4 BUSINESS R&D AND INNOVATION

Summary

4.1 Increasing innovation and R&D by business is a key part of the Government's productivity agenda. Innovation is an important determinant of economic growth in an era of market liberalisation, reductions in transport and communications costs and advances in science and technology. There is a clear relationship between R&D and productivity growth: studies show that a significant cause of the UK's productivity gap with the US is lower levels of R&D expenditure[1]. The DTI's Innovation Report identified that other factors were also important for a good innovation performance. These included more outcome-based regulation to encourage innovative compliance, demanding public sector procurement and a strong competition regime.

4.2 R&D intensity (the ratio of R&D across the economy to national gross domestic product) is a key indicator for measuring innovation performance. UK R&D intensity fell during the 1980s and 1990s as GDP growth outstripped growth in R&D. However, there are now signs that business R&D is rising as a share of national income.

4.3 As the Government sets out its aspirations for UK science and innovation over the coming decade, and the accompanying public investment to achieve these goals, a key determinant of the success of this strategy will be parallel commitment from the private sector to increase its investment in R&D and its links with the science base. This chapter explains the historic context of UK R&D and the economic rationale for raising R&D intensity in the UK.

Increasing knowledge-intensity of the UK economy

4.4 Research clearly shows that investment in business R&D generates substantial returns. A review of the literature reports that estimates of the private return to R&D cluster around 10-15 per cent, although they can be as high as 30 per cent. When one takes into account that benefits from the R&D also accrue to other firms or industries, then rates of return can reach 100 per cent.[2] As part of its goal to improve the competitiveness and innovation performance of the EU economy, the Barcelona European Council in 2002 set an aspirational target that R&D should rise towards three per cent of GDP by 2010 for the European Union as a whole, with business funding two-thirds of this total. France and Germany have adopted this as a national target.[3] A number of smaller Member States, whilst agreeing to the collective target in principle, have set less demanding national targets.

4.5 The UK faces a major challenge in trying to increase its R&D intensity towards the level of other major developed economies in Europe and beyond. To do this, real R&D expenditures would need to rise at a faster rate than trend economic growth (expected to be around 2½ per cent per annum). In the ten years between 1992 and 2002, annual R&D growth rates only exceeded 2½ per cent by a significant margin on two occasions. Since business R&D accounts for the largest share of total R&D, a

[1] DTI (2003) Competing in the Global Economy – The Innovation Challenge, DTI Economics paper 7.

[2] How important is Business R&D for economic growth and should the Government subsidise it? Griffith R, IFS briefing paper no 12, 2000

[3] Investing in Research: An Action Plan for Europe, European Commission, 2003

substantial increase in R&D intensity can only be achieved by significantly increasing business investment in R&D.

4.6 The Government agrees with the underlying policy analysis which led to the Barcelona target – the future potential of the UK economy and the rest of Europe to create wealth for the benefit of all must be more firmly rooted in knowledge-intensive activity, operating in a more flexible European economy. To do this, Europe must set more conducive economic framework conditions and supporting innovation policies:

- to capitalise more effectively on its knowledge assets in the science base and companies;
- to connect them more effectively through networks within and across countries in Europe; and
- to provide stronger incentives to invest and grow in Europe, through enabling enterprise by limiting costs of regulation, and opening markets through rigorous application of competition law.

4.7 The Government has built a strong platform for future growth in knowledge-intensive sectors in the UK through its successful reforms since 1997 to the macroeconomic framework and a range of microeconomic policies. The stronger growth performance of the UK economy since 1997, in comparison with the rest of the EU, is testimony to the positive impact of this approach to economic management.

4.8 The Government recognises, though, that continued future growth in output, employment and productivity are likely to depend increasingly on the UK's ability to create and exploit new knowledge. This in turn is reliant on the country's intellectual capital stock and flow. The economic analysis underlying the DTI's Innovation Report set out this analysis, which is being further developed during 2004 by the Prime Minister's Strategy Unit. Against this background, it is apparent that the UK would need to invest a higher proportion of its national income, from public and private sources, in creating productive knowledge assets and the people to exploit them, to secure a sustainable growth rate of the UK economy over the coming decade at or above the current rate.

4.9 To underpin the required increase in the output of the UK's knowledge-intensive economy, the Government considers that it is now right to set out a target for the UK to increase R&D intensity from the current level of 1.9 per cent to 2.5 per cent of GDP by 2014. Taking account of trends elsewhere in Europe, an increase to 2.5 per cent of GDP would be likely to put the UK among the leading major countries in the EU by the first half of the next decade.

