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Chapter:

3. Public and private funding of R&I and expenditure

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Abstract

The 2015 series of RIO Country Reports analyse and assess the policy and the national research and innovation system developments in relation to national policy priorities and the EU policy agenda with special focus on ERA and Innovation Union. The executive summaries of these reports put forward the main challenges of the research and innovation systems.

3. Public and private funding of R&I and expenditure

3.1 Introduction

Table 1: Basic indicators for R&D investments

Indicator	2011	2012	2013	2014	EU average (2014)
GERD (as % of GDP)	1.69	1.63	1.69	1.72	2.03
GERD (Euro per capita)	500.6	524.5	532	595.9	558.4
GBAORD (€m)	10,496.14	11,226.292	11,757.565	12,603.275	92,828.145 (Total EU-28)
R&D funded by BES (% of GDP)	0.78	0.74	0.78	0.8	1.12 (2013)
R&D funded by PNP (% of GDP)	0.08	0.08	0.08	0.08	0.03 (2013)
R&D funded by HES (% of GDP)	0.02	0.02	0.02	0.02	0.02 (2013)
R&D funded from abroad	0.3	0.32	0.31	0.33	0.2 (2013)
R&D performed by HES (% of GDP)	0.44	0.44	0.45	0.45	0.47
R&D performed by government sector (% of GDP)	0.15	0.13	0.13	0.13	0.25
R&D performed by business sector (% of GDP)	1.08	1.03	1.08	1.11	1.3

Source: Eurostat

3.2 Smart fiscal consolidation

3.2.1 Economic growth, fiscal context[1] and public R&D

The UK lost around 4.6% of its real GDP during 2008-09. However, relatively low growth of ca. 1.4% p.a. followed over the next three years. On the back of loose monetary policy, supportive government policy and employment growth, domestic demand started to strengthen in 2013 and led to an annual GDP growth of 2.9% in 2014. As the output gap closes the Commission expects growth to become more moderate at 2.3% in 2015 and to settle at 2.1% in 2016-17.

Public finances were strongly impacted by the 2008-09 crisis. The already high budget deficit (2008: 5.1%) jumped to almost 11% of GDP while overall GDP declined. Since 2010 the government has been implementing fiscal consolidation focusing mainly on expenditure cuts accounting for approximately 80% of the consolidation measures. As a result the headline deficit fell to 5.0% in 2014-15. Gross government debt continues to increase and is expected to peak at 87.6% of GDP in 2015-16 and to fall slightly to 86.1% during 2017-18. During 2017-18 the Commission expects the deficit to fall to 1.7% of GDP.

[1] Sources: DG ECFIN, http://ec.europa.eu/europe2020/pdf/csr2016/cr2016_uk_en.pdf

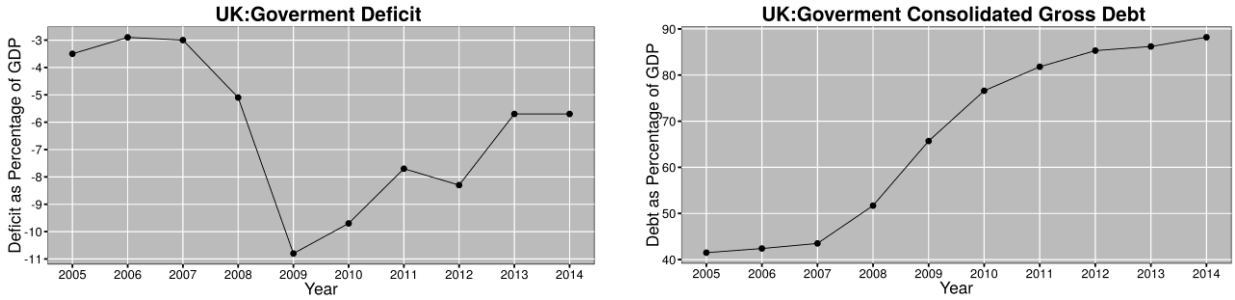

Figure 1: Government deficit and public debt
Data source: Eurostat

Total GERD in the UK was €33,999m in 2013. There are four main sources of R&D funding: the business sector (€15,710m), the government (€9,902 m), the private non-profit sector (€1,604m), and foreign funding (€6,350m). Direct funding from the government goes to business enterprises (€1,941m), the research performed within government (€2,104m) and the higher education sector (€5,650m).

Table 2: Key UK Public R&D Indicators

	2007	2009	2013
GBAORD, % of gov. exp.	1.47	1.28	1.28
GERD, % of GDP	1.69	1.75	1.69
out of which GERD to public, % of GDP	0.59	0.65	0.58
Funding from GOV to, % of GDP			
Business	0.07	0.08	0.1
Public (GOV+HES)	0.43	0.46	0.38
Total	0.52	0.57	0.49
EU funding, % of GDP	n.a.	0.03	0.04.

Source: Eurostat

3.2.2 Funding of R&D activities

Figure 5 below shows the historical evolution of GERD financing in current prices in the UK.

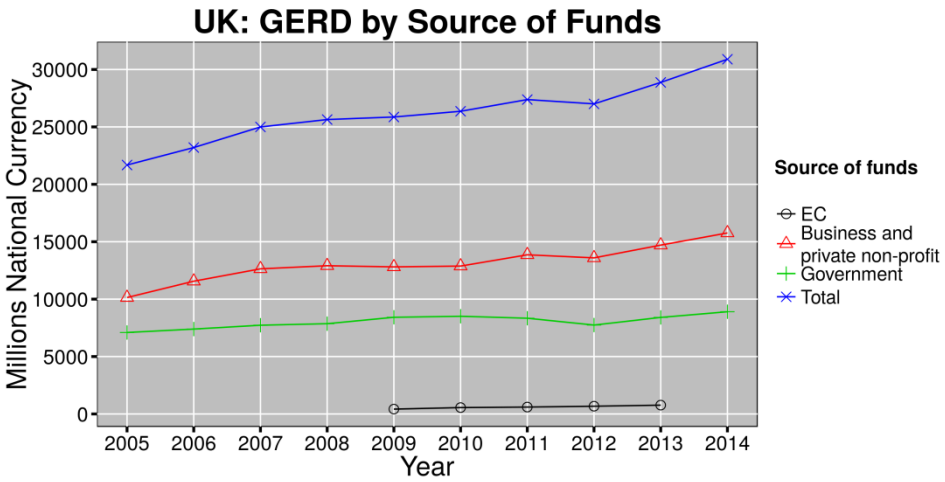

Figure 2: Funding of the total GERD
Source: Eurostat

With the exception of 2012, total GERD, in nominal terms, grew in the period 2005-2014, and particularly in the periods 2005-2007 and 2012-2014. This was due to the increase of the contribution from the business sector which is the main funder of UK R&D. Figure 5 also shows that the government funded GERD in 2014 fully had recovered from a mild decline in 2011-2012. The data about the contribution from the European Commission is sparse, but it increases monotonically between 2009 and 2012.

