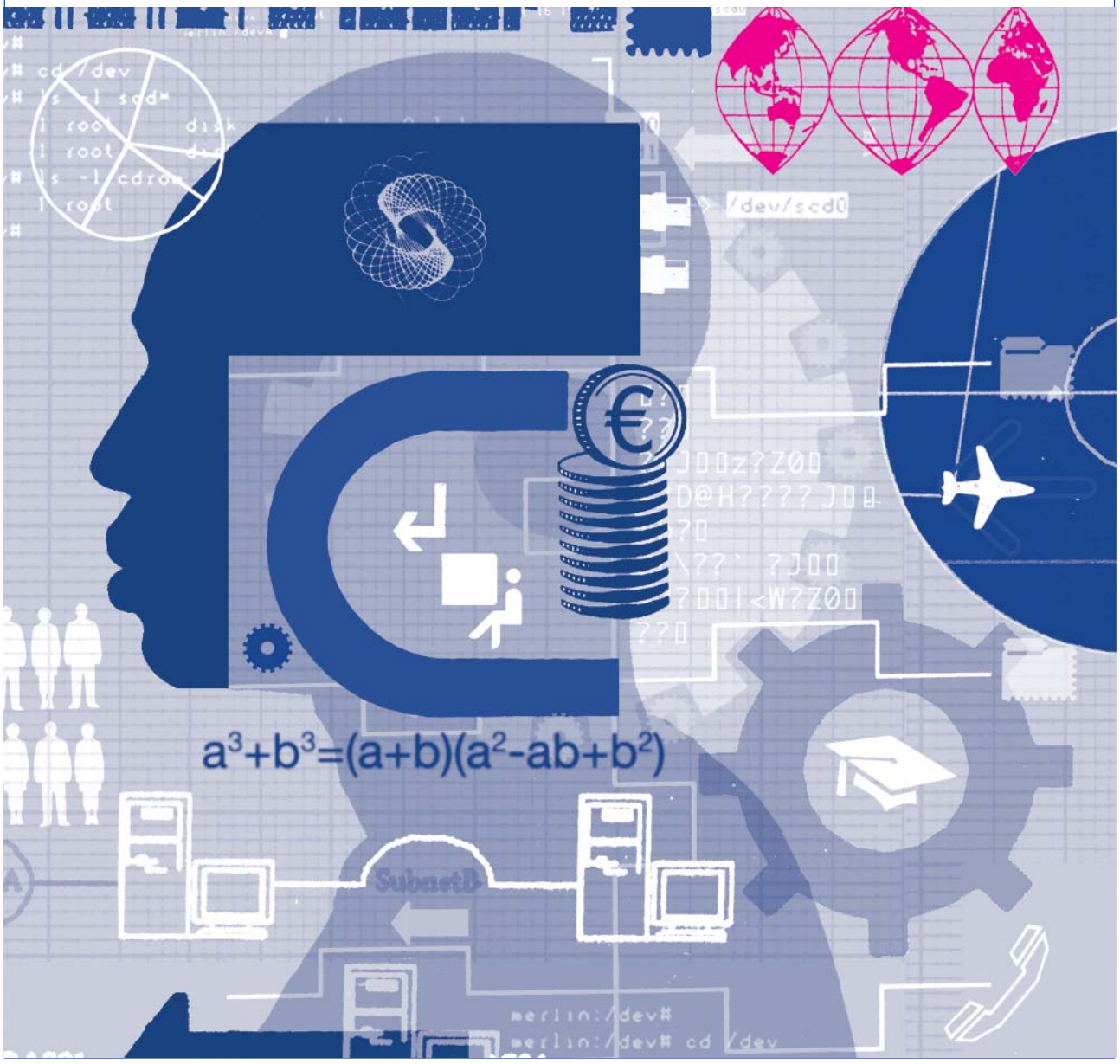
The knowledge economy in Europe

the work foundation

A report prepared for the 2007 EU Spring Council

Ian Brinkley
Neil Lee



Contents

Sponsors for the knowledge economy programme include:

BBC
DCMS
DfES
DTI
EDF Energy
Merck
Microsoft
PricewaterhouseCooper
Rolls Royce
SEEDA

This report is intended as a contribution to the public debate from The Work Foundation and does not necessarily represent the views of all sponsoring organisations.

Section 1

Introduction

"…a strategic goal for the next decade: to become the most dynamic and competitive knowledge based economy in the world" (Lisbon 2000 EU Council Strategy objective)

This report shows that Europe has seen a significant expansion in her knowledge industries over the past decade and at a similar rate to the expansion of knowledge based employment in the US. Moreover, in 2005 the size of Europe's knowledge economy measured by the share of total employment in knowledge industries is similar to the US.

What Europe has not seen is the accompanying economic dynamism of faster growth and higher productivity. Productivity growth has fallen in many EU States rather than accelerating, in contrast to the US. The key underlying reason is a slow down in the pace of technological innovation and a failure to increase investment in knowledge across the EU.

Increasing investment in R&D as a share of GDP must remains a key objective. But we believe that the Lisbon target of 3 per cent of R&D of GDP is not realistic and lacks a clear justification. New fiscal measures, such a tax credits, have a role but their impact on aggregate R&D spending as a share of GDP is likely to be small.

We therefore strongly endorse the Aho Report's central recommendation for a wider strategy that looks beyond the narrow confines of R&D and innovation policy. In particular, the key recommendation for a **European Pact for Research and Innovation** should be endorsed and implemented by the Spring 2007 EU Council.

