Department for Business Innovation & Skills

RESEARCH COUNCIL IMPACT REPORTS 2013

Trends in inputs, outputs and outcomes

MARCH 2014

Contents

Executive Summary

This report reviews evidence on trends in a selection of inputs, outputs and outcomes contained in the quantitative metrics within the Research Performance and Economic Impact Reports (Impact Reports) returned by Research Councils in 2013. It is the second such report produced by BIS, following last year's report which covered metrics returned in 2012.

The Impact Reports demonstrate the contribution made by Research Councils to economic growth and society through their activities. This report considers only the areas of influence of Research Councils that can be quantified; there are many more details of impact at the case study level contained in the Impact Reports themselves.

Total income drawn by the Research Councils from all sources has fallen in real terms by 10.2% from 2009/10 (when it peaked) to 2012/13, an annualised rate of 3.5%. At just under 6%, non-BIS income is a small proportion of total Research Council income, and since 2009/10 this has fallen by 34%, a greater rate than the fall in total income. Expenditure on Research Grants has increased overall (with variations between Councils) whilst expenditure in other categories like sponsored institutes and subscriptions to international facilities has generally fallen.

The total headcount of Principal Investigators, Research Leaders in sponsored institutes and Research Fellowships is estimated to have fallen by just over nine hundred since 2009/10, reaching a little over 8500 in 2012/13. This is a reflection of both a real terms reduction in funding levels and of various policies: for example, a move to ensure critical mass which has the effect of increasing the size of research teams and reducing the number of Principal Investigators and Research Leaders. This could mean that whilst the number of visible heads is lower the total number of researchers funded may be larger.

Total refereed publication counts (excluding the AHRC) have grown by 16% since 2008/09, an increase of 4% per annum, to reach an estimated 33,000 in 2012/13. Of course, volume is not everything, and various factors have contributed here, but other evidence does suggest that the quality of UK research is being maintained.

Total counts of patents and spinouts fluctuate over time. The falls in the past year represent a break from previous growth and may not necessarily be indicative of trends to come.

Total PhD starter counts (excluding the MRC) fell from a peak of around 5700 in 2009/10 to around 4500 in 2012/13. Whilst this does stem from a real terms cut in funding, it also reflects a move to increased concentration of funding (post-graduate support) among the best and brightest as pledged by Councils in their Delivery Reports. With estimated finishing rates for these students standing at 83% in 2012/13, Research Councils are currently delivering around 5,000 PhDs to the economy per year, of which over 90% find employment, and around a quarter find employment in the private sector, within 6 months of finishing. The number of PhDs delivered into the labour market is likely to drop to some extent in coming years because the number of PhD new entrants has fallen over the last few years.

Overall the quantitative evidence continues to suggest that in times of financial restraint the Research Councils are reallocating resources to concentrate funding among the best and brightest researchers and students to ensure sustained excellence and an efficient exchange of knowledge.

Introduction

This report summarises performance data from the seven Research Councils collected through their annual Impact Reports and provides a contextualised view of how this data can be interpreted and used to help identify trends and monitor developments. It covers data up to 2012/13, and is the second such report produced by BIS, following last year's report which covered data up to 2011/12[1].

The focus is exclusively on the the performance metrics, which relate predominantly to recent activities and outcomes rather than the wider economic and social impacts of past investments in research. These wider impacts are best captured through the wealth of case studies referenced in the individual Research Councils' Impact Reports.

The New Metrics Framework, first used to report against financial year 2010/11, is the quantitative element of the Department for Business, Innovation and Skills (BIS) impact reporting for Research Councils. It represents an approach to monitoring trends through a broad set of metrics, none of which is sufficient on its own to capture performance, but which together give a picture of some of the activities and investments funded by Research Councils in the most recent year.

The Research Councils use multiple quantitative and qualitative approaches to assess the achievements of science and research investments[2]. Trends over time can suggest useful avenues of investigation that have the potential to inform policy.

In what follows it is important to bear in mind that:

1. Metrics will necessarily leave out areas of progress and impact that cannot be quantified across all Councils; the analysis is therefore necessarily partial.
2. Metrics indicate the current state of affairs but not causes or reasons for changes. The analysis is therefore a static assessment of positions at different points in time.
3. Metrics do not capture detail on process or describe how research discoveries improve society. These processes take long periods of time to mature and some are described in case study evidence published by the Councils in their reports.

