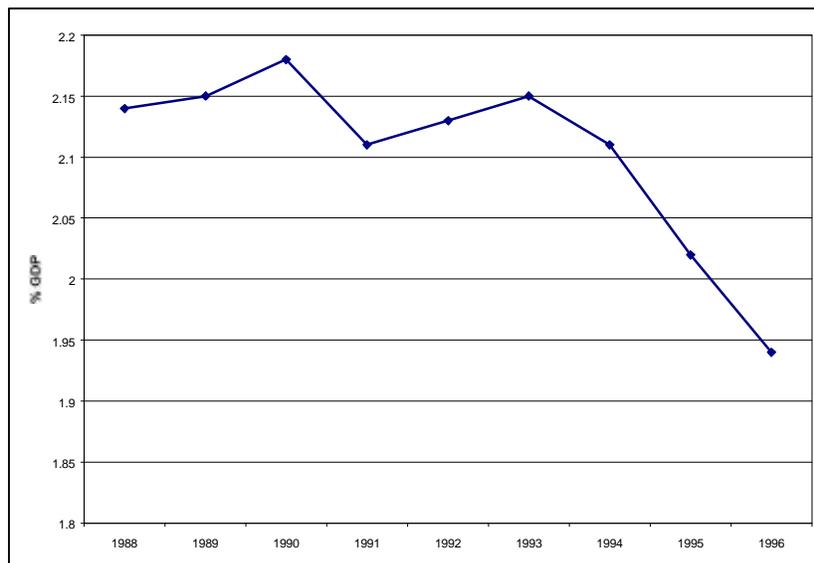


National Science and Technology Effort and Funding Goals

The election of Margaret Thatcher's Conservative government in the late 1970s began a period of government downsizing and liberalization of key British industries that persists to the present. Whereas the 1970s may be regarded by many as the high water mark of the postwar welfare state in Britain, characterized by heavy regulation and high taxes, prices, and unemployment, over the ensuing decades, the United Kingdom has come to represent the vanguard of deregulation and laissez faire policies.ⁱ

The ideological shift in the United Kingdom from welfare state to free market economics has had many important effects on the country, among them the introduction of considerable turmoil in the overall research and development enterprise. Figure 2 shows that between 1988 and 1996, for example, the government's direct support for R&D declined from 35.4% to 31.8% of the national (i.e., combined public and private sector) total, as R&D decision-making has been left increasingly to the private sector. Yet, as Figure 1 shows, as a percentage of GDP, overall R&D investments in the UK have declined significantly in recent years from 2.14% to 1.94%. The liberalization of major industries (e.g., airlines, telecommunications, and energy) and economic integration with the European Union have placed mounting pressure on firms' R&D expenditures. As a result, the UK now ranks fifth among G-7 countries as a sponsor of R&D.ⁱⁱ Moreover, between 1986 and 1996, for example, the portion of the United Kingdom's R&D effort accounted for by public investment fell by 14% in real terms, from \$9.6 billion to \$8.3 billion.ⁱⁱⁱ

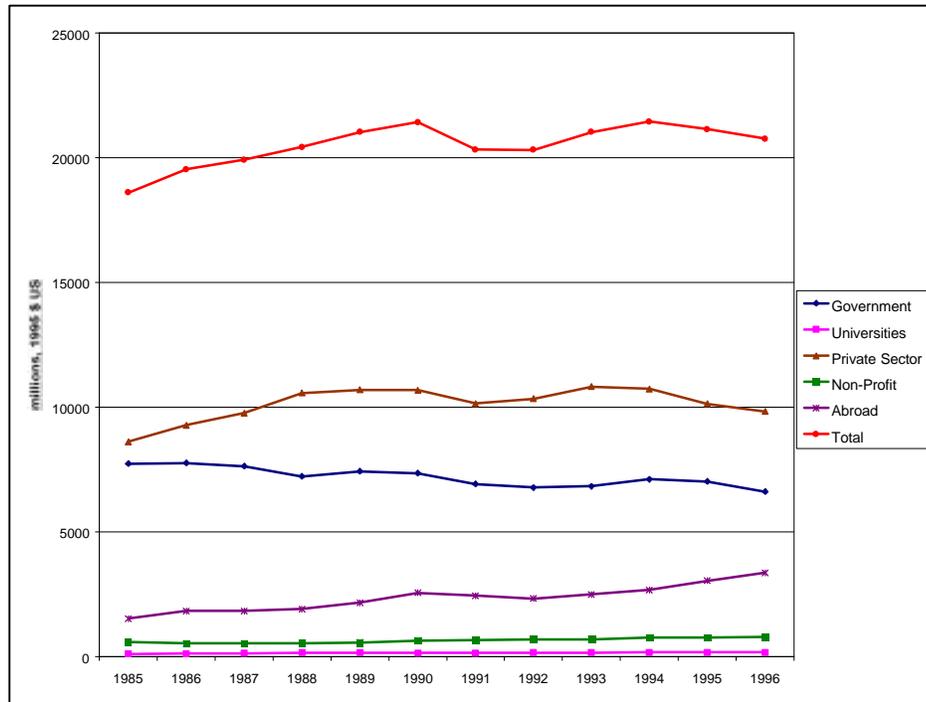
Figure 1. R&D as a Percentage of GDP, 1988-1996^{iv}