Kok and Aho – towards a European innovation strategy

In March 2004 the EU Council invited Wim Kok to establish a High Level Group to help the Council in its mid term review of the Lisbon Council's Strategy to make the EU the most dynamic and competitive knowledge economy in the world.

The Group reported in November 2004. The report was clear about the importance of Europe's drive to become a knowledge based economy: "*The strength of its knowledge industries and Europe's capacity to diffuse knowledge across the totality of the economy are fundamental to its success and are key to lifting its growth of productivity to compensate for failing population growth and pay for its social model.*"

The Kok report highlighted in particular weakness on R&D: *"one of the most disappointing of the Lisbon process to date is that the importance of R&D remains so little understood and that so little progress has*

been made". Kok was however adamant the target should neither be relaxed or the timetable extended, as this would send the wrong signal to policy makers and firms across Europe. However, from 2004 onwards EU documents talked about moving towards a 3 per cent target by the end of the decade.

Many of the key recommendations in the Kok report were developed as part of EU innovation policy in the revised Lisbon Strategy launched in Spring 2005.

However, as part of the follow up to the Hampton Court European Summit in 2005 a Group led by Mr. Esko Aho was asked to report on how to further build on the work already being undertaken to speed up the implementation of the revised Lisbon strategy.

The Aho Report – towards a European Pact for Research and Innovation

The Aho report was submitted in January 2006 in advance of the Spring 2006 EU Council. The central recommendation was to establish a Pact for Research and Innovation. The Pact would supplement the Lisbon agenda by focusing on three areas:

- Creating innovation friendly markets in key sectors such as pharmaceuticals, energy, environment, transport, security and digital content. Each sector should have an independent high level co-ordinator to co-ordinate action in each area;
- Trebling the share of the Structural Funds spent on R&D. The 3 per cent target is an indicator, not an end in itself. The productivity of R&D also had to be increased by greater resources for science, industrial R&D and science-industry links;
- Greater resource mobility, including cross-border mobility of labour, new financial instruments to provide venture capital, and mobility in organisation and knowledge through European technology platforms and clusters.

The Spring 2006 EU Council Summit welcomed the Aho Report and endorsed the recommendations for supporting innovation friendly markets: *" The European Council accordingly calls for a broad-based innovation strategy for Europe that translates investment in knowledge into products and services. In this context, The European Council notes the significance of the Aho report and invites the Commission to assess its recommendations and the incoming presidency to report on progress before the end of 2006".*

We began this report by suggesting that while Europe had developed a wide range of knowledge industries comparable in employment terms with the US, there had been little signs of an economic pay-off. We further suggested this must in part reflect a failure to invest in knowledge and R&D

compounded by a slow rate of innovation diffusion, especially in services. The next section sets out the evidence and implications of these conclusions.

Section 2

The knowledge industries in Europe

The Work Foundation Report *Defining the Knowledge Economy* reviewed the common definitions used. The knowledge economy has most commonly been defined in terms of technology and knowledge based industries reflecting R&D intensities, high ICT usage, and the deployment of large numbers of graduates and professional and associate professional workers. An industry-based definition is not entirely satisfactory because, as the report showed, the knowledge economy applies across all industries.

However, an industry-based approach has the advantage of being able to draw on official statistics based on internationally agreed definitions of knowledge-based industries. For this report we have drawn on the definitions developed by Eurostat and the OECD.

The Eurostat definition includes high to medium tech manufacturing and communications, financial and business services and health and education. Eurostat also includes recreational, cultural and sporting services and some travel services (sea and air) that the OECD excludes.

Eurostat also breaks the knowledge service sector down into four groups: high tech services (R&D and computing); financial services; market knowledge services (communications, travel and business

services) and other knowledge services (health, education, and recreational and cultural services).

For the purposes of this analysis we have looked at just the EU15, as historical data is much more limited on a EU25 basis.

Knowledge industry employment in Europe

In 2005 just over 40 per cent of the European workforce was employed in knowledge-based industries as defined by Eurostat. The Nordics and the UK had the biggest shares of employment in the knowledge economy. Sweden had 54 per cent of employment in knowledge-based industries, followed by, Denmark, the UK, and Finland with close to 50 per cent of total employment in knowledge-based industry. By comparison, Germany had 44 per cent of total employmet in knowledge based industry, France 43 per cent and Italy 37 per cent.

The vast majority of jobs, unsurprisingly, were in knowledge-based services – 35 per cent of total employment across the EU15. Technology based high to medium tech manufacturing contributed just under 7 per cent of employment, with high tech manufacturing accounting for just over 1 per cent of total employment.

EMPLOYMENT IN KNOWLEDGE BASED INDUSTRIES IN EU15 in 2005

	Manufacturing	Services	Total
Sweden	6.5%	47.8%	54.3%
Denmark	6.3%	42.8%	49.1%
UK	5.6%	42.4%	48.0%
Finland	6.8%	40.5%	47.3%
Neth'lands	3.3%	41.9%	45.2%
Belgium	6.5%	38.3%	44.8%
Germany	10.4%	33.4%	43.8%
France	6.3%	36.3%	42.6%
Ireland	6.0%	33.9%	39.9%
Austria	6.5%	31.0%	37.5%
Italy	7.4%	29.8%	37.2%
Spain	4.7%	27.0%	31.7%
Greece	2.1%	24.5%	26.6%
Portugal	3.3%	22.7%	26.0%
EU15	6.7%	34.7%	41.4%

Notes: high to medium tech manufacturing, and knowledge based services. Figures share of total employment. Knowledge and technology based industries are Eurostat definitions.
Source: Eurostat

The biggest single group of knowledge services were the public based "other" knowledge services of education and health, together with recreational and cultural services. These industries together accounted for about 19 per cent of total EU15 employment. The Nordic economies, the UK, and the Netherlands had the highest shares of employment in these industries at between 25 and 30 per cent.