4.10 To achieve this target requires substantial growth in business R&D in the UK. This in turn requires a similarly significant growth in the underpinning investment in the public science base, both to supply the skills and research results into the economy, and also to attract mobile business R&D investment into the UK. As this framework sets out, it will also require a continued strengthening of the linkages between the public and private sector research bases.

4.11 On the Government side, this Spending Review represents a further very substantial investment in the public science base, increasing funding, through the DTI and DfES, at an average annual rate of 5.8 per cent in real terms over the Spending Review 2004 period. At the same time, there are encouraging signs that, following decades of decline, private sector R&D in the UK is beginning to grow again. The

Government is committed to driving this partnership with the private sector forward - the central aim of this ten-year framework.

4.12 The framework sets out the Government's intention to increase investment in the public science base at least in line with the trend growth rate of the economy through the ten-year period, increasing science spending as a proportion of GDP.

4.13 However, the Government's overall ambition - that overall levels of R&D in the economy should reach 2 ½ per cent of GDP - would require a higher rate of annual growth than this across the aggregate private and public sector research bases - an average annual rate of 5 ¾ per cent from now over the coming decade. Table 4.1 below illustrates a possible scenario for achieving this growth rate, which in this case assumes an equal growth in both public and private sectors.

4.14 This scenario represents a considerable challenge both for Government and for UK business. It can be achieved only if this commitment from Government to invest substantially in the science base is matched by the private sector and leading charitable funding, and in particular that it is clear that private sector R&D funding is on a new and growing trajectory. This framework, therefore, sets out the Government's plans to monitor the implementation of the policy proposals to support the investment framework, reporting annually, as well as progress towards the 2 ½ per cent target.

Table 4.1: Indicative scenario towards 2½ per cent R&D/GDP target

	R&D investment as percentage of GDP	
	2004	**2014**
Science Base	0.35	0.5
Other Government R&D	0.31	0.3
Private sector	1.24[4]	1.7
UK total	**1.90**	**2.5**

4.15 Reaching 2½ per cent of GDP invested in R&D would result in an increase in UK-based R&D of around £16½ billion (in real terms, 2004-05 prices), some 75 per cent higher than the current level of investment of around £22½ billion.

Context: business R&D in the UK

4.16 Science, engineering and technology make a significant contribution to the UK economy in terms of GDP, economic growth and labour productivity. A recent report for the Engineering and Technology Board estimated that:[5]

- in 2002, SET-intensive sectors generated £252 billion of value added and accounted for 27 per cent of UK GDP at current prices;
- in the same year, SET skills generated directly £78 billion of value added and accounted for 8 per cent of total UK GDP at current prices;

[4] 2002 estimate (latest available)

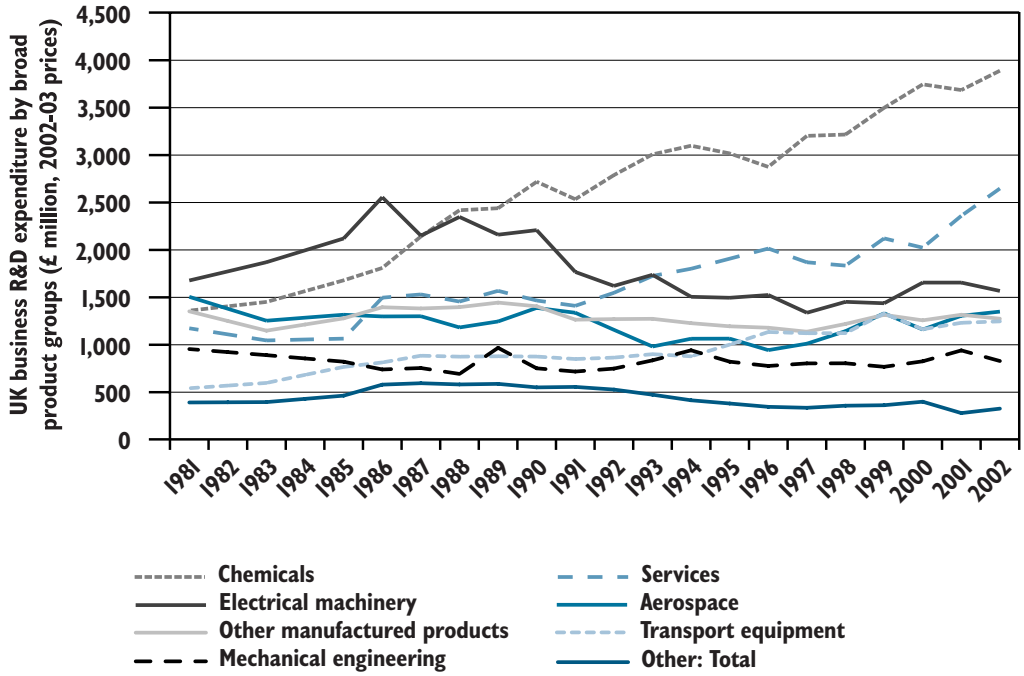
[5] Wealth Creation from Science, Engineering and Technology, 2004