3.2.2.1 Direct public funding from the government

Figure 6 shows a sharp increase of the total (civil) appropriations from 2012 onwards and a slight reduction in the gap between civil and total appropriations, with military R&D appropriations remaining a substantial component of the total. An increase in certain investments has been announced by the Government, but the cuts in R&D budgets of a range of ministries could explain the trends in this chart. However, in terms of percentage of GDP both the appropriations and government GERD follow a negative trend from 2009 (peak due to the low GDP) and are well below pre-crisis levels in 2014

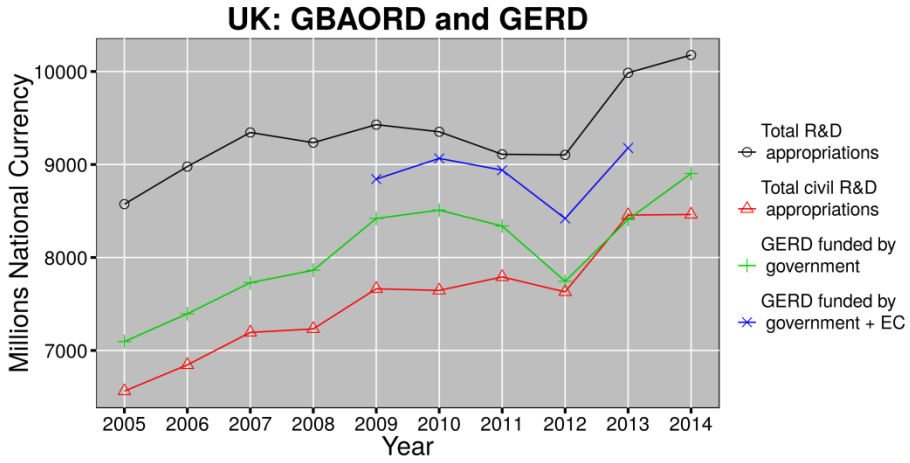

Figure 3: R&D appropriations and government funded GERD in millions of national currency
Source: Eurostat

The government states in its Science Budget (BIS, 2014d) that despite the need for tight control over public spending, it "remains committed to supporting our world-class science and research base". The ring-fencing of the Science Budget (in cash terms) announced in 2010 continues to protect spending (although it is subject to erosion by inflation, which has been very low over the recent period – see below). In addition, the government has announced investment in science infrastructure of £1.1b (c €1.5b) per year, protected in real terms to 2021, together with funding for new programmes such as Quantum Technologies, the Newton Fund, and further investment in high level skills. Thus, overall BIS investment in science and research will be £5.8b (c €7.7b) in cash terms for FY2015/16, representing an increase in the overall allocation compared to recent years.

Nevertheless, the Science Budget[2] Allocation also notes that this commitment represents a challenge to ensure that maximum benefit is obtained from this investment, which will imply continued efficiency savings, increased collaboration to develop creative solutions to shared goals, and greater efforts to leverage business and charity funding. As an example of this process, BIS has reduced teaching grant spending (via the Higher Education Funding Councils) by £1,033m (c €1,378m) from a 2013-14 outturn of £3,048m (c €4,064m) - a reduction of 34% - replacing it with student-routed income-contingent repayment loans. According to BIS (2015a) this "has been achieved whilst maintaining delivery of the Coalition Government's strategy in protecting funding for

2 That is, the Government's funding allocation to the Research Councils, Higher Education Funding Council for England, the Royal Society, the British Academy, the Royal Society for Engineering and a number of cross-cutting programmes (Science and society, Foresight, International activities and Evidence and evaluation).,

high-cost subjects – especially Science, Technology, Engineering and Mathematics (STEM), widening participation and safeguarding small and specialist institutions". Despite the recent Nurse review into the future of the Research Councils (see Section 2.2.1), it has been reported that the government has asked BIS to find £450m (c €600m) to cut in FY2015/16. Consultants from McKinsey and Company have been hired by BIS to help it make the 50 or so bodies under its authority "simpler, cheaper and better" (Smith, 2015).

Table 3: Allocation of the Science Budget; resource and capital funding 2010-2016

	£M	10-11 baseline	2011-12	2012-13	2013-14	2014-15	2015-16	total
Capital	SR Allocation	873	514	449	416	517	1,110	3,879
	Additional funding	-	246	163	514	551	39	1,513
	Total	873	760	612	930	1,068	1,149	5392
Resource	SR Allocation	4,576	4,576	4,576	4,576	4,576	4,576	27,456
	Additional funding	-	-	-	-	127	134	261
	Total	4,576	4,576	4,576	4,576	4,703	4,710	27,717
Total	SR Allocation	5,449	5,091	5,025	4,991	5,093	5,686	31,335
	Additional funding	-	245	163	514	678	171	1,773
	Total	5,449	5,336	5,188	5,506	5,771	5,857	33,109

Source*:* BIS (2014d)

3.2.2.2 Direct public funding from abroad

The data on public funding from abroad is rather sparse for the UK. In fact, the business sector is the major funder of UK GERD from abroad (around 70% of the total external R&D funding). The EC is the main external public funder and it has been monotonically increasing its share of the GERD from 2009 onwards. Overall, funding from abroad is an important contribution to the GERD whereof it represents a fluctuating share of between 16%-20%. The abroad contributions from government and international organizations play a minor role.

Table 4: Public Funding from Abroad to R&D in the UK (in millions of national currency)

Source from abroad	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total	4178.3	3954	4319.24	4550.24	4303.50	4646.20	4863.70	5358.30	5392.80	5836.10
BES					3447.60	3649.41	3380.80	3817.60	3881.90	
EC					423.10	556.30	601.10	675.20	768.20	
GOV							113.60	101.90	51.20	
HES							1.40	1.40	2.90	
Internatio-nal Organiza-tions					81.70	79.13	142.40	150.60	140.20	
Total as % GERD	19.27	17.04	17.28	17.75	16.64	17.62	17.76	19.84	18.68	18.89
EC as % GOVERD					5.03	6.54	7.21	8.72	9.13	

Source: Eurostat

Distribution of public funding

Figure 7, below shows how the distribution of public funding to performing sectors has evolved over time:

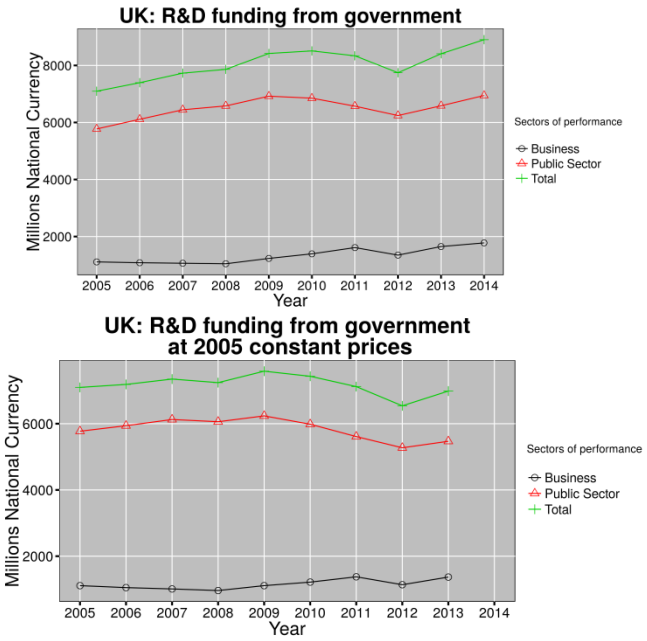

Figure 4: Government intramural expenditure by sectors of performance
Data source: Eurostat

Not surprisingly, the public sector (GOV + HES) is the main recipient of government funded GERD (Figure 7, left). After the drop between 2010 and 2012, total funding from the government increased and in 2014 surpassed the 2009 levels. Funding received by the public sector, although it followed similar trend, has not increased proportionally. This is due to the fact that the funding given by the government to the business sector is gradually increasing (with an exception in 2012). When fixed to 2005 constant prices, the decline of total government funding (and its component allocated to the public sector) from 2010 to 2012 are clearly emphasized.