The market based service sectors (high tech services, financial services, business and communication services) accounted for about 15 per cent of total EU employment. The highest shares of employment in market based knowledge industries were the UK and the Netherlands, with about 18 per cent of

total employment. Within market services, employment shares were as follows:

- high tech services (R&D and computing) accounted for around 3.5 per cent of EU15 total employment, with the highest shares in the Nordics, the UK and the Netherlands;
- financial services accounted for just over 3 per cent of total EU15 employment, with the highest shares in Ireland and the UK at just over 4 per cent;
- Business and communication services accounted for just under 9 per cent of total employment, with the highest shares in the Netherlands, Sweden, Finland, the UK and Italy.

EUROPE'S KNOWLEDGE INDUSTRIES IN 2005

EU15	% of total employment
Tech based manufacturing	6.9%
-High-tech manufacturing	1.1%
-Medium tech manufacturing	5.8%
Market services	15.3%
-High tech services	3.5%
-Financial services	3.2%
-Business/Communications	8.6%
Health, education, cultural	19.4%
All tech and knowledge based	41.5%

Source: Eurostat

Moving towards a knowledge based economy in Europe

Over the past decade most of the new jobs across the EU15 have come from the expansion of the knowledge-based industries. Between 1995 and 2005 employment across the knowledge based industries went up 24 per cent. In contrast, employment in the rest of the EU15 economy went up by just under 6 per cent.

Across the EU15 as a whole, technology and knowledge based industries saw employment grow by 13.3 million, while all other industries saw a net expansion in jobs of 5.3 million. Overall, the technology and knowledge based industries created 2.5 times more net jobs than the rest of the economy between 1995 and 2005.

At the national economy level, all EU15 states saw growth in knowledge-based industries exceed that in the rest of the economy. Indeed, in several economies the only net expansion in employment was in knowledge-based industries.

In Denmark, Germany and Austria employment in the rest of the economy fell. In the UK, Italy and Belgium growth in non-knowledge industries was modest. This was primarily because job losses in production industries such as medium to low-tech manufacturing, agriculture, construction, and energy and water offset job gains in non-

knowledge services such a retail and hospitality.

MOST NEW JOBS IN KNOWLEDGE BASED INDUSTRIES 1995-2005

Change in employment	knowledge based industries	All other industries
Spain	+74.6%	+42.4%
Ireland	+70.7%	+42.9%
Greece	+36.8%	+8.3%
Netherlands	+29.9%	+12.3%
Italy	+28.4%	+4.1%
Belgium	+23.3%	+3.7%
Finland	+29.6%	+13.5%
Austria	+18.3%	-5.4%
Germany	+17.1%	-8.6%
UK	+16.7%	+1.0%
France	+16.3%	+7.3%
Portugal	+11.1%	+1.4%
Denmark	+11.6%	-0.2%
Sweden	+12.8%	+2.0%
EU15	**+23.9%**	**+5.7%**

Note: Knowledge based industries are Eurostat definition other industries include medium-low tech manufacturing, construction, agriculture, energy and water, retail, hospitality and all other services. Portugal is 1998-2005.
Source: Eurostat

Technology based manufacturing

Employment in the EU15 manufacturing sector is concentrating in medium tech industries such as cars, chemicals and engineering. Overall, employment remained stable in these industries at the EU15 level. In contrast, both high tech and low-tech manufacturing has seen significant job loss, with high tech manufacturing seeing the biggest fall in percentage terms. This pattern of restructuring confirms the view that the EU is relatively strong in world markets in many medium- tech manufacturing industries.

EU MANUFACTURING JOBS SHIFT TO MEDIUM TECH INDUSTRIES 1995-2005

EU15 1995-2005	000s	%
High tech	-236	-11.3%
Medium tech	- 39	- 0.0%
All technology based	-275	-2.4%
Less technology based	-1481	- 7.5%
All manufacturing	-1756	- 5.6%

Source: Eurostat

The fall in high tech manufacturing employment is likely to reflect the end of the ICT production boom in the late 1990s and underlying technology driven improvements in productivity in the face of relentless international competition. The fall in low-tech manufacturing employment is more likely to be direct competition from low wage economies as firms closed or invested in labour saving technology to promote competitiveness.

One indicator often used to show the EU is moving in the right direction is the share of employment in high to medium tech manufacturing. This however seems perverse, as in the long run labour will move from high

productivity sectors such as high tech manufacturing. It would be far more sensible to measure the contribution of the technology based manufacturing sectors in terms of value added or exports.

The EU15 aggregate figures disguise much bigger shifts in employment at national level, suggesting a high level of economic restructuring across national borders. For example high tech manufacturing employment fell by 15 in France, 27 per cent in the UK and Sweden, and between 35 and 40 per cent in Belgium and the Netherlands. However, employment went up by between 60 and 80 per cent in Ireland, Greece and Finland and by 18 per cent in Spain.

Although high tech manufacturing was shedding jobs, many more were being gained in high tech services such as R&D and computing services. The fall of 11 per cent in high tech manufacturing employment across the EU15 was more than offset by a 37 per cent rise in employment in high tech services. By 2005 just over 1.8 million people worked in high tech manufacturing across the EU15, but 5.8 million worked in high tech services.

