2020. The categories resemble those used by Autor et al in that they distinguish between complex knowledge based roles requiring complex communication and judgemental skills, simple knowledge based skills that do not require such skills, and production roles. However they are further broken down into 'inward facing' and 'outward facing'.

**Measuring innovation**

Innovation surveys carried out by the DTI and the EU are helpful in trying to answer some of these wider questions. A substantial body of research is building up and will expand further as subsequent surveys extend the ability to look at time series data. Research is also increasingly focused on the service sector with the encouragement of the DTI.

In principle, another way to measure the knowledge economy would be to look at the share of GDP or employment accounted for by firms who generate innovations. The DTI's latest summary[21] of the evidence from the UK Innovation Survey groups innovation processes under four headings:

- Product innovation – bringing to the market or into use by business, new and improved products, including both tangible goods and the provision of services. The degree of innovativeness is shown by the distinction between products new just to the business or which are also new to the market.
- Process innovation – significant changes in the way that goods or services are produced or provided, again differentiating between processes new to the business only or also new to the industry.

[20] Foresight 2020, Economist Intelligence Unit 2006
[21] *Innovation in the UK: Indicators and Insights*, DTI Occasional Paper No 6, July 2006

- Categories of investment such as R&D, capital goods and software acquisition, design activity, for implementing current innovations or directed to future product or process changes.
- Management related types that have sometimes been referred to as soft or wider innovation, such as strategic changes to the organisation of business or its functions, in order to achieve gains in competitiveness through efficiency or service improvements.

Within the DTI survey an innovating business is defined as one that meets at least one of three key criteria: has introduced a new or significantly improved product or process; set up innovation projects either uncompleted or abandoned; spending on R&D, training, external knowledge, or machinery or equipment linked to innovation activity.

We might adopt a simple definition that a typical knowledge economy firm is an active innovator using the DTI survey criteria. The UK Innovation Survey covering 2002 to 2004 implies that 57 per cent of enterprises in the UK are part of the (private sector) knowledge economy. The same survey in 2001 showed that 43 per cent of businesses were classified as active innovators.

This implies a very rapid growth in innovative activity over a short time period – and raises the question of what is being measured. Moreover, because they are not weighted by employment or turnover, the published survey results do not allow us to say what share of national income or employment these figures represent and hence we cannot quantify the significance of the change.

The UK survey is especially valuable in widening the scope of innovation to include what is termed ‘wider’ innovation in intangible areas such as corporate strategy, advanced management techniques, marketing and organisational change.

Innovation surveys by non-government organisations vary considerably in terms of their methodology and focus, and either are ‘one-offs’ or have a relatively short time series. IBM’s ‘Global Innovation Survey’ for example provides a summary of the views of just under 250 of what the survey calls ‘thought leaders’, a mix of global companies, trade associations, government agencies and departments, and other organisations. The Booz, Allen, Hamilton ‘Global Innovation 1000’ is one example of a one-off analysis of the top 1,000 publicly listed companies by R&D spend. The survey found no correlation between R&D spend and company performance over a six year period, a surprising finding and contradicted by the DTI’s own analysis of company accounts in the R&D Scorecard.

**Summary points**

The knowledge economy is driven by the demand for higher value added goods and services created by more sophisticated, more discerning, and better educated consumers and businesses. Technological development has primarily been a supply side enabler. Globalisation acts as an accelerator that has speeded up the process on both sides. The defining features of a knowledge economy include:

- A fundamental shift in investment priorities towards the creation and exploitation of knowledge and other intangible assets such as R&D, software, design, development, human and organisational capital as the basis of competitive advantage;
- These processes operate across all industries and all forms of economic activity – high and low tech, manufacturing and services, public and private, small and large.
- Cheap, powerful and pervasive general purpose information and communication technologies coupled with mass education to graduate level and beyond.

For this report we use the following definitions:

*Knowledge industries* are defined by the OECD/Eurostat as high to medium tech manufacturing, high tech services, business services, financial services, health and education services (OECD) plus cultural and recreational services and international transport services (Eurostat).

*Knowledge workers* are defined by proxy measures as either the top three standard statistical occupational codes (managers, professionals, associate professionals and technical) or graduate or higher levels of education.

*Knowledge assets* or intangibles are defined as investment in R&D, software, design and development, exploration, copyright, brand equity, human and organisational capital.

*Knowledge services trade* is defined as trade in business, financial, high tech, and telecommunication services, royalties and licence fees, education and medical services, and cultural services.

However, there are very few statistics that directly measure the knowledge economy and those that do are produced by international organisations. The ONS should give greater priority to developing further robust statistical measures of knowledge work, knowledge industries, knowledge trade and investment in knowledge based assets.

In this section we look at three questions:

- How many people work in the knowledge economy and how far are they driving a shift towards new forms of flexibility?
- Is the labour market becoming more polarised with more good 'knowledge' jobs at the top and more low paid work at the bottom with less in between?
- Are we producing too many knowledge workers for the economy to absorb efficiently?

**Employment in knowledge industries**

We undertook an analysis comparing 1995 and 2005. Change in the labour market has been driven by three related factors:

- The increased demand for knowledge workers across most sectors and the expansion of the knowledge based industries at a faster rate than in the rest of the economy.
- Technology driven change, creating and enhancing some jobs and removing others such as routine manual and non-manual jobs.
- Structural change with the contraction of manufacturing employment and the increase in services.

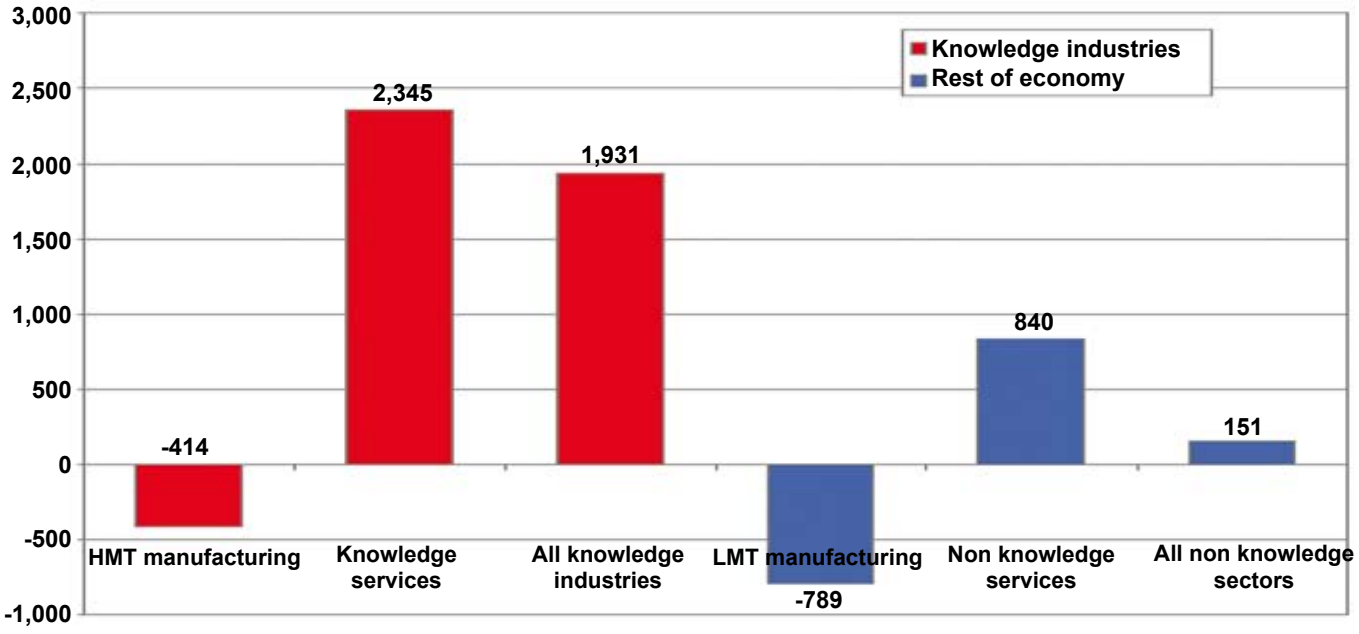
Overall, the knowledge based industries increased employment by just under two million between 1995 and 2005, an increase of 17 per cent. The biggest increase in percentage terms was in high tech services, up 40 per cent, followed by health, education and recreational services with growth of 27 per cent and business and communication services with growth of 24 per cent. However, financial services saw very little net job growth in this period. High tech manufacturing shed substantial numbers of jobs, so that employment fell by 21 per cent.

**How many knowledge workers?**

With no standard definitions of knowledge workers, estimates of knowledge workers in the economy have varied widely. In this report we have used the two most common proxies: the top three standard occupational groups (managers, professionals, associate professionals) or all those with graduate level education.

The two measures give somewhat different estimates of the number of knowledge workers in the UK. In 2006, for example, just over 40 per cent of the workforce was in the top three occupational groups and just over 30 per cent had been educated to graduate level. Over the

**Figure 3: Most new jobs in knowledge industry services - the change in total employment 1995-2005**




*Source: European Labour Force Survey*

**Note: HMT** is high to medium tech manufacturing, **LMT** is low to medium tech manufacturing. **Non knowledge economy** total includes agriculture, energy and water and construction.

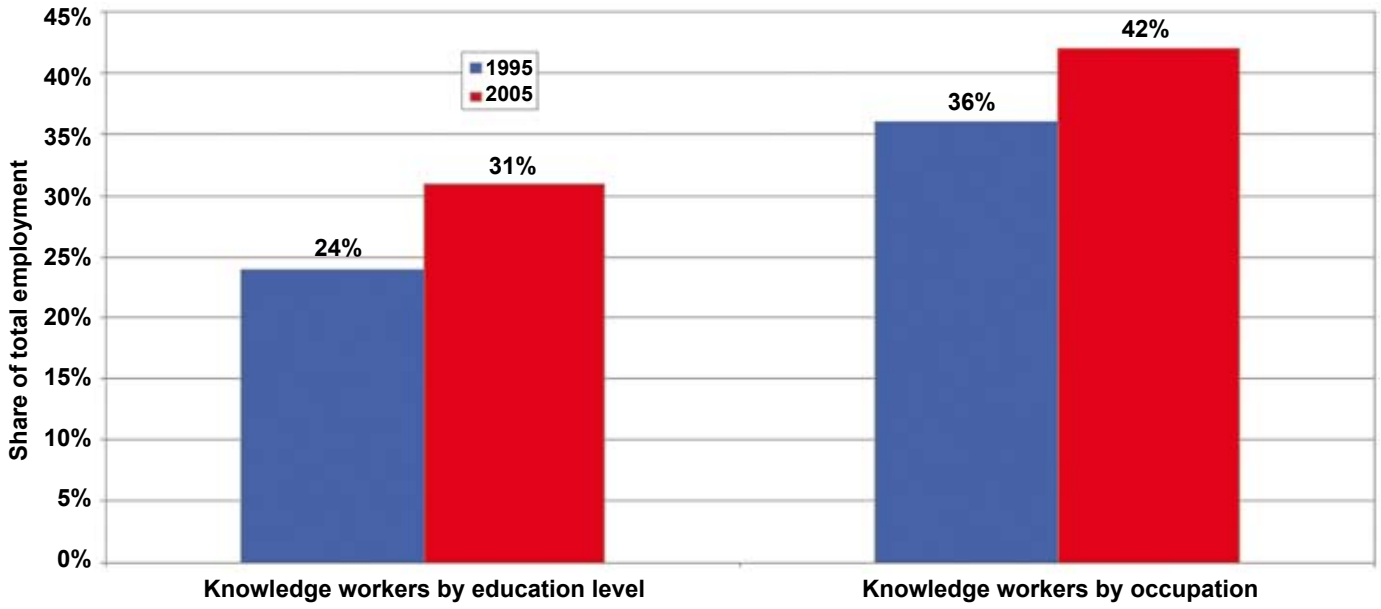
past decade both groups have grown, with expansion in the top three occupational groups providing most net new jobs in the UK.[22]

The growth in knowledge workers by occupation has been occurring for at least twenty five years. The SSDA Working Futures report estimated that between 1984 and 2004 the share of employment in the top three occupational groups went up from 31 per cent to 41 per cent. By 2014 the share is forecast to increase to 45 per cent, but on current trends this figure is likely to be exceeded.

In absolute terms, the number of knowledge workers classified by occupation increased from just under 7.9 million in 1984 to 12.5 million in 2004, with forecast growth to 14.2 million by

[22] Net expansion in employment occurs when job openings exceed job losses. However, significant job openings are created across all occupational groups as people retire or move to different occupations. This replacement demand is often on a significantly bigger scale than the demand generated by the net expansions in employment

**Figure 4: How many knowledge workers in the UK?**




*Source: Work Foundation estimates from the Labour Force Survey*

**Note:** Education is degree or higher; occupation is managers, professionals and associate jobs.

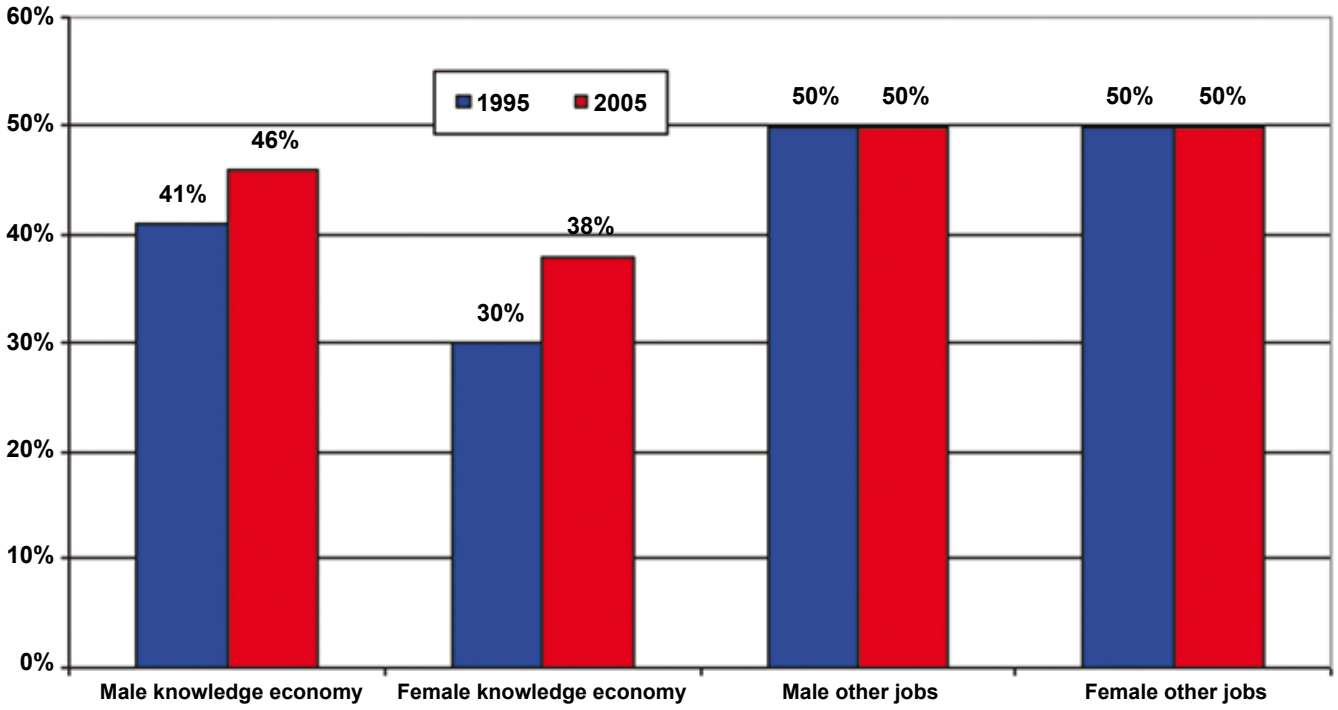
2014. Other non-manual occupational groups also increased – notably personal services (including care services) and sales and customer services. However, manual employment for both skilled and semi-skilled occupations and among the less skilled declined.

The fastest growth in knowledge work has been among better educated women. Indeed, the modest increase in the share of female employment in the workforce is entirely driven by increased employment of women in knowledge economy jobs. Knowledge work is still male dominated compared with the rest of workforce, but the balance is gradually changing.