3.2.3 Indirect funding – tax incentives and foregone tax revenues

Considering the absence of harmonisation of tax regimes in EU law, data come directly from national sources, using domestic definitions (attention should be paid when interpreting data from different sources). The amount spent on R&D tax incentives is slightly less than direct government support in the form of R&D grants and subsidies.[3] 'The use of schemes increased, notably during the crisis. Since schemes were launched in 2000-2001 up until 2013, over 100,000 claims have been made and more than £9.5 b in tax relief claimed according to the table of tax credit claims 2000-2013 below.[4] There was a significant rise in claims from large companies in 2008, remaining high throughout the crisis period. There is both an increase in the number of claims made by companies, as well as the size of individual claims by large companies.

An SME scheme was launched in 2000 and was extended in 2002 to include larger companies beyond the SME definition, introducing a separate scheme, the Large Companies Tax Credit. Another scheme introduced in 2003 based on the SME tax credit scheme is the vaccines research relief. The Above the Line scheme was introduced in 2013. There are also R&D capital allowances (since 1997) and since 2013, a patent box scheme.

The existing schemes can be described as follows:

Small or Medium Sized Enterprise (SME) Scheme: the R&D relief offers a deduction from corporation tax liability for R&D expenditure. The deduction rate has increased in the past five years. Currently, it offers SMEs a 125% deduction (e.g. for every £ 100 spent on R&D, a firm can deduct another £125 from its pre-tax corporate income). Furthermore, in case a firm did not make any profits, it can receive a tax refund of 24.75% from the amount of expenditure on R&D. The scheme includes an indefinite carry forward facility and the maximum amount of total amount of government support that one R&D project can receive is £7.5m.

Large Company Scheme: Currently two schemes coexist for large companies investing in R&D: the optional *Above the line (ATL)* scheme and *R&D relief for large companies*. The design of the latter one that will cease in April 2016, is essentially the same as for the SMEs, offering a lower rate of 30%. The ATL, that will become mandatory for all large companies after April 2016, offers a 10 percent taxable credit on the amount of firm's R&D activity set against corporation tax liabilities. For firms without corporation tax liabilities, the credit is fully paid out net of tax with a cap equal to the total sum of *Pay-as-you-earn (PAYE)/National Insurance Contributions* (NIC) liabilities. No minimum amount of investment in R&D is required and firms can carry forward losses indefinitely.[5]

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[3] OECD, 2013, http://www.oecd.org/sti/2013OECD-NESTI%20RDTaxIncentiveSummaryDescription_03Apr2014.pdf

[4] R&D Tax Credits Statistics, August 2014: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/356382/Research_and_Development_Tax_Credits_-_August_2014.pdf

[5] Report to DG Taxud: 'A Study on R&D Tax Incentives Annex: Country fiches' *DRAFT FINAL REPORT*

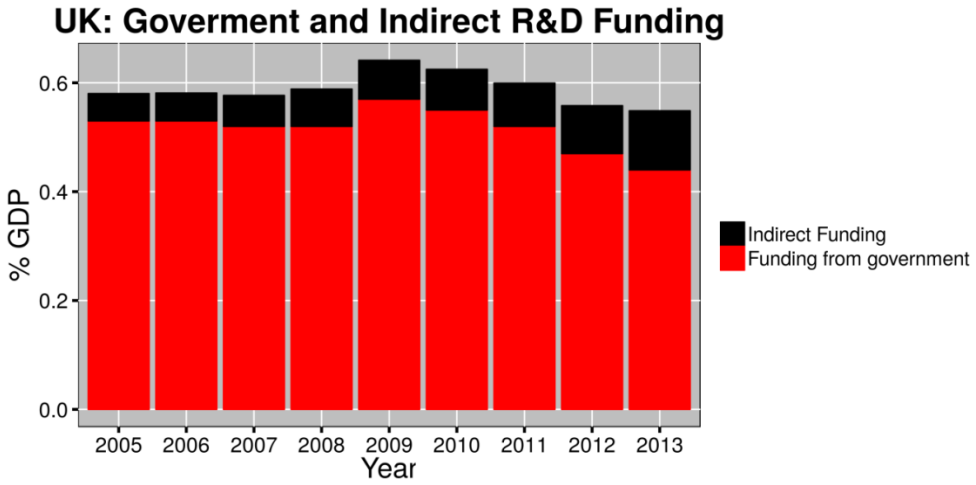


Figure 5: indirect funding to R&D in the UK (from R&D Tax Credits Statistics, August 2014)

As seen above, the indirect support to R&D in the UK is far from marginal and has increased its importance in recent years.

3.2.4 Fiscal consolidation and R&D

Figure 9 below shows the scatterplot of the structural balance versus the GBAORD as % GDP (left) and versus the GERD as % GDP (right)[6]:

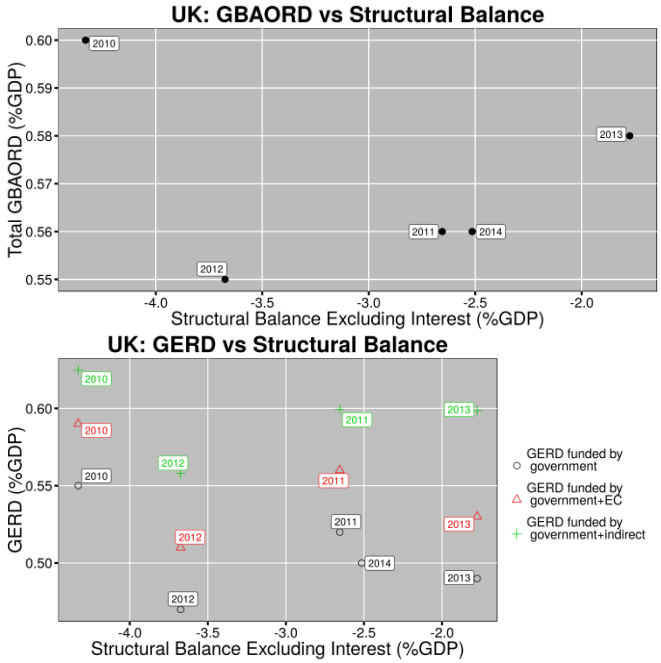


Figure 6: Fiscal consolidation and R&D

The fiscal consolidation process started in 2010 yielded mixed results and it is far from being complete. It is clear that the structural balance has improved significantly between

[6] Structural balance data comes from the AMECO database the other indicators were taken from Eurostat, and the British Government