- 61 per cent of the value added generated directly by SET skills was generated outside the SET-intensive sectors; and
- SET-intensive sectors accounted for 17 per cent of total GDP growth in the UK between 1993 and 2000.

4.17 Business expenditure on R&D (BERD) is the most commonly used economy-wide measure of technological innovation (although studies show that it is a partial measure and biased towards certain sectors[6]). Nevertheless it is widely used as a proxy for performance in an area where fully comprehensive measures of performance are lacking.

4.18 Since the 1980s, UK BERD in real terms has increased. The largest increases occurred in the chemicals (including pharmaceuticals) and transport equipment sectors. Large increases have also occurred in the service sector. This may reflect growing tendencies to outsource R&D.

Chart 4.1: UK business R&D expenditure by sector



Source: Office for National Statistics

4.19 Although rising in real terms, BERD as a percentage of GDP has fallen steadily and is now below the OECD average. Research suggests that this is largely due to falls in defence expenditure during the 1980s and slow growth in R&D spending within manufacturing, particularly machinery, equipment and transport, during the 1990s.[7]

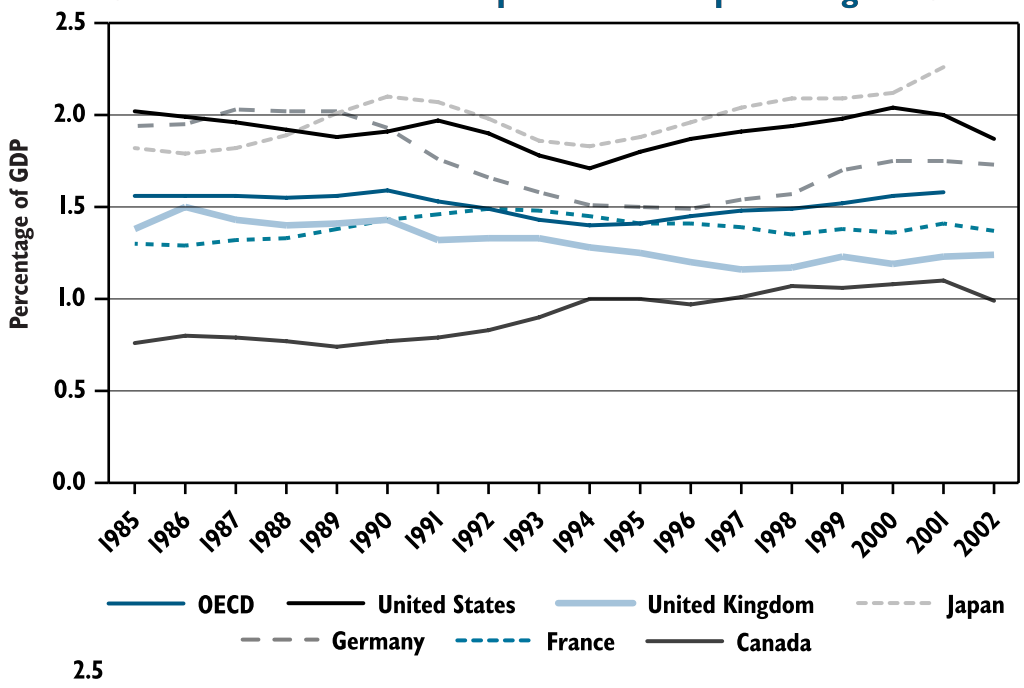
[6] Some of the caveats of R&D measures are set out in *Competing in the Global economy: The Innovation Challenge*, DTI Economics paper 7, 2003

[7] IFS Understanding the UK's poor technological performance, Briefing Note no 37, 2003

4.20 Compared to its peers (US, France, Germany):

- UK business R&D is heavily dependent on foreign affiliates, attracted to the strength of the UK science base and the relative cheapness of UK researchers (although the latter advantage may be eroding[8]);
- differences in industrial structure explain some of the difference in R&D intensity between the UK and US and the UK and France, but the most significant cause is lower R&D intensities in several leading sectors; and
- business R&D in the UK is heavily dependent on the efforts of a few leading firms, particularly in pharmaceuticals and aerospace, which, by international standards, spend substantial amounts on R&D.