**Knowledge work and employment flexibility**

The growth of knowledge work has in turn been linked to more wide ranging changes in the nature of employment – from the disappearance of traditional managers and work hierarchies, to the growth of new flexible work forms as knowledge workers reject conventional long term relationships with one employer. Knowledge workers, it is argued, have more bargaining power

**Figure 5: Women drive knowledge work expansion 1995-2005**



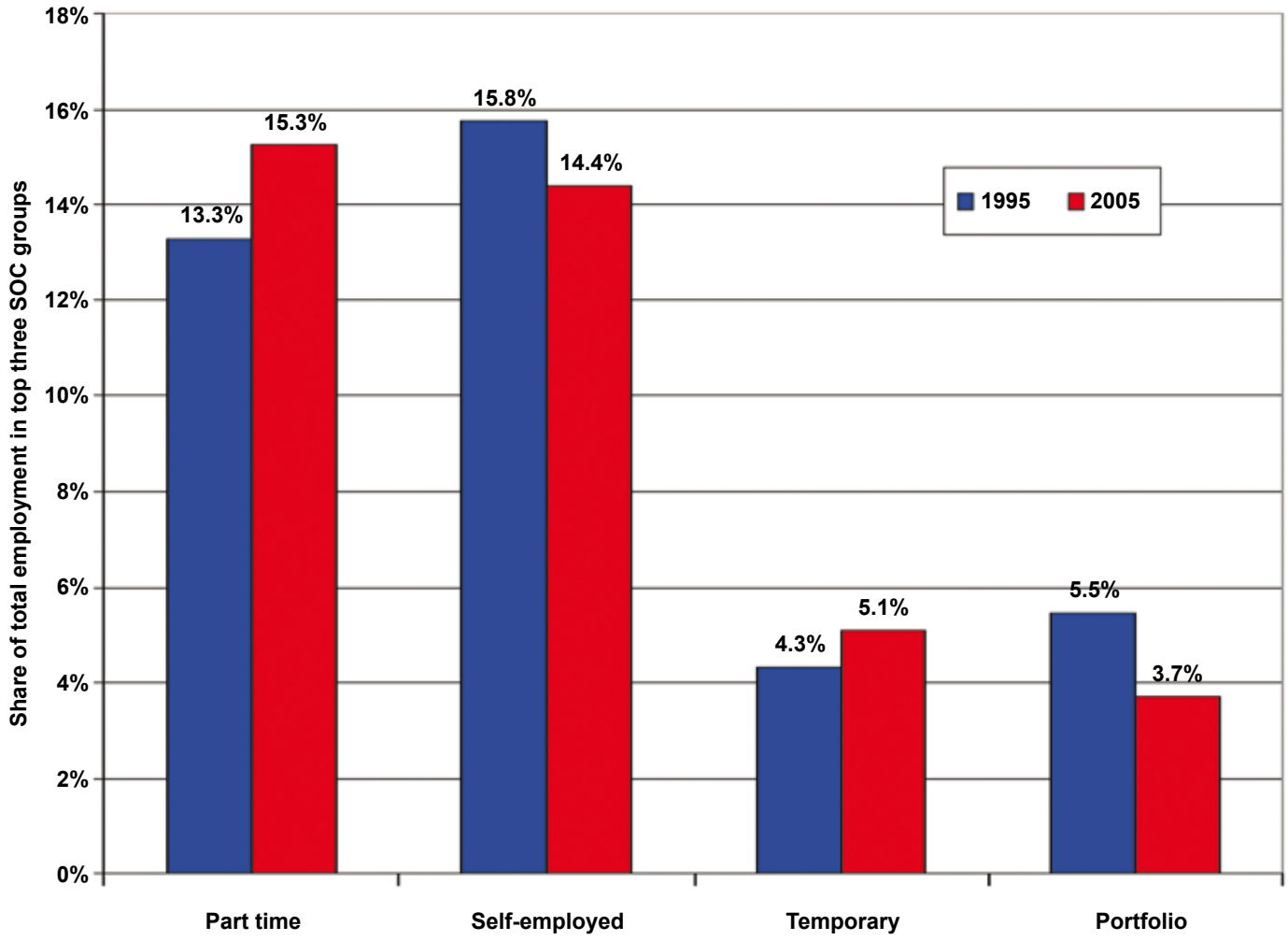

*Source: Labour Force Survey, Work Foundation estimates*

**Note:** All figures total employment, UK share in each category. Knowledge work defined as top three occupational categories.

in the labour market and therefore may be more inclined to embrace what the former Prime Minister recently described as 'empowered flexibility'.

There is little sign that knowledge workers – defined by the top three occupational groups – are becoming more flexible other than through conventional and familiar forms. We found no association between the growth of knowledge work and newer forms of work flexibility such as portfolio working (more than one job). Knowledge workers were much more likely to have flexible work arrangements than non-knowledge workers. But apart from flexitime, it was more striking how uncommon formalised flexible working arrangements – such as job-share – were among both knowledge workers and non-knowledge workers alike.

**Figure 6: Knowledge workers and 'flexible' employment forms**




*Source: European Labour Force Survey*

**Note:** Portfolio working all with second job.

Knowledge workers are increasingly turning to more conventional flexible work arrangements such as part time work. Over this period, the total number of knowledge workers in part time work went up by 50 per cent. However, the impact on the share of knowledge workers in part time jobs was modest – in 2005 just over 15 per cent of knowledge workers worked part time compared with 13 per cent in 1995. Knowledge work is still far more likely to be full time than

non-knowledge work – in 2005 just under one third of non-knowledge workers were in part time employment.

The incidence of self-employment is higher among knowledge workers than non-knowledge workers but has fallen for both groups. Just over 16 per cent of knowledge workers were self-employed in 1995 but by 2005 this had fallen to just over 14 per cent. There has been some increase in temporary working, but the vast majority of knowledge workers are permanent employees. Portfolio working or having more than one job – once suggested as the way forward for knowledge work – has declined from just over 5 per cent to just over 3 per cent of knowledge workers.

We could find no evidence that knowledge workers – on average – are more inclined to job hop, strike out on their own, or are less likely to be in long tenure jobs. Knowledge workers on average have longer job tenures than non-knowledge workers and average tenures have not fallen significantly over the past decade.

Just over 37 per cent of knowledge workers had been with their current employer for at least ten years, while 22 per cent had been with their current employer for less than two years. Both shares were much the same in 1995. There has been movement in middle tenure employment, with a fall in the share of knowledge workers who had been with their current employer for between five and ten years and an increase in employer tenures of between two and five years. These changes are most likely because of strong job creation in these occupations over the past decade – by definition, such jobs will not be long tenure.

The same pattern was true for non-knowledge workers. Non–knowledge workers have on average shorter tenures with their current employers than knowledge workers, so that 27 per cent had been with the current employer for at least ten years and 33 per cent had been with their current employer for less than two years. However, these shares have also not changed greatly since 1995.

The question asked in the Labour Force Survey refers to time with current employer rather than current job. So this question will not tell us whether knowledge workers are becoming more mobile within firms and organisations, either through choice or changes in employer internal practices or both. The results are also an average – there may well be sub-sets of knowledge

workers who move very frequently between employers, especially in their younger years. But they are not typical of the knowledge workforce as a whole.

**Table 4: Employer tenure for knowledge workers 1995-2005**

| With current employer | 1995 | 2005 | Change |
|---|---|---|---|
| **Under 2 years** | 22.0% | 22.7% | +0.7 |
| **2 to 5 years** | 18.5% | 21.3% | +2.8 |
| **5 to 10 years** | 22.0% | 18.9% | - 3.1 |
| **10 to 20 years** | 22.4% | 21.9% | - 0.5 |
| **More than 20 years** | 15.1% | 15.2% | +0.1 |

*Source: Labour Force Survey*

**Note:** Knowledge workers are top three occupational groups.

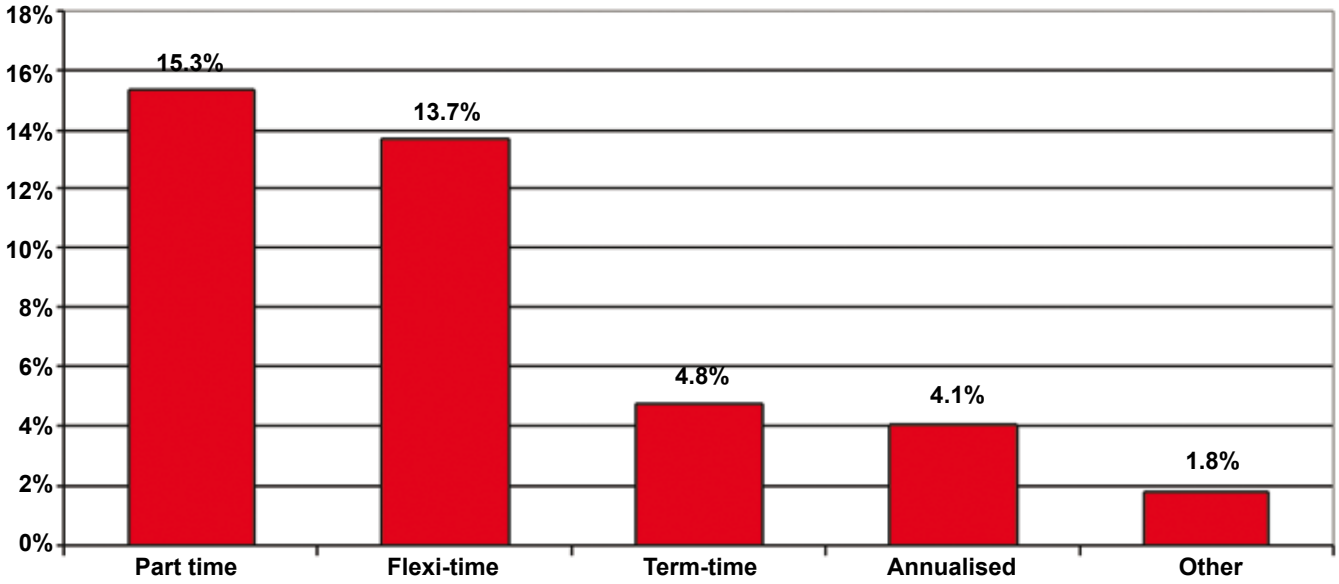
## Knowledge workers and flexible hours

All forms of work involve trade-offs between more and less positive aspects and one potential perceived trade-off for knowledge workers has been long and unsocial hours and job interest and pay. In 2005 about 21 per cent of knowledge workers said they usually worked at least 48 hours a week. This compares with just 11 per cent of non-knowledge workers.

However, there has been a marked decline in the incidence in long hour working over the past decade for both knowledge workers and non-knowledge workers. Among knowledge workers the fall in the share was from 27 per cent usually working 48 hours or more a week in 1995 to 21 per cent in 1995. Some of this decline can be attributed to the growing popularity for part time work among knowledge workers.

Knowledge workers are also more likely to take advantage of flexible hours arrangements. About 35 per cent said they had some form of hours flexibility compared with 19 per cent of non-knowledge workers. The most popular were also the most familiar – flexi-time working, term-time working and annualised hours. Other forms of hours flexibility such as job share, nine day fortnights, 4.5 day weeks, and zero hours contracts were rare and together totalled less than 2 per cent of knowledge workers.

**Figure 7: Knowledge workers and formal flexible hours arrangements**




*Source: Labour Force Survey*

**Note:** Formal working arrangements, categories can overlap. Other includes job-share, 9 day fortnights, 4.5 day weeks and zero hours contracts.

However, even among knowledge workers only 14 per cent said they had flexi-hours (the most common formal arrangement) and 76 per cent said they had no formal hours flexibility. For non-knowledge workers the shares were even lower – only 9 per cent had flexi-time arrangements and 81 per cent said they had none.

However, work flexibility may be more widely available than these responses indicate. The Labour Force Survey questions ask about whether people were working flexible hours at the time of the survey, rather than availability of flexible working arrangements in the workplace. Moreover, the categories refer to formal flexible work arrangements. We would expect knowledge workers to make extensive use of informal flexibilities. According to the latest European Working Conditions Survey, over 75 per cent of knowledge workers said they had autonomy over methods, the speed and task order in their job.

**The knowledge economy and the 'hourglass' labour market**

The expansion of the knowledge economy has given rise to concerns that the labour market was polarising, with more relatively good jobs at the top, more bad jobs at the bottom, and a contraction of jobs in the middle. Research has shown this was indeed part of the labour market story in the 1980s. Our first report on the knowledge economy and the labour market looked at whether wage polarisation had continued to grow[23].

We looked at changes in the distribution of wages between 1995 and 2005 and found:

- Overall, the share of workers in better paying and poor paying jobs remained stable between 1995 and 2005, except at the very top (an increase in the share of jobs paying 200 per cent or more of the median wage).
- There is some polarisation for men, with some increase in jobs paying 80 per cent or less than the median and some increase in very well paid jobs at the top. However, even for men the share of very low paying jobs – 60 per cent or less than the median – fell.
- There is no evidence of polarisation for women, with the share of low paying jobs falling and the share of better paying jobs increasing as women move up the jobs ladder.

Overall the picture is one of stability with relatively little change except at the extremes of the labour market with fewer very badly paid jobs and more very well paid jobs. The worsening inequality in the labour market charted in the 1980s has not reversed but nor has it got significantly worse over the past decade.

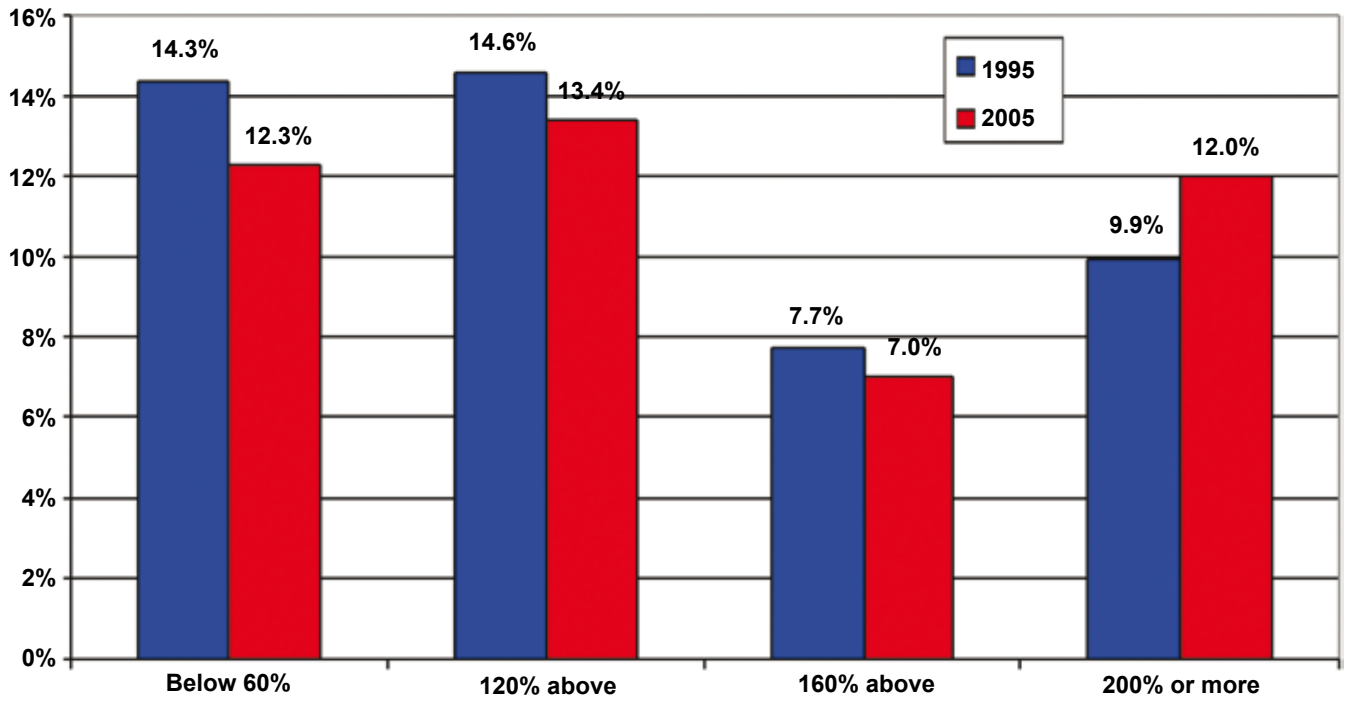
The increased polarisation observed in previous periods has been attributed to technological change and possibly competition from low wage manufacturing. However, the pace of both has increased over the past decade, so either they were not the key drivers or other factors have intervened to offset their impact.

We suggest three reasons why the growth of the knowledge economy has not been associated with growing wage inequality over the past decade.

- The National Minimum Wage has increased the relative wages of the very low paid, in contrast to the period before when the relative wages of the low paid were falling.

[23] Fauth B. and Brinkley I., *Labour market Polarisation and Labour Market Efficiency*, The Work Foundation, 2006

**Figure 8: Share of jobs by wage levels 1995-2005**




*Source: Labour Force Survey, Work Foundation estimate*

- The knowledge industries have provided more non-manual 'middle wage jobs' to replace those lost in the skilled trades in sectors such as manufacturing.

- The nature of employment has changed, with more jobs further down the jobs ladder such as admin and secretarial occupations involving the complex communication skills identified by Autor et al. More basic processing clerical jobs are still being computerised, but this is offset by the growth of jobs that computers assist and enhance rather than destroy.

**Do we have too many knowledge workers?**

One concern is that the big expansion in knowledge workers over the past decade (proxied by graduates) has overrun demand. Graduates are therefore increasingly being forced into non-graduate jobs and in turn forcing non-graduates into less attractive jobs. We might expect this to be associated both with falling wage premia for graduates compared with non-graduates and worsening labour market outcomes for some non-graduates as their employment opportunities contract.

Graduate employment is certainly increasing in jobs traditionally not associated with graduates. In administrative and clerical jobs for example the number of graduates employed has risen sharply over the past decade, up from 300,000 in 1995 to over 420,000 in 2005, an increase of over 40 per cent. Graduate employment in personal services has increased even more dramatically – nearly three fold from around 40,000 in 1995 to over 150,000 in 2005.

However, not all 'non graduate' occupations have seen significant increases while employment of graduates in some of the top three occupational groups has also increased rapidly. For example, graduate employment in managerial positions has increased from 33 per cent of all managerial jobs in 1995 to 43 per cent in 2005. As a result, the share of graduates in knowledge based and non-knowledge based occupations has changed little over the past decade. In 2005 about 85 per cent of graduates were employed in knowledge jobs, a share virtually the same as in 1995.

Our analysis does not support the over-supply hypothesis. There is little evidence that aggregate wages for graduates have fallen significantly compared with non –graduates. We found no change in the shares of less well paid jobs or well paid jobs occupied by female graduates between 1995 and 2005. We found some increase in the share of less well paid jobs occupied by male graduates around or just under the median, but this was offset by an increase in male graduates in very well paid jobs (200 per cent or above the median).