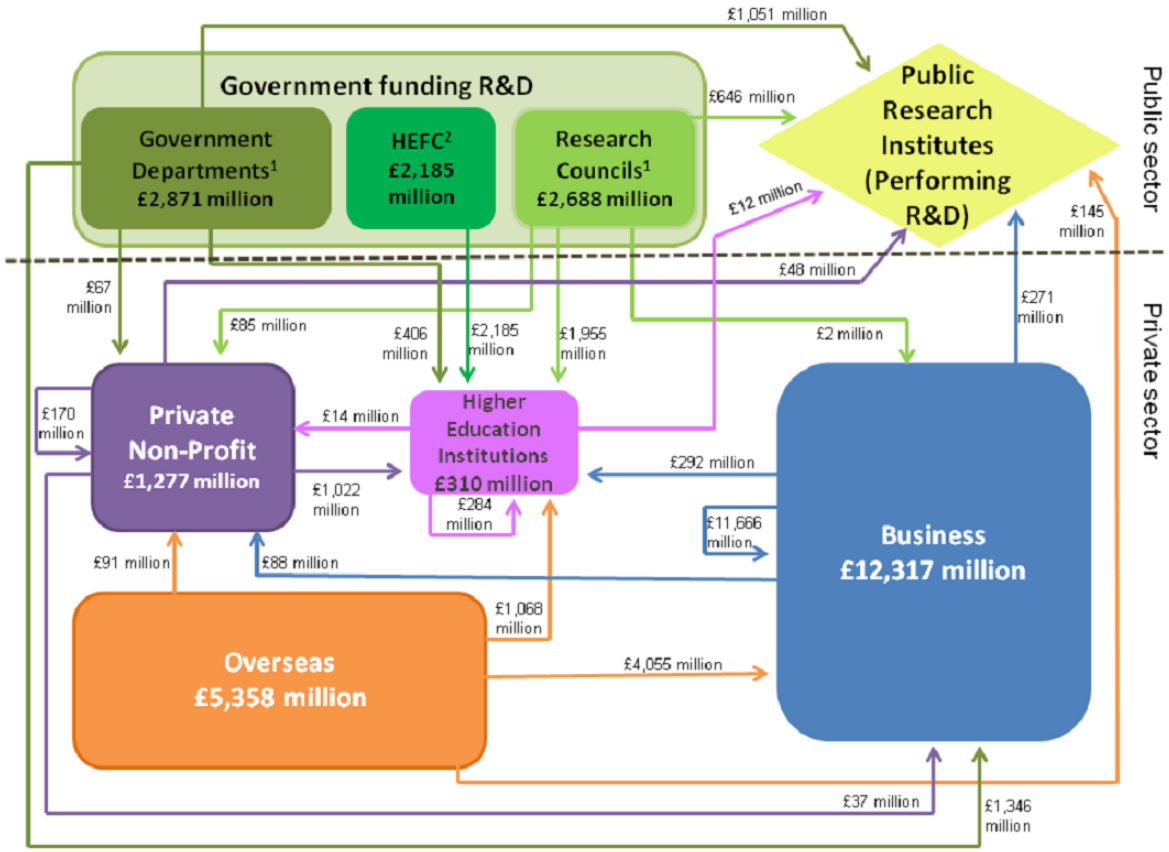
2010 and 2013/14, although still negative. Meanwhile both GBAORD and government financed GERD decline in the post-crisis period (about 0.05% and 0.08% of GDP respectively between 2010-2012). The 2013 pick-up of the GBAORD apart from being . very small (ca. 0.02% of GDP) it was followed by another slight decrease in 2014. Therefore, it is evident that post-crisis fiscal consolidation (austerity measures) has come at the expense of direct public financing of R&D, which has been cut across the board, including on R&D. Indirect financing is rather important in the UK, and although adding them to the direct public support does not alter the final conclusion they improve the picture by reducing the differences between the years (i.e. the difference in the total public support between 2010 and 2013 is much smaller than that of direct funding only)

3.3 Funding flows

3.3.1 Research funders

The Department for Business, Innovation and Skills (BIS) is the major provider of research funds for the public sector. It is also responsible for the allocation of the UK Science Budget via the Research Councils and, to a lesser degree, the Royal Society and Royal Academy of Engineering. The Research Councils, which in turn support R&D and research training both in HEIs and their own institutions, provide research grants for both programmes, projects and research centres. In addition, some of the Councils maintain their own research facilities in the UK and abroad for university researchers. Substantial funds are also allocated in the form of block grants to UK universities from the Higher Education Funding Councils and their equivalents in the devolved administrations (see below). These block grants are made on the basis of an allocation exercise (the Research Excellence Framework - REF) based on a peer review process which assesses the research outputs and research impacts of university 'research-active' staff. A comprehensive overview of the flows of UK government funding for R&D is provided in Figure 2.

Figure 7: Flows of R&D funding in the UK, 2012: Source: ONS, 2014[7, 8] .



The overall size of the Science Budget is confirmed through the Chancellor of the Exchequer's Spending Review announcement. Following this, the Research Councils, HEFCE, the UK Space Agency and the National Academies are required to set out delivery plans for the CSR period, taking account of BIS priorities for science and research funding. Ministers' decisions on the allocations of science and research funding took account of the extent to which the Delivery Plans met the BIS priorities and also took account of views expressed in a wide-ranging consultation process on science spending.

The UK Government also provides support to the private sector to help companies invest in R&D through a number of mechanisms, including tax credits administered via the Treasury, and Innovate UK (formerly the TSB), which also has responsibility for the formulation and delivery of a national technology strategy. Largely through its Technology Programme, Innovate UK will deliver over €500m of funding in 2014-15 to support technology and innovation, through collaborative work between businesses or between businesses and academia[9]. Other Ministries and Departments, particularly the Department for Environment, Food and Rural Affairs, the Ministry of Defence and the Department of Health, also have significant research portfolios within their areas of responsibility, and commission R&D through their own laboratories and institutes (or, in

[7] http://www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2012/stb-gerd-2012.html#tab-R-D-Expenditure-by-Funding-Sector

[8] Average exchange rate for 2012: £1.00 = €1.2312

[9] Innovate UK Delivery Plan 2014-15. Available at: https://www.gov.uk/government/publications/innovate-uk-delivery-plan-2014-to-2015

many cases, their former institutes which are now privatised or have intermediate agency status) or from outside sources, especially HEIs.

As can be seen from Figure 9, the private-non-profit sector forms a major source of funds for the public sector research base. Comprising a range of charities and foundations, the largest funders are the medical research charities, such as Arthritis Research UK, Breast Cancer Campaign, the British Heart Foundation, Cancer Research UK and the Wellcome Trust In 2012, the sector provided some £1,277m (c €1,600m) of research funds, some of it to Public Sector Research Establishments and private research facilities, some to its own research facilities, but the largest share (£1,022m/c €1,278m) went to support research in the HE sector.

3.3.2 Funding sources and funding flows

It is not possible to distinguish regional or local budget allocations for research since these are provided through a range of mechanisms to individual researchers, research centres and institutes, PSREs and HEIs: research funds are not allocated on any regional basis. EU Framework funding is applied for and allocated competitively on a similar basis with no overall assessment of the regional destination of such funds.

Although EU Structural Funding is allocated on a regional basis (see below), these figures cover a seven year period and no distinction is made between the uses of such funds. However, the accompanying evidence paper for Our Plan for Growth notes that, in England, about £600m (c. €750m) of these funds will be allocated to research and innovation activities in the 39 LEP areas (BIS, 2014b). Some £10.8b (c €13.4b) will be allocated over the funding period – an average of £1,543m (c €1,920m) per annum: this compares to a figure for total UK GERD of £28.875b (c €36.093b) in 2013. The ERDF, which is more closely concerned with research and innovation, contributes around €3.6b of the total Structural Fund contribution.

Table 5: EU Structural funds by region

	2014-20	
Region	£m	€m (approx.)
England	6,937.2	8,671.2
Scotland	894.6	1,118.3
Wales	2,412.5	3,015.6
Northern Ireland	513.4	641.8

Source: BIS, 2014e

Between 2007 and 2014, the EU contribution for 7th Framework Programme funding to the UK amounted to €6,880.53m, while in 2013 and 2014, the UK overtook Germany as the number one recipient of funding from FP7 (BIS, 2014b). More detailed figures for FP6, FP7 and Horizon 2020 participation are provided below.

Table 6: FP7 UK and EU28 data

	No. projects	No. participants	No. coordinators	EU Contribution	% of total EU
FP6 - UK	4,549	9,120	1,719	2,526,632,188	16.0%
FP6 – EU28	36,796	67,696	9,328	15,749,796,104	100.0%
FP7 - UK	10,553	18,047	5,265	7,052,806,132	17.2%
FP7 – EU28	72,440	120,697	23,204	40,917,932,471	100.0%
H2020 – UK	1,924	3,027	1,055		15.5%
H2020 – EU28	13,219	21,851	4,970		100.0%

Source: DG R&I

In all categories, the UK is second only to Germany except for the number of coordinators in FP6 in which instance it provided the highest number of all EU Member States.

