National Audit Office

MEMORANDUM FOR THE HOUSE OF COMMONS SCIENCE AND TECHNOLOGY COMMITTEE

JUNE 2013

Cross-government

Research and Development funding for science and technology in the UK

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Research and Development funding for science and technology in the UK

Memorandum for the House of Commons
Science and Technology Committee

June 2013

In response to a request from the House of Commons Science and Technology Committee, this report provides an overview of Research and Development (R&D) spending in the UK since 1985, details the flow of funding from public and private sources, and compares R&D expenditure in the UK with expenditure in other countries.

Contents

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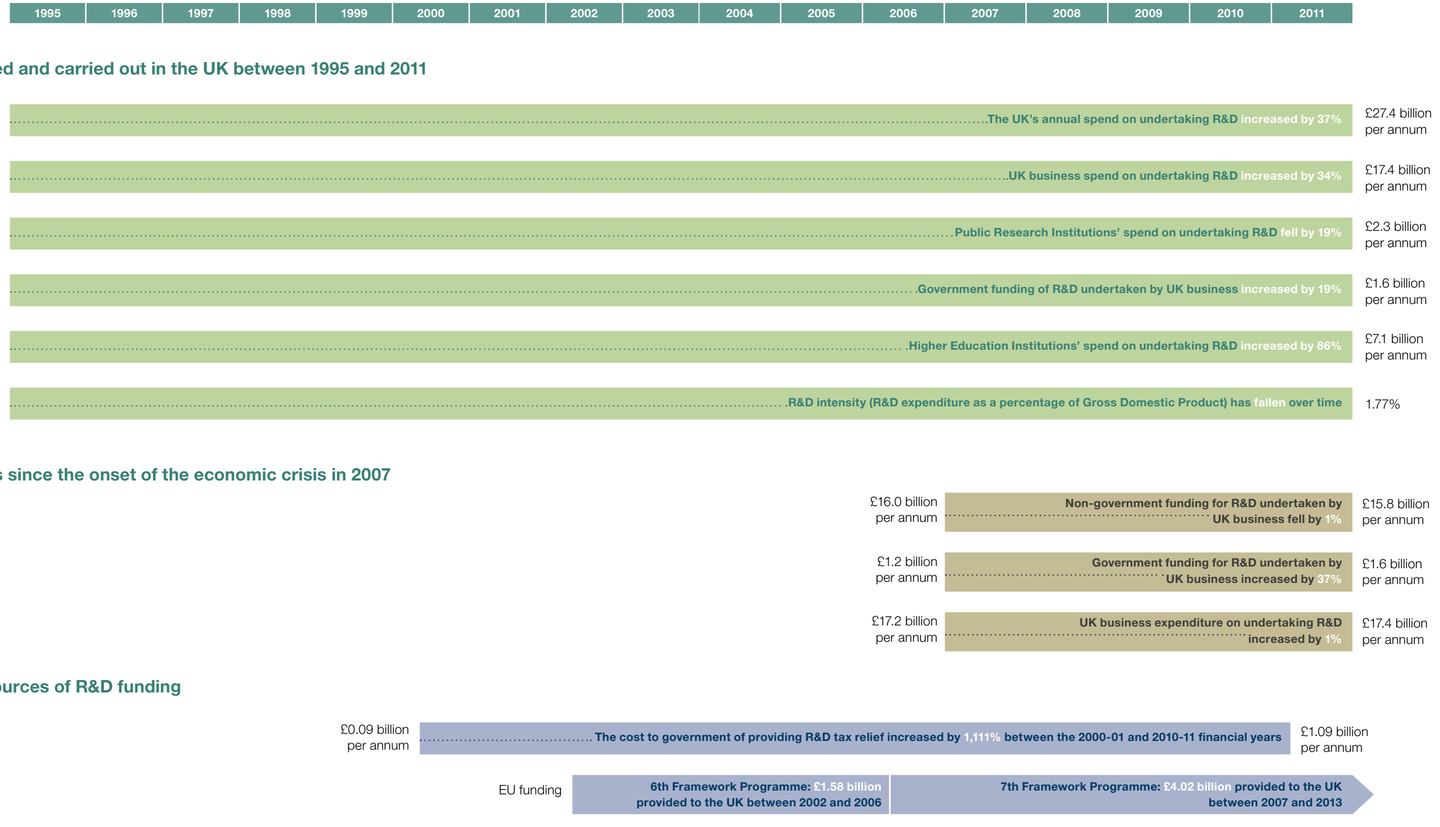
Key facts

Some differences between absolute figures do not reconcile to the percentage change due to rounding differences



Key characteristics in 2011

Regional concentration

89%
of the UK's spend on R&D takes place in England

52%
of the UK's spend on R&D takes place in London, the South East or the East of England

UK business

£17.4bn
spent undertaking R&D by UK business

44%
of UK business spend on undertaking R&D was by the top ten businesses in terms of R&D performed

£4.9bn
spent undertaking R&D within UK business was by the pharmaceuticals sector – **28%** of the UK's total spend on undertaking R&D

40%
of the total overseas funding for UK business R&D was for the pharmaceuticals sector

£4.0bn
spent undertaking R&D within small- and medium-sized enterprises – **23%** of the total spend by UK business

4%
of UK business R&D was undertaken by independent small- and medium-sized enterprises, which are not part of a larger enterprise group

No UK company featured in the Thomson Reuters list of the 'Top 100 Global Innovators' in 2012

Summary

1 In response to a request from the House of Commons Science and Technology Committee, this report provides an overview of Research and Development (R&D) spending in the UK since 1995, details the flow of funding from public and private sources, and compares R&D spending in the UK with spending in other countries.

2 The report is structured as follows:

- Part One provides a definition of R&D, and summarises the accountability for publicly funded research in the UK and the government's strategy for innovation and research.
- Part Two sets out R&D spend in the UK in 2011, the most recent year for which figures are available, and describes how spending has changed over time.
- Part Three examines the UK business sector, focusing particularly on R&D spending by industry and on the contribution made by small- and medium-sized enterprises.
- Part Four explores how the UK compares internationally, in terms of its 'R&D intensity' and overall investment in R&D.

3 The report is based on information from the following sources:

- Office for National Statistics (ONS) data which set out R&D funding, and the amount spent on carrying out R&D, across different sectors;
- HM Revenue & Customs (HMRC) data on the number of businesses that claim R&D tax relief, and the cost to the Exchequer;
- Organisation for Economic Cooperation and Development (OECD) data, comparing R&D activity across a range of countries;
- Thomson Reuters' index of the 'Top 100 Global Innovators' in 2012;
- Department for Business, Innovation & Skills (BIS) data on the UK's share of European Commission funding under the Framework Programme as well as its 2010 Scoreboard of the 1,000 UK companies most active in R&D;
- a UK Innovation Research Centre report, which included an international comparison of R&D carried out by Higher Education Institutions, using OECD data; and
- a Technopolis Group report, commissioned by BIS, examining the impact of the European Commission's Framework Programmes on research and technological development in the UK.

More detail on the sources of information is set out in Appendix Two.

Key findings

4 R&D is historically the most cited metric of innovation in an economy. A recent literature review published by BIS found that the broad consensus suggests a rate of return from investment in R&D of between 20 and 50 per cent. The government's Innovation and Research Strategy for Growth does not include any targets for investing in R&D, but focuses on monitoring the UK's performance in terms of research outputs and measures of business innovation. Its annual Innovation Reports outline progress in improving the innovation performance of the UK (paragraphs 1.1 and 1.11).

5 According to ONS data, between 1995 and 2011, overall annual spending on R&D in the UK increased in real terms by 37 per cent, from just under £20 billion to just over £27 billion. Most of this increase resulted from a growth in UK businesses' spend on undertaking R&D. However, spending declined between 2007 and 2010, around the onset of the economic crisis, as well as from 2004 to 2005 and 1995 to 1997 (paragraph 2.7, bullets 1 and 2).

6 The government has progressively reduced the amount it spends on undertaking R&D itself, but at the same time, has increased the funding it provides to UK business. Between 1995 and 2011, R&D undertaken by Public Research Institutions (defined here as research bodies associated with government departments and the Research Councils) fell by £559 million (19 per cent) in real terms, but government funding of UK business increased by £255 million (19 per cent). Between 2007 and 2011, government funding of UK business R&D increased at the higher rate of 37 per cent, perhaps to compensate for the reduction in funding that UK business received from non-government sources over that period (paragraph 2.9, bullet 2 and paragraph 2.10).

7 Higher Education Institutions have played an increasingly significant role in undertaking R&D within the UK, with activity in the sector increasing in value by £3.3 billion (86 per cent) in real terms between 1995 and 2011. OECD data show that in 2011, Higher Education contributed around 27 per cent of the total R&D undertaken in the UK, compared to an average of 19 per cent across the OECD area as a whole. Research by the UK Innovation Research Centre shows that the growth in R&D undertaken by Higher Education Institutions is mirrored by other OECD countries. However, these data also show that, since 2005, other countries' Higher Education Institutions have increased their spending on undertaking R&D at a faster rate than the UK. This could reflect the increasing emphasis that some countries are placing on Higher Education as a way to rebalance their economies and recover from recession (paragraph 2.9, bullet 3, paragraph 2.11 and paragraph 4.4).

8 **Regional analysis shows that R&D activity is concentrated in England, which accounted for 89 per cent of the UK's total expenditure on R&D in 2011 (compared to England's 84 per cent share of the UK population).** Within England, R&D activity is concentrated in three regions – London, the South East and the East of England – which together accounted for £14 billion of activity in 2011 (52 per cent of the total R&D carried out in the UK). These distributions should be considered in the context of population distributions and Gross Value Added (a measure of the economic value of goods produced in an area). In 2011, the three regions with the highest concentration of R&D activity also had a higher than average proportion of the UK population living there and had the highest Gross Value Added. The amount of R&D carried out by government itself is highly variable across regions, but is more concentrated in the three regions with the largest overall R&D spend (London, the South East and the East of England) as well as the South West and Scotland (paragraphs 2.13 to 2.17).

9 **The total annual cost to government of providing R&D tax relief to companies has increased since the relief was first introduced in April 2000, from £89 million in 2000-01 to £1.1 billion in 2010-11, in real terms.** This growth has been driven by an increase in the number of claims made by companies, as well as the size of individual claims by large companies. In 2010-11, large companies made up 69 per cent of the total cost to government of providing relief (paragraphs 2.18 to 2.23).

10 **The UK receives a significant amount of European Commission grant to support research and innovation, although it is difficult to quantify how much of this funds activity that would meet the definition of R&D activity used by the ONS.** Between 2007 and 2013, the UK will have received €4.9 billion (around £4 billion) from the Seventh Framework Programme, the European Commission's main funding mechanism to support R&D activities. This represents around 9 per cent of the total funding available under the programme. Broader European funding mechanisms, such as the Structural Funds, also provide finance for research activities. However, it is difficult to disaggregate the funds in order to quantify the proportion that supports R&D activities. The funds are managed by a number of government departments, none of which hold data on the level of support provided for R&D across the whole programme (paragraphs 2.24 to 2.27).

11 **UK business spending on R&D is concentrated in a small number of very large firms.** For example, in 2011, the top ten UK businesses, in terms of spending on performing R&D, spent £7.7 billion undertaking R&D (44 per cent of UK business spending). R&D undertaken by the UK's small- and medium-sized enterprises (SMEs – entities with fewer than 250 employees) accounted for 23 per cent of the overall spending on R&D by UK business in 2011. However, most of this spending is by the subsidiaries of larger enterprise groups, rather than independent SMEs, which in 2011 accounted for just 4 per cent of the R&D undertaken by UK business (paragraphs 3.1 and 3.8 to 3.9).

12 The UK pharmaceuticals sector, which accounted for 28 per cent of total UK business spending on undertaking R&D in 2011, is a key driver of innovation in the UK, but the UK's reliance on the sector is also a risk. The sector attracts much of the UK's overseas funding for R&D: in 2011, 40 per cent of the total overseas funding for UK business R&D was for the pharmaceuticals sector. The sector is also heavily dependent upon two major organisations, GlaxoSmithKline and AstraZeneca, who contribute the great majority of R&D activity in the sector (paragraphs 3.3 and 3.4).

13 UK spending on R&D relative to Gross Domestic Product ('R&D intensity') is ranked around the middle compared to other countries in the OECD area. In 2011, the UK's R&D intensity was around 1.8 per cent, which was below the European Union average (currently estimated to be 1.9 per cent) and a long way off the European Union's target of 3 per cent by 2020. Moreover, between 1995 and 2001, the UK's R&D intensity weakened, and since 2001 it has remained broadly unchanged, while for most other countries it has increased over both periods (paragraphs 4.3 to 4.6).

14 No UK company featured in the Thomson Reuters 2012 list of the 'Top 100 Global Innovators', which attempts to identify the world's most innovative organisations. The list tends to favour fast-paced, high-tech industries, with short product lifecycles, rather than the pharmaceutical and biotechnology companies that dominate R&D within the UK (paragraphs 4.7 to 4.9).

15 The UK government spends around 0.16 per cent of GDP on combined direct and indirect funding of business R&D. This is more than most other OECD countries. The balance of direct and indirect support varies between countries, although the UK uses direct and indirect support in roughly equal proportions (paragraphs 4.11 and 4.12).

Part One

Background

1.1 The government recognises the large body of evidence which shows that innovative economies are more productive and faster growing.[1] Research and Development (R&D) is historically the most cited metric of innovation in an economy and is relatively easy to compare across industries and countries. A recent literature review published by the Department for Business, Innovation & Skills (BIS) found the broad consensus suggests a rate of return from investment in R&D of between 20 and 50 per cent.[2]

1.2 The Organisation for Economic Cooperation and Development[3] (OECD) defines R&D as "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications."[4]

1.3 The *Frascati Manual*, published by the OECD, provides a detailed definition of R&D as well as guidance on measuring and reporting data. The guidance is widely used by a large number of international organisations. However, there is no single definition of R&D and some entities do not apply the OECD criteria when collecting and reporting data.

1.4 In the UK, the Office for National Statistics (ONS) uses the OECD definition of R&D for collecting and reporting the data that we present in Part Two.

The funding and performing of R&D

1.5 The accepted measure of a country's R&D activity is Gross Domestic Expenditure on R&D (or 'GERD'). This measure covers all spending on R&D in a national territory in any given year. It thus includes domestically performed R&D which is financed from overseas, but excludes spending on R&D which is conducted abroad. GERD forms the basis of all international comparisons of R&D activity.

1.6 The GERD total is often broken down into the subsidiary sectors of the economy which fund or carry out R&D. The breakdown that we use throughout this report is based upon the way that the ONS gathers data, and is set out in **Figure 1**. More detailed definitions are included at Appendix One. As ONS data include figures for R&D funded from the UK but carried out overseas (i.e. activity outside the GERD total), we have also included this in our funding landscape in Part Two.