We could also find no conclusive evidence that labour market outcomes worsened significantly for non-graduates over the period 1995 to 2005. If graduates were displacing non-graduates from jobs, we might expect non-graduates to experience a relative increase in unemployment or lower employment compared with graduates.

The relative employment rate between graduates and non-graduates remained unchanged (the share of the working age population in work). The relative unemployment rate measured by the ILO definition improved (ie the gap between graduates and non-graduates narrowed). However, inactivity rates worsened (the share of the working age population not in work or unemployed by ILO definitions).

What these figures confirm however is the large gap between graduates and non-graduates on these key measures of labour market outcomes using international definitions of unemployment,

**Table 5: Labour market outcomes for graduates and non-graduates 1995-2005**

| | 1995 | | | 2005 | | |
|---|---|---|---|---|---|---|
| | **Degree** | **Non-degree** | **Difference** | **Degree** | **Non-degree** | **Difference** |
| **Employed** | 85.6% | 68.2% | -17.4 | 87.5% | 70.0% | -17.5 |
| **Unemployed** | 3.7% | 7.2% | - 3.5 | 2.3% | 4.6% | - 2.3 |
| **Inactive** | 10.7% | 24.6% | -13.9 | 10.2% | 25.4% | -15.2 |

*Source: Labour Force Survey*

in work and inactivity. In 2005 nearly 88 per cent of graduates of working age were in work compared with only 68 per cent of non-graduates, just under 4 per cent of graduates were unemployed compared with over 7 per cent of non-graduates, and while 11 per cent of graduates were classified as economically inactive (not in work or unemployed) over 25 per cent of non- graduates were inactive.

So while the growth of the knowledge economy over this period is not associated with worsening labour market outcomes for non-graduates, neither is it helping narrow labour market divides despite improving qualification levels among the non–graduate population.

It is possible that we are seeking greater polarisation within the graduate workforce between, for example, different degree courses (arts versus science) different degree levels (post graduate versus graduate) or different institutions (old versus new universities). So graduates with post graduate degrees in subjects in short supply from more prestigious universities will have seen an increase in wage premia and some other graduates may have seen a fall in wage premia. If this were true we might expect to see greater polarisation in wages within the graduate workforce.

Looking just at degree holders, our findings mirror those for the workforce as a whole: overall, there is little significant change in the shares of graduates in better paid and worse paid jobs, but with some polarisation for male degree holders (more in both bad paying and well paying jobs) and none for women. These results might change in the future because so far only a relatively small share of graduates have moved into traditionally non-graduate jobs, the impacts might not be showing up at the aggregate level.

**The geographic distribution of knowledge work**

The Work Foundation's *Ideopolis* research has found that places with a higher proportion of employment in knowledge intensive industries and/or a higher proportion of knowledge workers qualified to level 4 and above are more productive.

Yet there is a divide across the UK between those places that are adapting to the wider economic shifts described in this report, and thriving, and those places that are being left behind. A significant part of this is due to the differences between different places' knowledge economies. Partly this is because some types of knowledge-intensive employment are more productive than others. Places with a higher proportion of private sector knowledge-intensive sectors are more productive than places dominated by public sector knowledge-intensive sectors measured by conventional economic indicators such as GVA per head.

As part of the *Ideopolis* programme[24], we have mapped public and private knowledge-intensive sectors across the UK. There is a significant divide in the location of these different types of sectors and it is one that correlates closely with conventional measures of productivity. London and the South East are the clear home for most private sector knowledge-intensive industries, and areas with a high share of employment in private sector knowledge industries tend to be highly productive measured by GVA per head. The North and Wales are much more likely to have knowledge economies dominated by the public sector, and tend to be less productive.

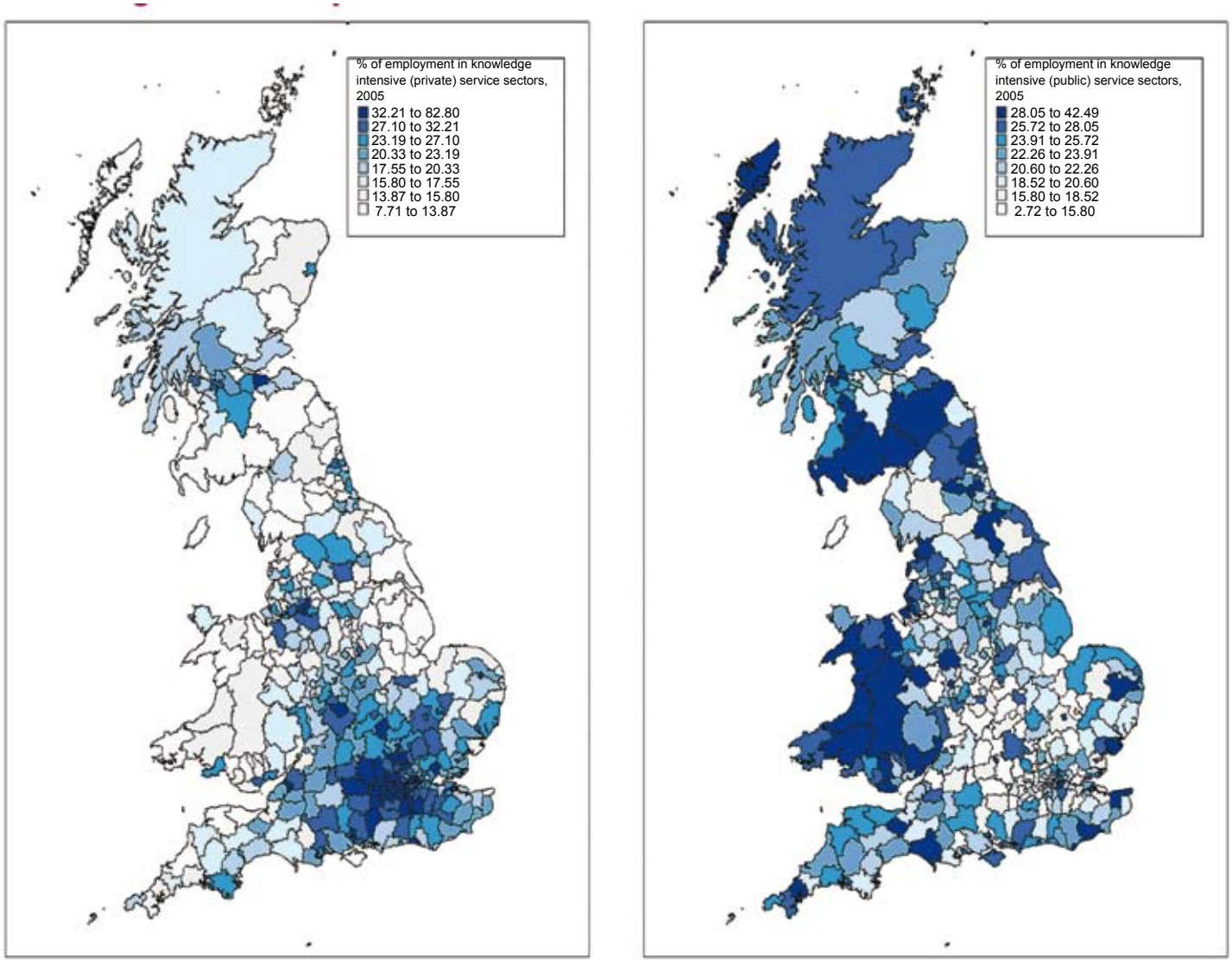
This is shown in the two charts on the next page plotting employment density by industrial sector. The public based industries for the purposes of this analysis include public administration as well as the two knowledge industry sectors of education and public health in order to give an overview of the public sector as a whole.

This is not a simple North/South knowledge economy divide. Whilst the south east continues to lead the way in terms of knowledge-intensive employment and productivity, our work shows that the divide between the 'knowledge-haves' and the 'knowledge-have-nots' is more complex than this, with cities like Leeds and Manchester starting to buck this trend and grow their private sector knowledge-intensive economies.

Nor is it just about a simple divide between a 'good' private sector and a 'bad' public sector knowledge economy. Places like Cambridge, York and Oxford are all dominated by public sector knowledge intensive employment (mainly higher education) and yet score highly in terms of GVA. The public sector can also contribute to the generation of spin-off knowledge-intensive

[24] Clayton, N. *The Public Sector in the Knowledge Economy*, January 2008

**Figure 9: Different places, different challenges: Public versus private sector knowledge economy**




*Source: Labour Force Survey, Work Foundation estimate*

companies, as in Cambridge's Silicon Fen. Furthermore, the clusters research and science parks affiliated to higher education institutions create high-value employment, for example Sheffield City-Region's environmental technologies sector, building on university research, grew by nearly 50 per cent between 1998 and 2005.

Cities are at different stages of adaptation to the knowledge economy and their economic history will continue to influence the conditions for future success. Cities with different histories and different economic structures are facing contrasting challenges in adapting to the changing economy. This is true even if they sit side by side in the North of England. Recognising that Hastings' knowledge economy has more in common with that of Hull than with that of Southampton; but that both might learn more from Sheffield's growth over the past ten years than from Manchester, which faces very different issues and is some way ahead, would be an important step forward in the mind sets of policy makers and city leaders grappling with economic strategies. So too would be recognition that growing the knowledge industries in cities that are currently dominated by the public sector requires different interventions to those places that have historically had high levels of private sector investment and industry.

- Knowledge based industries and knowledge related occupations have provided most of the new jobs in the UK over the past decade.

- Greater labour market polarisation in the UK associated with the 'hourglass economy'– more good knowledge economy jobs at the top, more bad poorly paid jobs at the bottom and fewer in the middle – has halted over the past decade.

- The knowledge economy has been broadly good for women's employment. Much of the expansion in the knowledge workforce has come from women graduates. There was some polarisation between well paid and badly paid jobs for men and male graduates but we found none for women and female graduates.

- We are not producing too many graduates for the economy to absorb – the gaps in wages and employment prospects between graduates and non-graduates have remained stable.

- The growth of knowledge work is not associated with new forms of flexible employment: knowledge workers are just as likely to be in long term secure jobs as they were ten years ago.

- Underperforming regions and localities in both the North and the South will need to draw on their public sector knowledge base as part of a wider strategy to encourage private sector development.

**Globalisation and the knowledge economy**

We see globalisation acting on the knowledge economy in at least three ways.

Firstly, the expansion of global markets for technology based goods and knowledge services provide economies of scale and helps drive their expansion within OECD economies. The Internet has allowed the opening up of niche markets that would not have been economically viable at the national level. These trends are not confined to the OECD. The World Bank has forecast the emergence of what it terms a 'global middle class' within the developing world, numbering perhaps 1.2 billion by 2030. This large group will *'participate actively in the global marketplace, demand world-class products and aspire to international standards of education'* according to the Bank[25].

Secondly, globalisation encourages and speeds up the pace of innovation. Many knowledge-based industries – especially in areas such as manufacturing, telecommunications, finance, and energy supply – are heavily exposed to international competition. Across all sectors, innovation depends critically on the ability of firms and organisations in the knowledge economy to exploit the constant flow of ideas, innovations and technologies through global networks. There is a broad trend towards the internationalisation of R&D across the OECD. There has also been a rapid growth in recent years in the international trade in R&D services, with the UK again emerging as a major net exporter.

Thirdly, globalisation has helped remove (or at least alleviate) supply side constraints in capital and labour markets. Firms can access world markets via the City and other financial institutions for investment capital in fast growing sectors, helped by the development of specialist listings for high tech firms. Most foreign direct investment (which includes takeovers as well as investment in physical assets) is centred on the knowledge economy. Inward investment has become an increasingly important vehicle for technology transfer, innovation and the funding of R&D in several economies, notably the UK.

Global labour markets for knowledge workers have also become increasingly important, in both specialist areas such as IT services and in research but also finance, health and education. Many multinationals are adopting global strategies to manage the demand and supply of high skilled labour. This, in turn, will influence the location of future investment[26]. Educational institutions in many OECD economies are competing to attract foreign students.

[25] *Global Economic Prospects 2007*, World Bank 2007

[26] A global survey of executives and senior managers by the Economist Intelligence Unit in 2004 found human capital considerations featured strongly among supply side factors assessed as critical in influencing R&D location, such as the availability of both R&D scientists and local managers with the required expertise and the overall cost of R&D labour (*Scattering the Seeds of Innovation*, EIU 2004)

The shift towards the knowledge economy is a global phenomenon. All OECD economies are seeing more of their economic activity accounted for by knowledge based industries, measured as both a share of GDP and as a share of employment. In all economies for which we have comparative data the knowledge industries are big generators of new jobs. The share of knowledge workers in the workforce is rising, whether measured by occupation or by educational attainment. World trade in knowledge based services is growing rapidly supported by increasing flows of Foreign Direct Investment (FDI).

**Economic activity across the OECD becoming increasingly knowledge based**

According to the OECD, the share of GDP accounted for by the knowledge based industries accounted for about 41 per cent of UK GDP in 2002. The UK ranked third among the major G7 economies, just behind the US and Germany[27]. The UK also ranked third out of the G7 when the OECD separated out market services by excluding education and health.

The main reason for the higher share in Germany and the US is their bigger technology intensive manufacturing base (defined by the OECD as high to medium tech). This also accounts for Ireland's outlier position as the most knowledge intensive industrial structure in the OECD. The UK's relatively high position primarily reflects offsetting strengths in market services.

What is striking is that some economies assumed to be high innovation and/or high investors in human capital do not have an exceptionally high share of knowledge based industries. The Nordics, Netherlands and Japan for example all have smaller shares of GDP produced by market based knowledge industries than Germany, the US, France or the UK. Even when education and health services are added back in, only Sweden overtakes the UK and France. The share of knowledge industries is not always a reliable guide to knowledge intensity, reinforcing the point that industry based definitions only capture part of the knowledge economy.

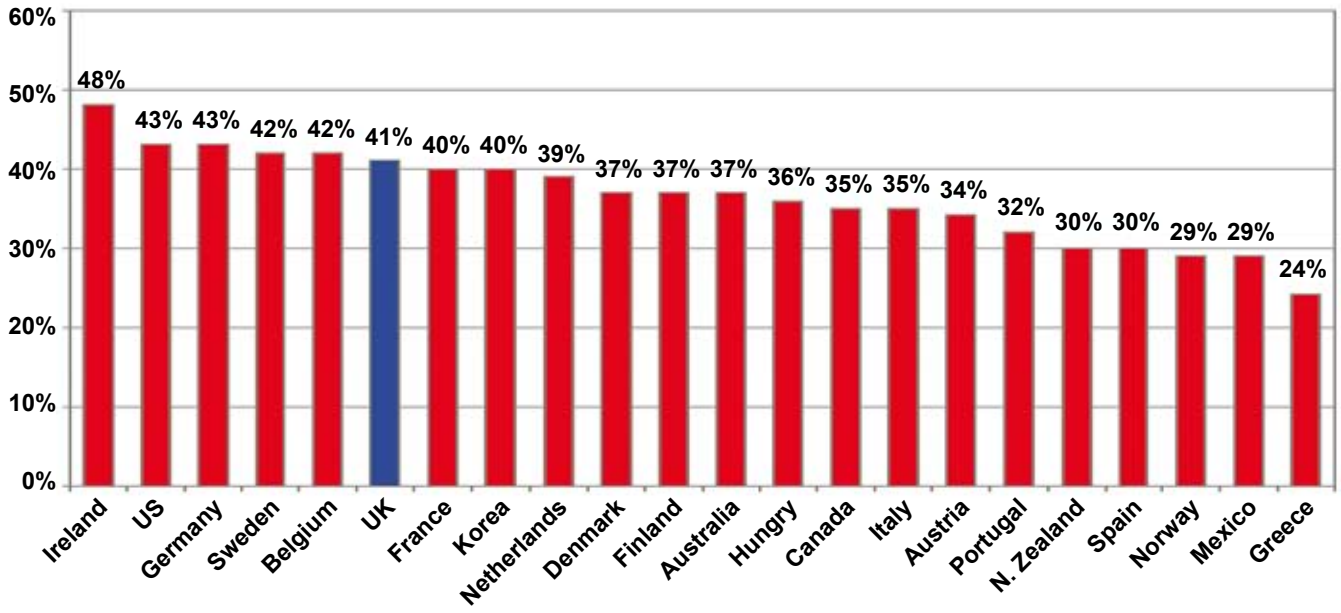
**Knowledge based industries are major job generators across the OECD**

More up to date figures on employment in the knowledge based industries from Eurostat show that the UK ranked third out of the EU15 in 2005, with 48 per cent of total employment, just behind Sweden and Denmark. This compares with a EU15 average of 41 per cent.

The UK had one of the highest shares of employment in market services – as defined by Eurostat – alongside the Netherlands and also an above average share of employment in education, health, and recreational and cultural services. This more than offset the lower than average share of employment in high to medium technology manufacturing.