More broadly, as noted above, the UK receives significant research funding from abroad: the contribution from this source rose from £5,172m (c €6,465m) in 2011, through £5,327m (c €6,659m) in 2012 to £5,393m (c €6,741m in 2013 (ONS, 2015[10]).

The private sector is also both a major funder and performer of R&D. In 2012 the sector´s total expenditure on R&D was €21.96b. The majority of this (€14.39b) came from the business sector itself, with €1.66bn from Government sources (mainly on defence) and €4.19b from overseas sources. By comparison, UK GOVERD for 2012 was €9.63b.

3.4 Public funding for public R&I

3.4.1 Project vs. institutional allocation of public funding

The largest performer of research in the UK is the Higher Education Sector. This receives funding via a mix of institutional block grants, competitive 'responsive mode' grants and through the Higher Education Innovation Fund which encourages knowledge transfer activities. The second largest public research budget is that disbursed via the Research Councils. The private sector also receives substantial R&D support, via a range of innovation support measures, rather than direct state aid for research: the largest single instrument being the combined R&D Tax Credit schemes, which account for some 75% of the public support for private R&D.

UK funding of research takes a variety of forms and routes. The largest single budget is probably that allocated to defence R&D although a substantial proportion will be dedicated to development and demonstration purposes rather than research. Much of this budget will go to the private sector, not only in the UK. Other thematic areas, notably health and environmental funding will also attract significant budgets, via the responsible ministries, and again to a variety of research performers, although the Public Sector Research Establishments recive the majority.

The share of responding funders' total budget allocated as project-based funding was 80% in 2013 (higher than the EU average), compared to 20% of the total budget allocated as institutional funding based on institutional assessment and/or evaluation (below the EU average). No trend data are available on these figures (European Commission, 2014a). A further proxy indicator may be derived from GBAORD expenditures:

[10] Available at: http://www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2012/stb-gerd-2012.html#tab-R-D-Expenditure-by-Funding-Sector

Table 7: General University Funds

	2011	2012	2013
General advancement of knowledge financed from General University Funds	€2,822 m	€2,731 m	€2,834 m
General advancement of knowledge financed from other than General University Funds	€2,091 m	€2,025 m	€1,593 m

However, these figures do not align closely with the data derived from the Higher Education funding councils and the research Councils provided below.

3.4.2 Institutional funding

Institutional funding in the UK is almost always allocated based on institutional assessment. The main stream of support is that allocated to the universities in the HE Sector, in the form of a block grant from the Higher Education Funding Council for England (HEFCE) and its equivalent bodies in the devolved administrations. This is allocated on the basis of a mechanism known as the Research Excellence Framework (formerly the Research Assessment Exercise – RAE), a peer review process which produces 'quality profiles' for each submission of research activity made by HEIs. There were four RAEs (in 1992, 1996, 2001 and 2008). Once funding levels for institutions (which are actually made on a subject oriented 'cost-centre' basis and which may apply at a sub-departmental level) have been set, these are used for the annual allocation of funding until the next round of assessment One of the major criticisms of the process is the enormous amount of staff time and resources that HEIs have to devote to the process of preparing submissions. After a series of extensive consultations and reviews, the Higher Education Funding Councils replaced the RAE with the new REF, which is more "metrics-based" and which also takes the notion of research 'impact' into account. The first REF took place in 20013/14.

University block funding supports research infrastructure costs. Total research funding from the four UK HEFCs from 2011 to 2013 was £2.257b (c. €2.752b); £2.185b (c. €2.731b); and £2.297b (c. €2.871b) respectively. This was provided by the Scottish Funding Council (SFC) in Scotland, Higher Education Funding Council for Wales (HEFCW) in Wales and Department of Education and Learning Northern Ireland (DELNI) in Northern Ireland.

3.4.3 Project funding

The largest category of project-oriented, competitive or 'responsive mode' funding is that provided via Research Council grants and programmes. Between 2011 and 2013, the UK Research Councils provided research funding of £3.189b (c. €3.986b), £3.001b (c. €3.751b) and £3.366b (c. €4.208b).

Research Council funds are awarded on the basis of applications made by individual researchers, which are subject to independent, expert peer review. Awards are made on the basis of the research potential and are irrespective of geographical location. Responsive mode funding is very flexible and supports projects ranging from small travel grants to multi-million pound research programmes and from one-month to six years. The funding covers a wide range of activities, including research projects, feasibility studies, instrument development, equipment, travel and collaboration, and long-term funding to develop or maintain critical mass. The major beneficiaries of responsive mode funding are individual researchers or research teams at Higher Education Institutes. This type of funding may be categorised as 'bottom-up' or 'free funding'.

Each Research Council funds research and training activities in a different area of research ranging across the arts and humanities, social sciences, engineering and physical sciences and the medical and life sciences. RCUK supports over 50,000

researchers including 19,000 doctoral students, around 14,000 research staff, and 2,000 research fellows in UK universities and in their own Research Institutes[11].

3.4.4 Other allocation mechanisms

A significant amount of R&D is commissioned by the Government through the form of contracts. These may be extramurally with the higher education sector, the private sector, and Research and Technology organisations, or intra-murally with Non-Departmental Public Bodies and Public Sector Research Establishments. No detailed breakdown of these figures is available. Similarly, detailed figures on the allocations of the Research Councils to their own institutes and units and on departmental research spending at non-academic research performing organisations are not available.

3.5 Public funding for private R&I

3.5.1 Direct funding for private R&I

The majority of the remaining Government support for research funding falls within the broad area of innovation support and include various knowledge transfer support mechanisms and tax credits for R&D. These target a mix of research performers and all parts of the R&D spectrum from fundamental research to market innovation. Other than the tax credits for R&D (which provides indirect support – see below), the main competitive direct-funding support scheme for companies to carry out R&D is the Smart programme (formerly Grant for R&D) which targets SMEs and is funded through BIS. A large number of schemes are aimed at linking the public and private sectors (which may therefore be categorised as 'research networks'), thereby promoting the flow of new research ideas into new technologies and commercialised products, processes and services: examples include several of Innovate UK's schemes such as Knowledge Transfer Networks, Collaborative R&D and Knowledge Transfer Partnerships – all funded through the Technology Strategy Board, and the Research Councils' CASE awards. Many of these schemes involve variable elements of co-funding from industry and are not always eligible for the definition of 'direct funding'. Several schemes also aim at the stimulation of additional financing support, particularly for SMEs.

3.5.2 Public Procurement of Innovative solutions

In 2013/14, the UK public sector spent a total of £242 billion (€319b) on procurement of goods and services (including capital assets); this accounted for 33% of public sector spending (total managed expenditure).[12] Public procurement accounts for approximately 14.46% of GDP. [13] Procurement by central and local governments according to Government figures[14] is divided as follows: 58% Central Ministerial Departments and NHS, 33% Local Government, 7% Devolved Governments, 2% Non-Ministerial Department. The Government has set a target of procuring 25% of goods and services by value from small and medium-sized enterprises (SMEs) by 2015, which it met in 2014 when it spent 26% with SMEs.