Private sector R&D in many key technology areas has also declined significantly in recent years. With the exception of the pharmaceuticals industry, research expenditures fell in real terms in each of the R&D-intensive industries shown in Figure 3, below.

Among the industries that experienced the sharpest reductions in R&D investment were the extractive industries (including oil and coal production), where investments fell by 56% to \$93 million between 1989 and 1996, and the electricity, gas, and water supply industries, where investment fell by 40% to \$214 million over the same period.^v

Figure 2. Expenditures on R&D in the United Kingdom by Funding Source, 1985-1996



A major factor that has contributed to the recent decline in private sector R&D in the UK has been the country's relatively volatile macroeconomic conditions over the past two decades; at various times, high inflation rates, large fluctuations in demand, and large budget deficits have all discouraged long-term investment. Perceptions of volatility have encouraged companies and financial institutions to place greater emphasis on short-term gains and to steer away from longer-term R&D projects. This emphasis on short-term gains has had a particularly great impact on the R&D activities of small and medium-sized companies, which typically have neither the internal capital nor the access to external sources of finance that larger corporations have. Yet even large corporations that have historically been the largest sponsors of private sector R&D have scaled back their research efforts significantly in most industries, considering shareholders' dividend expectations and the rising tide of takeover activity in the UK's increasingly liberalized marketplace.^{vi}

The federal government's downsizing of its support for R&D over the past two decades has also compounded the decline of R&D performance and funding by private enterprises. Between 1981 and 1995, for example, the UK's total private sector R&D

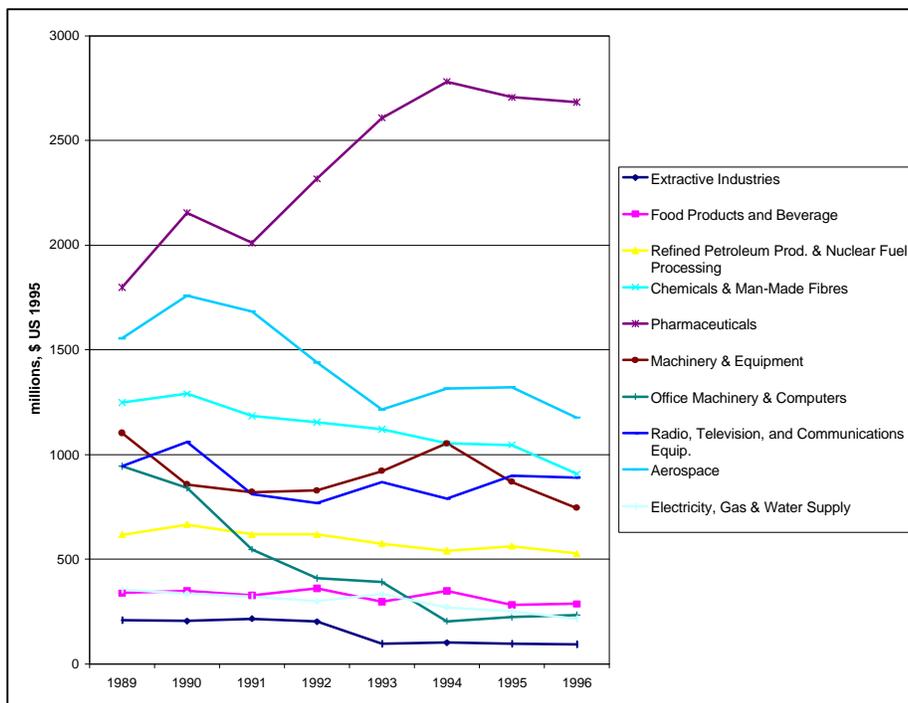
investment as a percentage of GDP fell from approximately 1.5% to 1.3%, causing Britain to fall from the third to the fifth rank among G-7 countries as a private R&D sponsor. Despite its aim of privatizing the conduct of research via reliance on market mechanisms to determine the appropriate levels and directions of investment in innovation, the British government acknowledges that this policy has not worked well and that the country's R&D has reached a critical level of ill health and a condition that threatens future economic growth and international competitiveness.^{vii}