[27] There is no comparable figure for the share of total knowledge industry in GDP for Japan, but it is likely to be less than in the UK

**Figure 10: Share of national income from knowledge based industries across the OECD in 2002**



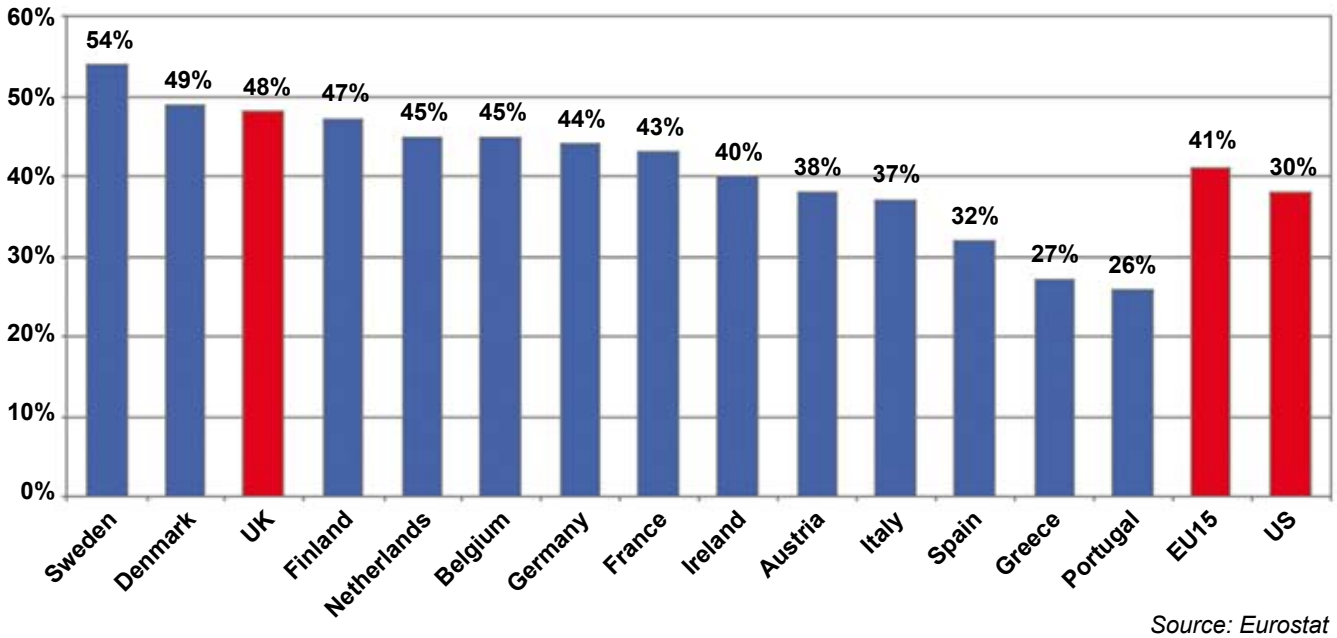

*Source: OECD*

**Note**: Share of knowledge based industries in gross value added (current OECD definition: high to medium tech manufacturing; financial services; telecommunications; business services; education and health services).

Across all EU15 economies the knowledge intensive industries have been major creators of new jobs. For the EU15 as a whole, employment in the knowledge based industries went up by 24 per cent compared with 6 per cent in the rest of the economy. In the UK, the contrast was even more marked, with a 17 per cent expansion in the knowledge based industries compared with 1 per cent in the rest of the economy. Outside the knowledge industries, jobs were also being created in significant numbers in services such as retail and hospitality, but were being offset by job losses in low tech manufacturing, agriculture, and energy and water.

There are no directly comparable figures for non-EU economies, but we have applied the Eurostat definitions to US Bureau of Labor Statistics industry level employment data to get an approximate match. These suggest that in terms of employment, the US has a similar sized knowledge economy to the EU15 and that it has grown at a similar rate over the past decade.

**Figure 11: Employment in knowledge based industries in 2005**



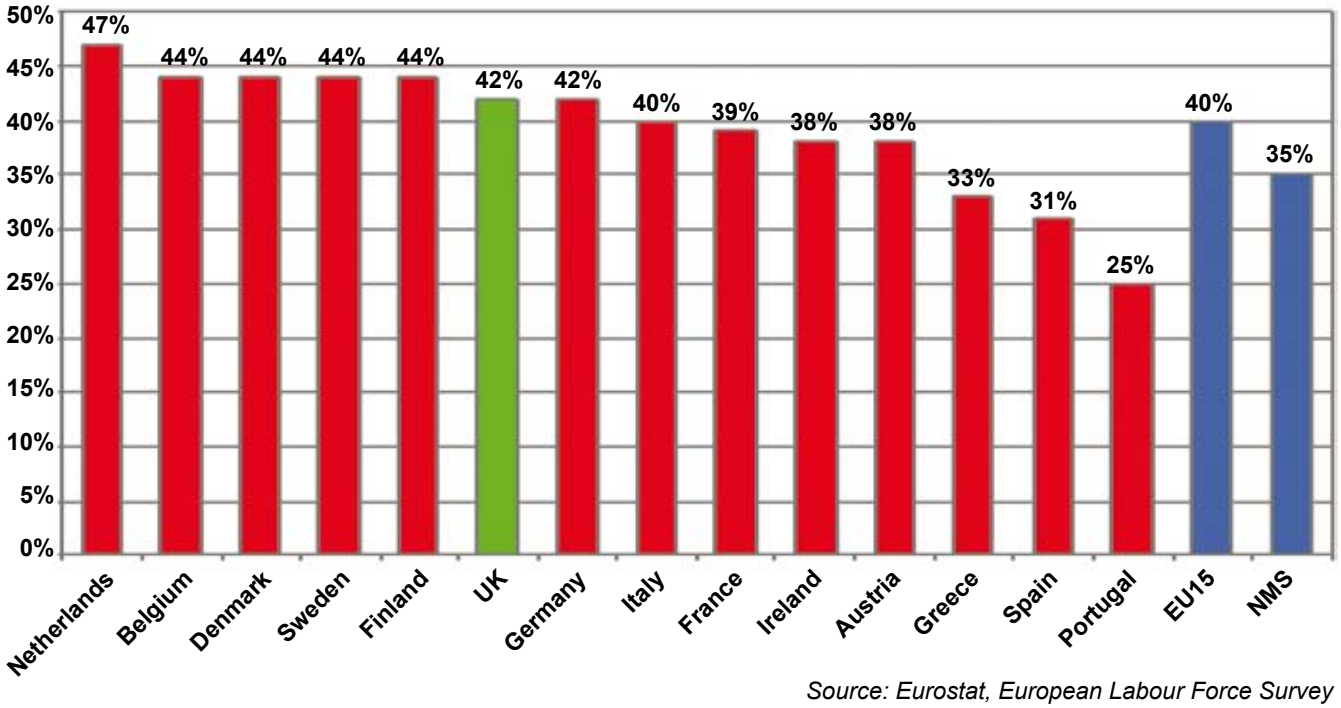

*Source: Eurostat*

**Note**: EU15 is share of total employment using Eurostat definitions (high to medium tech manufacturing, finance, business services, communications, health, education, cultural services, air and sea travel). US estimates is Work Foundation estimate for share of employees derived from US Bureau of Labor Statistics for similar industries and is not directly comparable.

These comparisons measure employment in knowledge industries, rather than employment in knowledge jobs, across all sectors. As reported above, there are severe difficulties in readily obtaining comparable figures across the OECD for knowledge workers as defined by occupation. ILO estimates show that in 2004 the UK ranked in the middle of those economies – 11th out of 25 - for which figures are available. However, there are no comparable figures for either the US or Japan.

More up to date figures from the EU show that the UK's knowledge workers as a share of total employment (42 per cent) is somewhat higher than the EU15 average (40 per cent). The UK share is similar to Germany, and slightly higher than Italy and France, but lags the Nordics (44 per cent) and the Netherlands (47 per cent).

**Figure 12: Knowledge workers across the European Union in 2006**




*Source: Eurostat, European Labour Force Survey*

**Note:** Share of knowledge workers defined by occupation (managers, professionals, associate professionals) in total employment; NMS = New Member States

However, there are significant differences between EU countries in the categories of knowledge worker. The UK and Ireland have very high proportions of managers compared with the rest of the EU. Managers account for 36 per cent of all knowledge workers in the UK compared with 23 per cent across the EU15, 21 per cent in France, 13 per cent in Germany, and 12 per cent in Sweden.

We cannot tell from the statistics whether the extent of knowledge working is consequently overstated in the UK (for example, relatively low paid, low skill jobs being described as managers) or that respondents in the UK are more likely to describe their job as managerial rather than, say, professional or technical. Institutional and structural differences will also play a role – for example, Germany's strong vocational training system and large manufacturing sector may account for the much higher proportion of technical related occupations in the German labour market compared with the UK.

**Trading in ideas and knowledge**

Globalisation has been one of the key underlying drivers of the knowledge economy. Global markets have opened up for knowledge services in response to strong and consistent demand for knowledge based assets primarily from business and other sectors across the OECD. Most traded knowledge services are business to business and the ability to successfully enter these markets depends on the ability of firms and other organisations to exploit their domestic and overseas science, technology, education, and cultural and creative bases[28].

Over the past decade the UK has excelled in doing exactly that through an almost unique restructuring of the trading base towards knowledge based services[29]. The UK is the only major economy where the value of trade in services has grown faster than trade in goods over the past fifteen years.

As a result, nearly a quarter of UK exports now consist of knowledge based service exports compared with 15 per cent in the US and less than 10 per cent in Germany, France and Italy. The UK has proved highly competitive – in 2004 the UK had a surplus worth 3.4 per cent of GDP compared with about 0.5 per cent for the US, balance for Germany and France, and deficits for Japan and Italy.

This change has taken place through three inter-related channels:

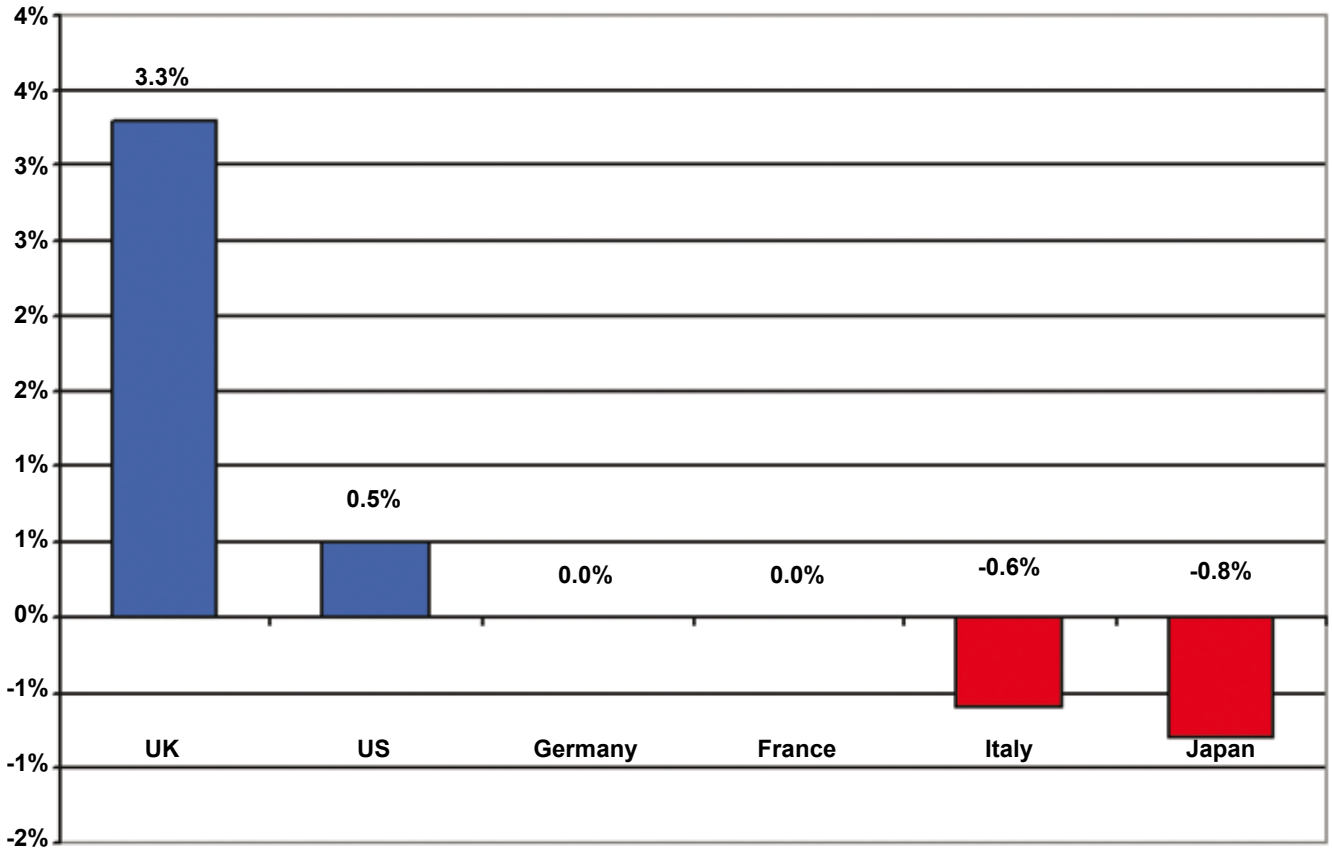
- The shift in the balance of trade by value towards knowledge services;
- The shift in manufacturing trade towards high tech exports;
- The manufacturing base becoming a major producer of traded services.

Trade in knowledge services has increased faster than trade in more traditional areas such as transport and tourism. This has been pushed by the switch in business investment towards knowledge based assets, technological developments, especially the Internet, allowing new markets to develop; and the growth of richer and more sophisticated consumers demanding higher value added services including the output of the creative and cultural industries.

In 2005 the UK exported about £75 billion worth of knowledge service exports, and imported just under £40 billion. Although often seen as just the City, over 60 per cent of knowledge service exports come from non-financial industries including business services, communication services, trade in intellectual property, and creative and cultural services.

[28] The evidence summarised in this section is set out more fully in Brinkley, *Trading in Knowledge and Ideas*, The Work Foundation Knowledge Economy Working Paper June 2007
[29] Rowthorne and Coutts, *The UK in the World Economy*, 2005

**Figure 13: Trade balances on knowledge services in 2005**

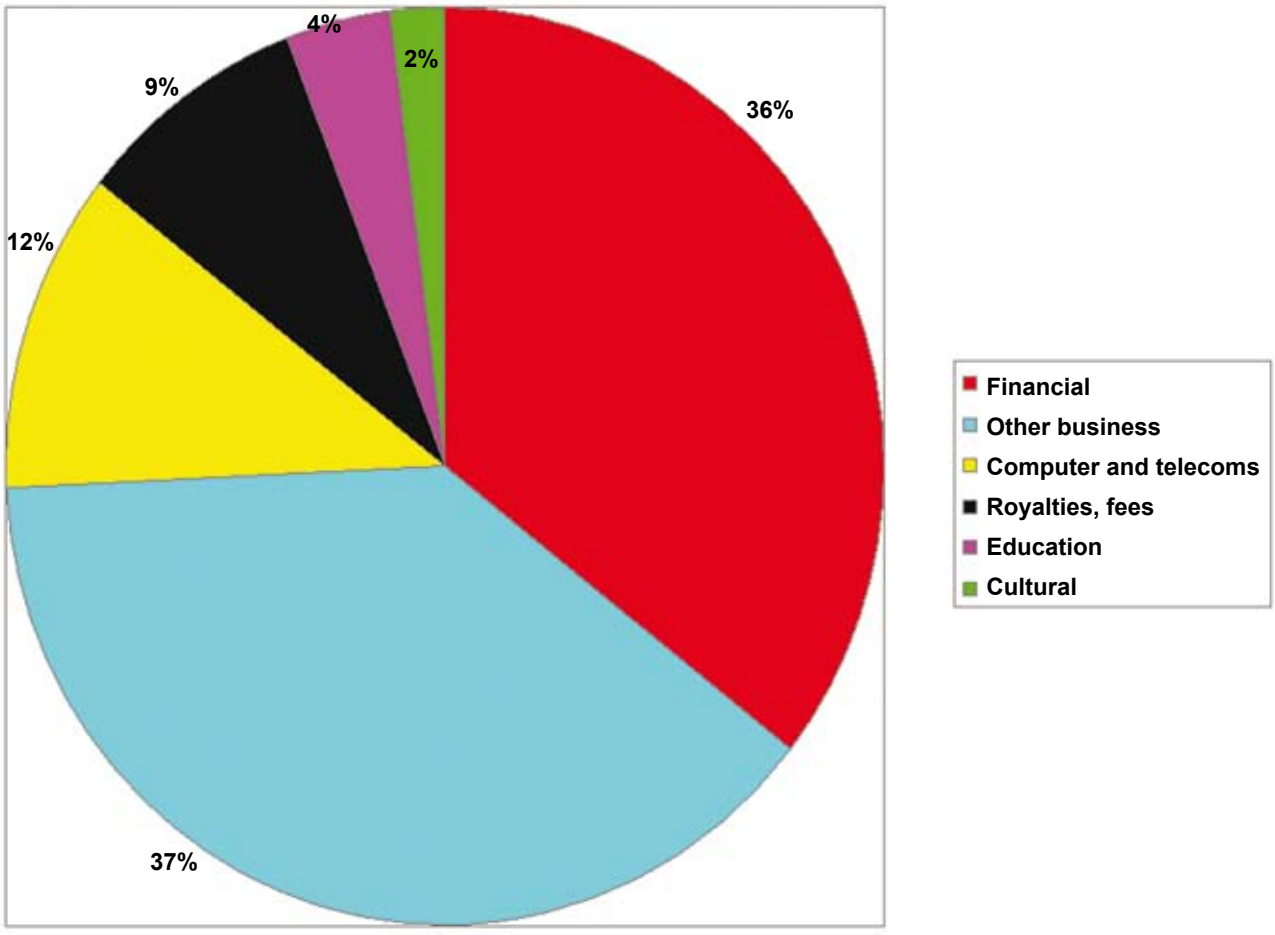



*Source: Eurostat/OECD*

**Note:** Knowledge services are business, communication, computer and information and cultural services. Japan is 2004. Figures exclude educational services.

The UK's strong position in knowledge based service trade comes from the consolidation of existing strengths such as the City and technical service. There has also been very rapid growth in what have been virtually new markets in areas such as computer and information services and R&D services. The UK has also been well placed to take advantage of rising demand for cultural services. The ability to exploit the science, technology and education base has been especially important: in 2005 trade in R&D services, royalties and fees, copyright creativity, and education fees from foreign students provided £16 billion in exports.