Legal public procurement framework

The UK transposed the two 2004 Directives on public procurement (2004/17/CE and 2004/18/CE) in 2006. The following regulations came into force on 31 January 2006 to implement the 2004 directives:

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[11] http://www.rcuk.ac.uk/

[12] http://researchbriefings.files.parliament.uk/documents/SN06029/SN06029.pdf

[13] 2014, European Commission, DG Internal Market study: http://ec.europa.eu/internal_market/publicprocurement/docs/modernising_rules/20141105-indicators-2012_en.pdf

[14] Public Expenditure Outturn Updates, 25 February 2010: https://www.gov.uk/government/publications/standards-and-policies-for-hm-treasury-statistics

- Public authorities (the State, regional and local authorities and other public bodies): The Public Contracts Regulations 2006 [15](SI 2006 No.5);
- Utilities (i.e. certain operators in the water, energy, transport sectors): The Utilities Contracts Regulations 2006 (SI 2006 No.6)[16].

A new set of directives were agreed in early 2014 (2014/24/EU and 2014/25/EU). They are now being transposed into UK law by the UK government (for England, Wales and Northern Ireland) and the Scottish government (for Scotland).[17]

The Defence and Security Public Contracts Regulations 2011 is the enabling UK legislation for the EU Defence and Security Directive (2009/81/EC). This came into force on 21st August 2011.

The Public Services (Social Value) Act 2012[18] requires relevant authorities that are engaging in a procurement exercise to consider how the proposed procurement might improve the economic, social and environmental well-being of the relevant area, and how these improvements might be secured.[19]

Pre Commercial Procurement and Public Procurement for Innovation landscape

Innovative public procurement (PPI) is encouraged in the UK and the Government has produced guidelines under the concept of Forward Commitment Procurement (FCP), a tool introduced in 2006. This is "an early market engagement tool that brings together progressive thinking and best practice from the private sector and the innovation and procurement communities, together with the understanding of the demand side barriers to the commercialisation of innovative goods and services. Although designed to address the particular barriers to market faced by environmental innovations, the FCP approach can, where appropriate be used to deliver efficiency savings and support the procurement of innovative solutions in other markets, such as sustainable development, healthcare and construction" (BIS, 2011). The FCP concept covers both public and private sector organisations.

In spring 2012 the Department for Business, Innovation and Skills (BIS) launched a pilot scheme labelled Procurement Compacts[20]. The idea of this scheme was for large public and private organisations to join forces to buy products and processes that help reduce the carbon footprint of private and public actors (see below under initiatives). Organisations would not only bundle their demand, but also develop joint roadmaps of future demand, sending clear signals to the industry in order to both induce the generation of new innovations and to accelerate the diffusion of new products and services.

In the UK, the Small Business Research Initiative is the main support scheme that focuses on demand–side issues, operating under the auspices of Innovate UK; it involves several government departments in supporting innovation procurement solutions from SMEs. It was first established in the UK in 2001 to increase access of small and medium-sized enterprises (SMEs) to public sector procurement, and to support the procurement of R&D with an option in the R&D contract to acquire the innovation generated. The scheme was evaluated in 2015 and the report is pending publication by Innovate UK.

The SBRI has two main roles; the first role is 'Operational Effectiveness' and involves the government acting as a 'lead' customer for new products and services. This modality

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[15] http://www.legislation.gov.uk/uksi/2006/5/contents/made
[16] http://www.legislation.gov.uk/uksi/2006/6/pdfs/uksi_20060006_en.pdf
[17] http://researchbriefings.files.parliament.uk/documents/SN06029/SN06029.pdf
[18] http://www.legislation.gov.uk/ukpga/2012/3/enacted
[19] Public Procurement. Standard Note: SN/EP/6029. Last updated: 31 January 2014. http://www.parliament.uk/briefing-papers/SN06029.pdf
[20] https://www.gov.uk/government/policies/investing-in-research-development-and-innovation/supporting-pages/using-government-purchasing-power-to-stimulate-innovation

represented roughly two thirds of the calls and around 50% of the SBRI spending in the financial year 2011–2012. Departments such as the Ministry of Defence (MoD) and the Department of Health (DoH) have been the main clients for this action. Departments have tended to run the competitions and review processes themselves, with the TSB acting as facilitator. This would, in principle, ensure the necessary context-specific skills and understanding of the problem for which procuring an innovative technology delivers the solution. The second role is to support 'Strategic Objectives', i.e. to provide a route to market for innovations that support broad policy objectives, with the solution developed through SBIR providing opportunities for the market more broadly. In this mode departments, such as the Department for Environment, Food and Rural Affairs (Defra) and the Department of Environment and Climate Change (DECC), would run competitions for innovations that support their policy objectives. In this role, the SBRI would drive the process, articulate the call, conduct the assessments and support the award process. The projects under this second modality have tended to be smaller, with the exception of the 'Retrofit for the Future' initiative, which ran five projects at a cumulative value of £18m. Retrofit for the Future was run in conjunction with DCLG to identify innovative solutions to reduce carbon emissions and energy use in the existing social housing stock.[21]

The BIS governance framework specifies that each support programme above a defined funding threshold must present a business case in order to justify its support. Each business case contains information about the programme's benefits, costs, risks and timescales used to judge whether or not the programme is (and remains) desirable, viable and achievable (BIS, 2010). All business support schemes are also subject to periodic evaluation in order to assess their effectiveness and performance, to gain policy insights and lessons for their continued implementation and to assess that the rationale for their creation remains unchanged.

PCP/PPI initiatives

Within the SBRI framework, six of the larger UK government departments targeted £100m in Fiscal Year 2013/14 and £200m in FY2014/15 in SBRI initiatives.[22]

The UK Energy Technology Institute (ETI) was set up to accelerate the development, demonstration and commercial deployment of energy technologies and help achieve climate change goals. Its approach illustrates how an entity that is financed by a combination of public and private funds, and in which private and public partners collaborate on research and innovation, can undertake a PCP in compliance with state aid rules.[23]

BIS and the Prince of Wales UK Corporate Leaders Group launched three low carbon procurement compacts (2010-2015). Compacts are partnerships between government and the voluntary/non-profit sector that commit the public sector to be a customer for low carbon products and services. They are an invitation to suppliers of all sizes, particularly SMEs, to seize the opportunities available.

The compacts are in the areas of:

- Heat and power from renewable biomethane;
- Low carbon transport;
- Zero carbon catering

The initiative aims to significantly reduce UK emissions and demonstrate to other organisations that low carbon solutions can work.

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[21] UK Public Procurement of Innovation: The UK Case, Elvira Uyarra, Jakob Edler, Sally Gee, Luke Georghiou and Jillian Yeow

[22] http://www.slideshare.net/investni/pat-doyle

[23] http://cordis.europa.eu/fp7/ict/pcp/case-eti-uk-pcp.pdf

As noted in Section 1.2.2 above, all business support schemes are also subject to periodic evaluation in order to assess their effectiveness and performance, to gain policy insights and lessons for their continued implementation and to assess that the rationale for their creation remains unchanged.

3.5.3 Indirect financial support for private R&I

The UK employs R&D tax credit schemes and these in fact form the largest single source of government support for business R&D. These provided almost £1.2bn (€1.5bn) of relief to in excess of 12,000 companies in the financial year ending March 2012. This supported around £11.9bn (€14.9bn) of expenditure, an estimated two-thirds of all business R&D revenue expenditure, reducing the cost of the qualifying expenditure by around 25% for SMEs and around 8% for large companies. In addition, as of 1 April 2013, companies have been able to apply for a lower rate of Corporation Tax on profits earned on patented inventions and certain other innovations. This scheme is being introduced progressively over 5 years: a further cut will be made to the main rate of corporation tax from 23% to 20% in April 2015. Most recently, in the Autumn Statement 2014, it was announced that government will increase the rate of the 'above the line' credit from 10% to 11% and will increase the rate of the SME scheme from 225% to 230%, from 1 April 2015.