Figure 1
The sectors which fund or carry out Research and Development

Sectors funding R&D

UK business

Entities whose primary activity is the market production of goods or services (other than Higher Education) for sale to the general public at an economically significant price.

Overseas

Institutions and individuals located outside the political borders of a country and all international organisations (except UK business) including facilities and operations within the country's borders. It includes funding from public and private entities overseas as well as the European Commission.

Private Non-Profit

Non-market, Private Non-Profit institutions serving the general public, such as charities. They provide individual or collective services without charge or at prices that are not economically significant.

Government

All departments, offices and other bodies which provide services to the community (other than Higher Education) which cannot otherwise be conveniently and economically provided. In the UK, it is made up of government departments and agencies, Higher Education funding bodies and Research Councils.

Sectors carrying out R&D

UK business

See definition on the left.

Overseas

Institutions and individuals located outside the political borders of a country and all international organisations (except UK business) including facilities and operations within the country's borders.

Private Non-Profit

See definition on the left.

Public Research Institutions

All departments, offices and other bodies which provide services to the community (other than Higher Education) which cannot otherwise be conveniently and economically provided. In the UK, it is made up of government departments and agencies and Research Councils.

Higher Education Institutions

All universities, colleges of technology and other institutions of post-secondary education, as well as entities administered by, or associated with, Higher Education Institutions.

Source: Office for National Statistics

The government's strategy for innovation and research

1.7 BIS last published a strategy document on innovation and research in 2011.[5] It acknowledged that other countries spend more on research, and that the UK must enhance its ability to accelerate the commercialisation of emerging technologies. It made a commitment to strengthen the research base and continue to fund a balance of basic and applied research projects. The strategy emphasised that government has a role to play in helping entrepreneurs, financiers and innovators, by:

- funding 'blue skies' research as well as new discoveries and inventions;
- improving the interface between Higher Education Institutions and business; and
- delivering a better environment for commercialising research.

1.8 BIS has taken a number of steps in support of these aims, including the branding of Catapult Centres (new technology and innovation centres which aim to bridge the gap between academia and business) and enhancing the tax advantages for small companies carrying out R&D. The 2010 Comprehensive Spending Review also announced that annual revenue funding for science and research would be ring-fenced in cash terms at £4.2 billion, although in real terms, the funding that will be received in 2014-15 is around 10 per cent less than the funding received in 2010-11.[6]

1.9 Since the 2010 Comprehensive Spending Review, the government has announced an additional £1.5 billion of capital funding to support innovation. This includes £600 million to be invested in R&D and the infrastructure of the Research Councils. The government suggested that this funding would be focused on such areas as energy-efficient computing, advanced materials and energy storage.

1.10 The focus of the government's approach to R&D has evolved over time. Previously, it focused more on promoting strong scientists, engineers and technologists, while the 2011 Innovation and Research Strategy for Growth places a greater emphasis on supporting 'blue skies' and 'curiosity-driven' research. There has been a consistent focus on facilitating the collaboration and exploitation of research, with an emphasis on improving the way companies develop new products, processes, services and markets.

1.11 The 2011 Strategy does not include any targets for investing in R&D, but focuses on monitoring the UK's performance in terms of research outputs and measures of business innovation. It has a range of indicators for measuring progress, including the UK's share of the top 1 per cent of cited research papers, and the levels of business investment in R&D. Annual Innovation Reports outline progress in improving the innovation performance of the UK. Previous strategy documents included a target to increase total UK R&D intensity to 2.5 per cent of GDP by 2014.[7]

Accountability for publicly funded research

1.12 BIS has overall policy responsibility for government investment in science, technology and engineering. One of its key deliverables is to "ensure that future investment in science and research is focused on excellence".

1.13 There are three main channels for funding R&D publicly in the UK:

- a block grant allocated to Higher Education Institutions by the Funding Councils of England, Scotland and Wales, and the Department for Employment and Learning of Northern Ireland on the basis of past research performance;
- research grants and other research support allocated by the seven Research Councils to research teams on the basis of proposals submitted by teams and evaluated on excellence by peer review; and
- spending by government departments on R&D.

1.14 The funding bodies' block grant is intended to support research infrastructure and enable institutions to undertake research in keeping with their own mission and strategic research priorities. The majority of the block grant is allocated as 'quality-related research' funding through a formula based on the quality, volume and relative cost of research in different areas. But there is no requirement for universities to spend this grant in accordance with the funding bodies' calculations, as they are autonomous institutions and free to spend the money according to their own priorities.

1.15 Research Councils compile annual Impact Reports which are intended to demonstrate how their activities make a contribution to economic growth and social welfare. The reports also provide trend analysis that may inform future policy development.

Tax incentives

1.16 Governments use different policy mechanisms to incentivise business to invest in R&D activities. The data published by ONS examine **direct** support provided to businesses in the form of grants, contracts or donations.[8] However, governments can also provide businesses with **indirect** forms of funding, most commonly in the form of tax incentives. The different forms of tax incentives available to businesses in the UK, and the associated costs to government, are explained in paragraphs 2.18 to 2.23.

European Commission grants

1.17 The European Union's strategy for growth over the next decade includes a target for 3 per cent of GDP to be invested annually in R&D by 2020. There are several sources of European Commission finance which support R&D, although only the Framework Programme has R&D as a primary objective. The First Framework Programme was introduced in 1984, with a total budget of €3.75 billion. In 2007, the Commission launched the Seventh Programme, which lasts for longer than previous programmes and has a much larger budget of €53.22 billion. The next Framework Programme, Horizon 2020, will run from 2013 until 2020, with a budget of €80 billion.

1.18 Access to funding usually requires collaboration among at least three research entities from different member states working on projects within key thematic areas, such as Energy or Transport. The standard reimbursement rates for research and technological development activities are 50 per cent and 75 per cent for non-profit public bodies, small- and medium-sized enterprises (SMEs), and Higher Education Institutions.

1.19 Broader European funding mechanisms, such as the Structural Funds, can also provide finance for R&D activities. These investments fulfil the objectives of the EU Cohesion Policy by, for example, increasing regional competitiveness. More detail on European R&D funding can be found at paragraphs 2.24 to 2.27.

Part Two

UK funding landscape

The UK funding landscape through direct forms of support

2.1 In this section of the report, we use ONS data to set out spending on R&D in the UK in 2011, the most recent year for which figures are available. We also explain how the amounts have changed over time.

2.2 **Figures 2**, **5** and **6** show the flow of funding between the different types of bodies that fund or carry out R&D activities. The nodes around the periphery represent the four sectors which provide R&D funding, and the central nodes represent the five sectors which receive funds and carry out R&D activities. As ONS data include figures for R&D funded from the UK but carried out overseas, we have included it in our analysis, although this spending is normally excluded from national measures of Gross Domestic Expenditure on R&D (GERD), to allow for international comparison. The total overseas spending is also incomplete, as it does not include spending funded from the Private Non-Profit sector and Higher Education Institutions.

2.3 The arrows in the diagrams represent the various streams of funding flowing from the four sources of funding to the five sectors carrying out the R&D. Funds that are generated and used by the same organisations, or within the same sector, are included for completeness. The diagrams can be used to analyse R&D funded at a point in time (Figure 2), or to analyse the changes that occur over a period of time (Figures 5 and 6). In Figure 5, we have chosen 1995 as the base year because this is the earliest date for which comprehensive data are available. In Figure 6, we have chosen 2007 as the base year because this was immediately before the global financial crisis. All totals are expressed in 2011 prices, to correct for the effect of inflation and present the changes over time in real terms.

2.4 **Figures 3** and **4** show trends in the amounts spent funding and carrying out R&D, over the period 1995–2011.

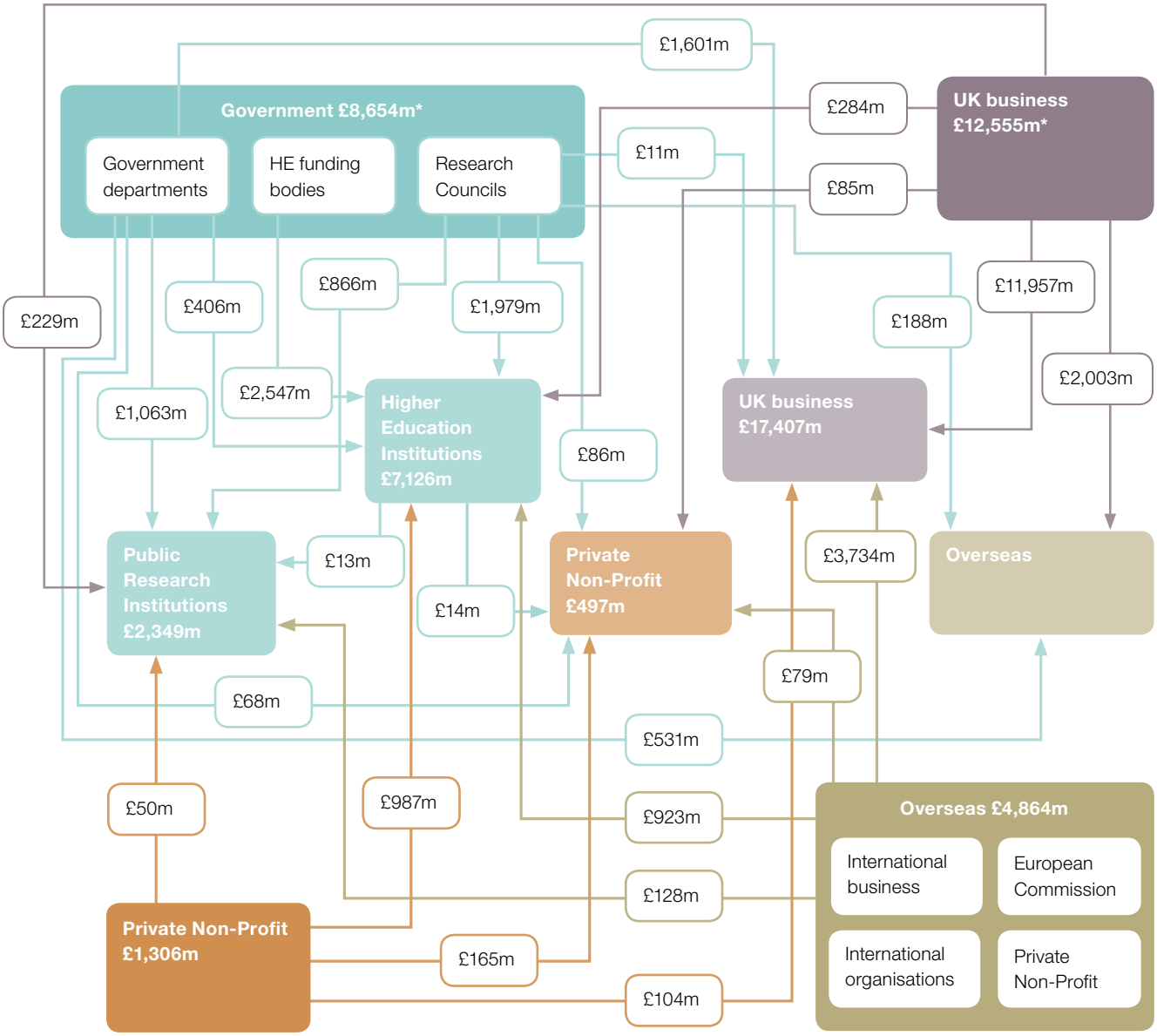
2.5 Overall, Figures 2 to 6 show an increase in the annual amounts of R&D funded and performed over time. Paragraphs 2.6 to 2.10 highlight the key points arising within this overall trend.

2.6 Figure 2 shows that:

- 64 per cent of the R&D undertaken in the UK in 2011 was by UK business, largely financed by UK business itself, which contributed to 69 per cent of the sector's overall funding. Higher Education Institutions also played a significant role in terms of carrying out R&D, representing 26 per cent of the UK's total spending on R&D undertaken in 2011.
- 46 per cent of the funding for R&D undertaken in the UK in 2011 was by UK business. The government also played a significant role, contributing to 32 per cent of the funding.

Figure 2

Research and Development funded and carried out across all sectors in 2011



NOTES

1 Government (providing funding) is the total of government, Research Councils, Higher Education Institutions and Higher Education Funding Councils.

2 Higher Education funding bodies (providing funding) is the total of Higher Education Institutions and Higher Education Funding Councils.

3 Public Research Institutions (carrying out research) is the total of government and Research Council sectors.

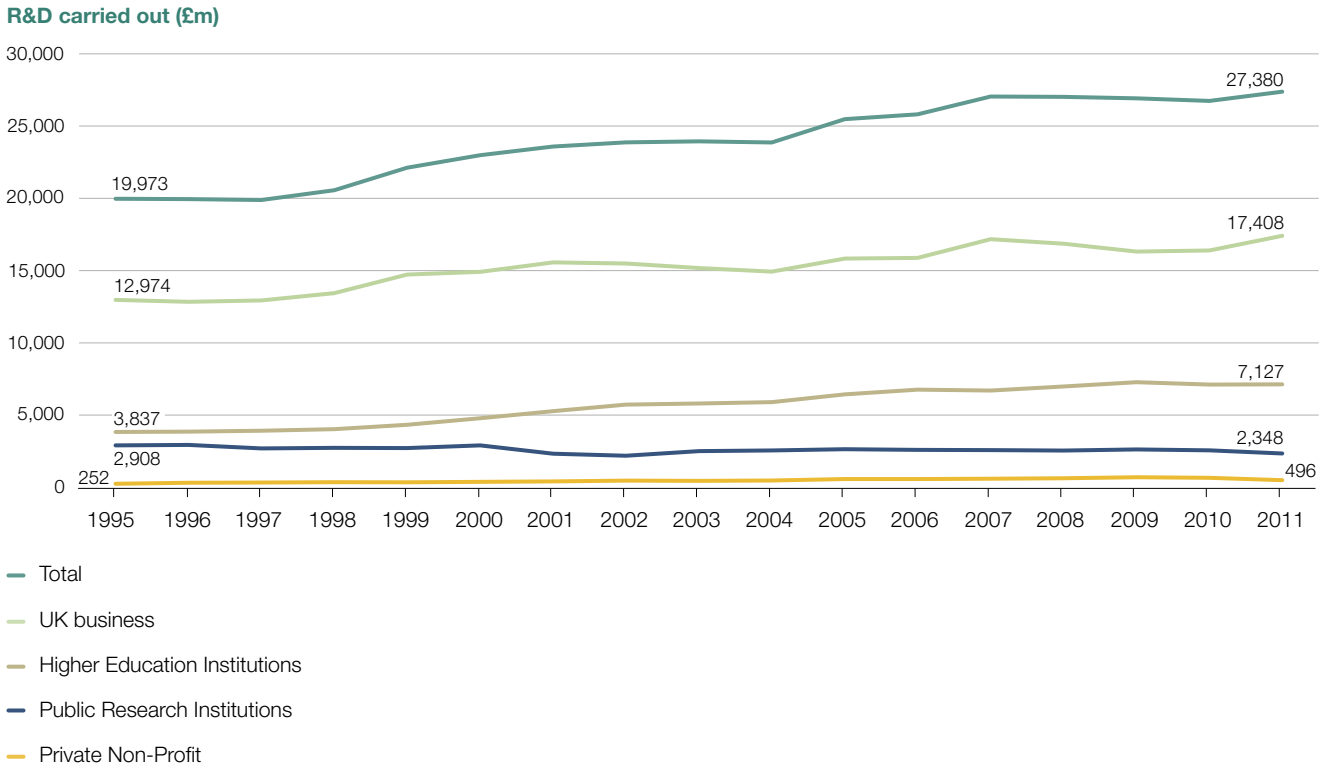
4 There are no ONS data on the Higher Education Institutions and Private Non-Profit sector's funding to overseas entities. As a result of this:

- We have not included a total figure for R&D carried out overseas, but funded from UK entities (as this total would be incomplete).
- To allow consistency between the totals for funding by each sector, when calculating the total funding by the government and business sectors, we have excluded the funding they provided to overseas from the total (see figures with *).