Knowledge based services

Knowledge based services employment increased by 31 per cent over the period. There was also a significant increase in employment in other services such as retail and hospitality, up by just under 14 per cent.

Even so, knowledge based services have been growing twice as fast as other services across the EU15. Of the 21 million jobs created in services in this period across the EU15, nearly 14 million or two thirds of the total were in knowledge-based services.

The fastest growing knowledge based services were market-based sectors such as business services and communications and high tech services, which expanded by just nearly 55 per cent and nearly 40 per cent respectively between 1995 and 2005. The more public based knowledge services also grew significantly, but at a somewhat slower pace of 27 per cent. In contrast, financial services contributed little in the way of net job growth, expanding by just over 2.5 per cent.

KNOWLEDGE SERVICES PROVIDE MOST NEW SERVICE JOBS IN EU15 1995-2005

EU15 1995-2005	Change 000s	Change %
Business and communications	+5090	+54.5%
High tech services	+1581	+37.1%
Health, education	+6838	+26.7%
Financial services	+ 129	+ 2.5%
All knowledge services	**+13637**	**+30.7%**
Less knowledge intense services	**+ 6945**	**+13.5%**

Note: education and health include recreational and cultural; business and communication include some travel services.
Source: Eurostat

There are of course significant differences at the national level, although in all economies knowledge based services increased faster than less knowledge-based services. The most extreme example was Germany, where knowledge based service employment increased by 26 per cent, but less knowledge intensive services saw net growth of only 2 per cent.

Although financial services employment showed only modest growth at the EU15 level, there were significant gains in Ireland, Spain and the Netherlands. However, job shedding in financial services in Germany and Italy largely offset these gains.

In contrast, high tech services expanded in all economies, with exceptionally strong growth in Spain, Ireland, the Netherlands and Austria. However, in absolute terms the UK created the largest number of high tech service jobs, more than offsetting large-scale job losses in high tech manufacturing.

Business and communication services also expanded in all economies, but in both absolute and percentage terms the leading EU economy by a significant margin was Italy, followed by the Netherlands and Spain.

How Europe compares with the United States

There is no US equivalent of the Eurostat statistics on employment in knowledge-based industries. However, we have carried out an analysis of the US employment statistics using similar but not identical groups of industries to those used by Eurostat. The US figures are also for employees while the EU figures include all in work such as the self-employed and family workers. The figures are not therefore directly comparable, but we think they are approximate enough to allow some broad conclusions to be drawn.

Overall, employment in knowledge-based industries in the US in 2005 appeared to be about 38 per cent, roughly comparable to the EU average. However, employment in knowledge based industries in the US was less than in the Nordics, the UK, and the Netherlands.

The two most important reasons were the lower share of employment in high to medium tech manufacturing and lower shares of employment in public based services such as education and health in the US compared with the EU.

Over the past ten years the knowledge-based industries in the US have grown at roughly similar rates as in the EU. Between 1995 and 2005 employee employment in knowledge-based industries in the US grew by 21 per cent. Over the same period knowledge based industry employment across the EU went up by 24 per cent. However, there are some significant differences in composition.

Firstly, technology based manufacturing shed far more jobs in the US than in the EU over this period. Overall, high to medium tech manufacturing employee employment fell by 17 per cent compared with a 2 per cent fall in total employment in the EU. This was mainly because US medium tech manufacturing shed significant numbers of jobs, in contrast to relative stability within the EU.

Secondly, there was also a significant increase in employment in US financial services, up 19 per cent. In contrast, there was little net job expansion in financial services in Europe. In Europe, however, business and communication services grew much faster in Europe, up by 55 per cent compared with 32 per cent in the US.

Employment in education and health services grew at roughly the same rate in both the US and the EU over this period.

Employment growth in non-knowledge services was also broadly comparable over this period in both the US and the EU15. The big difference was in non-manufacturing production industries such as energy and water, agriculture, and construction. US employment grew significantly in these sectors, in contrast to a slight fall across the EU15.

CHANGE IN EMPLOYMENT IN KNOWLEDGE BASED INDUSTRIES IN EUROPE AND THE UNITED STATES1995-2005

Knowledge based	US	EU15
High-medium tech manufacturing	-15.7%	- 2.4%
Knowledge based services	+27.2%	+30.7%
All knowledge based	+20.9%	+23.9%
Low-medium tech manufacturing	-18.3%	-7.5%
Less knowledge based services	+12.7%	+13.5%
All non-knowledge based industries	+10.2%	+ 5.7%
Total employment	+14.0%	+12.6%

Note: US figures based on work Foundation estimates, using US Bureau of Labor Statistics. US is employees, EU15 is total employment.
Sources: Eurostat, Work Foundation.

Investing in knowledge

Europe has a well-developed knowledge economy measured by employment in knowledge-based industries. But there has been little pay-off so far in terms of increasing the potential growth and productivity of Europe. Indeed, the expansion of employment in knowledge-based industries has seen a slowdown in productivity growth in Europe, while a similar expansion of knowledge based employment in the US has been accompanied by an acceleration in productivity growth.

One reason may be that Europe has expanded the number of knowledge jobs but has not made the underpinning investment in knowledge that would release wider economic benefits.