**Figure 14: Knowledge service exports in 2006**




*Source: Pink Book, 2007*

**Note:** Share of total knowledge service exports

**The creative and cultural industries**

The standard statistical break-down in the official statistics only captures part of the importance of the creative and cultural sectors to the economy as defined by the DCMS. The Work Foundation report to government on the Creative Economy[30] showed that, according to the OECD and UNESCO, the UK's creative industries account for nearly twice as large a share of GDP as in the US or France and the UK is one of the world's biggest exporters of cultural services. Exports of the creative and cultural industries in 2004 were worth £13 billion according to the DCMS.

[30] *Staying Ahead*, The Work Foundation, 2007

**High tech manufacturing**

Globalisation is forcing manufacturing to restructure, with lower shares of trade in some low tech manufacturing sectors and higher shares in the high to medium tech industries that constitute the knowledge economy manufacturing sectors. The UK has moved further and faster in this direction than most other EU economies. The share of manufacturing exports accounted for by high tech industries in the UK is now similar to that in the acknowledged high tech leaders in the world economy, the US and Japan, and significantly higher than in France, Germany and Italy. Between 1992 and 2003 the share of manufactured exports generated by high tech industries in the UK increased from 26 per cent to 36 per cent.

**Table 6: Share of manufacturing exports from high tech industries (OECD definition)**

| | 1992 | 2003 | Change |
|---|---|---|---|
| **United States** | 34% | 36% | +2 |
| **UK** | 26% | 35% | +9 |
| **Japan** | 30% | 29% | -1 |
| **France** | 18% | 23% | +5 |
| **Germany** | 15% | 19% | +4 |
| **Italy** | 10% | 11% | +1 |

*Source: OECD*

**The rise of services within the manufacturing process**

It would be easy to see these changes as a simplistic manufacturing versus services story. But manufacturing has emerged as a major provider of knowledge based service exports in its own right. A recent study[31] for the DTI shows that between 1997 and 2003 the manufacturing industries provided about one quarter of business service exports and around 40 per cent of earnings from technical services and earnings from royalties and fees. The study concluded:

> *'The propensity to import and export services appears to be higher in manufacturing than services. Trade in producer services may therefore be even more important to manufacturing than services.'*

A recent OECD paper[32] concludes that the traditional boundaries between manufacturing and services are blurring because of the development of new business assets that put much more emphasis on investment in intangible knowledge assets. The OECD said:

[31] Hijzen, Pisu and Upward *A Portrait of Trade in Services*, Report to the DTI June 2006
[32] *The Changing Nature of Manufacturing in OECD Economies*, OECD STI Working Paper 2006/9

*'Manufacturing activity in OECD countries increasingly incorporates high value added services. This change seems due to business models that increasingly emphasise intellectual assets and high value added services such as R&D, financial, and after-sales services instead of manufacturing as such.'*

Firms have been developing services either as part of their final offering to consumers or as a logical development of their manufacturing interests. In a study published in 2003 Jonathon Howells has described the phenomena as 'service encapsulation' so that: *'manufactured goods are offered to consumers in their own right but rather in terms of their wider service attributes.'* This is not new – for example, car companies have been offering financial and other packages to help sell their cars for many years. However it appears to be growing in importance and becoming more sophisticated. Howells cites examples of Rolls Royce and General Electric offering hours of flight packages rather than just aero-engines and AstraZeneca developing healthcare services to complement new cancer drugs.

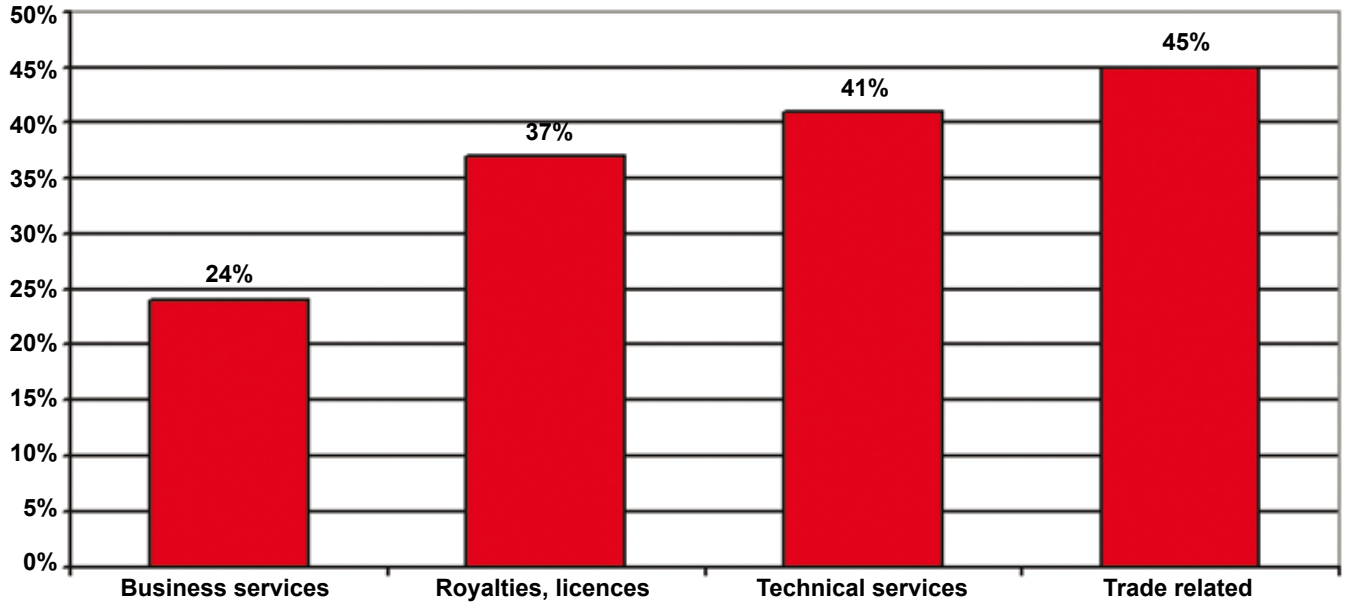
In some areas the growing importance of services within the manufacturing process reflects the increasing decentralisation of manufacturing production across the world. For example, trade with China is far more complex than a simple exchange of manufactured goods produced in China and the UK respectively. In many industries, high value added components are shipped from Western manufactures to assembly operations in Chinese plants either owned by or dependent on Western multi-nationals. The finished product is then shipped back to the UK where high value added services are included before the final presentation to the end user, whether consumer or business.

**Impact on manufacturing employment**

The OECD suggests that the shift in employment towards service related jobs supports the hypothesis that a new manufacturing model is emerging. According to the Working Futures report, the share of knowledge workers (defined as the top three occupational groups) employed in manufacturing went up from about 21 per cent to 32 per cent between 1984 and 2004. However, this shift would also be partly explained by technological displacement affecting manual jobs more severely than non-manual jobs.

When we look just at the industries classified as technology and knowledge based, the share of knowledge workers in total employment increased – but less strongly than in the rest of the manufacturing sector. Between 1984 and 2004 the share went up from just under 26 per cent to 34 per cent.

**Figure 15: Knowledge service exports from UK manufacturing**




*Source: Hijzen, Pisu, Upward A Portrait of Trade in Services, University of Nottingham report for the DTI, June 2006*

**Note**: Share of knowledge based service exports produced by manufacturing 1997-2003

One problem in interpretation is that the sectors in the Working Futures analysis are quite broad, so we cannot distinguish between high tech and medium tech manufacturing. We do not, for example, know from this analysis whether the trend in the high tech manufacturing industries is different to medium tech manufacturing.

Even though the sectoral trends clearly need more explaining, the fact is that the manufacturing workforce is, within the next twenty years, going to see more people employed in non-manual jobs than in manual work. Within the knowledge and technological based manufacturing industries in 2004 about 37 per cent of the workforce were non-manual workers, including admin and clerical workers, sales and personal service workers.

**Offshoring and the knowledge economy**

The broadly positive story set out above has however come under challenge from concerns that offshoring – the transfer of jobs to lower wage locations – will threaten employment across a wide range of knowledge worker occupations previously thought to be protected from international competition.

A recent paper prepared for the Finnish Presidency[33] described the possibly of a second 'great unbundling' in service jobs following the same path of manufacturing. However, while the impact of manufacturing affected firms within sectors, the offshoring phenomena would affect individuals and functions across a very wide range of industries. Some estimates of the potential impact of offshoring suggest that up to 20 per cent of service industry jobs might be at risk, many of them relatively high skill. The US economist Alan Blinder warns that we have so far 'barely seen the tip of the offshoring iceberg, the eventual dimensions of which are staggering[34]'

The positive story on the knowledge economy would change quite dramatically if jobs on this scale were seriously at risk of being exported to Mumbai or Shanghai. The UK's specialisation in knowledge services could turn from today's strength into tomorrow's weakness. One commentator in the UK has warned about the consequent development of a 'high skills, low wage economy'[35] Nor would the impact stop just with knowledge workers. With fewer 'good jobs' there would be downward pressure on wages in the rest of the economy as more workers competed for the personal service jobs that could not be offshored.

These concerns should be taken seriously. However, our review[36] of the available evidence leads us to a different and more optimistic conclusion. We see the more likely outcome as increased trade in knowledge services both North-North and North-South with little, if any, net impact on levels of knowledge economy employment. As a result of increased trade, it would be no surprise to see a much stronger presence of Indian and other Asian owned firms providing knowledge services operating in the UK (a sort of reverse offshoring). However, we do expect the pace of structural change to speed up with rates of both job destruction and job creation linked to changes in international trade in knowledge services increasing.

The debate is hampered by almost non-existent official statistics on offshoring and a number of one-off studies and estimates with little consistency in either definition or quality. As a result, we have to rely on indirect measures. So far it is very hard to see any impact from offshoring in either the trade or employment figures.

Offshored services to India would show up as imports to the UK. The official statistics show that in 2004 the UK imported about just under £200 million in IT related services from India (computer, information, and telecommunications) or roughly double the level of imports ten

[33] Baldwin, *The Great Unbundling(s)*, September 2006
[34] Blinder A, *Offshoring: the Next Industrial Revolution*, Foreign affairs March-April 2006
[35] Brown et al *Towards a High Skilled, Low Wage Economy*, in Skills and Economic Performance, SSDA 2006
[36] Rudiger, Katerina *Offshoring: a threat for the UK's knowledge jobs?* June 2007

years ago. The UK exports roughly £100 million in such services to India. These figures are tiny when compared with the overall trade in IT related services, where the UK exports about £9 billion and imports £5 billion. Most of the imports come from high wage economies: for example, we import four times more IT related services and 16 times more business services from Germany than India.

Employment estimates suffer from a lack of any consistent definition of the IT industry or IT occupations making it possible to 'prove' more or less optimistic outcomes depending on how wide or narrow the focus is. However, a study by the ONS[37] looking at the occupations thought most vulnerable to offshoring between 2001 and 2004 concluded:

> *'Employment growth in the occupations considered susceptible to offshoring have been very strong. The redundancy levels for these occupations, although high relative to the whole economy, have been falling. The overall reemployment rate for these occupations has also shown an increase…'*

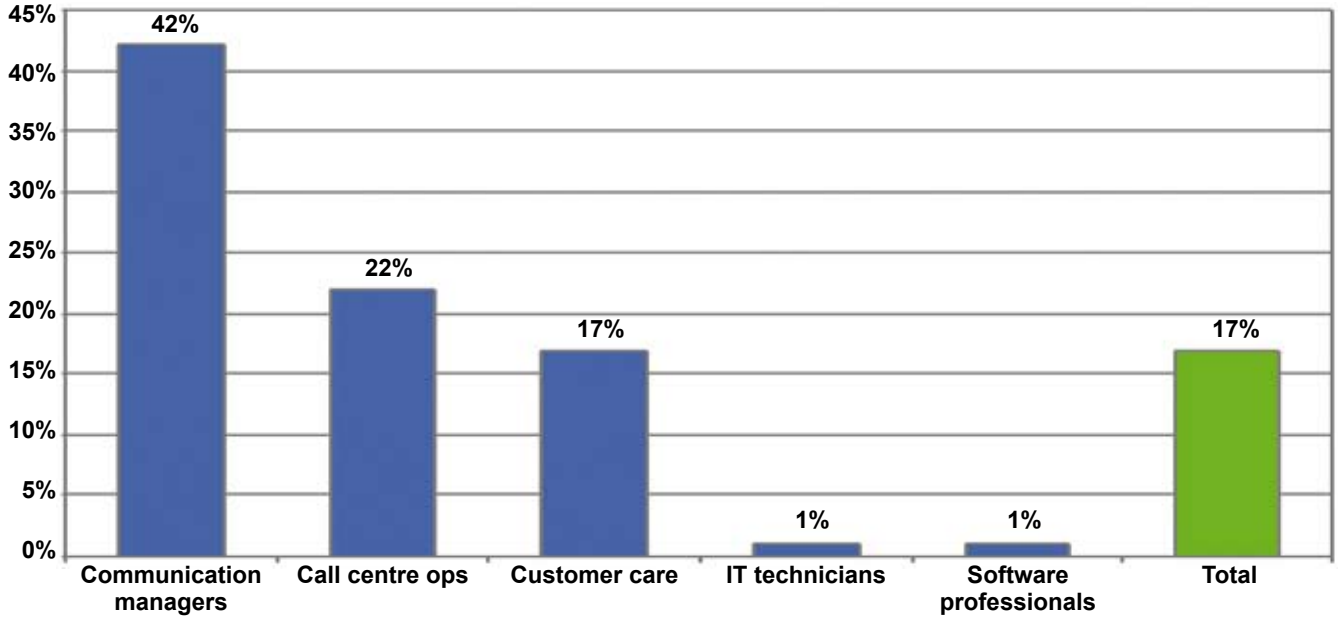
We have updated the original ONS study to the first quarter of 2007. The extended analysis confirms the ONS finding that the jobs thought to be most vulnerable to offshoring show a net rise in employment of 17 per cent between 2001 and 2007 rather than decline. The overall increase in employment slows down after 2005, but it is not known how much of this is due to changes in general economic conditions, sectoral factors, or increased offshoring. There is the usual caution in putting too much weight on the figures for individual occupations due to small sample sizes within the Labour Force Survey.

Of course this does not mean that jobs are not being offshored and it is entirely possible that without offshoring the level of employment in the worst affected occupations would be higher. With no direct measures of offshoring, we may be under-estimating the impact. The statistics on services trade are not as robust as those for manufacturing and may struggle to capture firm to firm service transactions. However, neither can we measure potential job gains elsewhere in the economy created as a result of higher efficiency among firms who offshore some of their activities.

We cannot afford to be complacent and say that the absence of any measurable impact to date means this happy state of affairs will continue. Many commentators point to the fast moving nature of some of these service areas, making any backward looking study out of date before it is published.

[37] Heckley G, *Offshoring and the labour market,* Labour market trends September 2005

**Figure 16: Employment change in occupations vulnerable to offshoring 2001-2007**




*Source: Labour Force Survey*

**Note:** Occupations as identified by Gavin Heckley, ONS Labour Market Division in Labour Market Trends, September 2005 (SOCs 1136, 2132, 3131, 7211, 7212) All figures Uk employees 2001 in Spring Quarter, 2007 in Q1.

However, in our view, knowledge services remain 'sticky' because they rely so heavily on both tacit knowledge and face to face contact. In many knowledge service areas the internationally tradable market is dominated by large multi-national companies who are able to offer a global brand and reputation for expertise delivered consistently across national boundaries. Although the technology exists to provide these services remotely, in practice firms rely on local service delivery.

The predominance of the City of London in world financial services is well known, but the same advantage applies in other areas. For example, the UK has developed as the European 'hub' for advertising services according to the EU commission, alongside Tokyo and New York.

The World Bank's most recent assessment of globalisation is that the landscape is still predominantly 'hill and mountains' because endowment, human capital and the policy environment still matter. As long as they do, we think it unlikely that we are on the verge of a 'Third Industrial Revolution' where much of the knowledge economy is swept away by the forces of globalisation.

**Summary of main points**

- The UK has a well-developed knowledge economy by international standards measured by the share of GDP in knowledge based industries (41 per cent, OECD 2002) or the share of total employment (48 per cent, Eurostat, 2005), or the share of knowledge based workers (42 per cent, Eurostat, 2006).
- The UK has emerged as a world leader in trade in knowledge services with the biggest trade surplus of the major OECD economies (3.3 per cent of GDP in 2004, OECD and Work Foundation estimates).
- Although financial services and the City remain important generators of knowledge based services, just over two thirds come from business services, high tech services, and education and cultural services.
- UK manufacturing is now a significant generator of business and trade related knowledge service exports as the boundaries between manufacturing and services blur due to globalisation and there is a shift towards intangible investment.
- Offshoring has had no measureable impact on knowledge economy jobs, and trade in knowledge services remains overwhelmingly with richer economies. However, trade related structural change will increase in some knowledge service industries.
- As knowledge services trade increases we expect to see increased flows of foreign direct investment, with increasing investment in economies like the UK from India and China as well as vice versa.

In this section we focus on three aspects of innovation:

- R&D investment
- Innovation and enterprise
- Public sector innovation.