Source: National Audit Office analysis of Office for National Statistics data. The underlying data used in the above analysis can be found at: www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2011/tsd-gerd-2011.html

Figure 3

The value of Research and Development carried out by sector, 1995 to 2011



NOTES

1 All figures are in 2011 prices to exclude the impact of inflation.

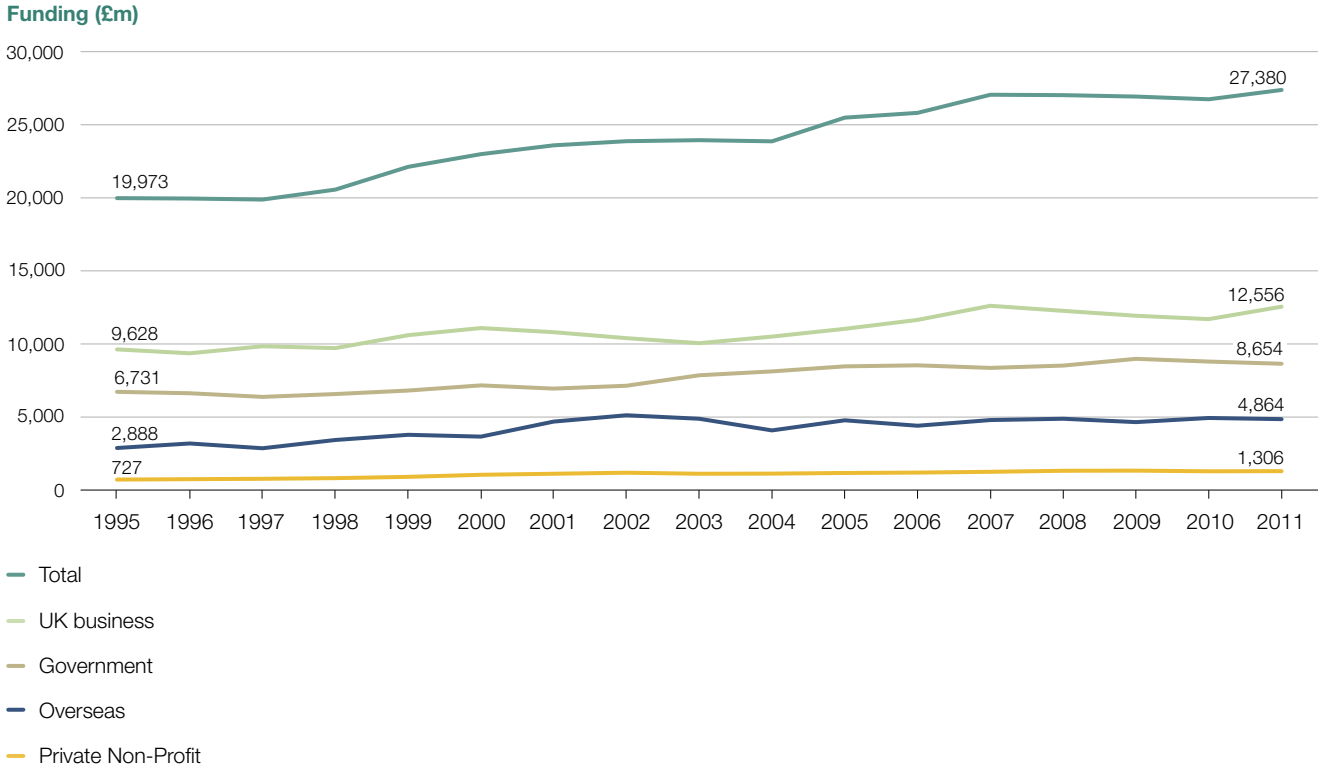
Source: National Audit Office analysis of Office for National Statistics data. The underlying data used in the above analysis can be found at: www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2011/tsd-gerd-2011.html. The Office for National Statistics inflator used to convert figures from cash terms to 2011 prices was calculated using data available at: www.ons.gov.uk/ons/dcp171778_302928.pdf, page 4

2.7 Figure 3 shows that:

- From 1995 to 2011, Gross Domestic Expenditure on R&D in the UK increased by £7.4 billion in real terms (37 per cent), from £20 billion to £27.4 billion. Most of that increase resulted from R&D undertaken by UK business, which grew by £4.4 billion (34 per cent) over the period.
- Gross Domestic Expenditure on R&D peaked in 2007 at £27.1 billion. But in 2008, around the onset of the economic crisis, total spending on R&D started to decline, alongside a reduction in R&D funded and carried out by UK business. Spending picked up in 2011, again as a result of an increase in R&D undertaken by UK business.

Figure 4

The value of Research and Development funded by sector, 1995 to 2011



NOTES

1 The government total is the combined total of the government departments, Higher Education funding bodies and Research Councils.

2 All figures are in 2011 prices to exclude the impact of inflation.

Source: National Audit Office analysis of Office for National Statistics data. The underlying data used in the above analysis can be found at: www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2011/tsd-gerd-2011.html. The Office for National Statistics inflator used to convert figures from cash terms to 2011 prices was calculated using data available at: www.ons.gov.uk/ons/dcp171778_302928.pdf, page 4

2.8 Figure 4 shows that:

- Almost half of the increase in Gross Domestic Expenditure on R&D between 1995 and 2011 (amounting to £2.9 billion) was financed by UK business. The overseas and government sectors also played a significant role in funding the increase in Gross Domestic Expenditure, with increases of £2 billion and £1.9 billion respectively.
- Overall, since 2003, the overseas sector's funding of R&D performed in the UK has remained broadly unchanged (although there was a sharp decline in 2004 followed by a recovery in 2005).

Figure 5

Changes in the value of Research and Development funded and carried out across all sectors, 1995 to 2011

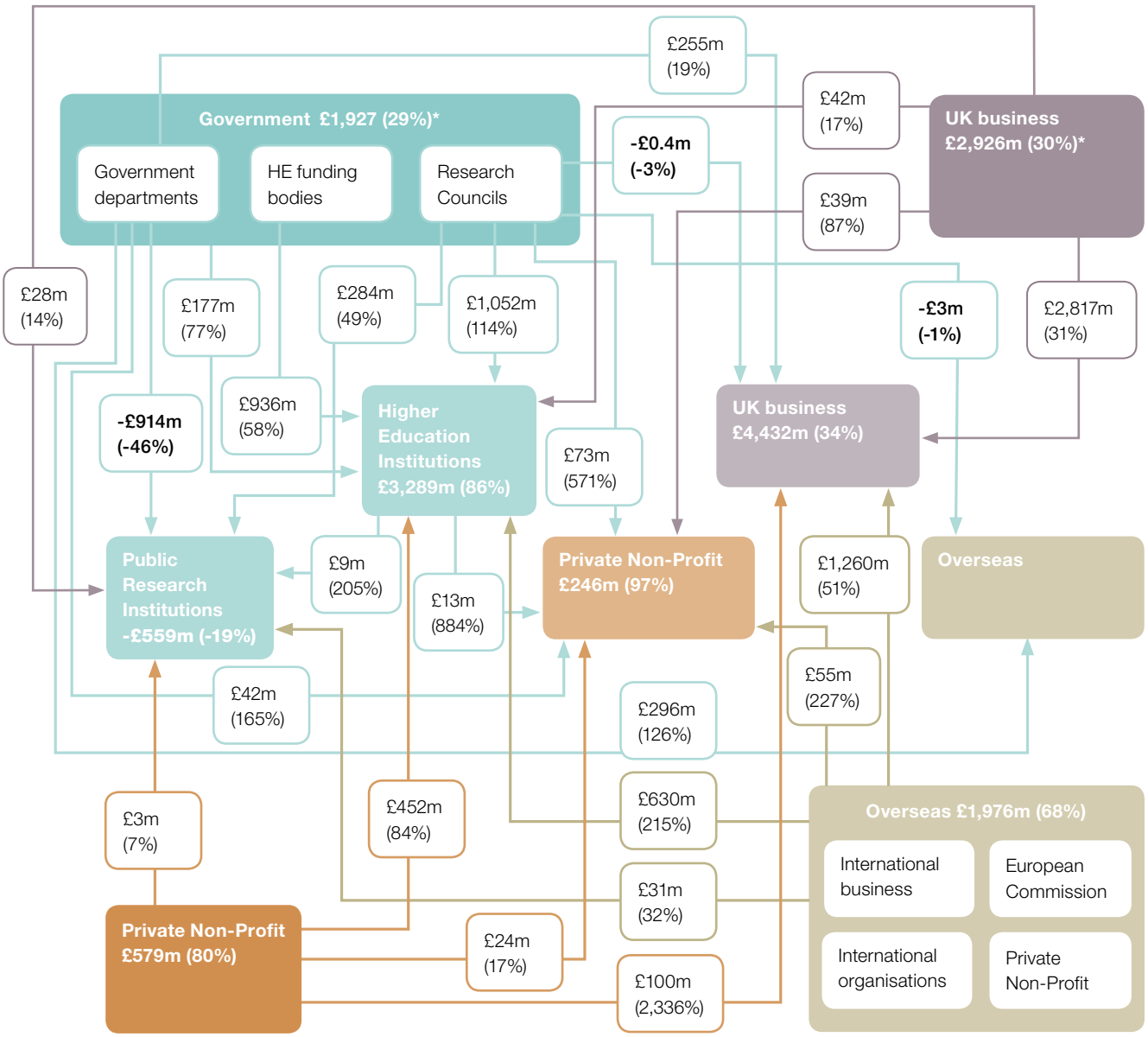


Figure 5 *continued*
Changes in the value of Research and Development funded and carried out across all sectors, 1995 to 2011

NOTES

1 Government (providing funding) is the total of government, Research Councils, Higher Education Institutions and Higher Education Funding Councils.

2 Higher Education funding bodies (providing funding) is the total of Higher Education Institutions and Higher Education Funding Councils.

3 Public Research Institutions (carrying out research) is the total of government and Research Council sectors.

4 There are no ONS data on the Higher Education Institutions and Private Non-Profit sector's funding to overseas entities. As a result of this:

- We have not included a total figure for R&D carried out overseas, but funded from UK entities (as this total would be incomplete).
- To allow consistency between the totals for funding by each sector, when calculating the total funding by the government and business sectors, we have excluded the funding they provided to overseas from the total (see figures with *).

5 No ONS data on UK business funding to overseas bodies is available for between 1995 and 2002, and so the variance has been excluded from the 1995 to 2011 comparison.

6 All figures are in 2011 prices to exclude the impact of inflation.

Source: National Audit Office analysis of Office for National Statistics data. The underlying data used in the above analysis can be found at: www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2011/tsd-gerd-2011.html. The ONS inflator used to convert figures from cash terms to 2011 prices was calculated using data available at: www.ons.gov.uk/ons/dcp171778_302928.pdf, page 4

2.9 Figure 5 shows that:

- The growth in R&D performed by UK business was mainly financed by increased funds from UK business itself and from overseas, with real term increases of £2.8 billion and £1.3 billion respectively.
- Between 1995 and 2011, the government sector progressively reduced the amount it spent on carrying out R&D, with a reduction of £559 million in real terms (19 per cent) in R&D undertaken by Public Research Institutions. The sector saw a £914 million decline in its funding from government departments, partially offset by increases in funding from other sources. However, while funding for R&D in the government sector declined, government departments' funding to UK business over the same period increased by £255 million (19 per cent).
- Higher Education Institutions play an increasingly significant role in terms of undertaking R&D, with activity in the sector increasing by £3.3 billion (86 per cent) in real terms between 1995 and 2011. This increase was mainly financed by the Research Councils, the Higher Education funding bodies, the Private Non-Profit sector, and overseas, with increases of £1.1 billion, £936 million, £452 million and £630 million respectively.