The government has responded with a series of measures aimed at changing the UK's incentive structure as it affects private R&D. For example, the 1997 Corporation Tax Reform removed a bias in the tax system that favored the distribution, rather than retention, of profits. Other initiatives, such as the Department of Trade and Industry's SMART program, provide grants for feasibility studies and product development; a Small Firms Loan Guarantee Scheme aims to improve small high-tech firms' access to finance; and the government's Business Links program serves as a clearinghouse, providing information, advice and technical assistance to help firms secure R&D funding from private sources.^{viii} Nonetheless, the most recent data suggest that the UK's overall R&D enterprise—having declined by 7% in real terms between 1989 and 1996—remains anemic and requires renewed commitments to reinvestment.^{ix}

The British government has also established several government-industry working groups that focus on specific barriers to innovation faced by industry. Working groups focus, for example, on the financing and management of high-technology start-ups and aim to identify and eliminate barriers to high-technology industry growth, including problems associated with the acquisition of capital (especially for smaller firms) and with the domestic tax environment for technology firms. The Investment Working Party, chaired by the Minister for Science, Energy, and Industry, includes representatives from small and large firms in the manufacturing and service industries and serves as a clearinghouse to identify ways that U.K. business can improve its performance in innovation.^x

Since 1994, a key element of the government's R&D effort has been the Technology Foresight Programme, housed in the Office of Science and Technology of the Department of Trade and Industry. The Foresight Programme is a government-sponsored forum in which representatives from federal agencies, industry, and academia meet to identify the UK's technology priorities in fifteen key economic areas, including energy. The Programme has provided over \$300 million for collaborative research projects since its inception. The Foresight Programme, like many of the other government-sponsored programs described above, underscores the British government's continued reliance on market mechanisms and reluctance to intervene in the economy directly to shore up the country's R&D infrastructure. While several of the programs described here have been successful in achieving their intended aims, most have tended to favor the refinement and commercial deployment of technologies already in the development process. Thus, longer-term projects, riskier ventures with less certain payoffs, and the basic research end of the innovation process in many respects continue to languish under the current orientation of the British R&D system.

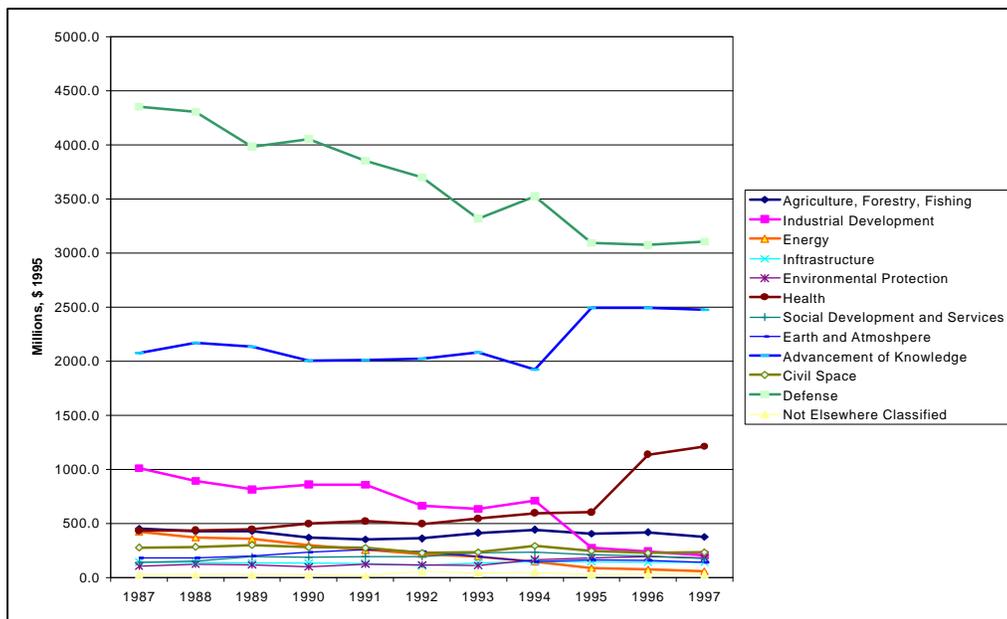
Figure 3. Selected UK Industries' R&D Expenditures 1989-1996