A knowledge-based economy reflects fundamental shifts in the nature and sources of knowledge and how knowledge is organised, analysed and transmitted. Innovation both reflects these changes and acts as a driver to bring them about. This in turn offers new challenges to firms and policy makers. In a recent assessment of innovation performance across a selection of economies, the OECD comments:

> *'Such changes pose much greater challenges to firms, and to innovation policy makers, than mere accumulation of existing types of knowledge and incremental improvements in existing products and processes. Knowledge is not identical with technology, which combines both codified and tacit knowledge with skills, artefacts, designs, routines, software and forms of organisation to carry out practical tasks. Also the kinds of knowledge involved in market driven activities and public services go much wider than those incorporated in technology'* (Innovation Policy and Performance OECD 2005).

In reality, there tends to be a strong relationship between innovation in tangible technologies and innovation in intangibles such as work organisation. For example, work by Hitt and Brnysonsson[38] has highlighted the strong relationship between investment in computers and investment in organisational capital.

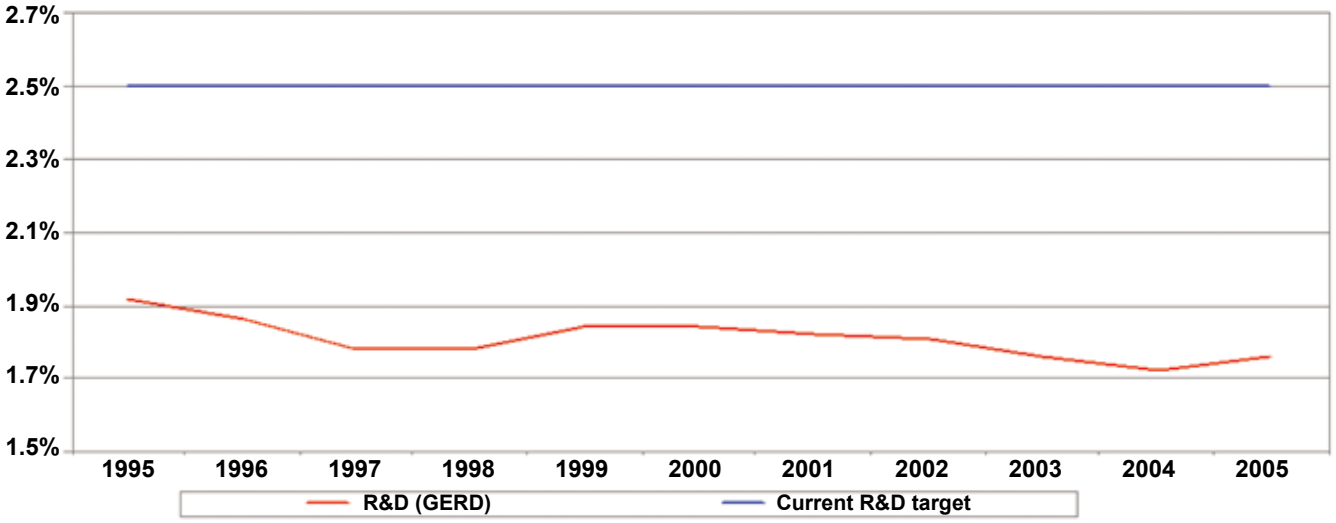
**R&D investment**

The UK's record on R&D investment has long been major source of concern for policy makers. As a share of GDP, the UK invests significantly less than most other major economies such as Germany, Japan, the US or France. In 2004 R&D investment by both the public and private sectors was 1.9 per cent in the UK, 2.2 per cent in France, 2.5 per cent in Germany, 2.7 per cent in the US, and 3.3 per cent in Japan, according to the OECD.

The current government has set itself a long term ambition of increasing the share of R&D investment to 2.5 per cent of GDP, roughly the current share in Germany. However, despite a more supportive policy framework – including the introduction of an R&D tax credit – little progress has been made towards the target. Indeed, investment in R&D is now somewhat lower as a share of GDP than it was in 1997. The UK is not alone in this experience – the EU has also

[38] Brnysonsson and Hitt, 2003. *Computing Productivity: Firm level Evidence*, MIT

**Figure 17: R&D spending falls behind target**




*Source: Office for National Statistics, 2007*

**Note:** *GERD as share of GDP*

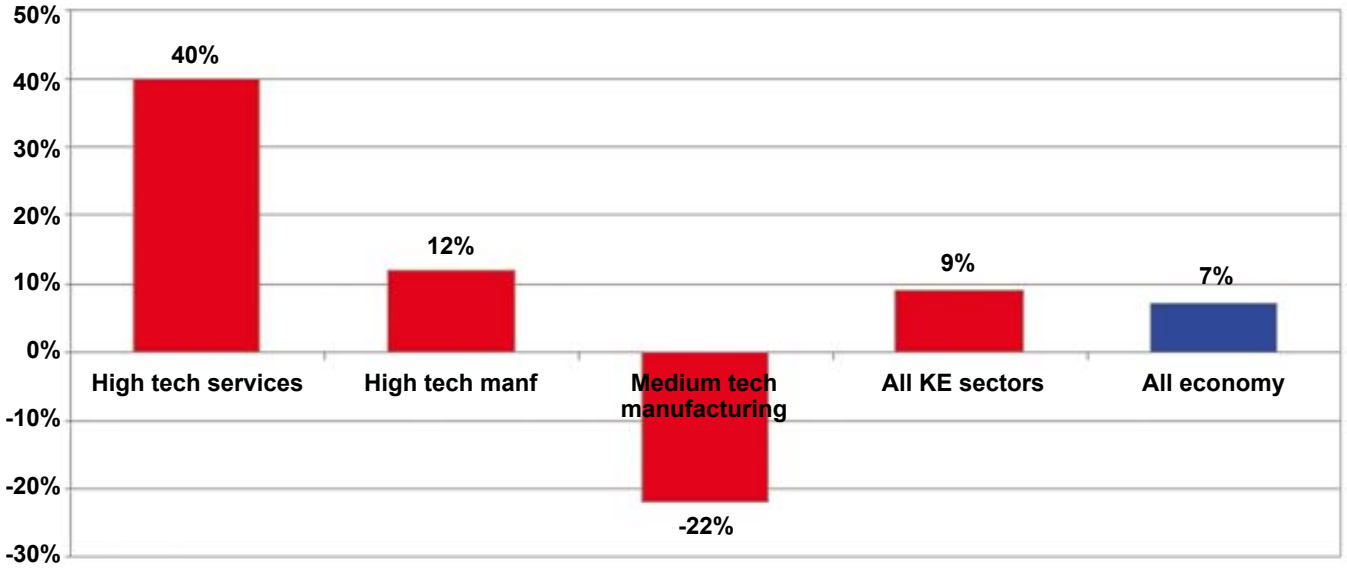
made little progress towards meeting the even more ambitious 3 per cent of EU GDP spent on R&D set out in the Lisbon Strategy.

UK business investment in R&D has increased by nearly 27 per cent in cash terms between 1999 and 2006 but over the same period the economy has grown by 43 per cent in cash terms. As a result, the share of business investment in R&D has fallen. When we look at the change by industry sector we can pick out three important trends:

- The main reason for the fall in R&D as a share of GDP is the sharp decline in some medium tech manufacturing sectors such as cars.
- R&D has however also grown less strongly than GDP in high tech manufacturing.
- R&D is growing very strongly in knowledge intensive high tech services, so the share of R&D undertaken in the service sector has increased substantially.

However, the overall picture is more complex than the aggregate R&D statistics for shares of GDP would suggest for the following reasons:

**Figure 18: Business R&D spending in the UK 1999-2006 (real terms)**




*Source: Office for National Statistics*

- Structural factors such as the share of R&D intensive industries, market size and ownership are all limiting the growth of R&D as a share of GDP.

- The BERR Scoreboard suggests that on a like for like basis UK firms are just as likely to be R&D intensive as their foreign counterparts[39].

- Knowledge based services where UK companies perform well by international standards on average undertake less R&D than manufacturing as a share of value added (although investment has been increasing rapidly in recent years) and rely less on patenting to protect their innovations.

- International trade in R&D services – essentially a trade in intellectual property – was almost non-existent ten years ago and has increased substantially, so the UK may be benefiting much more from R&D performed overseas by multi-nationals (including UK based).

[39] The R&D Scoreboard uses a different definition of R&D based on what firms report to that used in the OECD statistical definitions used in the UK statistics produced by the ONS. The EU Commission has come to a similar conclusion comparing the EU average firm in R&D intensive sectors against the average US firms in the same sectors

- Business has shifted investment to other 'intangible assets' including software and what economists have called non-scientific R&D (copyright and licence fees, new product design and development): some measures suggest the gap against the US is much less than in R&D that falls within the OECD definition.

The UK's weakness in R&D and the lack of progress towards the target can therefore in part be ascribed to underlying structural factors, including a relatively small high to medium tech manufacturing sector compared with other major economies, as much as any reluctance among UK based firms to invest in R&D. However, structural factors are unlikely to be a complete explanation, and the continued weakness of R&D investment is also a continued source of weakness in terms of both technological innovation and productivity performance. It would be a huge error to think that R&D is no longer important in a knowledge based economy.

**R&D and productivity**

The vast majority of studies find a clear and positive link between productivity and R&D and this finding is not in doubt. But exactly how much? There is clearly no simple link between R&D investment and overall productivity growth. Both Germany and Japan have increased R&D spending as a share of GDP over the past decade and seen no increase in productivity.

Our review of the evidence found a wide range of estimates ranging from R&D explaining almost all productivity growth to studies that assign R&D an important but minor role[40]. This is surprising given the vast number of studies looking at the impact of R&D investment on growth and productivity.

One reason for the differences is the difficulty of accounting for all the factors that drive innovation and hence productivity growth. It is very hard to capture the important linkages between R&D, investment in technological innovation and intangible investment, especially when these take place over considerable periods of time. A further reason for caution is that studies in the US may understate the potential impact of R&D in economies such as the UK which are less close to the technological frontier.

**The internationalisation of R&D**

Multi-nationals imported technology has significant and positive spillover impacts on the domestic industrial base. This is especially important in the UK because compared with other major economies the UK is more dependent on foreign funding of R&D. There is also some evidence that UK firms locating some R&D in the US can gain in terms of economic efficiency and in effect increase their stock of R&D[41].

[40] Comin, Diego (2004) '*R&D: A Small Contribution to Growth*' Journal of Economic Growth
[41] Griffiths, Harrison and Van Reenan (2004) *Technological sourcing*, IFS

Most R&D remains tied to the home markets and corporate headquarters, but there is some evidence of a steady increase in the internationalisation of R&D. The previous section described the growth in trade in R&D services for the UK. Our wider analysis looking at trade between Europe and the rest of the world showed that, although it had grown rapidly, the basis for growth up to 2004 was primarily trade between the US and the EU.

The opening up of new locations in Asia may make R&D in the future more truly globalised. Moreover, the very rapid increase in trade in R&D services over the past decade suggests that the constraints of national boundaries are declining. The high level of foreign funding of R&D in the UK increases the economies vulnerability to these changes. In common with other major economies, the UK has to contend with the increased attractiveness of other locations for R&D but also has a weaker 'anchor' that tends to keep most R&D at home in economies like Germany, Japan, France and the US.

If we are entering an era where R&D is much more mobile than in the past, then the factors that make R&D attractive in particular locations become even more important. Our review of the evidence presented to a seminar in Brussels in February 2007 showed that human capital endowments – the ability to access high quality researchers and research managers – were often a key consideration[42]. This also came across as a major background consideration in a knowledge economy roundtable event on whether the proposed changes to the regulatory environment governing the pharmaceuticals industry would reduce the amount of R&D undertaken in the UK.

Finally, if R&D spending is becoming more mobile, so too might R&D researchers. Indeed, both the Kok and Aho reports recommended that increasing cross-border mobility should be a key objective in increasing the pace of technological innovation in the future. The latter said cross border movements should be 'as high as technically feasible'. Hard evidence on mobility is in short supply, but one study[43] looked at movements of 'inventor-scientists' (those who had filed patents in more than one country). This found that although the numbers were increasing they were relatively small, and tended to be highly concentrated in particular sectors.

**Universities**

Universities and other public bodies undertaking R&D and public subsidies, loans and grants can increase private R&D through three related processes. Firstly, they can reduce the cost of a particular project, making it more likely to go ahead. Secondly, public funding can directly

[42] *Globalisation and R&D,* Knowledge Economy Brussels Seminar, February 2007; R&D seminar *Commercialisation of R&D*, The Work Foundation, July 2007
[43] UK Institute for Fiscal Studies Briefing Note 68, citing preliminary work by Professor Manuel Trajtenber

reduce the cost of equipment and labour used in private sector R&D. Thirdly, it can decrease the cost of all projects by knowledge transfer within the organisation, allowing private researchers to build on advances made in the public sector.

Public funded R&D is already highly efficient, measured by citations and research papers produced. A traditional criticism was that it was less efficient at translating this performance into marketable products. However, the performance of UK universities in terms off commercialising their research has improved. For example, the number of spin-outs is now comparable with the US.

However, the role of universities goes far wider and is much more important than the narrow measure of spin outs and the linear view of 'knowledge transfer'. Indeed, our work on the knowledge economy suggests that investment in human capital at all levels and especially in higher education is essential if the UK is to be successful as a knowledge based economy in the future.

We have already highlighted the importance of sustaining centres of scientific excellence in retaining and attracting new R&D to the UK. Universities are increasingly valuable in their own right as agents of economic growth. Universities are major generators of knowledge service exports in the form of fees paid by foreign students to study at UK institutions. In 2005 education services generated a £3 billion trade surplus. As the Sainsbury Review rightly says:

> *'the change in the purpose and self-image of the university has been driven by the concept of the knowledge economy, an economy in which ideas and the ability to manipulate them are of more importance than the traditional factors of production. In this economy, a world class university looks an increasingly useful asset'.*

UK universities perform well in terms of the 'Shanghai' rankings which measure academic output. A recent analysis published as a Brueghel Policy Briefing[44] shows the UK and Switzerland are the only two countries who approach the performance of the US in the top 50 universities and only the UK, Switzerland, Denmark and Sweden approach or exceed the US in the top 100 universities.

The UK achieves this good record despite relatively modest investment in the higher education sector. For example, according to the OECD, investment in higher education represented 0.7

[44] Alghion P. et al, *Why Reform Europe's Universities?* Brueghel Policy Briefing, September 2007

per cent of GDP in the UK in 2003-2004 compared with an EU average of 0.8 per cent, between 0.9 per cent and 1.2 per cent in the Nordics, and 2.4 per cent in the US. Clearly, other factors than spend are important. Nonetheless, sustaining and if possible expanding the number of UK world-class universities is likely to prove an extremely good long term investment.

However, all universities and higher education institutions have a potentially important role in economic performance and regeneration. For example, we are undertaking further research on the role of higher education in the knowledge economy in cities as part of The Work Foundation's Knowledge Economy and *Ideopolis* programmes. This research is looking at how the education institutions in a city can contribute to local economic development and how city leaders can develop effective relationships with education institutions.

**Innovative capacity – human capital**

In a recent speech the OECD Chief Economist noted that the UK's ability to take full advantage of foreign R&D might be held back by lack of domestic capacity. He said:

> *'…one of the biggest drags on innovation is found to be insufficient capacity to absorb foreign knowledge. This is captured in our empirical work on R&D determinants by the positive interaction between the stock of foreign R&D and the proportion of researchers in the workforce.*[45]*'*

However, the UK science base appears to punch well above its weight in terms of scientific output and UK researchers might be more productive than in some other OECD economies. The size of the research workforce could also reflect differences in industrial structure. Moreover looking just at researchers is too narrow a focus on the range of relevant skills and expertise required for the knowledge economy.

By international standards the UK has, at the moment, a good supply of graduates in science and engineering in terms of quantity. Many, however, do not enter science and engineering jobs but are attracted into sectors such as finance. The skills they have are clearly attractive to employers and arguably help drive innovation in sectors where the UK is highly competitive in world markets.

Some might say, however, that producing more scientists and engineers is an expensive way of providing knowledge based service industries with graduate labour. Others have even gone so far as to suggest that from the point of view of successful innovation within firms, education

[45] Jean-Philippe Cotis, speech to the Government Economic Service Annual Conference, Nottingham 2005

systems may be over-emphasising high level analytical skills based on mathematical and scientific skills at the expense of more interpretive skills[46]. However, sectors such as the IT industry have complained that not enough graduates with the relevant IT related skills enter the industry, requiring either firms to train up non IT graduates or resort to importing skilled labour.

Many commentators also raise the possibility of weakness in complementary skills in the non-graduate workforce and amongst managers, inhibiting firms making all the changes they would need to make in work organisation to allow the full exploitation of new technologies. UK research, now rather dated, by Professor Toby Wall suggests UK managers were less good at getting the best out of new technologies compared with their foreign counterparts for exactly this reason. More recent work by Professor Ewart Keep and others has highlighted the more general extent and persistence of such failings in the UK's vocational training systems and the quality of managers.

Other research by Bloom, Sadun and van Reenan has also highlighted managerial differences in the relative productivity performance of US and European managed companies, and suggested this is linked to a better performance in adapting to the new general technologies rather than the more specific technologies of the past[47]. However, as our review of the evidence on R&D and ICT has shown[48], it is not entirely clear how much of the better performance of US managers is driven by internal factors – such as financial incentives or more flexible internal structures – and how much by external factors such as the intensity of competition.

**Hidden innovation - resolving the productivity paradox?**

The UK's productivity paradox is the lack of an improvement in the underlying rate of productivity growth despite the rapid development of the knowledge economy. In The Work Foundation's CSR Submission we argued that this was partly a measurement problem and partly the unpredictable lag between the increased investment in ICT and the impact on statistical measures of productivity[49].