As noted in Cunningham (2015), precise figures are unavailable to be able to provide a clear picture of any trends in the balance of direct versus indirect funding over time, although since there is some evidence that companies, at least in the early stages of the schemes, increased their uptake of the R&D Tax Credits, it is likely that the balance of expenditure has slightly increased in favour of indirect schemes since the introduction of the tax credits. However, as no major new measures have been introduced in recent years and no significant funding increases made to direct measures, it is likely that the overall balance has remained more or less static for the last three years.

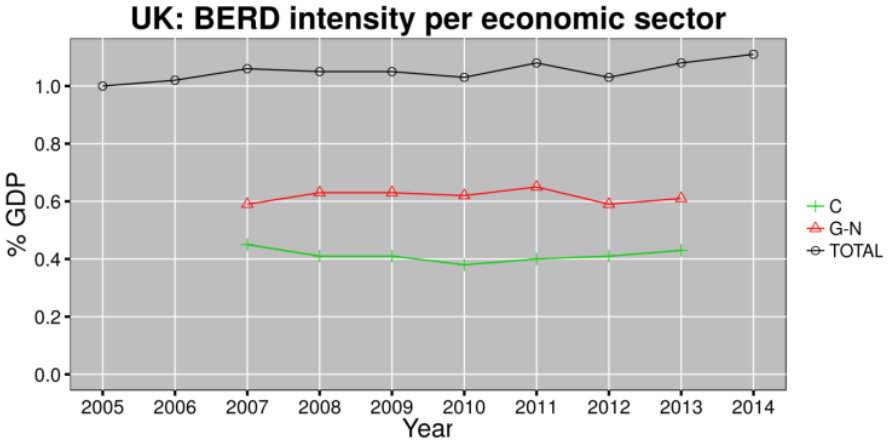
3.6 Business R&D

3.6.1 The development in business R&D intensity

As seen below, UK BERD has been rather stable, fluctuating only slightly in a 0.1% of GDP "band" in the last decade, between its 2005 level of 1% and its 2014 level of 1.11% of GDP. Manufacturing and services were its major components, together accounting for more than 95% of the BERD expenditure in the period under scrutiny and with the latter out-pacing systematically the former with around 0.2% of GDP. Both of them were slightly fluctuating, but their overall trend between 2007 and 2013 is that of stagnation. The UK economy is made up of a strong financial and businesses services sector, and while the share of manufacturing in the economy is much smaller and has seen a decline over a number of decades, R&D in the manufacturing sector includes aerospace, automotive, and chemicals, with an important EU and global export component. An important share of business R&D in the UK is conducted by foreign-owned companies in 2013[24].

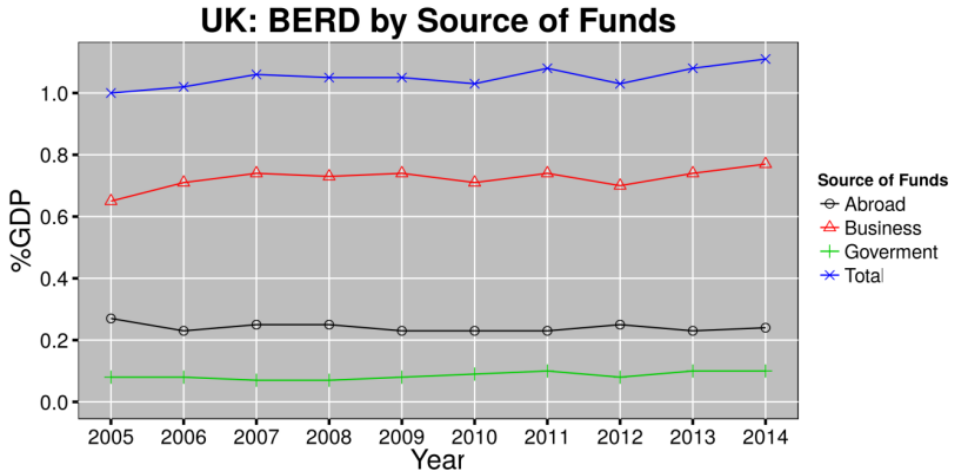
[24] ONS, 2015: http://www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2013/stb-gerd-2013.html

Figure 8: BERD intensity broken down by most important macro-sectors: C= manufacturing, G_N=services



The private sector is the main funder of the UK BERD as below. Given that both the external (abroad) and the government sector was a rather stable funder (0.09% of GDP - government, 0.24% of GDP – external sector) fluctuations in BERD stem mainly from variations of the funding from the private sector. This has been on a very slightly ascending path from its 2005 level of 0.65% of GDP reaching 0.77% of GDP in 2014.

Figure 9: BERD by source of funds



3.6.2 The development in business R&D intensity by sector

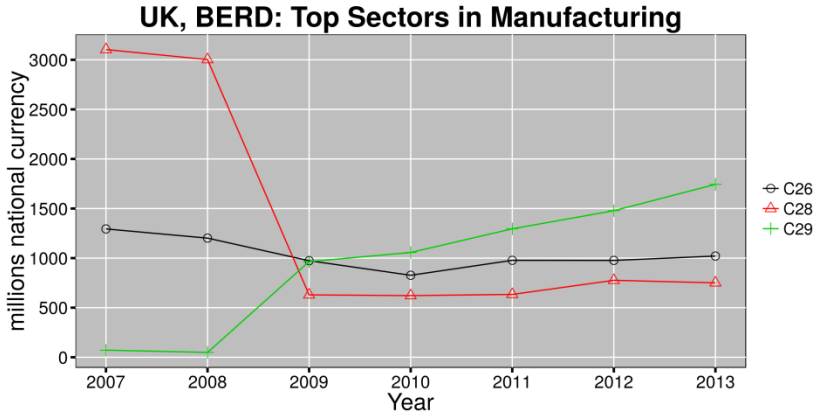
The highest BERD spenders in the manufacturing sector are high-technology (computer, electronic and optical products, C26), or medium-high tech (automotive industry, C29 and the machinery and equipment sector, C28) sectors. Companies such as Square Enix and Amdocs, Arm holdings and CSR UK, Delphi and GKN are among the larger UK enterprises conducting R&D[25].

During the 2008 financial crisis the machinery & equipment BERD seems to have suffered an important one-off loss in 2009 which could be due to an R&D site closure, offshoring or other factors. While UK manufacturing in general showed increasing levels of productivity due in part to R&D investment, the UK overall has very low non-R&D investments[26], which impacted on machinery and equipment after the crisis in a period of very low investment where new plants and machinery could not be financed. Since

[25] http://iri.jrc.ec.europa.eu/scoreboard.html
[26] EU Innovation Union Scoreboard data

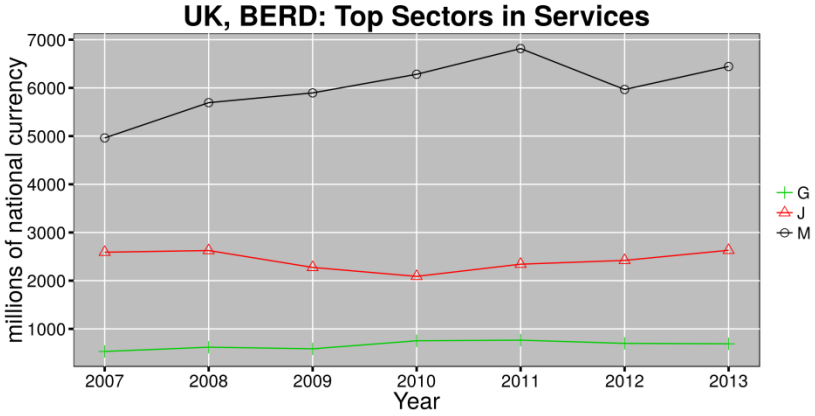
then, BERD in this sector has registered small fluctuations around an average yearly value of £682m. On the other hand, the automotive industry BERD increased spectacularly during the same year. It has remained on an ascending path ever since showing strong and steady growth with a compound average growth rate (CAGR) of 15.9%. The automotive industry is backed by government in its industrial strategy and has received investments in production facilities in recent years. BERD in the computer & electronics sector decreased by around 30% in 2008-09 stabilising at around £1,000m since.