Figure 6

Changes in the value of Research and Development funded and carried out across all sectors, 2007 to 2011

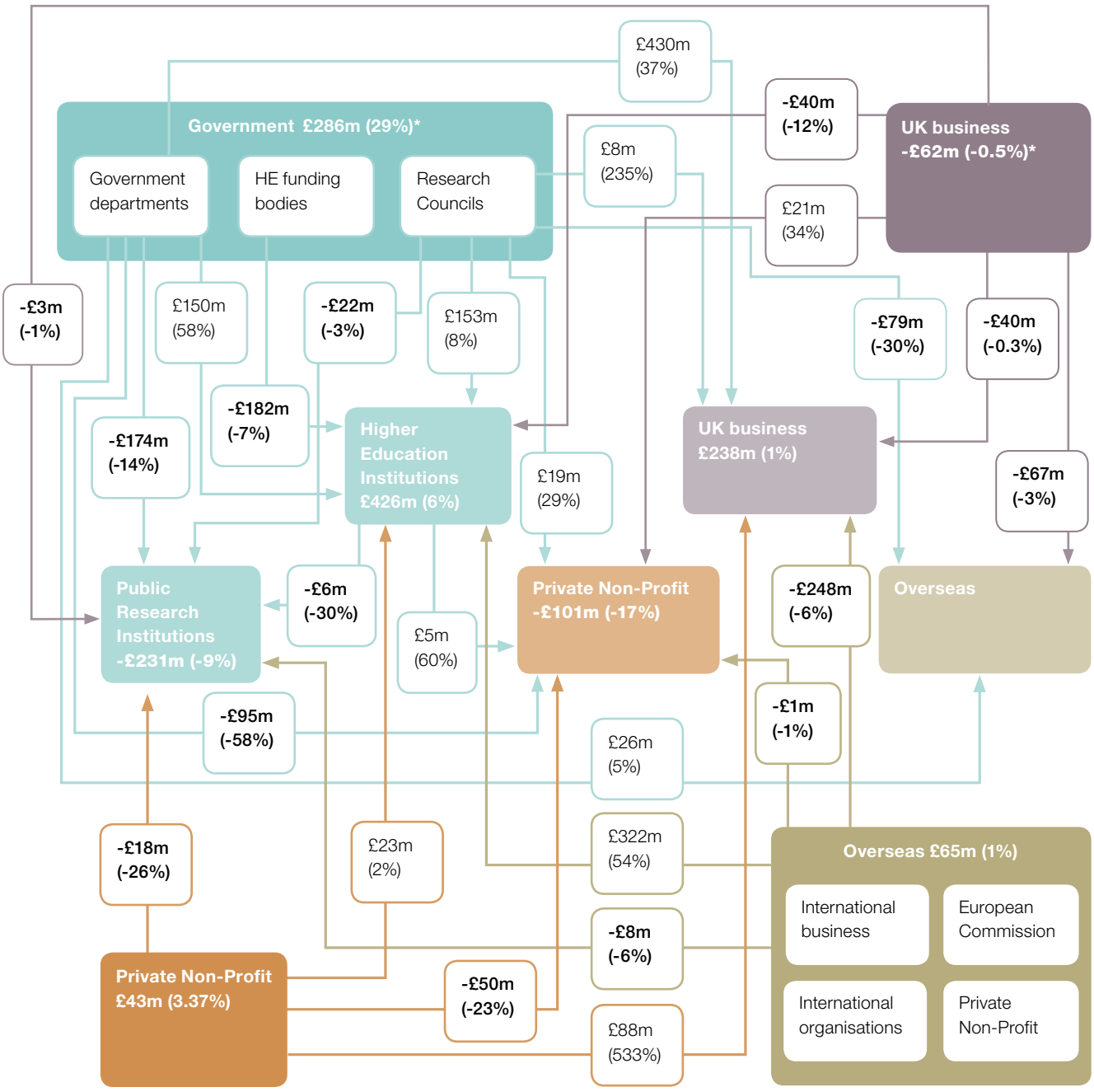


Figure 6 *continued*
Changes in the value of Research and Development funded and carried out across all sectors, 2007 to 2011

NOTES

1 Government (providing funding) is the total of government, Research Councils, Higher Education Institutions and Higher Education Funding Councils.

2 Higher Education funding bodies (providing funding) is the total of Higher Education Institutions and Higher Education Funding Councils.

3 Public Research Institutions (carrying out research) is the total of government and Research Council sectors.

4 There are no ONS data on the Higher Education Institutions and Private Non-Profit sector's funding to overseas entities. As a result of this:

- We have not included a total figure for R&D carried out overseas, but funded from UK entities (as this total would be incomplete).
- To allow consistency between the totals for funding by each sector, when calculating the total funding by the government and business sectors, we have excluded the funding they provided to overseas from the total (see figures with *).

5 No ONS data on UK business funding to overseas bodies is available for between 1995 and 2002, and so the variance has been excluded from the 1995 to 2011 comparison.

6 All figures are in 2011 prices to exclude the impact of inflation.

Source: National Audit Office analysis of Office for National Statistics data. The underlying data used in the above analysis can be found at: www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2011/tsd-gerd-2011.html. The ONS inflator used to convert figures from cash terms to 2011 prices was calculated using data available at: www.ons.gov.uk/ons/dcp171778_302928.pdf, page 4.

2.10 Figure 6 shows that between 2007 and 2011, funding of UK business R&D from non-government sources fell in real terms by £200 million (1 per cent). This included a £40 million (0.3 per cent) reduction in the funding from UK business itself. Over the same period, government increased its funding to UK business by £438 million (37 per cent).

2.11 Research by the UK Innovation Research Centre shows that the growth in Higher Education Institutions' R&D spending is mirrored by other OECD countries.[9] However, these data show that, since 2005, other countries' Higher Education Institutions have increased their R&D spending at a faster rate than the UK. This could reflect the increasing emphasis that some countries are placing on Higher Education as a way to rebalance their economies and recover from recession.

2.12 In the future, we are likely to see further increases in R&D activity within Higher Education Institutions. In March 2012, the government announced that a new UK Research Partnerships Investment Fund would provide an additional £100 million of funding to the sector, and in November 2012, the funding was increased to £300 million.[10] The Fund, which aims to encourage Higher Education Institutions to form strategic partnerships with other research bodies, requires co-investment from a third party, of a minimum of double the amount granted from the government's fund. The original £300 million fund should therefore result in at least £900 million of investment in research between 2013 and 2015 (or 13 per cent of Higher Education Institutions' total R&D spending in 2011).

Regional breakdowns

2.13 **Figures 7** and **8** show the breakdown of R&D spending across UK regions. The figures are based on regional analysis included in the 2011 ONS R&D dataset for the first time, and extending back to 2001. Our analysis excludes data from the Private Non-Profit sector, as no regional data on the sector are available from before 2011. However, R&D undertaken by Private Non-Profit organisations is small, relative to the other three sectors (around £0.5 billion per annum).

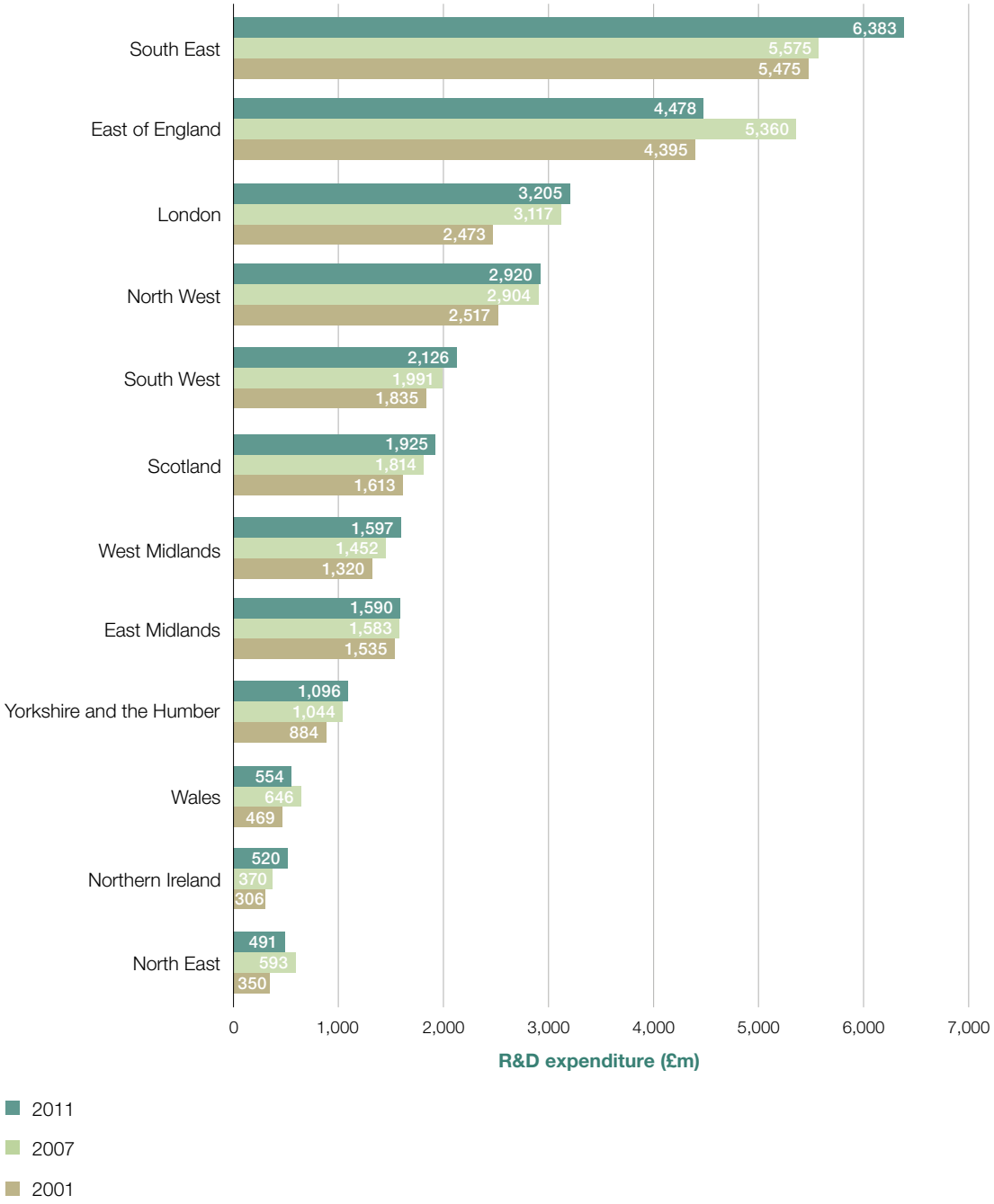
2.14 Figure 7 shows that there were real overall increases in spend on carrying out R&D activity across all regions of the UK between 2001 and 2011, with ten of the twelve regions seeing increases of 15 per cent or more. However, between 2007 and 2011, spending on undertaking R&D fell in three of the regions – Wales, the North East and the East of England – by 14 per cent, 16 per cent and 17 per cent respectively.

2.15 The UK's R&D activity is concentrated in England, which accounted for 89 per cent of total spending on R&D in 2011. In contrast, the spending on R&D undertaken in Scotland, Wales and Northern Ireland made up 7 per cent, 2 per cent and 2 per cent respectively. These distributions should be considered in the context of population distributions and the regions' economic Gross Value Added (a measure of the value of goods produced in an area). In 2011, 84 per cent of the UK population lived in England (compared to 16 per cent living in Scotland, Wales and Northern Ireland combined), and England contributed to 86 per cent of the UK's Gross Value Added.

2.16 Within England, R&D activity is concentrated in three regions – London, the South East and the East of England – which together accounted for £14 billion of activity in 2011 (52 per cent of the total R&D performed in the UK). These regions also contain a higher than average proportion of the UK population and are the three areas with the highest share of the UK's Gross Value Added.

Figure 7

Research and Development expenditure by UK region, 2001, 2007 and 2011



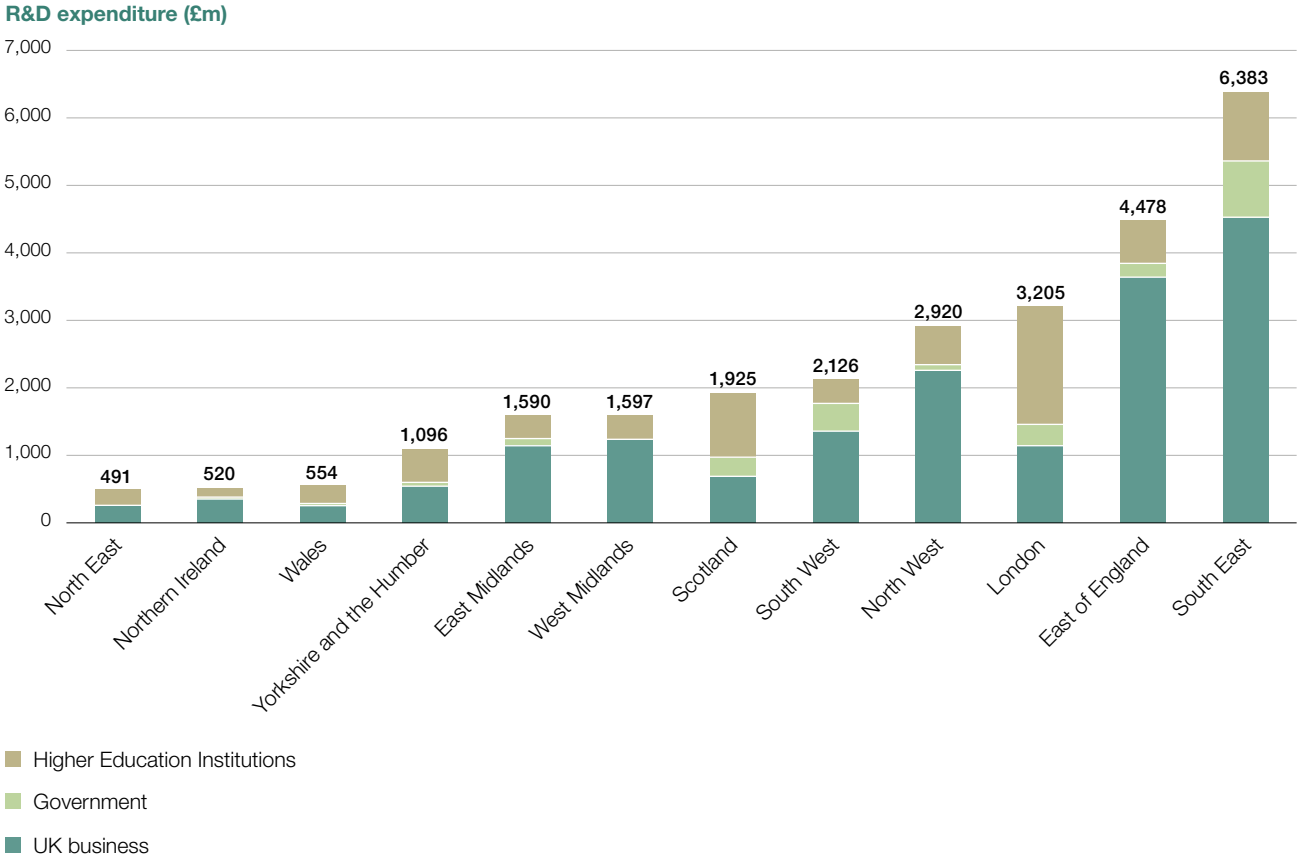
NOTE

1 All figures are in 2011 prices to exclude the impact of inflation.

Source: National Audit Office analysis of Office for National Statistics data. The underlying data used in this analysis are available at: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-300392, UK Gross Domestic Expenditure on Research and Development Regional Tables 2001–2011. The Office for National Statistics inflator used to convert figures from cash terms to 2011 prices was calculated using data available at: www.ons.gov.uk/ons/dcp171778_302928.pdf, page 4

Figure 8

Research and Development spending by sector of performance and UK region, as at 2011



NOTE

1 All figures are in 2011 prices to exclude the impact of inflation.

Source: National Audit Office analysis of Office for National Statistics data. The underlying data used in this analysis is available at: www.ons.gov.uk/ons/ publications/re-reference-tables.html?edition=tcm%3A77-300392, UK Gross Domestic Expenditure on Research and Development Regional Tables 2001–2011. The ONS inflator used to convert figures from cash terms to 2011 prices was calculated using data available at: www.ons.gov.uk/ons/dcp171778_302928.pdf, page 4

2.17 Figure 8 shows that the amount of R&D undertaken by government is highly variable across regions, but is more concentrated in the three regions with the largest overall R&D activity (London, the South East and East of England) as well as the South West and Scotland. In particular, the South East region had £834 million of government R&D carried out in 2011 (36 per cent of the total government spend). Government-funded R&D was lowest in the North East (zero), West Midlands (£1 million) and Northern Ireland (£21 million).