Work by Professor Jonathan Haskell and Tony Clayton at the Office for National Statistics, described in more detail in Section One, have illustrated how important correctly measuring some forms of intangibles could be in getting a more accurate picture of investment and economic growth and hence future productivity growth. NESTA, in a recent report, has also highlighted the importance of 'hidden innovation' in explaining the apparent contradiction

[46] Richard Lester and Michael Piore, *Innovation: the Missing Dimension*, 2004
[47] Nick Bloom, Rafaella Sadun and John Van Reenen (2005) 'It ain't what you do, it's the way that you do I.T. *Centre for Economic Performance*, LSE
[48] Lee, Neil *R&D and ICT: Evidence Paper for the knowledge economy programme*, The Work Foundation (forthcoming)
[49] *Knowledge economy and the CSR*, The Work Foundation February 2007

between a good overall macro-economic performance and weak performance on conventional R&D and innovation measures[50].

Although the discussion has tended to focus on knowledge-based services, the issue of ICT diffusion and the measurement of innovation are just as relevant in more traditional sectors. Indeed, much of the productivity improvement in the US over the past decade has come from ICT diffusion in the wholesale and retail sectors.

Much of the productivity gap between the UK and the US appears to be greatest in sectors such as retail where the problems of measuring productivity and innovation are also likely to be especially difficult. Conventional productivity measures place UK retailing below that in the US, France and Germany. Latest estimates put the UK retail sector productivity levels at 54 per cent of the US and 77 per cent of the EU average[51].

However the UK retail sector is, at face value, dominated by large, highly efficient and often very profitable firms. One possibility is that UK firms have developed a different and more labour intensive business model that suits UK consumer markets but reduces measured productivity.

Our work on trade in ideas and knowledge throws up further contradictions. The conventional measures of productivity show that the financial services sector has productivity levels (measured by output per hour) barely half that of the EU and the US[52]. However, the UK's financial services sector is extremely competitive in international markets. Either the conventional productivity indicators are misleading or the domestic financial services sector in the UK is even less efficient than the international productivity comparisons suggest.

The EU Innovation Survey shows the UK does well on wider measures of innovation that include changes in marketing, corporate strategy and organisational and managerial change. In other words, the UK is relatively good at innovation with intangible assets. Unfortunately, the data is now a little dated, as the comparative figures for the UK for these wider innovation measures from the latest CIS are not yet in the public domain.

These results are consistent with the highly developed nature of the UK knowledge economy, the shift towards competitive business models based on the exploitation of knowledge based

[50] NESTA, *The Innovation Gap* October 2006
[51] *Sector Skills Almanac*, 2007, p.80, SSDA
[52] *Sector Skills Almanac*, 2007, p88, SSDA. Output per hour in financial services was 47 per cent of the US level and 58 per cent of the EU average in 2003

assets, and the comparative advantage the UK has in knowledge service trade. However, a degree of caution is required in interpreting the results from international comparisons through surveys that necessarily require some subjective judgements from respondents. Nor does it follow that strengths in these areas will fully offset any weaknesses in the exploitation of more technology based innovations.

**Innovation from new enterprise**

Twenty five years ago, David Birch categorised the firm population of the US into 'elephants' (big, public companies), 'mice' (small businesses that stay small) and 'gazelles' (new fast growing dynamic companies, including the future Microsofts). Elephants shed jobs overall while gazelles were prolific new job generators. As Birch put it, employment in the Fortune 500 grew in every year before 1980 and declined in every year afterwards[53].

The key driver behind this shift in economic activity was, according to Birch, the transformation towards a knowledge economy. The source of value added had shifted away from big industrial plants to the exploitation of knowledge where the economies of scale that gave machine and labour based activity their competitive advantage no longer mattered as much.

The knowledge based gazelles consist of firms innovating and experimenting with a wide range of new technologies, products, processes and services that eventually will unseat the established order and, in time, will become the new corporate establishment.

For example, many have pointed to the rapid growth of Silicon valley and Route 128 in Boston and the increased role of Universities and other knowledge based institutions in generating 'spin-outs' as examples of how new companies could rapidly grow from nothing to become major industry players in areas such as fast moving technology and knowledge based manufacturing and services. Almost all OECD economies have consequently developed policies that focus on encouraging more of such spin outs in the hope that they will eventually produce 'gorillas' – gazelles that go on to become world class companies in their particular sector.

Firms such as Microsoft, Dell and Intel are examples of firms founded twenty five years ago or less. In a recent speech, the President of the US Kaufman Institute claimed that 75 per cent of firms in the US Fortune 100 did not exist in their current form in 1980.[54] About 22 per cent of the US companies now in the world top 1000 measured by market capitalisation were created after 1980 compared with 5 per cent of European companies in the top 1000, according to the

[53] *Small Business and the Knowledge Based Economy*, Report from Advocacy's 25th Anniversary Symposium, US Small Business Administration
[54] Schramm, C.J. *Entrepreneurship, Capitalism and its European promise*

European Commission[55]. Moreover, the same research found that 70 per cent of the new US entrants were in the IT sector.

In a speech at the 25th Anniversary Symposium of the US Small Business Administration's Office for Advocacy in 2002, Birch[56] said:

> *'We are in the middle of a revolution, a transition period. These periods don't go on forever. After 20 to 30 years the new order will establish itself. The successful upstarts will become the formidable firms…I think this new order will hold until 2030 when all hell will break lose'.*

If we date the revolution perceived by Birch and others from the early 1980s, then the window of opportunity opened by changes in markets, the new ICT technologies and globalisation is now closing as the new established corporate order settles down. One implication of this world view is that the established Western corporations are more likely to face competitive challenges from new Asian corporations than the next generation of home grown gazelles.

**Towards an entrepreneurial economy**

A recent review of the evidence by Erik Stam and Elizabeth Garnsey at Cambridge University[57] identifies a 'knowledge spillover theory of entrepreneurship' that argues that entrepreneurialism is the key mechanism by which the ideas and knowledge generated in research and scientific centres is taken to market and more widely diffused across business. This is essentially a technology and market led process:

> *'Radical changes in ICT and biotechnology have created market opportunities that are more effectively developed by new firms than by established companies. The shift to knowledge based activity is said to be the driving force underlying the emergence of the entrepreneurial economy'[58].*

The entrepreneurial economy is a term coined by Audretsch and Thurik and contrasted with what they called the managed economy. They put more emphasis on globalisation, supported by new technologies, as driving the shift from corporations towards small and new enterprises as comparative advantage in the advanced industrialised economies moves towards more localised knowledge intensive economic activities.

[55] European Commission, *Towards a European Knowledge Area* June 2007
[56] *Small Business and the Knowledge Based Economy*, Report from Advocacy's 25th Anniversary
[57] Stan and Garnsey, *Entrepreneurship and the Knowledge Economy*, University of Cambridge, 2006
[58] Audretsch and Turik, *What's New about the New Economy?* ERIM Report Series,2000

*'Just as the comparative advantage in economic activity based on capital and labour rendered the managed economy as an appropriate response, the shift to knowledge based economic activity is the driving force underlying the emergence of the entrepreneurial economy.'*

**The rebirth of the corporation**

For others, however, large and established still matter, especially in many areas outside IT where firms founded many decades ago still predominate in their sector and have gone on to achieve global reach. Others argue that the key role of intangible knowledge based assets – brands, R&D, software, design, product innovation, managerial competencies and human capital – continues to favour the large company organisation[59],[60]. A recent study suggested that:

*'corporations will increasingly harness entrepreneurial talent for their own purposes. Budding entrepreneurs may be drawn into them if organisations generate knowledge that individuals find difficult to acquire on their own. Even more than today, generating knowledge will be a collective activity and organisations may have greater ability to assemble people with relevant expertise than individuals.' (p89)* [61]

A recent analysis reported by the OECD[62] shows that big companies have increased their share of employment and GDP across the EU, US, and Japan over the past ten years.

*'The largest enterprises are, across the world and in each of its main regions, high-powered productivity engines. These enterprises – in most cases multinationals – are well equipped and brightly staffed so as to make the best out of combining globally the highest possible productivities achieved in each and every location'.*

**SMEs, gazelles and job growth**

Gazelles are only part of a wider population of high growth firms that includes the large and established as well as the small and the new. All gazelles are high growth firms, but not all high growth firms are gazelles.

A study undertaken for the Small Business Service confirmed that SMEs in the UK labour market made a disproportionate contribution to net employment growth in the late 1990s. One

[59] Strassman P.A., *The Importance of Knowledge capital*, 2000. As the sample of just under 1,800 firms was publicly quoted US corporations, it might be more accurate to distinguish between large and small corporations rather than large or small firms
[60] Bryan and Joyce, *Mobilising Minds*, McKinsey 2006
[61] Bryan and Joyce, *Mobilising Minds*, McKinsey 2006
[62] *Enhancing the role of SMEs in Global Value Chains*, OECD Tokyo Conference, OECD Background Report, p82, 2007

recent and more up to date estimate suggests that by international standards, the UK is second only to the US in the incidence of high growth firms.[63]

An OECD review of international evidence[64] published in 2000 found that both large and small firms could be defined as high growth and both made significant contributions to employment growth. In three studies in France, Italy and the Netherlands high growth firms accounted for 5 per cent or less of the firm population but provided between 50 and 60 of net new employment between the mid 1980s and mid 1990s (albeit for different periods and two of the studies relate just to manufacturing).

**First findings in the UK – strong growth of SMEs in knowledge based sectors**

We are in the process of undertaking work on looking at aggregate changes in the share of SMEs in total employment in the UK. The first findings are encouraging – we see substantial increase in employment in both SMEs and large firms across the knowledge based industries comparing 1995 and 2005. The evidence so far suggests that firms of all sizes are doing well in knowledge based industries, especially in service industries.

However, we can only undertake a static analysis – that is we can only compare the share of employment in SMEs in one year and the share of employment in SMEs in another year. We cannot capture fast growing firms who move from being SMEs to large firms over the intervening period, so the above estimates will if anything understate the contribution of knowledge based SMEs to overall job growth.

**Self employment and enterprise**

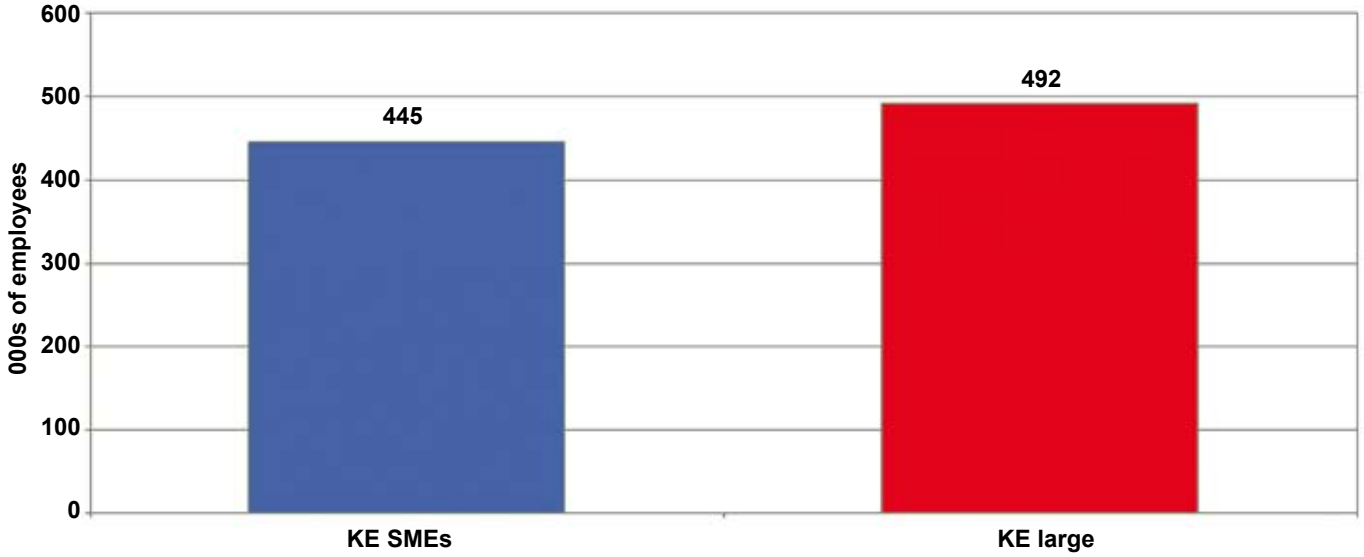
We also looked at indicators of self-employment, but it is clear from the evidence that self-employment rates are poor indicators of entrepreneurship, especially in the knowledge economy. For example, although the incidence of self-employment among knowledge workers has not increased, there has been substantial growth in employment in knowledge based SMEs. However, the aggregate figures disguise some important underlying changes in the nature of self-employment. The self-employed today are far more likely to be well-educated graduates in managerial, professional or associate professional jobs.

**Gazelles and high growth firms – an evidence gap**

Some studies focus on recent firms that started small and others on more established firms. Studies typically either define a certain level of performance using various indicators and say that all firms who meet the target are high growth; alternatively, they have taken, say, the top 10 per cent of performing firms in the particular firm population as high growth. The GEM High

[63] Hoffman and Junge 2006, (in Stan and Gurnsey). Young high growth firms defined as at least 60 per cent job growth in three years in firms less than five years old and with between 15 and 200 employees over the period 1999-2001
[64] Schreyer, *High Growth Firms and Employment*, STI Working Paper OECD 2000. The definition used is different to the latest OECD version

**Figure 19: SMEs growing in knowledge based industries**




*Source: Work Foundation estimate based on Inter-Department Business Register, Enterprise Directorate (provisional findings)*

**Note:** Change in private sector employee employment 1995-2005, excluding health and social care and labour recruitment services

Growth Entrepreneurship Survey[65] also includes an indicator of what the survey terms high growth entrepreneurs, but this is defined in rather different terms as an aspiration among start ups to employ at least 20 people within five years.

As a recent OECD assessment[66] noted, policy makers may have a good idea of what might encourage enterprise in general but:…*what is not so clear is what combination of conditions works best and, indeed, what types of entrepreneurs and businesses need to be fostered in order to maximise the potential number of high growth firms. The key reason for this situation is a lack of evidence relating to the numbers of high-growth enterprises. Indeed, hardly any official estimates of high-growth enterprises currently exist.*

In an attempt to encourage greater standardisation in the future, the OECD has suggested the following definition of a high growth enterprise: *All enterprises with average annualised growth in employees greater than 20 per cent per annum, over a three year period, and with more than*

[65] Erkko Autio, *Global Report on High Growth Entrepreneurship*, GEM 2007
[66] Ahmad and Gonnard, *Enterprise and Gazelles*, ICE Copenhagen Conference, February 2007

*ten employees in the beginning of the observation period, should be considered as high growth enterprises.*

**Implications for the knowledge economy**

Although this is still work in progress, we think the evidence – incomplete, partial, and inconclusive as it is – is consistent with the Birch retrospective view that we are coming to the end of a period in which gazelles turning into gorillas challenged the existing corporate order.

The same forces that opened the window of opportunity in the 1980s and 1990s – markets, technologies, and globalisation – are now closing it in most advanced industrialised economies. Gorillas are not coming through because the conditions in which they might flourish are no longer present. If this hypothesis is true, we will have to wait for the next unpredictable technological upheaval for the next generation of Microsofts, Dells, etc.

Another intriguing but unproven speculation is that the new corporate order has co-opted the next generation of potential gorilla founders by fostering 'intrapreneur' type arrangements that give individuals freedom and resources to experiment and develop new ideas but within the job security offered by a big company.

The latest BERR report on globalisation[67] identifies a small subset of firms called 'born globals' who are knowledge intensive or knowledge based and who have to turn to global markets for growth and economies of scale to benefit from R&D and innovation because domestic demand for their specialised products and services is limited. As the report notes:

> *These young and innovative SME exporters contribute crucially to the flexibility which allows the economy to respond to economic shocks and changes to the UK's comparative advantage. In time, some of these dynamic SMEs and 'born globals' of today will become the large firms in profitable mature sectors of the future.*

There is little doubt that some of these firms will in time become significant enterprises, but it is more questionable whether they will unseat the established order in the way US IT sector companies did in the 1980s. The fact that gorillas emerged only in the US and largely in one sector might suggest particular factors at work, including the size of the US domestic market.

A recent assessment of high tech start ups in the UK concluded:

[67] BERR, February 2008. *Globalisation and the Changing UK Economy*

*'There is no magic bullet available to government which will produce British versions of an Intel or Hewlett-Packard – and no clear market failure which calls for government intervention.'*[68]

We suspect that for a medium sized economy like the UK, the emergence of gorillas was never a very realistic proposition.

What we do not know is what happens to gazelles in the UK – one possibility is that they grow to a certain size and those with potential are then taken over by an established player. Whether this is good or bad for the economy is hard to judge – but the rapid expansion of jobs in knowledge based SMEs over the past decade certainly suggests that if such a process exists it has not inhibited new enterprise in the knowledge economy.

**Innovation in public based services**

The focus of much of the debate, and indeed much of the literature, has been on innovation in the private sector. However, a significant part of the knowledge economy by industry is public sector based in education and health services. Knowledge workers by occupation make up a significantly higher share of the public sector workforce when compared with the private sector.

The first findings for the knowledge economy programme are set out in a research report prepared by Research Republic[69], and include 12 case studies covering a wide range of service organisations including the DfES (Student Loans Company), Microsoft (Partnership with the Black Country Consortium), BBC Vision (Digital Media Initiative), SEEDA (Enterprise Hub Networks), London Connects, the Competition Commission, Croydon Primary Care Trust, Liverpool City Council (with BT) the Information Commissioner's Office, and Warwick University.

Innovation in the public sector is driven by a number of factors:

- The upward pressure on costs, especially in health, as technological and research improvements increase the quality of methods and treatments but inputs remain labour intensive;
- Rising consumer expectations of service quality, the degree of information given, and personalisation of services;
- Increased productivity across the public service workforce while controlling wage costs;
- Contestability (or potential contestability) and the development of hybrid public-private delivery bodies.