The OECD has developed a composite indicator of knowledge investment comprising investment in R&D, investment in IT software and investment in higher education as a share of GDP. By this measure the most EU economies with the exception of the Nordics failed to increase knowledge investment between 1994 and 2002. In contrast, the US increased investment significantly and pulled even further way from the rest. In 2002 the US invested 6.6 per cent of GDP in knowledge compared with 3.9 per cent in Germany, 3.7 per cent in France and the UK, and 2.4 per cent in Italy.

A key element of knowledge investment highlighted by Kok was R&D, with the report citing evidence that up to 40 per cent of productivity growth could be linked to R&D spending. However, latest figures suggest the disappointment expressed in the Kok report at the lack of progress since Lisbon remains well founded.

INVESTMENT IN KNOWLEDGE – EUROPE FALLS BEHIND 1994-2002

% of GDP	1994	2002	Change
Sweden	5.1%	6.8%	+1.7
US	5.4%	6.6%	+1.2
Finland	4.7%	6.1%	+1.4
Korea	4.9%	5.9%	+1.0
Denmark	3.7%	5.5%	+1.8
Japan	3.9%	5.0%	+1.1
Canada	4.5%	4.7%	+0.2
Australia	3.9%	4.1%	+0.2
Germany	3.4%	3.7%	+0.3
Belgium	3.6%	3.8%	+0.2
Netherlands	3.4%	3.8%	+0.4
France	3.4%	3.7%	+0.3
UK	3.5%	3.7%	+0.2
Austria	2.3%	3.4%	+1.1
Spain	2.1%	2.8%	+0.7
Ireland	2.6%	2.4%	-0.2
Italy	2.0%	2.4%	+0.4
Greece	1.1%	1.9%	+0.8
Portugal	1.3%	1.8%	+0.5

Note: investment in knowledge defined as investment in R&D, software, and higher education.
Source: OECD

The Lisbon target was 3 per cent of GDP spent on R&D by 2010. The Barcelona Council in 2002 confirmed the overall target and indicated that two thirds or 1.2 per cent of GDP should come from business.

Latest figures show that the EU15 overall invested 1.9 per cent of GDP in R&D in 2004, with 1.2 per cent coming from business. In contrast, the US invested 2.7 per cent of GDP

in R&D in 2004, with 1.9 per cent coming from business.

Between 1994 and 2004 R&D spending as a share of GDP across the EU15 increased by less than 0.1 per cent of GDP. The US and Japan increased spending by between 0.3 and 0.4 per cent of GDP over the same period. R&D spending went up in several EU States but R&D spending fell as a share of GDP in France, the UK, the Netherlands, and Ireland.

Since 2000, when the Lisbon target was set, the position has worsened. EU spending on R&D as a share of GDP was virtually unchanged between 2000 and 2004. R&D spending fell in Sweden and Finland, Belgium, the UK, the Netherlands and Greece.

The relative position against the US did not deteriorate however because US spending on R&D as a share of GDP has also fallen since 2000. Business investment in US R&D increased very rapidly in the second half of the 1990s on the back of the ICT production boom, but since 2000 has been falling back to more sustainable levels.

R&D as share of EU GDP 1994-2004

Total R&D % of GDP	2004	1994-2004	2000-2004
Sweden	3.70%	+0.38	-0.53
Finland	3.47%	+1.18	-0.09
Japan	**3.20%**	**+0.41**	**+0.15**
US	**2.66%**	**+0.26**	**-0.07**
Denmark	2.58%	+0.76	+0.34
Germany	2.49%	+0.31	+0.04
Austria	2.34%	+0.83	+0.43
France	2.16%	-0.16	+0.01
EU15	**1.92%**	**+0.07**	**+0.01**
Belgium	1.90%	+0.21	-0.07
UK	1.79%	-0.22	-0.05
Netherlands	1.78%	-0.19	-0.12
Ireland	1.20%	-0.07	+0.07
Italy	1.11%	+0.09	+0.06
Spain	1.07%	+0.26	+0.16
Portugal	1.00%	+0.41	+0.24
Greece	0.57%	+0.08	-0.07

Note: EU15, Denmark 1995-2004; Greece, Sweden 1995-2004 and 2001-2004. Austria, Finland 1994-2005; Italy, Japan 1994-2003.
Source: Eurostat

However, even taking the post 2000 slowdown into account, investment in R&D in the US in 2004 was still significantly higher than in 1995. EU R&D investment levels represented 77 per cent of US investment levels in 1995, but by 2004 this had fallen to 72 per cent of US levels.

The overall US R&D performance was also assisted by a stronger contribution from non-

business investment (much of it defence related) since 2000. The EU non-business R&D effort has also increased very slightly as a share of GDP since 2000, but much less than in the US.

INVESTMENT IN R&D 1994-2004 – EUROPE FALLS BEHIND THE US

R&D investment	1994	2004
% of GDP	US =100	US =100
Total	77	72
Business	70	66
Non-business	93	86

Source: Eurostat

Eurostat has not published a similar time-series for ICT spending (including hardware, equipment, software and services). However, latest figures for 2004 show a significant gap against the US. In 2004 the US invested 4.6 per cent in ICT compared with 3 per cent across the EU15. In 2002 investment in ICT represented 3.2 per cent of EU15, but the period is too short to allow any conclusions to be drawn.

The top EU performers were Sweden and the UK with ICT investment of 4.4 per cent and 4.2 per cent of GDP respectively, followed by the Netherlands, Finland and Denmark. The UK and the Netherlands are unusual in having high rates of investment in ICT despite modest rates of investment in R&D.

The US and European Experiences Compared

Why then did the US and European experiences vary so much over the past decade? Research suggests some possibilities, but is far from conclusive.