Tax incentives

2.18 This section of the report explains the different forms of tax incentives available to companies, and provides HM Revenue & Customs (HMRC) data on what it costs the government to provide this relief. We have presented HMRC data separately from the ONS data on direct funding for R&D, as the datasets use different definitions and parameters. For example, HMRC uses a much wider definition of R&D, which includes testing stages and trials that would be excluded from the ONS definition.[11]

2.19 The UK government introduced R&D relief for SMEs in April 2000, and extended it to larger companies in April 2002.[12] The relief allows companies that are subject to UK corporation tax to reduce their tax bills by a proportion of their revenue spending[13] on R&D.[14] There are two separate schemes:

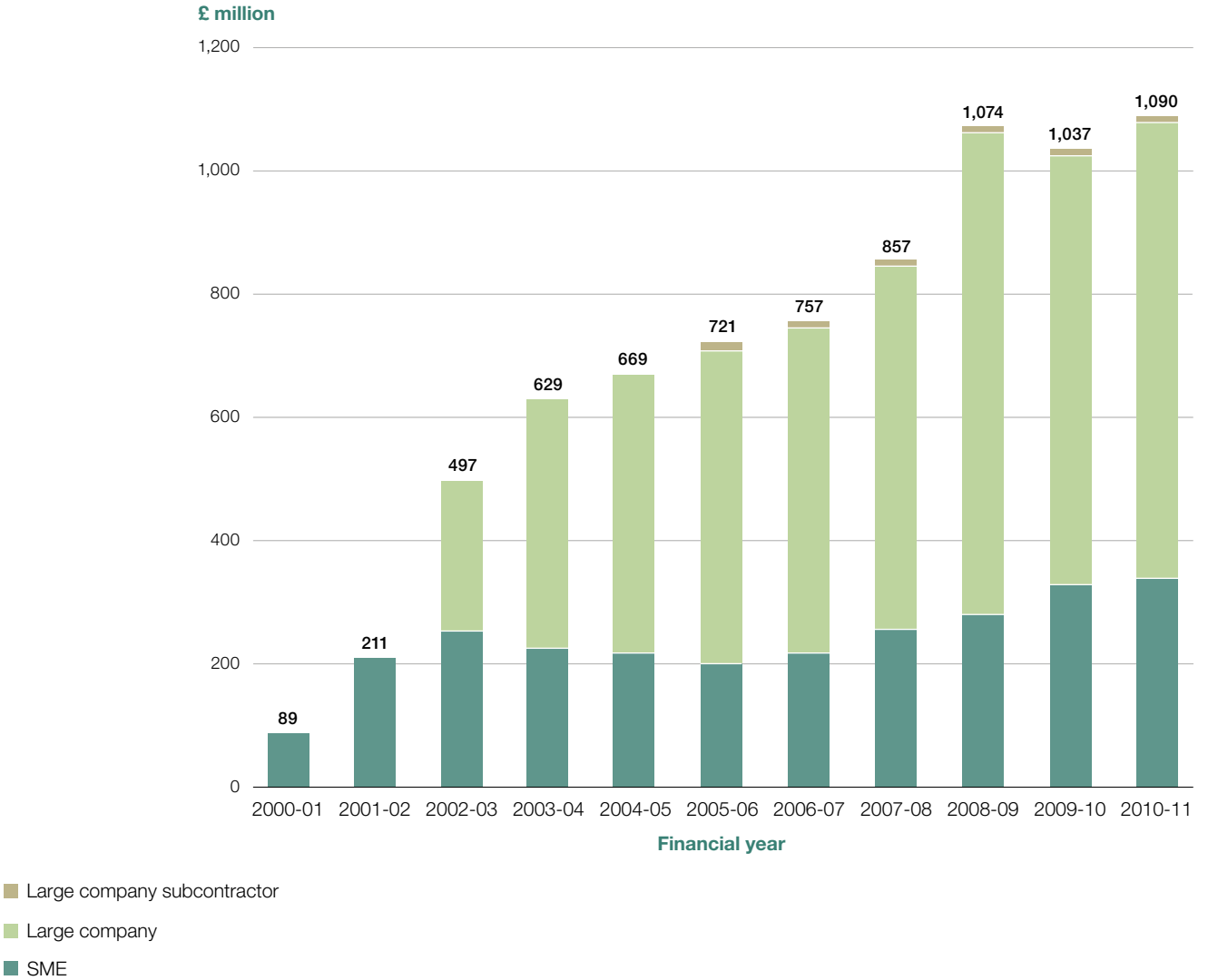
- **The SME Scheme** reduces an organisation's corporation tax bill by allowing it to reduce its profits subject to corporation tax by 225 per cent of qualifying spending on R&D. An SME that has no tax bill to reduce can either enhance its trading losses to be carried forward or back, or claim a cash payment, known as a tax credit. The scheme is open to all SMEs, which HMRC defines as organisations with fewer than 500 employees and one or more of the following: annual turnover not exceeding €100 million; or a balance sheet not exceeding €86 million.
- **The Large Company Scheme** allows larger organisations to reduce their profits subject to corporation tax by 130 per cent of qualifying spending on R&D. Losses enhanced by the R&D relief can be carried forward or back. Since April 2013, the 'Above the Line' scheme has allowed companies with no tax bill to claim a tax credit, to the value of 10 per cent of their qualifying spend.

2.20 R&D relief applies only to revenue spending, but companies that are subject to UK corporation tax can also claim relief on their capital spending on R&D, using R&D allowances.[15] The relief allows companies to deduct the full cost of a qualifying asset from their profits subject to corporation tax for the year. This has the effect of allowing companies to claim the resulting deduction in their corporation tax sooner than they would otherwise, since for other assets, the full cost would generally be deducted from the profits subject to corporation tax over a number of years. ONS data show that, in 2011, capital spending on R&D was £1.01 billion (6 per cent of the total capital and revenue spending on R&D).[16]

2.21 Figure 9 shows that the total cost to government of providing R&D tax relief to companies increased each year from April 2000 to March 2011, except during the 2009-10 financial year, when it fell by 3 per cent from the previous year.

Figure 9

Support claimed through Research and Development tax relief, 2000-01 to 2010-11 financial years



NOTES

1 When the SME scheme was first introduced in 2000, companies were entitled to reduce their profits subject to corporation tax by 150 per cent. Since then, there have been a number of changes to this rate: in July 2008, the rate changed to 175 per cent; in April 2011 to 200 per cent; and in April 2012 it changed to 225 per cent, the rate in force at the time of writing this report.

2 HMRC introduced the Large Company scheme in 2002. The initial rate of enhanced deductions was 125 per cent, until 31 March 2008, when it was increased to 130 per cent. In April 2012, the government removed the requirement for large companies to have to spend at least £10,000 on qualifying R&D costs in an accounting period in order to claim the relief.

3 The Figure shows costs falling on the Exchequer according to when the company incurred the R&D spending, rather than when tax would have been received, or the payment was made by HMRC.

4 All figures are in 2010-11 prices to exclude the impact of inflation.

Source: National Audit Office analysis of HMRC data. Data are available at: www.hmrc.gov.uk/statistics/research-tc/rd2.pdf.
We have converted HMRC figures to 2010-11 prices, using HM Treasury's Gross Domestic Product (GDP) deflators – 27 March 2012 update

2.22 **Figure 10** shows how the overall growth in the schemes has been driven by an increase in the number of claims made by companies, as well as the size of individual claims by large companies.

Figure 10

Number and average cost of Research and Development tax relief claims, 2000-01 to 2010-11 financial years

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Number of SME claims	1,860	3,410	4,640	5,160	5,310	4,960	5,270	5,980	6,660	7,460	8,170
Number of large company claims			690	1,050	1,310	1,490	1,670	2,030	2,260	2,310	2,450
Total number of claims	1,860	3,410	5,330	6,210	6,620	6,450	6,940	8,010	8,920	9,770	10,620
Average cost of SME claim (£)	47,694	61,997	54,910	43,709	41,256	40,908	41,660	42,985	42,267	44,060	41,616
Average cost of large company claim (£)			351,665	384,378	343,262	348,005	322,092	295,464	350,608	306,808	306,122
Average cost of all claims (£)	47,694	61,997	93,327	101,310	101,019	111,850	109,142	106,972	120,389	106,184	102,637

NOTE

1 All figures are in 2010-11 prices to exclude the impact of inflation.

Source: National Audit Office analysis of HMRC data. Data are available at: www.hmrc.gov.uk/statistics/research-tc/rd2.pdf. We have converted HMRC figures to 2010-11 prices, using HM Treasury's Gross Domestic Product (GDP) deflators – 27 March 2012 update

2.23 Figure 10 also shows that the cost of providing R&D relief to companies is mainly driven by the Large Company Scheme. In 2010-11, large companies made up 69 per cent of the total cost to government of providing relief, although only 23 per cent of the claims were submitted by large companies. This is because the size of claims under the Large Company Scheme tends to be greater, with an average claim of around £306,000, compared to around £42,000 under the SME Scheme.

European Commission funding

2.24 The overseas funding figures in the ONS data include funds from European Commission grants and from other overseas entities shown in Figures 2 to 4. The overseas funding figure appears small given the scale of funding provided to UK organisations through the Framework Programme and Structural Funds. The most likely explanation is that both the Framework Programme and Structural Funds include funding for activities that would not be categorised as R&D according to the OECD definition used by the ONS.

2.25 Figure 11 shows the UK's allocation of European Commission funding under the Sixth and Seventh Framework Programmes, which ran from 2002–2006 and 2007–2013 respectively. This funding has supported activities not defined as R&D by the ONS. For example, it includes the training and career development of researchers.

Figure 11
European Commission funding allocated to the UK under the Framework Programmes

Sixth Framework Programme (2002 to 2006)

Objective	Allocation (€m)	Allocation (£m)
Integrated projects (supports multi-partner projects in thematic areas of priority)	866	582
Specific targeted projects (supports multi-partner research with a more limited scope or ambition than under Integrated projects)	553	372
Marie Curie actions (support for training and career development of researchers)	384	258
Networks of excellence (aims to reduce the fragmentation of European Union research by integrating the research capacities of participants)	181	122
Specific actions to promote research infrastructures	156	105
Specific actions for SMEs	76	51
Coordination actions (multi-partner projects that promote the networking and coordination of research activities)	68	46
Specific support actions (contribute to the implementation of activities, analysis and dissemination of results and the preparation of future activities)	59	40
Total	**2,343**	**1,576**

Seventh Framework Programme (2007 to 2013)

Objective		
Collaborative projects (supports projects carried out by a consortia of participants from different countries, and from industry and academia)	2,443	1,995
Support for frontier research	1,164	951
Support for training and career development for researchers	716	585
Combination of collaborative projects and coordination and support action	231	189
Coordination and support actions (supports the coordination and networking of projects)	175	143
Research for the benefit of specific groups, such as SMEs	142	116
Networks of excellence (support 'virtual research centres' that integrate resources from research units)	47	38
Total	**4,918**	**4,017**

NOTES

1 Some of the funding objectives support activities that would not be defined as R&D using the OECD definition used by the ONS.

2 These data show funding that has been committed by the European Commission and does not include other funding that other entities might be required to provide as a condition of the European Commission grant.

3 We have not audited the figures in the table.

4 We have calculated the sterling equivalent using the average (mean) exchange rate for the period of the programme. In our calculation, we assume that the European Commission funding received by UK entities is distributed equally throughout the period of the programme. The exchange rates were taken from UK Forex, May 2013. See www.ukforex.co.uk/forex-tools/historical-rate-tools/yearly-average-rates

Source: Department for Business, Innovation & Skills data

2.26 The total budget was larger under the Seventh Framework Programme (an average of €8.9 billion, or £7.2 billion, a year as opposed to €4.5 billion, or £3.0 billion, a year under the Sixth Framework Programme).[17] The UK was also allocated more funding under the Seventh Framework Programme (an average of €820 million, or £669 million, a year) than under the Sixth Framework Programme (an average of €586 million, or £394 million, a year).

2.27 Parts of the Structural Funds, in particular the European Regional Development Fund, also support R&D activities, although it is difficult to quantify the proportion. The funds are managed by a number of UK government departments, none of which holds data on the level of support across the whole programme that would meet the ONS's definition of R&D.

Part Three

UK business sector analysis

3.1 Of the sectors that undertake R&D in the UK, UK business makes the largest contribution. In 2011, it carried out R&D worth £17.4 billion (64 per cent of total R&D undertaken in the UK).[18] However, R&D undertaken by UK business is concentrated in a small number of large firms. For example, in 2011, the top ten UK businesses in terms of carrying out R&D spent £7.7 billion (44 per cent of the total undertaken by UK business) and the top 50 spent £11.8 billion (68 per cent of the total undertaken by UK business).

3.2 This section of the report examines R&D carried out in the UK business sector, focusing particularly on the contributions made by different industry sectors and SMEs. It draws on ONS data as well as the BIS 2010 Scoreboard of UK businesses spending the most on R&D.