[68] Owen, 2004.*Where are the Big Gorillas? High Technology Entrepreneurship in the UK and the role of public policy*
[69] Lekhi, R P*ublic Service Innovation: a Research Report for The Work Foundation's Knowledge Economy Prograrmme*, Research republic LLP, July 2007

In many respects, innovation in public services will be similar to that in private services. However, one underlying difference is the public service organisations attempt (in principle) to actively diffuse knowledge and innovation created in part of the service through the spread of best practice, while private sector organisations seek to control individual innovation in order to gain competitive advantage.

Innovation in the public services can take similar forms to the private sector – new products, organisational and process change and service delivery innovations. But it can also arise from changes in public service governance (for example, devolution and partnership arrangements), the introduction of new language and concepts, radical policy driven innovation in services such as SureStart and the Open University, technology related change (LearnDirect).

The evidence suggests successful innovation has been associated with greater centralisation (which rather flies in the face of the current enthusiasm for decentralisation); higher amounts of administrative support; greater internal communications; some flexibility in resourcing; technical and professional knowledge; senior management commitment; rewards for innovative teams and individuals; and staff diversity.

However, in the public services, perception is often the criteria for success and therefore failure. Innovation failure is associated with ad-hoc and poorly worked out policy and service improvements, a lack of commitment from staff, pressure to improve what is already being done and heavy workloads. In addition, it can be difficult to define the public interest. Finally, excessive change and overlapping innovations can also be harmful to service improvement.

Of all the factors that currently drive public service innovation, the primary one is greater efficiency in service delivery. For example, in 2007 an Audit Commission report noted that 43 per cent of local and fire authorities said innovation was taking place, and of these nearly 80 per cent reported efficiency as the key driver, responding to peer pressure and local political and community expectations. Two areas of particular importance in recent public policy developments are shared services and public procurement, and both are focused on efficiency gains in order to improve service delivery.

There remain some difficult questions – should efficiency continue to be the primary driver of innovation, or should quality of service and user need have more prominence? What are the practical measures that would allow policy makers and public managers to foster greater

innovation and in which areas? As showed earlier, in the private sector innovation often fails. Will the public sector ever be able to fail?

**Summary of main points**

- The successful exploitation of R&D undertaken in both the UK and overseas remains of central importance to the UK's long term success as a knowledge economy.
- R&D has not increased as a share of GDP, primarily because of big falls in medium tech manufacturing but also because R&D in high tech manufacturing has grown more slowly than GDP.
- The high level of overseas funding for R&D makes the UK more vulnerable to the twin challenge from new lower cost locations for R&D and a relatively weak home market anchor that would otherwise keep R&D in the UK.
- The UK does well internationally in wider forms of innovation – design and development, marketing and organisational change – and sectors which traditionally have done little R&D can still be strong technical and technological innovators.
- The knowledge economy has seen strong employment growth in both SMEs and large firms across the knowledge based industries, but we know relatively little about the fast growing innovative 'gazelles' who generate disproportionate numbers of new jobs.
- Innovation in the public services has been primarily driven by the efficiency agenda and specific policy initiatives rather than continuous service improvement: there are substantial imbalances between risk and reward and the consequences of failure that constrain innovation.

# 5. Towards a knowledge economy policy framework

**The economy**

Our submission to the Comprehensive Spending Review (CSR) argued that the UK should develop an explicit knowledge economy strategy to reflect the changing nature of modern economies. Our central recommendation is that within the CSR framework, the government should develop a knowledge economy strategy.

The 2007 CSR refers more explicitly to the knowledge based economy than in previous years. However, the CSR fell short of the strategic framework that we believe the importance of the knowledge economy merits. As a result, the spending priorities in the CSR are not as closely aligned with supporting the knowledge economy as they might be. OECD indicators of investment in knowledge suggest the UK is falling behind the world-leaders.

It is vital that the opportunity is not missed again and that the government start to work towards such a knowledge economy strategy.

The 2008 Budget can signal a major turning point by starting a wide-ranging and fundamental review of the public investment, corporate and industrial support system that in some respects still reflects the investment priorities of the 1960s and 1970s. We must continue to modernise the focus of spending and fiscal incentives to reflect the emerging new economy and meet the challenges of globalisation:

- In the near future 50 per cent of economic activity and employment will be generated by the technology and knowledge intensive industries.
- A new manufacturing model is emerging, based on integrating high value added services in the production process, giving rise to the possibility of ‘reindustrialisation’ in parts of the economy.
- Global competition for R&D and other forms of knowledge based investment is growing.
- There has been a profound shift in business investment priorities: investment in intangibles worth 40 per cent of investment in tangibles in 1970 is now worth 130 per cent.

**Justifying knowledge economy policy interventions**

The Government can support the knowledge economy and intangibles in two ways:

- General framework policies: macro-economic stability, competition policy, education and skills; policy;
- Specific policies designed to address a market failure.

Market failure does not mean that the market does not work, but that the outcome is sub-optimal in economic and social terms – typically because the public rate of return exceeds the private rate of return. Some of the arguments that must be considered to demonstrate that intervention is justified include:

- Evidence of spillovers: for example, the R&D tax credit has been justified because the benefits of R&D investment are shared across many firms and not just the firm making the investment. Similar arguments have been made on employer provided training.

- Efficiency arguments: to help markets reallocate resources effectively and efficiently from declining to growing industries and occupations – for example, many forms of active labour market policies, structural adjustment funds.

- Regional effects: investment may benefit particular regions and sub-regions disproportionately – for example, the private sector knowledge industries are concentrated in the South East and some in London. Public support is required to redistribute economic activity and increase the economic potential of underperforming places.

- International competition: intervention is required to create a level playing field because other countries offer tax-breaks and other subsidies, or home industry suffers some other disadvantage that has to be offset if UK is to remain/become a major player.

- Distributional and social effects: some sections of society may lose out because it is not in the interest of the private sector to invest in them – for example, public support for people to acquire basic skills is justified because employers do not find such investment profitable.

- Size and scale effects: SMEs require special support because it is more expensive for them to comply with regulation or undertake certain forms of investment on the same terms as large firms or face additional barriers (eg venture capital). Also argued that SMEs provide entrepreneurial vigour.

- Simplicity, affordability and administrative costs: schemes should be attractive and easy to use by business and cheap to administer. However, there may be trade-offs against 'deadweight' – when the incentives mainly go to firms who would have undertaken the investment without support.

- Information failure: firms, investors and policy makers may be making poor decisions because of the lack of good quality information and agreed standardised benchmarks – for example, how intangible assets ought to be reported in balance sheets and company reports and the general lack of statistical information on many aspects of the knowledge economy.

**Budget consultative process**

The Budget should announce the start of a consultative process on how best to develop government policies towards the knowledge economy as follows:

- March 2008 Budget announcement
- March-July consultative meetings and roundtables
- Autumn 2008 PBR sets out proposed policy changes
- Budget 2009 enactment.

Part of the programme could be an audit of what support is already on offer to support intangible investment and other aspects of the knowledge economy. This would need to look at both the spending and tax sides. For example, workforce training receives substantial government support through subsidies and grants.

Our basic approach is that specific policy interventions have to be justified rather than assumed. It is not sufficient to demonstrate that particular sectors or sub-sectors are a growing and important part of the economy. Evidence gathering and assessment is a vitally important part of this process, but inevitably decisions and policy judgements will have to be made before all the evidence can be assembled.

In some areas – such as improving the supply of well-educated labour or increasing R&D support – increased public investment can be highly effective. But there may also be significant parts of the knowledge economy where the most appropriate response is to let well alone. In some areas the best results will come from further liberalisation, especially in opening up markets overseas for knowledge based services.

**Rebalancing investment support**

There is a substantial imbalance in the way we support investment through fiscal incentives. We provide much more in fiscal incentives for investment in vehicles, machines and buildings than investment in knowledge based intangibles.

Over the longer term, the government could consider a number of options. One would be the extension of the existing allowances to other forms of investment and develop the R&D tax credit so that it captures more spending in support of innovation where this could be justified. Revenue neutral proposals could balance extensions with reductions or even phase out for some existing tax-breaks. Moving in this direction would re-focus allowances and credits on the knowledge economy and also more clearly on areas were taxpayer support can be justified on economic and social grounds.

We have focused on R&D – where the case for public intervention is already widely accepted – as examples of some of the areas that could be addressed as part of a post Budget consultative process.

As we showed in Section Three, neither the UK nor the EU has made progress towards achieving R&D targets as a share of GDP. This continued failure at both EU and UK level raises some major policy questions – not least why there has been a shortfall between ambition and outcome.

National governments – including the UK – have been criticised for not doing enough. The framework to directly support R&D has improved in recent years, but other areas such as the supply of high quality graduates in the relevant disciplines who want to work in the R&D intensive sectors may also be an important constraint. However, industrial structure, market and ownership are also factors explaining why R&D has not grown as a share of GDP, and these underlying structural problems are hard for any government to address except in the very long term.

This does not let governments off the hook if, on average, US companies receive more support than European companies and European companies in turn receive more support than in the UK. And it could be argued that if European and UK firms face additional constraints – such a home market size – then support will have to be more generous if the R&D targets are to be met. It is also often argued – and hard to dispute – that US business R&D receives a significant boost from military related spending that has potentially both defence and civil applications.

The UK has also failed to increase public investment in R&D as a share of GDP and one reason has been cut-backs in R&D spend by the MoD and other government Departments. The Sainsbury Review called for these cuts to be reinstated, pointing out that the UK invests less than the US, Germany and Japan. In addition, guidelines governing the next CSR allocation could be strengthened to place more emphasis on Departmental R&D as a factor in determining future public spending allocations.

We suggest, as a first step, looking at increasing R&D support in three areas. These measures are all consistent with the Sainsbury Review's emphasis on the need to maximise R&D investment across sectors:

- **Increase the large firm R&D tax credit to ensure as much future R&D as possible is located in the UK.**
- **Increase the coverage of the R&D tax credit to cover the copyright of new processes and products.**
- **Increase public investment in R&D towards the international average**.

**Increasing the R&D tax credit**

Although the majority of R&D is still undertaken within the home market of multi-nationals, R&D is becoming more footloose, with investment by multi-nationals increasingly going where the technical specialisations they need are readily available and the relative cost of R&D is lower.

However, the UK is vulnerable to these shifts in global R&D because an exceptionally high share of R&D is funded from abroad compared with other major economies. The UK is facing increased competition from lower cost locations on the one hand and has less protection from the home market anchor for R&D activities that economies such as the US, Germany, France and Japan enjoy.

The R&D tax credit on its own is unlikely ever to be sufficient to retain R&D in the UK, but should be seen as part of a package that makes the UK an attractive base for R&D. The UK has been an attractive location for inward investment, not least through sustaining world class educational institutions and centres of scientific and technological excellence.

**Widening the scope**

We think there is also a case for increasing the scope of the R&D credit to cover copyright development, starting with SMEs. This is especially important for the creative industries – a fast growing and relatively successful part of the UK economy. The Work Foundation's report *Staying Ahead* noted that the cost of copyright might be one of the factors that would inhibit innovation, especially for the many small firms that dominate parts of the creative sector. It would also make it more attractive for firms in these sectors who undertake some R&D to do more and for those who do not undertake R&D to do so.

**Manufacturing**

Manufacturing is just as much part of the knowledge economy as services and the process and changes we have documented affect manufacturing as much as services. Indeed, a key part of the knowledge economy story is the incorporation of service related activities into the production process. Manufacturing firms have lead the way in opening up new global markets for knowledge based services on the back of their manufacturing activities.

However, the decline in high and medium tech manufacturing as a share of GDP should be of concern, as these sectors include some our most technologically advanced sectors where the UK should have a comparative advantage. In contrast to the UK, similar sectors in Germany, France, and Sweden have either remained stable or grown as a share of GDP, according to the Sainsbury Review.

**The labour market**

The key labour market policies on the knowledge economy are ensuring the continued supply of high quality labour to support the expansion of knowledge work and the knowledge industries. We could find little evidence that the supply of knowledge workers – proxied by graduates – is exceeding supply.

Our analysis of structural change in the labour market over the past decade is in some respects reassuring. The expansion of the knowledge economy is not associated with growing polarisation or with a trend towards more insecure or long hour employment. However, if the relative positions of knowledge and non-knowledge workers have not worsened since 1995, they have not improved either.

It is positively associated with improvements in the relative position of women. The modest increase in the feminisation of the workforce over the past decade was entirely driven by more women graduates entering the top three occupational groups. However, this has not been at the expense of their less well-educated peers having to take worse paid jobs.

We can find no evidence that the growth of knowledge work is driving new forms of employment or reducing corporate ties, despite the prediction of labour market gurus and some high profile examples reported in the media.

The regional distribution of knowledge industry employment provides major challenges in both addressing the traditional North-South economic divide and the underperformance of localities in all regions. Understanding how to maximise the opportunities that the public sector can create to generate private sector knowledge industries, as well as to create GVA in its own right, is vital for cities wishing to increase their productivity and close the gap. This is particularly urgent in light of the much tighter financial settlement in this autumn's Comprehensive Spending Review.

**Trade, globalisation and offshoring**

The UK economy is experiencing a major structural change in the way we trade with the rest of the world. We are trading in ideas, knowledge, and the exploitation of science to a greater extent than at any point in the past century.

We can find little evidence that offshoring has had a significant impact on either employment or trade over the past decade. We think the most likely scenario is increased global trade in knowledge services – both North-North and North-south with a growing presence of Asian knowledge service producers setting up subsidiaries in Western markets (reverse offshoring). However, this also implies more trade related structural change in services with potentially adverse impacts on those who lose out.

it would be unwise to assume that in the future a growing surplus on trade in knowledge services will help offset a growing deficit on trade in manufactured goods.

As part of an overall, strategic response ensuring our support for overseas trade and opening up new markets reflects the changing pattern of comparative advantage in services, the government should develop a sector specific response building on current examples such as the DTI's initiatives across a range of knowledge and technology based industries, the Treasury's Task Force on the City, and the forthcoming DCMS Green Paper on the creative industries will identify specific areas were policy can help sustain the success of the sector.

**Enterprise and the knowledge economy**

Our review of the evidence shows that some see the lead role of the US government in generating high growth firms as crucial. Although cultural factors may play a role, they also emphasise the advantages of large home market, a highly developed financial system, and

support from government for both basic science and small firms more generally. Others strike a more cautious note: despite favourable framework conditions in the UK the high tech sectors, already dominated by US first movers, do not offer an easy environment for UK-owned 'gorillas'. As such the scope for new policy interventions is limited.

Any policy suggestions must, at this stage, be tentative, but we are cautious in suggesting the UK economy can realistically generate future 'gorillas'. But we also argue that more could be done to develop a broad-based enterprise framework most relevant to knowledge economy dynamic SMEs focusing on the role of universities and other knowledge based institutions, investment in the science and technology base, intellectual property regimes, and the supply of venture capital.

Moreover, given the evidence suggesting local linkages and contacts remain vital for start ups and growth in knowledge based industries, despite advances in IT communications, local and sub-regional regeneration strategies need to focus even more on how to encourage knowledge based enterprise. The Work Foundation's *Ideopolis* programme has identified nine key drivers that can help cities and city-regions develop a knowledge economy based regeneration strategy.

**Summary of the main points**

- **We need to develop an overall strategic framework to ensure the UK retains a world leading knowledge economy, including a major review of the corporate tax and business support and enterprise support regimes to take account of the shift in business investment priorities.**
- **We would like to see more emphasis on supporting our R&D intensive sectors in both manufacturing and services, but particularly high tech manufacturing: R&D in the UK is potentially more mobile that in any other major economy and preserving the attractiveness of the UK as a place to do R&D is therefore vital.**
- **As well as R&D tax credits, a critical area will be ensuring sectors like pharmaceuticals, aerospace and IT have an adequate supply of high quality human capital to undertake and manage research.**
- **The decline in the high tech manufacturing sector relative to other economies such as Germany, France and Sweden is of concern: the Manufacturing Forum should be asked to focus on why this is taking place, whether additional public intervention is justified and, if so, what form it might take.**

- **Industry level focus: where appropriate, an industry-specific policy focus should be strengthened and if necessary extended, building on the current initiatives across government in areas such as manufacturing, the creative economy, the City and the IT industry.**
- **Investing in the science, technology and education base generates significant and growing knowledge service exports, as well as supporting R&D and technological innovation in the UK. The UK higher education sector, for example, is an international success story.**
- **The expansion of the higher education sector, as recommended by the Leitch report, is essential to support the growth of the knowledge economy: the UK cannot count on being able to import large numbers of knowledge workers in the future.**
- **It is in the UK's interests to press for open trade in services at both European and world level together with liberal migration policies to help sustain the growth of knowledge based industries such as business services, finance, IT, and health and education.**
- **Offshoring is not a threat to the knowledge economy for the foreseeable future, but will generate more structural change for particular occupational groups and create more losers: ensuring an effective policy response will be essential, especially in the face of rising protectionist sentiment.**
- **The knowledge industries and knowledge based firms and organisations in other sectors are also big employers of non-knowledge workers and addressing weaknesses in skills and work organisation for these groups are equally important.**
- **The generally positive association between women's employment and the growth of the knowledge economy should be taken into account in future strategies to tackle the gender divide.**
- **Firms and organisations need to make sure their future employment strategies for knowledge workers reflect their (implied) preference for secure long term conventional employment relationships, better work-life balance, and flexible working arrangements.**
- **Underperforming regions and localities in both the North and the South will need to draw on their public sector knowledge base as part of a wider strategy to encourage private sector development.**

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