Recognizing these shortcomings, the government has begun to take action to reverse the trend in support for research. One of its most important objectives in this regard is the refurbishment of the university-based research infrastructure. Over the next three years (1999-2002), the government, in partnership with the Wellcome Trust—the United Kingdom’s largest charitable funder of scientific research—will invest \$2.3 billion (\$665 million of which will come from the Wellcome Trust) in the construction and renovation of university research facilities, and the purchase of new equipment through a new public-private sector initiative called the Joint Infrastructure Fund. While the Joint Infrastructure Fund will focus on the full spectrum of university-based scientific research, the Wellcome Trust’s contributions to the Fund will be devoted primarily to the development of facilities in the biomedical and related scientific fields.^{xi}

As Figure 4 shows, the overall decline in R&D investment has had different implications for different research areas. Defense R&D, for example, has been one of the hardest hit areas over the past decade. While the defense R&D budget had begun to decline in the late 1980s, the rate of decline accelerated after 1991, in the aftermath of both the Cold War and the Gulf War. Between 1986 and 1996, defense R&D spending fell by 30% in real terms, before recovering slightly, by 0.8%, in 1997. Budget reductions of more than 80% in both the industrial development and energy areas, reflect the government’s policy shift in favor of a reduction of its intervention in the economy.

Figure 4. Government R&D Expenditure by Socio-Economic Area 1986-1997



A few research areas have, on the other hand, enjoyed increasing government support in recent years. For instance, after a long period of flat and falling budgets, government investment in general university funds (“advancement of knowledge”) jumped 23% between 1993-1994. The Labour government, which took office in 1997, reiterated its predecessor’s stated commitment to improving the science base. In addition to its support for university-based science, the government is aiming to promote the commercialization of university research by creating incentives for researchers to partner with industry and for entrepreneurs to start new, technology-oriented small businesses.^{xii} The government’s partnership with the Wellcome Trust to rebuild the country’s university science infrastructure is a critical underlying component of this task.

In contrast to the reductions in R&D support observed in many areas, government funding for health research has also grown substantially, by 60% in real terms since 1991. This trend stands at odds with the United Kingdom’s general policy of reduced government roles in research. The government’s increasing emphasis on R&D funding in the health area reflects the major potential benefits to the economy that the current advances in the health and biotechnology fields hold. The government’s investments in health science and technology aim to provide the necessary basic infrastructure and expertise that leadership in the health industries require. For example, the United Kingdom’s pharmaceutical industry has historically been a world leader; yet recent surveys of pharmaceutical industry executives and researchers have indicated that a lack of qualified scientific personnel has become a limiting factor to the future strength of the U.K.’s leadership and competitiveness in this and other key industries.^{xiii}

ⁱ See Daniel Yergin and Joseph Stanislaw, *The Commanding Heights* (New York: Simon and Schuster, 1998).

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- ⁱⁱ Department of Trade and Industry, Office of Science and Technology, *Science, Engineering, and Technology Statistics 1998* (July 1998), p.71.
- ⁱⁱⁱ The United Kingdom's ratio of industrial R&D to gross domestic product fell from 1.61% to 1.47% over the period. Reported in Economic and Social Research Council, "Promoting R&D Through Fiscal Incentives: An Assessment of the Arguments," http://www.ifs.org.uk/research/corporate/R_AND_D_CREDIT.HTM
- ^{iv} Department of Trade and Industry, Office of Science and Technology, *Science, Engineering, and Technology Statistics 1998* (July 1998), p.71.
- ^v Department of Trade and Industry, Office of Science and Technology, *Science, Engineering, and Technology Statistics 1998* (July 1998), p. 36.
- ^{vi} HM Treasury and Department of Trade and Industry, *Innovating for the Future: Investing in R&D*, Consultation Document (March 1998).
- ^{vii} HM Treasury and Department of Trade and Industry, *Innovating for the Future: Investing in R&D*, Consultation Document (March 1998).
- ^{viii} HM Treasury and Department of Trade and Industry, *Innovating for the Future: Investing in R&D (A Consultation Document)*, March 1998, Chapter 2.
- ^{ix} HM Treasury and Department of Trade and Industry, *Innovating for the Future: Investing in R&D*, Consultation Document (March 1998).
- ^x HM Treasury and Department of Trade and Industry, *Innovating for the Future: Investing in R&D (A Consultation Document)*, March 1998, Introduction.
- ^{xi} Department of Trade and Industry, "Allocation of the Science Budget 1999-00 to 2001-02," <http://www.dti.gov.uk/ost/allsb9902/ALLBOOK2.html>
- ^{xii} Department of Trade and Industry/Office of Science and Technology, *Our Competitive Future: Building the Knowledge Driven Economy*, (London: The Stationery Office Limited, 1998).
- ^{xiii} Economic and Social Research Council, "Innovation Update: The Role of Scientists and Engineers in Technological Change."