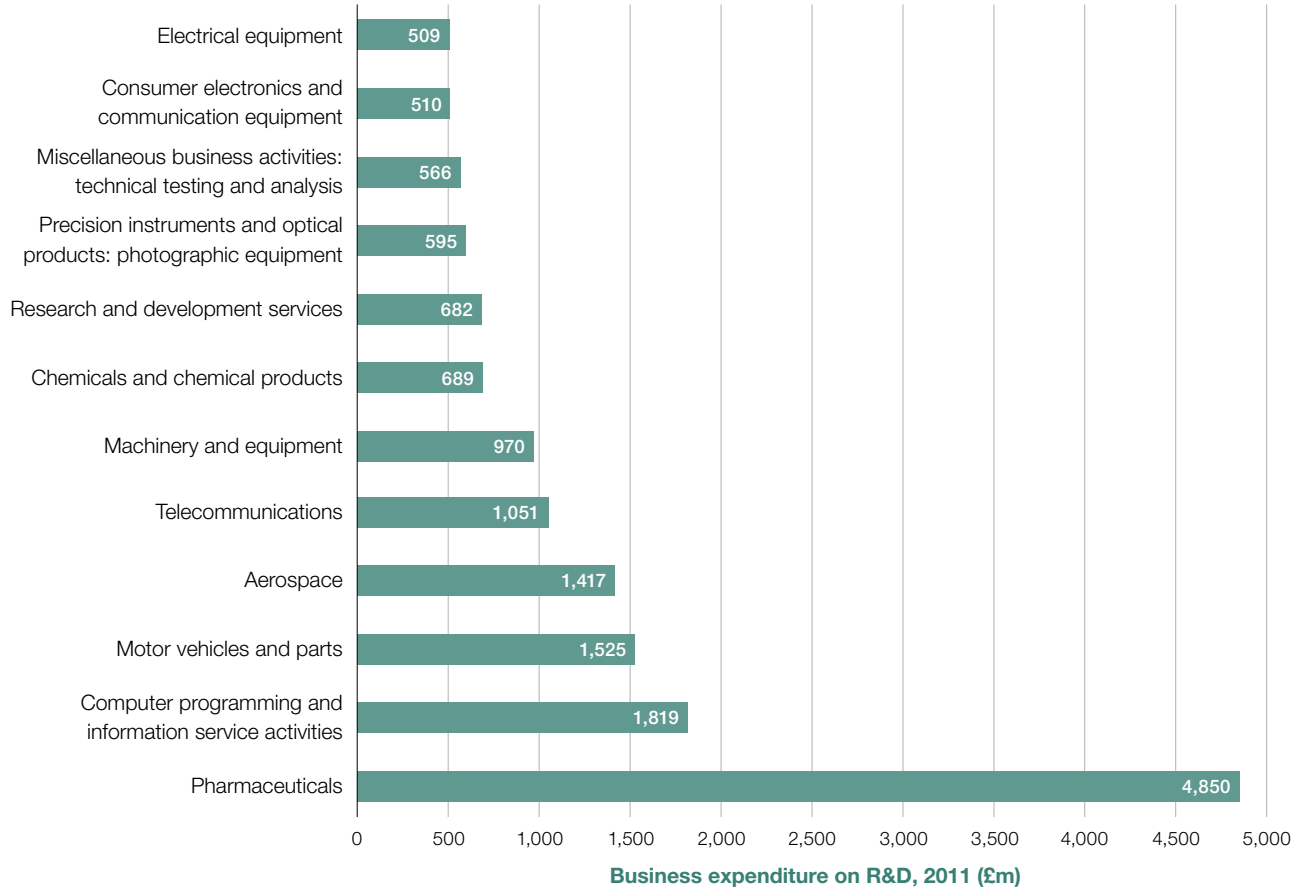
Analysis by industry sector

3.3 **Figure 12** shows that the pharmaceuticals sector is the largest UK performer of R&D, with total spending of some £4.9 billion in 2011 (28 per cent of the total by UK business). The sector has dominated over the last decade. In 2000, it represented 25 per cent of the total R&D activity undertaken by UK business, but between 2000 and 2011, R&D performance increased in real terms by £175 million (31 per cent), as shown in **Figure 13** on page 34. The sector attracts much of the UK's overseas funding for R&D. In 2011, overseas organisations invested £1.5 billion in R&D within the pharmaceuticals sector (40 per cent of the total overseas funding for UK business R&D).

3.4 BIS data show that the pharmaceuticals sector's R&D activity is heavily dependent upon two major organisations, GlaxoSmithKline and AstraZeneca. In 2009, these two organisations spent £6.4 billion on undertaking R&D, which constituted 71 per cent of R&D performed in the sector.[19] It should be noted, however, that the data are based on figures reported in the Annual Report and Accounts of these two organisations, using the accounting definition of R&D, and so differ from data reported by ONS which uses the OECD definition of R&D.

Figure 12

Sector analysis of the value of Research and Development carried out by UK business in 2011 (£m)



NOTES

1 The Figure shows the largest 12 sectors of the UK, in terms of business spending on R&D undertaken in the UK in 2011.

2 The Figure excludes business sectors which spent less than £500 million each on R&D in 2011. These sectors collectively spent £2.2 billion on carrying out R&D in 2011.

Source: Office for National Statistics data. Data are available at: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-283184, UK Business Enterprise Research and Development, 2011 – Datasets, table 8

Figure 13
Key trends in the largest Research and Development sectors

	Expenditure in sector, 2011 (£m)	Expenditure in sector as a percentage of total business R&D expenditure, 2011 (%)	Change in sectorial expenditure (2000 to 2011) (%)	Change in sectorial expenditure (2007 to 2011) (%)	Change in sectorial expenditure (2010 to 2011) (%)
Pharmaceuticals	4,850	28	+31	+13	+1
Computer programming and information service activities	1,819	10	+130	+11	+17
Motor vehicles and parts	1,525	9	+36	+49	+21
Aerospace	1,417	8	0	-38	-3
Telecommunications	1,051	6	+20	-37	-9
Machinery and equipment	970	6	+6	-14	+18
Chemicals and chemical products	689	4	-22	-6	+1
Research and development services	682	4	+23	+299	+8
Precision instruments and optical products: photographic equipment	595	3	-4	0	+19
Miscellaneous business activities: technical testing and analysis	566	3	+233	+1	-5
Consumer electronics and communication equipment	510	3	-62	-30	+5
Electrical equipment	509	3	-7	-15	-3
Other smaller sectors not listed above	2,226	13	+21	+40	+15

NOTES

1 All figures are in 2011 prices to exclude the impact of inflation.

2 The bottom row includes all UK business sectors which spent less than £500 million each on R&D in 2011.

Source: National Audit Office analysis of Office for National Statistics data. Data are available at: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-283184, UK Business Enterprise Research and Development, 2011 – Datasets, table 8. The Office for National Statistics inflator used to convert figures from cash terms to 2011 prices was calculated using data available at: www.ons.gov.uk/ons/dcp171778_302928.pdf, page 4

3.5 As shown in Figure 12, the sectors with the next highest spending on R&D, which contribute just over a third of UK business spend, are computer programming and information service activities (10 per cent), motor vehicles and parts (9 per cent), aerospace (8 per cent), telecommunications (6 per cent) and machinery and equipment (6 per cent). Of these sectors, computer programming and information service activities has shown the most growth over the last decade, with total UK business R&D spending of £1.8 billion in 2011 (a 130 per cent increase from 2000). The final third of spending is sourced from many smaller contributors, who each constitute less than 5 per cent of total UK business spending on R&D.

SMEs

3.6 In 2012, there were 4.8 million SMEs in the UK. These firms represent 99 per cent of the total number of UK businesses and account for 59 per cent of jobs and 49 per cent of turnover in the private sector.[20]

3.7 The government's December 2011 Innovation and Research Strategy for Growth includes a number of measures aimed at improving incentives for SMEs to innovate.[21] It includes a commitment to invest an additional £75 million over three years, through the Technology Strategy Board, to support R&D in SMEs. Successive governments have also created schemes aimed at promoting research in SMEs. For example, R&D tax relief for SMEs was introduced in 2000, and governments have since increased the rate of tax relief from the original 100 per cent in 2000, to 225 per cent in 2012 (as explained in paragraph 2.19).

3.8 **Figure 14** overleaf shows that SMEs spent £4 billion undertaking R&D in 2011 (23 per cent of total UK business spending on R&D performance). However, spending by independent SMEs, which are not part of a larger enterprise group, was significantly lower at £627 million (4 per cent of total UK business spending).

3.9 Since 2000, the amount spent by SMEs on conducting R&D has increased by 48 per cent for all SMEs and 40 per cent for independent SMEs. Spending as a proportion of total UK business spending has increased for SMEs, from 18 per cent in 2000 to 23 per cent in 2011. For independent SMEs, spending on undertaking R&D as a proportion of the total for UK business remained relatively constant, at 3 per cent in 2000 and 4 per cent in 2011.

Figure 14

SME spending on carrying out Research and Development, 2000 to 2011

£ million, 2011 prices

NOTES

1 SMEs are defined as organisations with fewer than 250 employees. Independent SMEs are those SMEs that are not part of a larger enterprise group.

2 All figures are in 2011 prices to exclude the impact of inflation.

Source: National Audit Office analysis of the Office for National Statistics data. Data are available at: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-283184, UK Business Enterprise Research and Development, 2011 – Datasets, tab 26. The ONS inflator used to convert figures from cash terms to 2011 prices was calculated using data available at: www.ons.gov.uk/ons/dcp171778_302928.pdf, page 4

Part Four

International comparisons

4.1 'R&D intensity' (R&D spending as a percentage of Gross Domestic Product) is one of the five key indicators of the European Commission's 2020 strategy for growth over the next decade.[22] The strategy includes a target for 3 per cent of Europe's GDP (public and private combined) to be invested in R&D by 2020. Most countries have adopted national R&D intensity targets, with the exception of a small number of member states, including the UK.

4.2 This section of the report examines how the UK compares internationally in terms of its R&D intensity and overall investment in R&D. It mainly draws on data from the OECD's Science, Technology and Industry Scoreboard.[23] The OECD's figures for UK Gross Domestic Expenditure on R&D differ from the ONS figures reported in Part Two, as the OECD expresses data in 'purchasing power of parity', using an exchange rate to adjust data such that identical goods in two different countries have the same price when expressed in dollars.

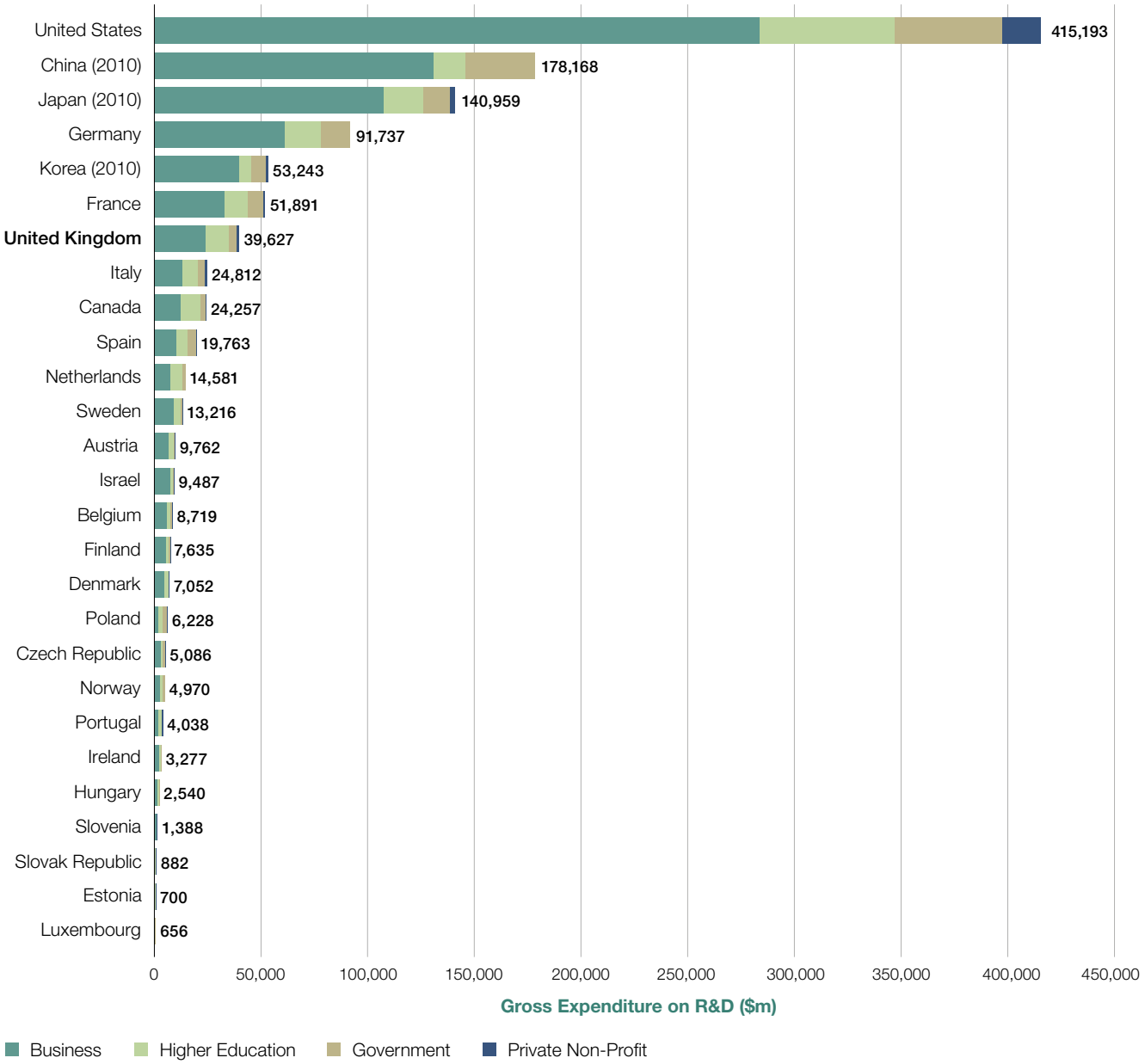
Gross Domestic Expenditure on R&D

4.3 **Figure 15** overleaf shows that the UK is placed in the top third of countries in terms of actual spending on R&D in 2011. However, in **Figure 16** on page 39, which shows R&D intensity, the UK is placed around the middle of the scale. In 2011, the UK's R&D intensity was around 1.8 per cent, which is below the European Union average (currently estimated to be 1.9 per cent), as well as the figures for Germany (2.8 per cent), the United States (2.8 per cent) and France (2.2 per cent). It should be noted, though, that the data used to calculate these figures have not yet been finalised and do not include figures for around 30 per cent of countries in the OECD[24] and around 20 per cent in the European Union area.

4.4 Figure 16 also shows that Higher Education Institutions play a more significant role in undertaking R&D in the UK than in other OECD countries. Higher Education Institutions contribute 27 per cent of total R&D in the UK, compared to 19 per cent across the OECD area as a whole. In contrast, UK business plays a less significant role than in other OECD countries, contributing to 61 per cent of the total R&D undertaken in 2010, compared to 66 per cent across OECD countries. The proportion of the UK's total R&D that is carried out by government (10 per cent) and the Private Non-Profit sector (2 per cent) is broadly comparable to the OECD area as a whole (12 and 3 per cent of total R&D respectively).