Dale Jorgenson and his colleagues (2006) [1]detect two surges of US productivity growth in the last decade, the first taking place between 1995 and 2000, and the second taking place after 2000.

The research suggests that the contribution of IT total factor productivity (TFP) and IT capital deepening constituted about 60 per cent of productivity growth from 1995-2000 and most of the acceleration when the period is contrasted with the preceding twenty years. This is consistent with conventional narratives according to which rapid technological progress as symbolised by “Moore’s Law,” has allowed each generation of new equipment to outperform prior generations.

The upshot is that IT performance has improved while prices have been falling. This is reflected in the high rates of TFP growth in IT-production. With falling price declines for IT

[1] Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh. “The Sources of the Second Surge of U.S. Productivity and Implications for the Future”. Harvard University mimeo, 2006.

investment, firms have sought to replace other productive inputs with IT assets. Considerable investment in IT, about one-third of nonresidential fixed investment in 2000, resulted in the large contribution of IT capital deepening to labor productivity growth.

However, this picture looks strikingly different after 2000. As Jorgenson and his colleagues point out, IT total factor productivity and IT capital deepening represent only 30% of productivity growth from 2000-2004 and decline in relative importance after 2000. The acceleration in aggregate productivity after 2000 reflects other factors such as labour productivity growth, non-IT capital deepening and non-IT TFP growth, all of which increase markedly.

However, while the impact of IT is less striking in the second period, it has not disappeared altogether. IT investment, for example, is less than 5 percent of aggregate output, but the two IT channels accounted for about 30 percent of the productivity growth since 2000. Only when the second surge of productivity, i.e., the change in the growth rate after 2000 is examined does the IT contribution turn negative. In one sense, this may be interpreted as a return to sanity after headiness of the late 1990s.

Van Ark and Inklaar (2006) and Inklaar, O'Mahony and Timmer (2005)[2] take up this thesis and use it to look at the reasons for the slowdown of productivity growth in Europe for the periods 1987-1995, 1995-2000 and 2000-2004. As is well documented, ICT investment, ICT production and the productive use of ICT in Europe generated less productivity growth during the late 1990s.

While IT-using industries continue to contribute to aggregate productivity growth and to the second productivity surge, it remains that "other industries" played a bigger role during the second productivity surge as the gap between IT-using and "other industries" narrowed. One reading of this is that these recent gains, while extensive, are short-term and cyclical in nature as firms push workers to increase efficiency and tentatively employ more workers. A rather more optimistic reading is that these gains reflect the productive benefits of other forms of technological progress outside of IT-

[2] Van Ark, Bart and Robert Inklaar. "Catching Up or Getting Stuck? Europe's Troubles to Exploit ICT's Productivity Potential," Groningen Growth and Development Center, Working Paper GD-79, September 2006.
Inklaar, R., M. O'Mahony and M. P. Timmer, "ICT and Europe's Productivity Performance; Industry-level Growth Account Comparisons with the United States", *Review of Income and Wealth*, 51(4), pp. 505-536, 2005

production, the general purpose technology (GPT) nature of IT.

Van Ark and Inglaar (2006) argue that a sluggish adjustment process towards so-called "soft savings" may cause a declining rate of productivity growth in Europe from ICT usage, in particular in the TFP growth of market services. These come on the back of earlier "hard savings" which are directly generated by ICT investment. Invoking and aligning themselves with the view that ICT is a general purpose technology, they argue that "soft savings" require investments in human and organization capital and other internal innovations, which are likely to be key in market services.

For Van Ark and Inglaar, realization of productivity effects from these soft savings is an uncertain, trial-and-error process. As such, an environment that is conducive to creative destruction and experimentation that produces space for good firms to excel and drives out inefficient users of ICT is essential. Indeed, in contrast to ICT, soft complements are paradigmatically sticky and difficult to transfer on the market and so will tend to persist longer in firms that are unproductive.

Evidence from level studies on product market regulation and labour market regulation underscores the importance of a competitive environment to resource allocation and productivity growth.

This is also confirmed by firm-level evidence on the dynamics of firm performance from the World Bank (Bartelsman, Haltiwanger and Scarpetta 2004)[3]. Looking at 24 countries and two-digit industries, it draws attention to the divergent post-entry performance of successful new firms, a pattern otherwise obscured by the broad similarities in entry and exit rates.

Notably, new firms in the US tend to expand grow more rapidly than European ones in the early years of life, a dynamic which suggests that barriers to growth are more important than barriers to entry. At the same time, entrants in the US are considerably more heterogeneous: they tend to be smaller in comparative size than incumbents and less productive than entrants in Europe. However, as the World Bank notes, they are more likely to exit early on and then expand if they do survive – a dynamic which suggests higher levels of learning by doing and more rapid sorting between successful and unsuccessful entrants in the US, although the larger US domestic market clearly plays a role.

[3] Bartelsman E., J. Haltiwanger, and S. Scarpetta, "Microeconomic Evidence of Creative Destruction from Industrial and Developing Countries," IZA Discussion Paper Series No. 1374 (2004)

This thesis is partly called into question by Bloom, Sadun and Van Reenen (2005)[4] who believe that any arguments highlighting US's superior environment must be complemented by arguments which take account of the organizational strength of US firms. They explore this by examining the IT performance of US owned organizations in the UK – the assumption being that US multinationals export their business models to affiliates. If environmental factors are decisive, then there should be no IT-related productivity increase.