Figure 10: top sectors in manufacturing:
C26= computer, electronic and optical products; C29=motor vehicles, trailers and semi-trailers; C28=machinery and equipment).



In the business services sector, professional, scientific and technical activities, ICT, as well as wholesale & retail are the top BERD receivers in this order. Professional activities BERD has been growing steadily and rather strongly (CAGR: 8.3%) between 2007 and 2011. However, this growth turned into a steep fall in 2012 of 12.5% followed again by a growth in 2013 in line with the above mentioned average growth of 8%. The reasons for this one-off fall are still unclear. ICT BERD decreased during the crisis but has recovered since and managed to surpass its 2008 level in 2013 for the first time.

Figure 11: top service sectors:
J=information and communication,
G=wholesale and retail trade, M=professional, scientific and technical activities

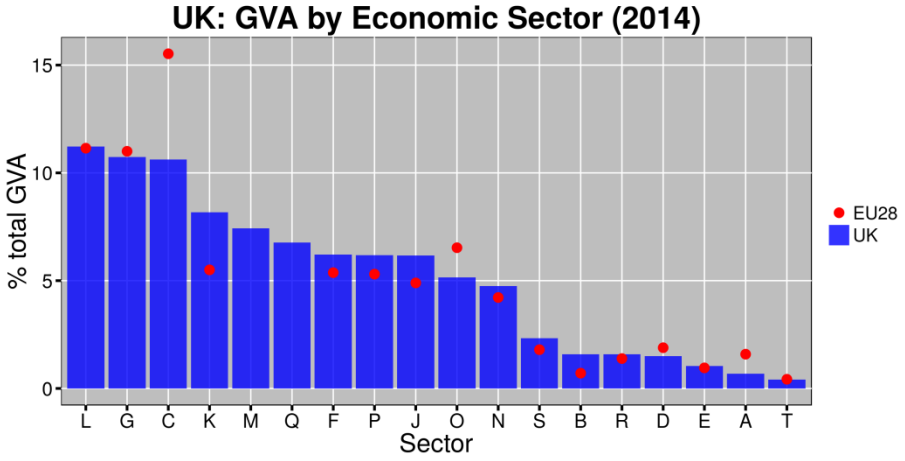


3.6.3 The development in business R&D intensity and value added

Looking at the contribution of the various sectors to the total gross value added (GVA), wholesale and retail trade, real estate activities, as well as manufacturing, were the top three sectors providing the highest GVA to the UK economy in 2011. These are obviously the largest economic sectors, with above 10% shares in GVA. They are followed by financial activities, health industry and professional activities with a share of 7-8% in total GVA each.

Comparing these graphs, wholesale and retail trade is both a top contributor to GVA and a top performer in BERD. However, large BERD receiver sectors like ICT or professional activities fail to be the among the top GVA contributors. One possible reason could be the relatively small size of the latter two compared to the former or to manufacturing as a whole. Real estate activities, financial services and the healthcare industry (excluding pharma) are not so important for the UK BERD, but they are among the top sectors in terms of GVA.

Figure 12: economic sectors as percentage of the total GVA
Top 6 sectors in decreasing order: 1) Wholesale and retail trade; 2) Real estate activities; 3) manufacture; 4) Financial and insurance activities; 5) Human health and social work activities; 6) Professional, scientific and technical activities.

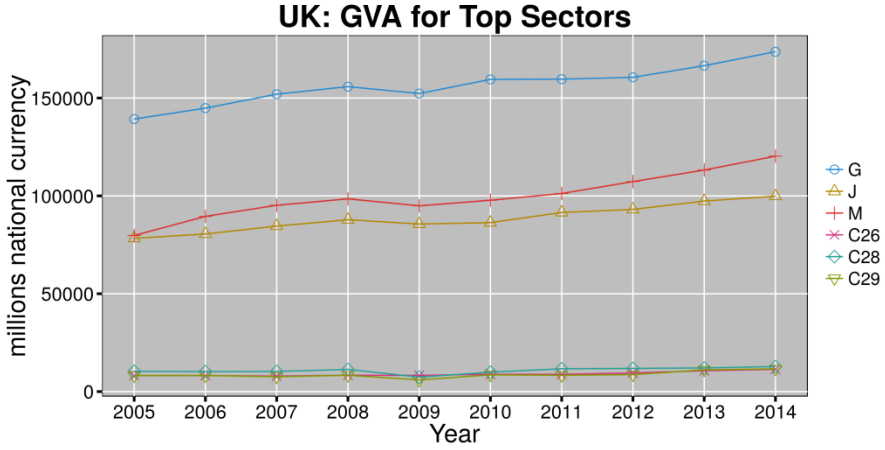


The manufacture of food, beverages and tobacco appears to be the leading manufacturing service in terms of GVA, but still it accounts for only 1.5% of total GVA. This is followed by the pharmaceutical and the fabricated metal products GVA with only 1% of total GVA. Other sectors shares are below 1%. Consistently with its importance in the manufacture in terms of BERD, the machinery and equipment sector appears to be important also in the GVA. Apart from the food and beverages sector one observes mainly medium to high tech sectors among the top six.

Figure 13: GVA in manufacturing.
Top 6 manufacturing sectors: 1) food, beverages and tobacco products; 2) basic pharmaceutical products and pharmaceutical preparations; 3) fabricated metal products, except machinery and equipment; 4) machinery and equipment; 5) chemicals, 6) computer, electronic and optical products

In line with the above discussion, the wholesale and retail as well as professional activities the information communication sectors are the top three in terms of G VA at factor cost. All three had an ascending trend between 2005 and 2011.

Figure 14: Value added for the leading sectors



The UK economy is characterised by a concentration of large firms and a broader number of much smaller enterprises. The UK's high-growth enterprise data shows an overall increase in the numbers of these types of companies across all six sectors. Employment trends are in line with the findings in this report – there is a slight increase in the number of STEM graduates employed in manufacturing, a stable level in wholesale and retail trade, and motor repair, while ICT has seen mostly increases since 2008, and professional, scientific and technical activities have also increased.

3.7 Assessment

Overall, the UK research system appears to function in an efficient manner. Given that the mechanisms by which institutional and project funding are allocated have been in place for considerable time and have remained relatively stable over that time, it may be assumed that they operate in a satisfactory manner. The effectiveness of these funding mechanisms is supported by the regular and periodic process of monitoring; review and evaluation to which all forms of support are subject. It should also be noted that the structure of this support system is by no means static – procedural changes are put in place as a consequence of the policy feedback processes noted above. However, any changes implemented are typically incremental rather than major and disruptive. For example, the review of the RAE which led the development of the REF (which is overall a very similar mechanism) addressed a number of concerns with regards to the allocation mechanism itself – it did not affect the balance between project and institutional funding.

There appears to be little impact concerning the balance between project and institutional funding for research, a balance which has remained largely static for several years. However, it may be argued that the current allocation mechanisms for both project and institutional funding are strongly predicated on the belief that scientific (taken in its broadest sense) quality is fundamentally linked to the production of publications in so-called 'high impact' journals. The recent introduction of the notion of 'research impact' (i.e. the broader and long-term social and economic effects of research) into the REF may help to differentiate the criteria used by both streams of funding.