Figure 15

International comparison of spending on Research and Development in 2011, $ million



NOTES

1 The OECD data have not yet been finalised and includes provisional figures.

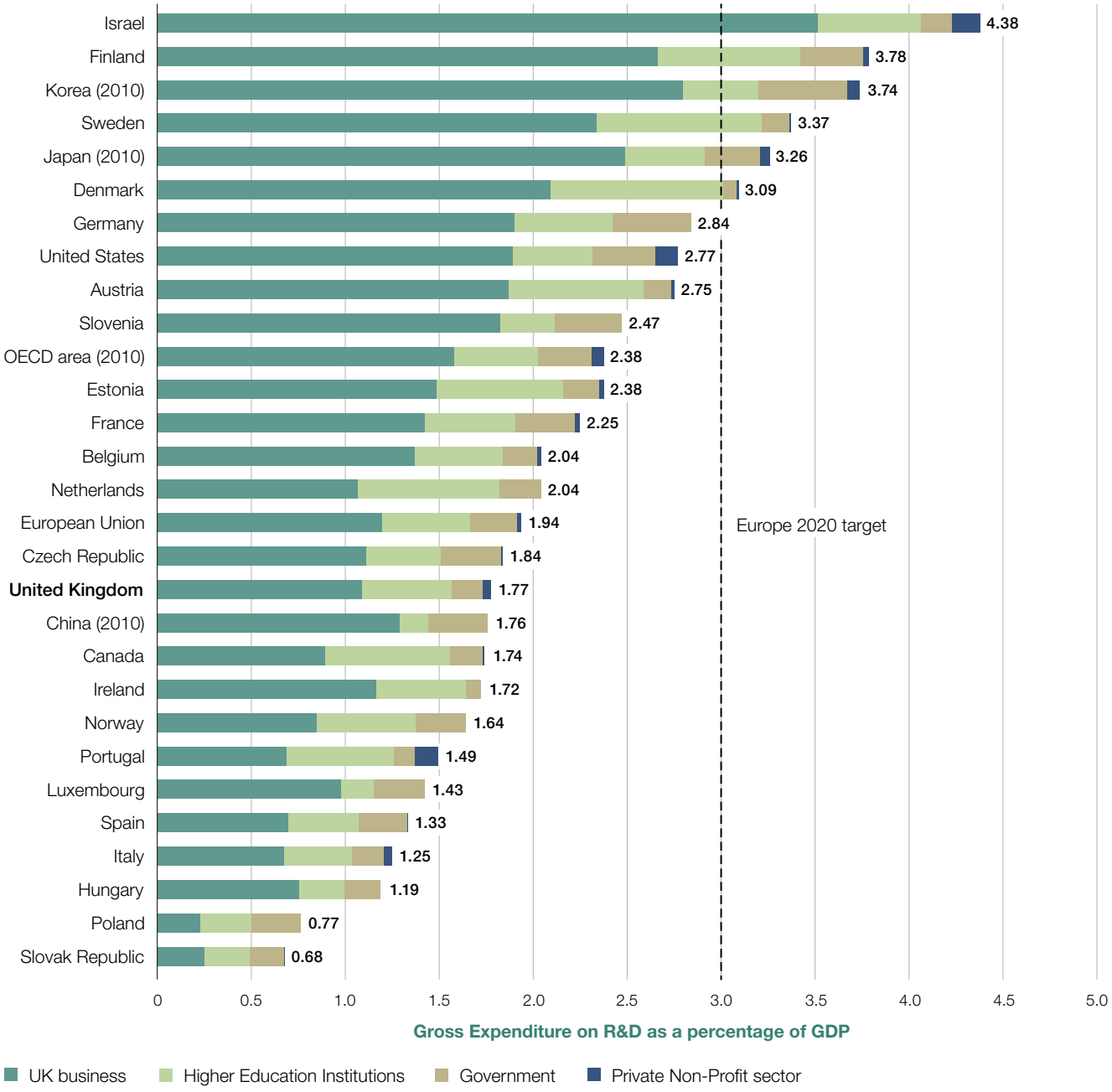
2 The Figure excludes countries that do not have data for 2011 on their Gross Domestic Expenditure on R&D, with the exception of China, Japan and Korea, where we have included these countries using their data from 2010. For all other countries shown, data are taken from 2011.

3 Figures are expressed in 'purchasing power of parity', using an exchange rate to adjust data such that identical goods in two different countries have the same price when expressed in dollars.

Source: National Audit Office analysis of Organisation for Economic Cooperation and Development (OECD) data. Data are available at: http://stats.oecd.org/Index. aspx?DataSetCode=MSTI_PUB, see Gross Domestic Expenditure on R&D – GERD. The analysis of expenditure by sector was calculated using data at: http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB, see percentage of GERD performed by Business Enterprise sector, Higher Education sector, Government sector, Private Non-Profit sector. Data downloaded in April 2013

Figure 16

International comparison of spending on Research and Development as a percentage of GDP ('R&D intensity') in 2011



NOTES

1 OECD data have not yet been finalised, and include provisional figures.

2 The Figure excludes entities that do not have data for 2011 on their Gross Domestic Expenditure on R&D, with the exception of China, Japan, Korea and the OECD area where we have included these countries using their data from 2010. For all other countries shown, data are taken from 2011.

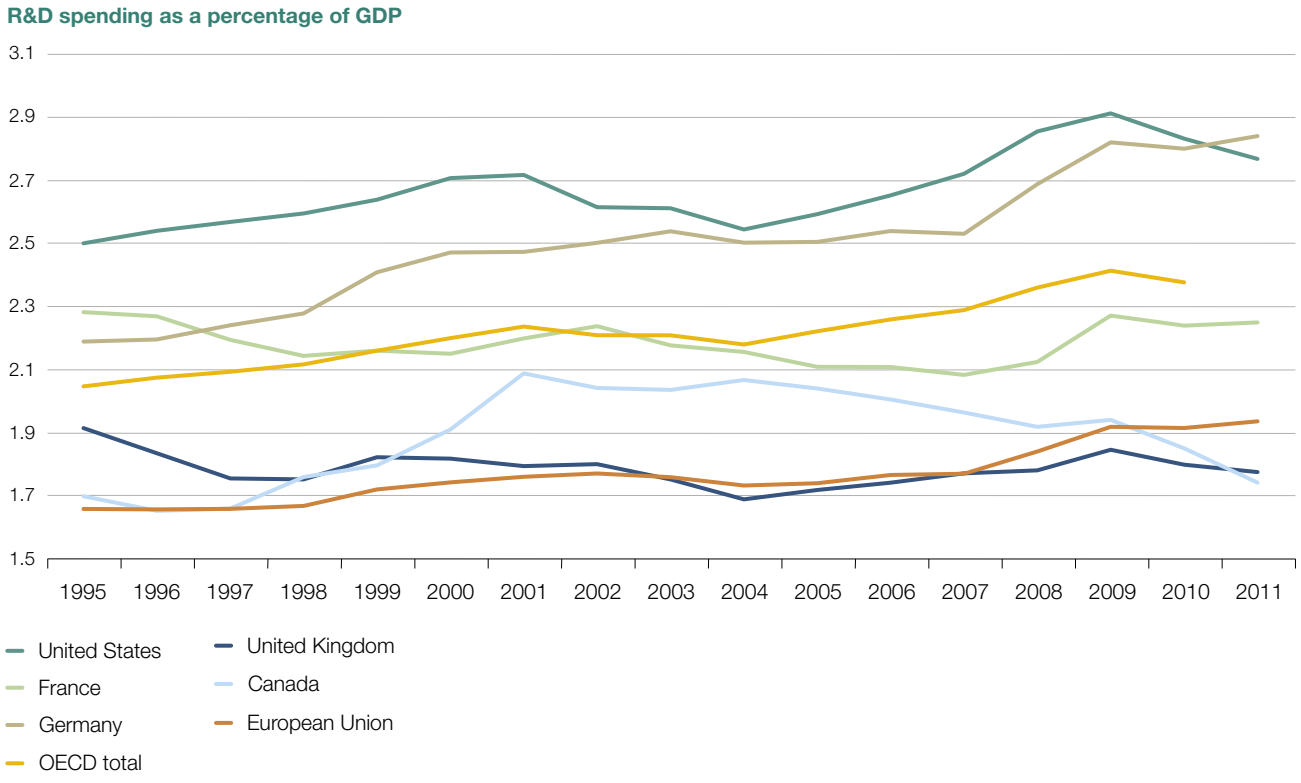
3 Figures are expressed in 'purchasing power of parity', using an exchange rate to adjust data such that identical goods in two different countries have the same price when expressed in dollars.

Source: Organisation for Economic Cooperation and Development (OECD) data. Data are available at: http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB, see GERD as a percentage of GDP. Data downloaded in April 2013

4.5 The time series in **Figure 17** shows that, between 1995 and 2011, the UK's R&D intensity declined from just over 1.9 per cent to just under 1.8 per cent. Most of this decline occurred between 1995 and 2001, as since 2001, the UK's R&D intensity has remained relatively unchanged. In 2010 and 2011, the ratio decreased, despite an increase in the absolute spending on R&D. This was as a result of GDP increasing at a higher rate than R&D spending.

Figure 17

Trends in Research and Development spending as a percentage of GDP, 1995 to 2011



NOTE

1 OECD data have not yet been finalised and include provisional figures.

Source: OECD data. Data are available at: http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB, see GERD as a percentage of GDP. Data downloaded in April 2013

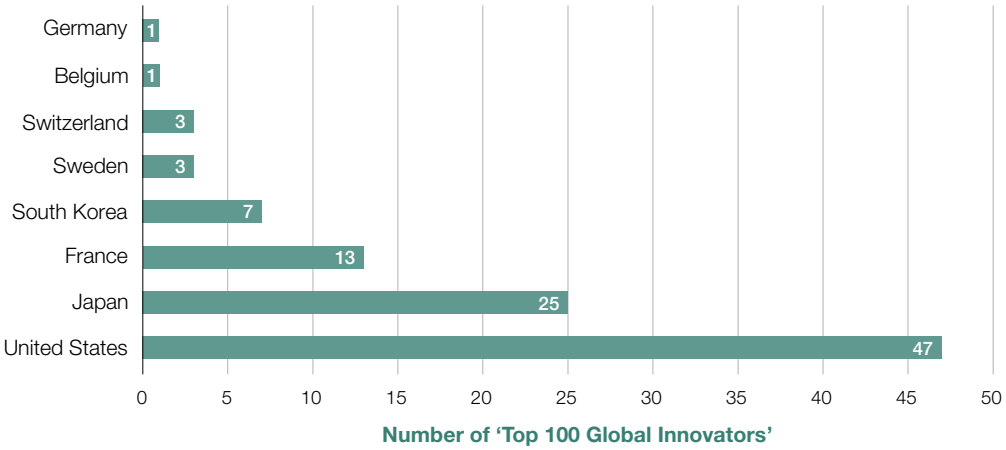
4.6 Figure 17 also shows that the OECD area as a whole increased its R&D intensity by 16 per cent between 1995 and 2010, and 6 per cent between 2001 and 2011. Of the 25 countries with data spanning the period from 1995 to 2010, all but four (the UK, France, the Netherlands and Slovak Republic) increased their intensity ratio over that period.

'Top 100 Global Innovators'

4.7 The Thomson Reuters list of the 'Top 100 Global Innovators' is an attempt to identify the world's most innovative organisations[25] (see Appendix Two for more detail).

4.8 **Figure 18** shows that the United States had 47 organisations on the list in 2012, which made it the country with the largest percentage of innovative organisations for the second time since the index was created in 2011 There were 32 organisations on the list from Asia (25 from Japan and seven from South Korea). Europe had 21 organisations on the list, with 13 of those organisations from France. Compared to 2011, there was a larger proportion of organisations from the United States and Asia, and a smaller proportion from Europe.

Figure 18
Geographic distribution of Thomson Reuters 'Top 100 Global Innovators', 2012



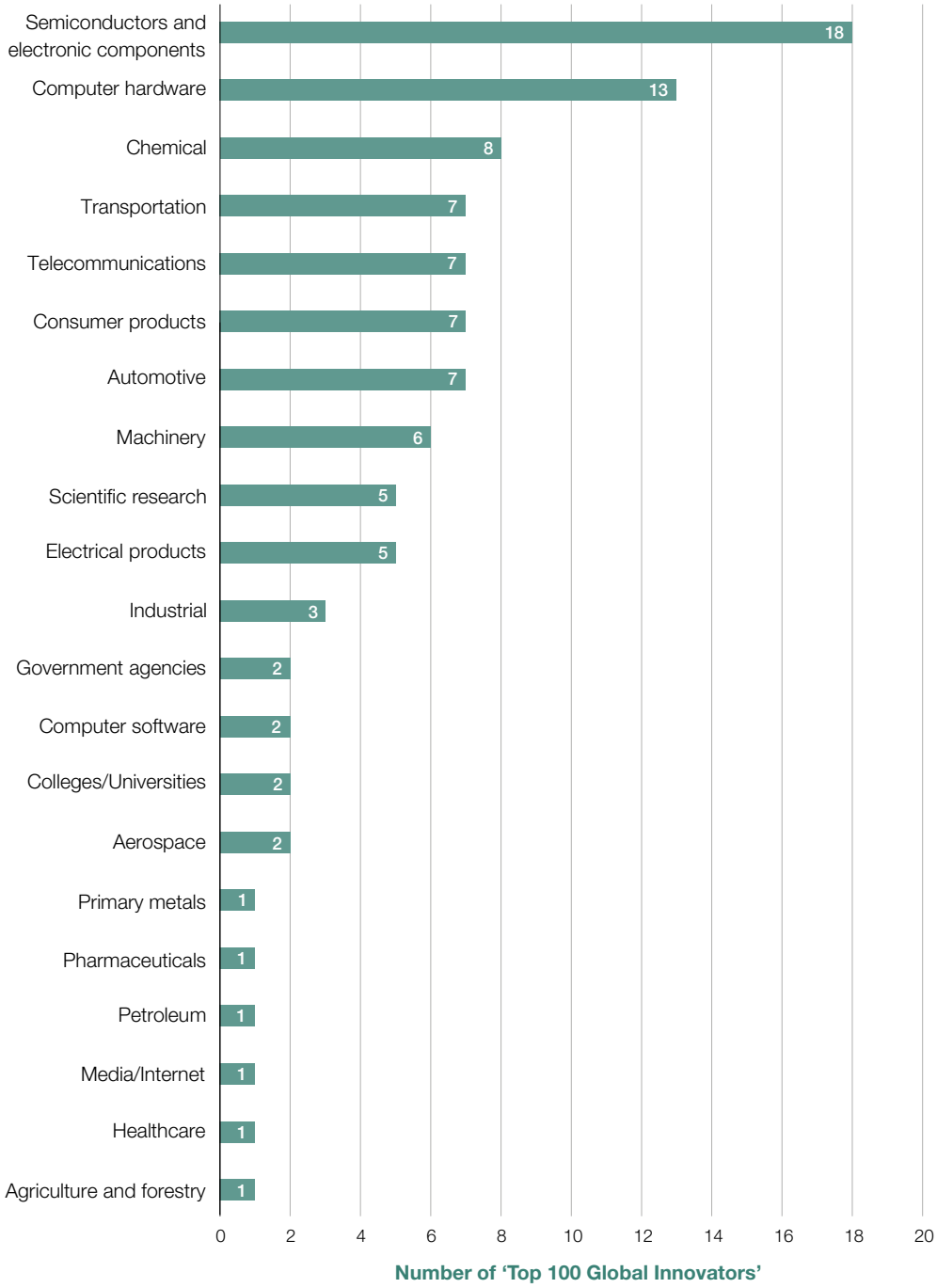
Source: Thomson Reuters Top Global Innovators, 2012. Available at: http://img.en25.com/Web/ThomsonReutersScience/1001639.pdf, page 10

4.9 No UK organisation featured in the 2012 list. The list tends to favour fast-paced, high-tech industries, with short product lifecycles, rather than the pharmaceutical and biotechnology companies that dominate R&D within the UK.