Chart 4.2: Business R&D expenditure as a percentage of GDP

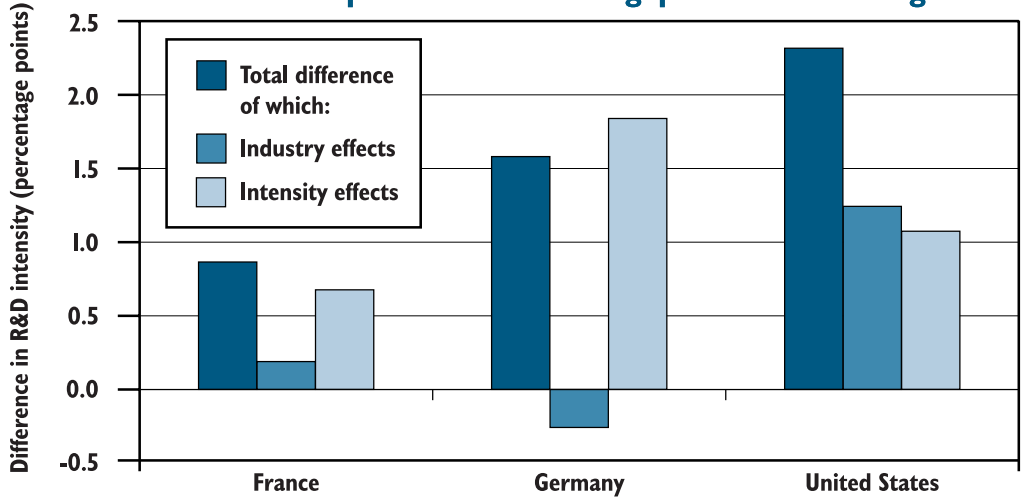


Source: OECD, Main Science and Technology Indicators (2004)

4.21 Differences between countries can be attributed to different shares of output in more R&D intensive sectors (such as pharmaceuticals) or differences in R&D intensity within any sector.

[8] Dougherty et al, Performing R&D abroad: international comparisons of value and price, Interim report to the National Science Foundation, 2002

Chart 4.3: Composition of UK R&D gap in manufacturing



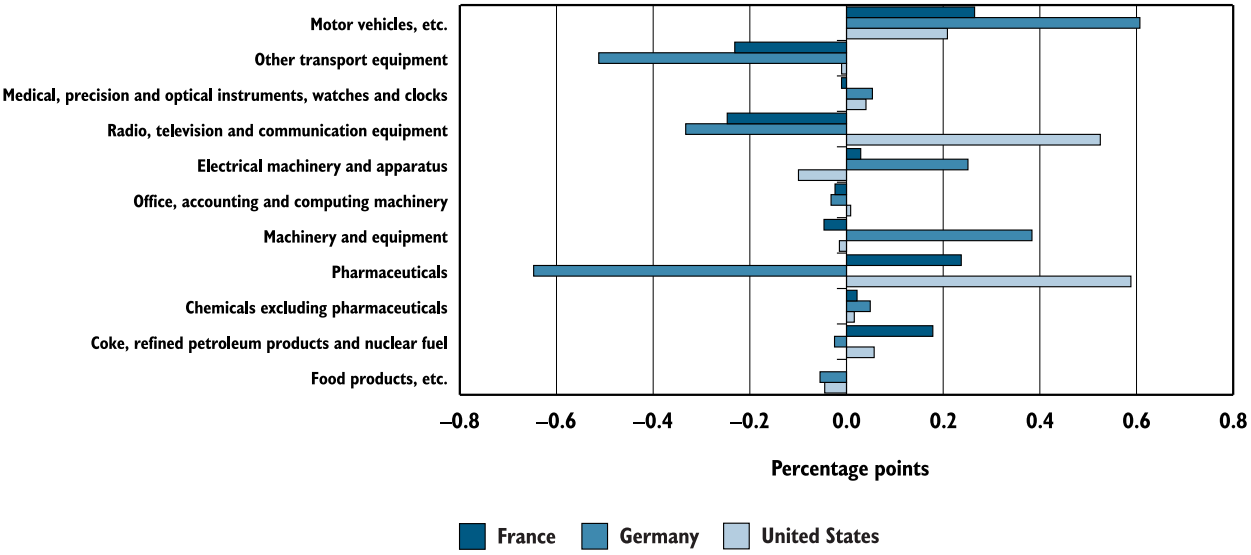
Source: OECD and DTI calculations (2004); R&D intensity calculated as R&D as a percentage of value added

4.22 Looking at UK and US manufacturing[9], differences in industrial mix and differences in R&D intensity within sectors account for roughly similar proportions of the difference in overall R&D intensity. Thus if the UK had the same mix of sectors within manufacturing as the US, manufacturing R&D intensity would rise from around 6 per cent to over 7.2 per cent. Industry mix effects account for a much smaller share of the difference in overall R&D intensities between the UK and France and the UK and Germany.