Interestingly, the biggest returns to ICT are found in the same ICT-using sectors that powered the US productivity revival, that is, wholesale and retail.

In accounting for these differences, the authors point to the role of *management practices.* This argument draws on work done with McKinsey that looks at the practices of 730 manufacturing firms in France, Germany, the US and the UK. Its main finding is that US firms are significantly better-managed mainland Europe or UK firms (Germany ranks 2nd, France 3rd and the UK trails last).

However, there is substantial variety within countries. For instance, though the UK fares poorly overall, its top firms are equal to those of the US. The study also finds that different countries excel at different aspects of management. For instance, German firms are good at shop floor and process management while US firms specialize in spotting talent and incentivising people.

The study attributes these differences to the degree of competition within different industry sub-sectors, and labour regulations. In addition to forcing firms to improve managerial practices by shaping up or closing, competition makes it easier for firms to adopt new practices. Labour market practices, however, obstruct competition by restricting hiring practices and talent management. However, competition seems to have little impact on brute effort. Here, the authors find little difference in terms of the hours worked by managers and workers in firms in sectors of high and low competition.

Bloom, Sadun and Van Reenen (2005)[5] distinguish between environmental and organizational factors by highlighting the role

[4] Bloom, Nick, Stephen Dorgan, John Dowdy, John Van Reenen and Tom Rippin. "Management Practices Across Firms and Nations". Centre for Economic Performance, LSE, 2005.

[5] Bloom, Nick, Raffaella Sadun and John Van Reenen. "It ain't what you do it's the way that you do i.t. - testing explanations of productivity growth using u.s. affiliates, Centre for Economic Performance, LSE, September 2005.

of managerial practices. However, it seems that those practices are largely attributable to the intensity of competition and in practice internal organization and external environment may be closely connected.

One reason for differences in diffusion are high costs: even though ICT hardware is traded internationally (as such prices should not vary) it seems that in the 1990s firms in the US and Canada paid less for ICT investment goods than firms in Europe and Japan (OECD 2001). Firm level surveys that ask firms and consumers about the barriers they face in using the Internet and electronic commerce also shed light on differences in diffusion.

Policy implications

Europe's productivity problem is essentially one of slowing technological progress. The argument that the inclusion of more unskilled workers has temporarily lowered EU productivity growth rates is wrong. As our analysis shows, employment structures across Europe have been shifting towards more skilled workers in knowledge-based industries.

The innovation slowdown and the the lack of an economic bonus from developing a knowledge based employment structure stem in our view, from the same root cause – lack of investment in knowledge. However we define knowledge investment, most European economies have not significantly increased their investments in this area over the past decade.

Framework conditions - Is the European social model the problem?

The Lisbon Strategy was clear that building the knowledge economy should be accompanied by greater social cohesion. The evidence on this point is reassuring. We can see no evidence that the strong growth in knowledge based industries over the past decade has significantly widened income inequality at the EU15 level (measured by the gini-coefficent) or indeed in most national economies.

Critics of the European social model might say this is precisely the problem. One reason why Europe has not got the economic benefits of the computer revolution, it is argued, is the degree of regulation in product and labour markets that slowdown the economic restructuring required to get the full benefits from ICT diffusion, inhibits investment in R&D and ICT, and prevent the necessary increase in wage inequality as knowledge workers with computers see wages increase faster than non-knowledge workers without computers.

There are strong arguments for continuing to modernise European product and labour markets. However, Europe has moved much closer to US levels of regulation in product markets over the past decade, and has also

reduced labour market regulation levels. Nor has stronger labour market regulation in Europe inhibited the development of knowledge-based industries compared with the US. Finally, the strong performance of the Nordic economies suggests there is nothing fundamentally incompatible with modern European social models and the development of a knowledge based economy.

Is it a measurement problem?

We cannot rule out that at least part of the problem is one of measurement – so that European productivity potential is being under-estimated. For example, European knowledge based services have done exceptionally well in world markets. However, this begs the question of why measurement problems have not also led to under-estimation of US productivity growth.

Is the 3 per cent target achievable?

With the record in mind, it must be a fair question to ask whether the 3 per cent target confirmed in the Lisbon mid-term review is achievable.

An obvious starting point is why 3 per cent? The US was investing around 2.8 per cent of GDP in R&D at the time of the Lisbon Council, and this has since fallen to just under 2.7 per cent.

Only three OECD economies invest 3 per cent or more of their GDP in R&D - Sweden, Finland and Japan. Over the past five years the share of GDP spent on R&D has fallen in both Sweden and Finland (albeit spending still remains well above 3 per cent of GDP). And a case can be made that Japan has been over-investing in R&D.[6]

The high rates of investment in some Nordic economies are based on robust innovation systems that took decades to build and stabilise against a background of strong social and political consensus Building similar robust systems across the EU is an even more challenging undertaking unlikely to be achieved over the next five years.

In our view the 3 per cent target as currently formulated is unachievable – and was probably unachievable at the time of Lisbon.

- Given that R&D investment across the EU has increased by less than 0.1 per cent of GDP in ten years, it would take a quite remarkable increase in the rate of investment to reach 3 per cent of EU GDP by 2010 or even 2015;
- Even if all the national plans in place in 2005 were fully implemented, R&D

[6] "Japan's investment in R&D has not contributed as much to the country's economic growth as can be expected from its volume" *Innovation Policy and Performance* OECD 2005

would only reach 2.6 per cent of GDP by 2010 according to Commission estimates[7];

- A recent independent assessment published by the Commission suggested that the underlying industrial structure of the EU makes the 2 per cent business investment target "*unrealistic and unachievable"* even by 2015[8].