4.10 **Figure 19** overleaf shows that the most prevalent industry within the 2012 list was semiconductor and electronic components, with 18 organisations, up from 14 organisations in 2011. The next most prevalent industry was hardware, with 13 of the top 100 organisations, up from 11 in 2011. Thomson Reuters identifies the increase in this category as being due to a growth in the need to manage and store large volumes of data. Other notable changes include a large increase in representation by the automotive industry (from three organisations in 2011 to seven in 2012) and transportation equipment manufacturing (from five in 2011 to seven in 2012).

Figure 19

Thomson Reuters 'Top 100 Global Innovators', 2012: sector distribution



Source: Thomson Reuters 'Top Global Innovators', 2012. Available at: http://img.en25.com/Web/ThomsonReutersScience/1001639.pdf, page 12

Tax incentives

4.11 Countries are increasingly using tax incentive schemes to encourage businesses to invest in R&D, and the financial incentives provided by schemes are becoming more generous.[26] In 2011, governments from 26 OECD countries used tax incentives to promote business spending on R&D, up from 12 in 1995 and 18 in 2004.[27] Existing R&D tax incentive schemes differ in terms of their generosity and design. They include spending-based incentives, such as tax credits or deductions from payroll taxes, as well as income-based incentives, such as reductions in the tax rate applied to royalty income. Some countries' schemes target specific types of research – for example collaborative working (Hungary, Italy, Japan, Norway and Turkey) or research by young firms or start-ups (France, Korea and the Netherlands).

4.12 **Figure 20** overleaf shows that the UK government spends more than most other countries on its combined direct and indirect funding of business R&D, relative to the country's GDP. However, we should be cautious about making comparisons between countries' spending on tax incentive schemes, as they use different methodologies for collecting and reporting their data. It should also be noted that Figure 20 shows data for both 2008 and 2009, as 2009 data are not available for some countries.

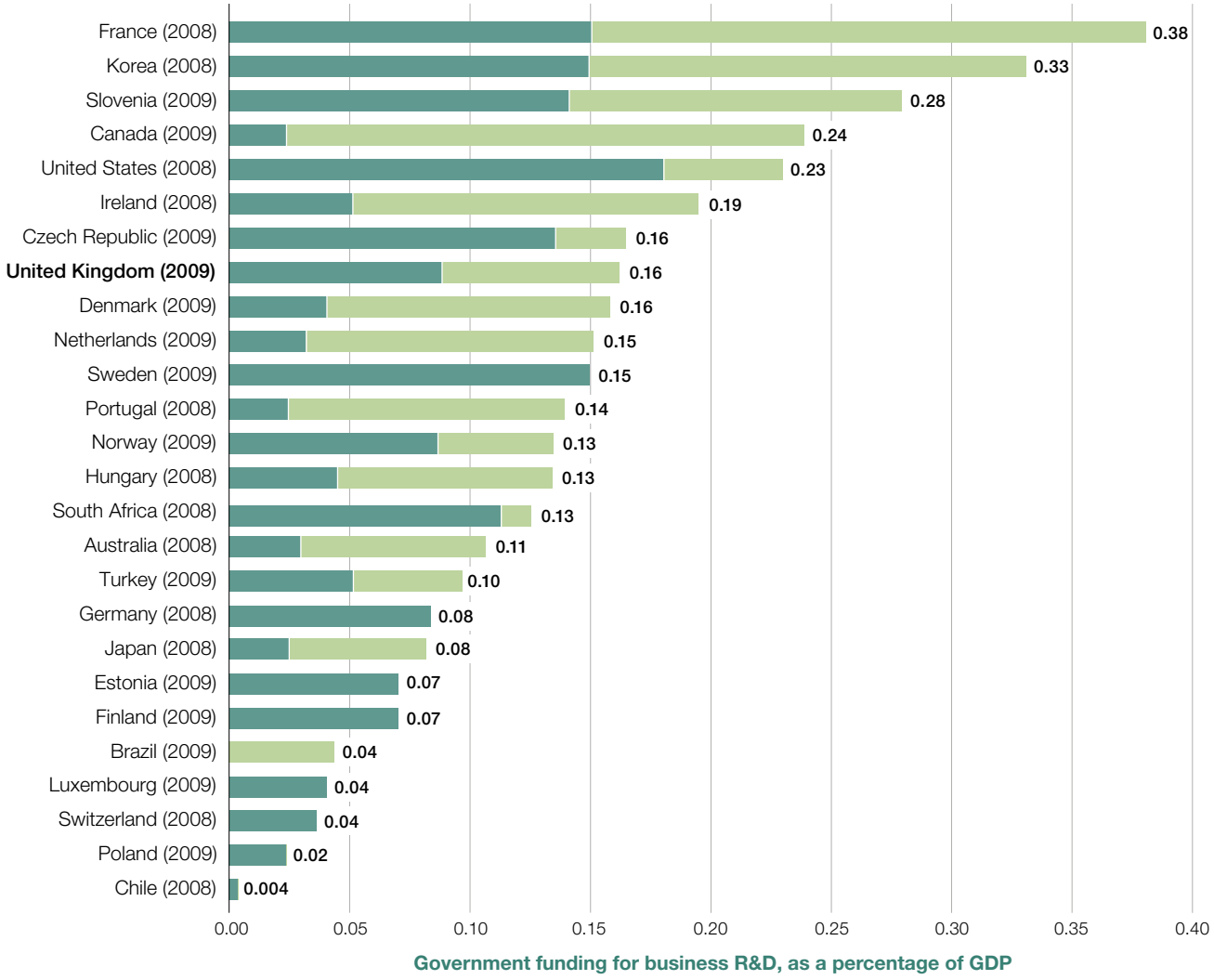
4.13 Figure 20 also shows how the balance of direct and indirect funding on R&D varies between countries. The UK uses direct and indirect support in roughly equal proportions. The United States and the Czech Republic rely more on direct support, while Canada, the Netherlands, Portugal and Japan mostly use indirect tax support. While tax incentive schemes are not generally targeted towards a specific group or project, direct forms of funding can be focused on specific activities that the government considers high value. According to an OECD report, tax incentive schemes are mostly used to encourage short-term applied research, while direct subsidiaries are directed more to longer-term research.[28]

The European Commission's Framework Programme funding

4.14 UK organisations were allocated around €2.3 billion of funding in the European Commission's Sixth Framework Programme (around 14 per cent of total European Commission funding).[29] Data taken part way through the Seventh Framework Programme show that the UK was allocated €1.3 billion (around 16 per cent of the total funding) as at November 2009. In both of these Programmes, the UK was the second highest recipient of funds, behind Germany, which was allocated £3 billion and £1.5 billion across the whole of the Sixth Framework Programme and the first part of the Seventh Programme respectively. In terms of the UK's share of funding compared to the share of European Union GDP, the UK is placed 18th out of 25 countries in the Sixth Programme and 13th out of 27 countries part way through the Seventh Programme, with a ratio of income to GDP of 93 and 99 per cent respectively. Member states contribute to the Framework Programme budget broadly in line with their share of European Union GDP, so GDP can be used as an approximate benchmark for relative performance within the Framework Programme.

Figure 20

Government funding of business Research and Development through direct forms of funding and tax incentives as a percentage of Gross Domestic Product, 2008 and 2009



NOTES

1 Caution should be taken in making comparisons between countries' spending on tax incentive schemes, as countries use different methodologies for collecting and reporting their data.

2 The Figure shows data for both 2008 and 2009, as 2009 data are not available for some countries.

3 The Figure excludes countries that do not have 2008 or 2009 data on their government's funding of business R&D through direct and indirect support.

4 The Figure shows UK data for 2009, when R&D tax relief entitled SMEs to reduce their profits subject to corporation tax by 175 per cent of their qualifying spending on R&D. Since 2009, the UK government has increased the rate of SME relief to 200 per cent from April 2011, and 225 per cent from April 2012, the rate in force at the time of writing this report. The rate of relief available to large companies has remained constant since 2009, at 130 per cent, although in April 2012, the government removed the requirement for large companies to have to spend at least £10,000 on qualifying R&D costs in an accounting period.

Source: Organisation for Economic Cooperation and Development (OECD) data. Data are available at: www.oecd-ilibrary.org/sites/sti_scoreboard-2011-en/05/05/index.html?contentType=&itemId=/content/chapter/sti_scoreboard-2011-48-en&containerItemId=/content/serial/20725345&accessItemIds=/content/book/sti_scoreboard-2011-en&mimeType=text/html

Appendix One

Detailed definitions

Activities that should be excluded when accounting for R&D

1 There are numerous activities which may have a scientific and technological basis, but which should be excluded from the formal measure of R&D according to the *Frascati Manual*. These include:

- education and training;
- scientific and technical information services;
- general purpose data collection;
- testing and standardisation;
- feasibility studies;
- specialised healthcare;
- patent and license work;
- policy-related studies;
- routine software development;
- production and related technical activities; and
- administration and other supporting activities.

Sectors which fund or carry out R&D

2 The main sectors which fund or carry out R&D are defined in the *Frascati Manual* as follows:

Sector	Definition
UK business	UK business includes "all firms, organisations and institutions whose primary activity is the market production of goods or services (other than Higher Education) for sale to the general public at an economically significant price". This sector includes Non-Profit Institutions (NPIs) that are market producers of goods and services for sale at prices designed to recover most or all of their costs. This also includes NPIs serving businesses and managed by associations of businesses e.g. trade associations and chambers of commerce.
Government	Government Expenditure on R&D (GovERD) includes "all departments, offices and other bodies which furnish, but normally do not sell to the community, those common services, other than Higher Education, which cannot otherwise be conveniently and economically provided". This includes NPIs controlled and mainly financed by government, but not administered by Higher Education Institutions.
Higher Education Institutions	Higher Education Institutions include "all universities, colleges of technology and other institutions of post-secondary education, whatever their source of finance or legal status" as well as entities administered by or associated with Higher Education Institutions.
Private Non-Profit	The Private Non-Profit (PNP) sector covers non-market, PNP Institutions serving households (the general public). These provide individual or collective services without charge or at prices that are not economically significant. The sector includes non-market units controlled and mainly financed by NPIs serving households e.g. professional and learned societies and charities.
Overseas	The Overseas sector is comprised of "all institutions and individuals located outside the political borders of a country and all international organisations (except UK business) including facilities and operations within the country's borders".

Source: OECD, Frascati Manual: Proposed standard practice for surveys on research and experimental development, 2002

Appendix Two

Further information on data sources

Office for National Statistics (ONS)

1 ONS produces an annual summary of R&D in the UK known as GERD (Gross Domestic Expenditure on R&D). These summaries are useful because they identify the transfer of funds between sectors and include historical figures enabling an analysis of the landscape over time.

2 ONS uses the four sector classification of R&D from the *Frascati Manual*, as follows:

- Business Enterprise Research and Development (BERD). This is an annual survey of 5,000 businesses. The sample is stratified into 'large' firms (those spending £3.3 million on R&D) and the remaining 'small' firms. The totals for non-sampled businesses are estimated using ratio estimation.
- Government R&D (GovERD). This is measured from a census of around 140 government departments, agencies and Research Councils.
- Higher Education R&D (HERD). This is provided by the Higher Education Funding Councils.
- Private Non-Profit (PNP). A new survey of the PNP sector was introduced in 2011, covering approximately 200 non-profit businesses.

3 The latest ONS dataset, released in March 2013,[30] includes for the first time:

- regional breakdowns of spending; and
- international comparisons, in terms of how much is spent on R&D as a proportion of countries' GDP.

Organisation for Economic Cooperation and Development (OECD)

4 The OECD produces a *Science, Technology and Industry Scoreboard*[31] every two years. The Scoreboard is based on over 180 indicators, and examines the trends in science, technology, innovation and industrial performance in OECD countries along with Brazil, Russia, India, China and South Africa (the 'BRICS' countries). The scoreboard features a comparative analysis of national R&D activity across the sectors.

5 The information is based on the *OECD Main Science and Technology Indicators* database and the *Research and Development Statistics* which are collected from the national statistical offices of each respective country and normalised, for example through the use of inflator and conversion indexes to determine current purchasing power parity for measures of expenditure.[32] The OECD datasets provide considerable scope for producing an international comparative analysis, but lack the detail required to examine the transfer of funds between institutional sectors within a country's economy and across national borders.

6 The OECD also produced an international comparison of direct and indirect R&D incentives as part of the Science, Technology and Industry Scoreboard Report in 2011. The analysis captured a range of tax incentives, such tax credits or accelerated depreciation charges, across the OECD member states. The data came from 2010 and 2011 R&D tax incentives questionnaires and are inherently difficult to compare as each member state estimates and reports the cost of tax incentives in different way.

HM Revenue & Customs (HMRC)

7 HMRC publishes annual R&D Tax Relief Statistics reports, which contain the latest information on the cost to the Exchequer of providing tax relief support, the number of claims, and the nature of companies claiming support. The most recent report was published in August 2012 and included data up to the 2010-11 financial year.

8 These reports are based on information provided by companies on Company Tax returns (known as CT600s). HMRC undertakes some verification of the figures, for example by identifying outliers, checking their veracity and then removing or correcting any erroneous records. Any large changes in figures from one statistical release to the next are also investigated. HMRC does identify some limitations in its data, such as a small number of late returns which add to the existing data and can therefore result in minor revisions to previously published figures. However, previous changes in data as a result of late returns have not been material.

Thomson Reuters

9 Thomson Reuters produced a list of the most innovative global companies in 2011, and repeated the exercise in December 2012.[33] The list is based upon an index, combining the following factors: volume of innovative patents; ratio of published applications to granted patents; global presence; and subsequent citations by other companies.

Appendix Three

Organisation for Economic Cooperation and Development (OECD)

1 The OECD is a forum of 34 countries committed to global economic development.

2 At the time of writing this report, its members were: Australia; Austria; Belgium; Canada; Chile; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Israel; Italy; Japan; Korea; Luxembourg; Mexico; Netherlands; New Zealand; Norway; Poland; Portugal; Slovak Republic; Slovenia; Spain; Sweden; Switzerland; Turkey; the United Kingdom; and the United States.

Endnotes

1 Department for Business, Innovation & Skills, *Innovation and Research Strategy for Growth*, December 2011, p. 21. Available at: www.bis.gov.uk/assets/BISCore/innovation/docs/I/11-1387-innovation-and-research-strategy-for-growth.pdf

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3 The Organisation for Economic Cooperation and Development is a forum of 34 countries committed to global economic development. See Appendix Three for details of current members.

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17 We have calculated the sterling equivalent using the average (mean) exchange rate for the period of the programme. In our calculation, we assume that the European Commission funding received by UK entities is distributed equally throughout the period of the programme. The exchange rates were taken from UK Forex, available at: www.ukforex.co.uk/forex-tools/historical-rate-tools/yearly-average-rates, accessed May 2013.

18 Office for National Statistics, *Business Enterprise Research and Development*, 2011. Available at: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-283184, accessed April 2013

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