4.23 Differences in R&D intensity between the UK and US attributable to industry mix effects are due to three industries: pharmaceuticals; radio, television and communication equipment; and motor vehicles. The share of US manufacturing output in these three industries is much greater than the UK. Comparisons between the UK and Germany show that there are significant industry effects, but these are offsetting: higher German shares in machinery and motor vehicles offset lower German shares in pharmaceuticals, radio, television and communication equipment and other transport equipment. Comparing UK and France, lower French shares in other transport equipment, radio, television and communication equipment are partially offset by higher French shares in pharmaceuticals and energy products.

[9] Manufacturing accounts for the majority, around 80 per cent, of all R&D.

Chart 4.4: Differences in overall R&D intensity caused by differences in industry structure

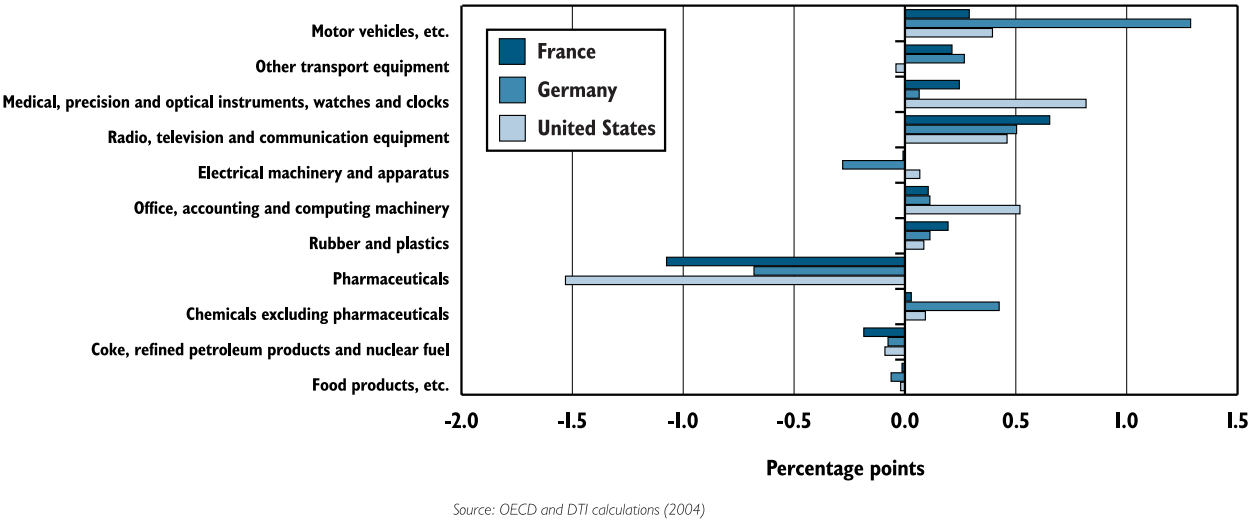


Source: OECD and DTI calculations (2004)
Other sectors not illustrated where differences insignificant: Manufacturing, Fabricated metal products, Basic metals, Other non-metallic mineral products, wood, paper, printing, publishing, textiles, rubber and plastics

4.24 Comparing R&D intensities within sectors, the only areas where UK firms consistently spend more as a percentage of value added are pharmaceuticals and energy products. The UK's dependence on pharmaceuticals R&D is also reflected in the R&D scoreboard which shows that the only UK firms to make the top 30 of the international R&D scoreboard are GlaxoSmithKline and AstraZeneca.

4.25 Across most sectors differences between UK, French, German and US R&D intensities are small. But there are large differences in office accounting and computing machinery; radio, television and communication equipment; instruments; motor vehicles; and other transport, suggesting that these sectors are largely responsible for the UK's lower R&D intensity.

Chart 4.5: Difference in overall R&D intensity caused by differences in sector intensities



Source: OECD and DTI calculations (2004)
Other sectors not illustrated where differences insignificant: Manufacturing, Fabricated metal products, Basic metals, Other non-metallic mineral products, wood, paper, printing, publishing, textiles, machinery and equipment