A further point concerns the supply of researchers and scientists. A very rapid expansion in R&D spending needed to meet the Lisbon target could be constrained by an inelastic supply of researchers, resulting in higher wages rather than increased activity. Hence the importance that Kok placed on making the EU attractive to researchers and enhancing their mobility both within and without the EU.

Business could overcome EU shortages by shifting some R&D investment overseas, most likely to the US or even to Asia. But this would just make it even harder to meet the Lisbon target. The Aho Group Report highlights the danger of Europe becoming less attractive to multi-nationals as a place to do R&D.

Are tax incentives enough?

Many governments across the OECD have turned to fiscal incentives such as tax credits to boost private sector R&D over the past decade. There are good theoretical justifications for the policy and some evidence that the tax credit works, in that it generate some additional R&D.

However, so far their introduction has had little impact on aggregate business investment R&D as a share of GDP. It may be that credits are increasing R&D spending but not sufficiently to offset the structural shift away from R&D intensive activities.

Most countries have opted for credits that reward all R&D spending, not just additional spending. As a result, deadweight costs can be high and the additional R&D generated small.

Policy makers may therefore simply be expecting too much from the policy measure. A recent assessment in the UK concluded that even under highly favourable assumptions, tax credits would add only 0.1 per cent of GDP to UK business investment in R&D by 2014.[9]

[7] *More Research and Innovation – Investing for Growth and Employment*, (COM 2005 488 final).

[8] *Policy Indicators and Targets*, Arundel and Hollanders, MERIT December 2005. The researchers suggest a business investment target of 1.6 per cent by 2015 is more realistic, which implies an overall R&D target of 2.3 per cent.

[9] *Productivity Policy*, IFS 2005.

The Aho report challenges some recent trends in R&D support. For example,

- concentrating specific support on SMEs ignores that natural ecology of industry, as small firms thrive in the slipstream of large firms: medium sized firms would be a better target group;
- fiscal incentives should concentrate on visible effects for firms, such as reducing or eliminating social costs for R&D workers, while R&D grants have an important role and should be sustained;
- a major shift in the share of the EU structural funds towards supporting R&D (the report suggests 20 per cent compared the current share of 6 per cent);

The report suggests that support for SMEs is better delivered through general innovation infrastructures, including incubators, science parks, regional development bodies, and knowledge transfer organisations.

Resetting the 3 per cent target

We have argued that the 3 per cent R&D target as currently expressed is unachievable within the current timetable. The language around the target has already been moderated, with recent EU Council statements referring to “towards 3 per cent” by the end of the decade.

We suggest extending the timetable to 2015 and moderating the target to allow for the underlying structural change in the EU economy. For example, a demanding but more achievable target would be 2.5 per cent of GDP by 2015, roughly comparable with current rates of US R&D investment as a share of GDP.

We recognise this leaves policy makers with a dilemma. As Kok argued, changing the target or the timetable would send completely the wrong message to national governments and support the pessimists’ view that the EU can never achieve the Lisbon targets. But sticking with a target that cannot be met also leads to disillusionment with the Lisbon process and discredits future target setting by the EU.

If the target is modified, it will be important to re-emphasise the importance of efforts in raising the share of R&D in all member States. In particular, strict adherence to national plans will be required even if a structurally adjusted target of 2.5 per cent of GDP is to be met.

Building innovation frameworks – the key priority for Europe

Successive Presidencies from 2004 onwards have been developing innovation policy in the direction set out in the Aho report. The report offers a good basis to further develop a demand led innovation strategy for Europe. This should help complete the rebalancing of the policy focus between innovation inputs,

such as the share of R&D in GDP, and outputs measured by innovation activity.

The positive role of regulation and standards is of particular interest in the current debate about whether excessive regulation inhibits Europe from taking advantage of ICT. The report instead highlights the positive role of harmonisation of regulation and the use of demanding standards to encourage technological innovation in goods and services markets.

The role of the public sector through public procurement, improved productivity in public services and public support for R&D is also highlighted in encouraging innovation in goods and services. This is clearly an important area, given that public based services account for a higher share of employment in some European economies and for a higher share of public spending than in the US.

The Aho report emphasise the important role of clusters and regional agglomerations, arguing that new firms thrive in proximity to the companies, investors and educational and research centres. The development of industrial clusters clearly must have a role. However, we put more emphasis on the role of city-regions in building innovation friendly markets. The Work Foundation's *Ideopolis* project shows how city-regions in the UK can enjoy economic success by identifying the key drivers for creating a vibrant knowledge based economy.

Next steps

This report has sought to make a contribution to the current debate on the future of innovation policy across Europe. Our conclusions include:

- Europe has developed knowledge based industries comparable in employment terms with the US but has failed to make the underpinning knowledge investment in areas such as R&D, ICT software and higher education;

- R&D must be increased, but targets must be realistic and have a clear justification. The current Lisbon target of 3 per cent of EU GDP for R&D spending is neither and should be recast;

- We endorse the broad thrust of the Aho report's call for a European Research and Innovation Pact, to create innovation friendly markets;

- An important focus for implementation will be at the city-region level through the development of knowledge cities.

The Work Foundation's knowledge economy programme will be looking in more detail at many of these issues, including the drivers of R&D and innovation in the service and public sectors. As results become available, we hope they will offer further insights into how Europe can maximise the economic rewards from developing a knowledge-based economy.