Appendices A and B show the structure of the Metrics Framework across three categories of metrics: inputs, outputs and outcomes. The list of metrics covers various dimensions of activity including expenditure, human capital, technology and knowledge exchange. Ideally all dimensions would be represented in all categories, e.g. human capital inputs

[1] https://www.gov.uk/government/publications/research-councils-impact-reports-2012-descriptive-analysis-of-quantitative-metrics

[2] To insert up date of: http://www.rcuk.ac.uk/documents/publications/EconImpactNote.pdf

(researchers), outputs (finishing students) and outcomes (destinations of finishing students). The differences in the nature of research across Councils and associated differences in approaches to data collection prevent such complete accounting in all areas.

Although Councils are given the same definitions for the metrics, variations in institutional organisation, data collection and measurement mean that each Council can often only provide a "best fit" of the concept required. Aggregations of activities across Councils should be viewed with that point in mind.

Recent developments in Research Council information management such as common data definitions, and Gateway to Research[3], point to a future of increased and improved common reporting, although there is likely to be an impact on comparisons with earlier years. In the interim the New Metrics Framework provides an overview of trends in some activities even though not all metrics are relevant for all Councils in all years.

The New Metrics Framework can be regarded as a Research Council counterpart to performance data collected by the Funding Councils for monitoring research performance among their funding units. It also provides a partial counterpart to HESA's Higher Education Business and Community Interactions Survey (HE-BCI)[4], which collects data on collaborative and commercial activity across Higher Education Institutions. As such the development of this framework contributes to the goal of developing more integrated monitoring systems of the dual funding system for UK research.

The UK Science and Research System

The UK government-funded Research Base is organised as a dual system of financial support to research undertaken in Universities and other publicly funded Research Institutions. The allocations booklet published in every spending review gives a full overview of how the system is organised and managed[5].

There are two main, but not exclusive, channels for the public funding of research in the UK:

- A block grant allocated to Higher Education Institutions by the Funding Councils of England, Scotland, Wales and the Department for Employment and Learning of Northern Ireland on the basis of past research performance. The current evaluation exercise to inform the allocation is the Research Excellence Framework (REF) in 2013/14[6].

[3] http://gtr.rcuk.ac.uk/
[4] See: http://www.hesa.ac.uk/component/option,com_pubs/Itemid,122/index.php?option=com_pubs&task=show_pub_detail&pubid=1718&Itemid=286 and http://www.hefce.ac.uk/whatwedo/kes/measureke/hebci/
[5] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32478/10-1356-allocation-of-science-and-research-funding-2011-2015.pdf
[6] www.ref.ac.uk

- Research grants and other research support allocated by the seven Research Councils to research teams on the basis of research proposals submitted and evaluated on excellence by peer review.

The seven Research Councils are as below, and they have published their individual Impact Reports 2013 (available via the links given in the footnotes) concurrently with the publication of this document.

Arts and Humanities Research Council (AHRC);[7]

Biotechnology and Biological Sciences Research Council (BBSRC);[8]

Engineering and Physical Sciences Research Council (EPSRC);[9]
Economic and Social Research Council (ESRC);[10]
Medical Research Council (MRC);[11]
Natural Environment Research Council (NERC);[12]
Science and Technology Facilities Council (STFC).[13]

Research Councils manage funding for UK research through coordinating and funding particular disciplines, areas of research or strategic priorities, whilst also supporting postgraduate and doctoral training. Whereas all Research Councils fund research grants, only some of them (BBSRC, MRC, NERC and STFC) sponsor public sector research institutes, providing these institutes with facilities and paying the salaries of researchers. Moreover, some Research Councils support UK membership and participation in international research ventures by managing international subscriptions. Finally, the Research Councils together manage the larger and cross-disciplinary elements of UK research capital infrastructure, mainly - though not exclusively - through the STFC.

The joint remit is therefore much broader than the individual remit of each Research Council. The umbrella organisation RCUK coordinates work across the seven Councils in areas where cooperation results in a better outcome than the sum of uncoordinated individual action. Capital infrastructure is a good example of the additional benefits to be gained from co-ordination at RCUK level. Note that RCUK also produces an impact report, covering cross-cutting themes, which complements the individual reports[14].

The Policy Context

The allocations booklet from the Comprehensive Spending Review 2010[15] and the Government's Innovation and Research Strategy 2011[16] provide an overview of economic

[7] http://www.ahrc.ac.uk/News-and-Events/Publications/Pages/Economic-impact-reports.aspx
[8] http://www.bbsrc.ac.uk/publications/planning/bbsrc-delivery-plan.aspx
[9] http://www.epsrc.ac.uk/newsevents/news/2014/Pages/announcements.aspx
[10] http://www.esrc.ac.uk/research/evaluation-impact/impact-evaluation/economic-impact-reports.aspx
[11] http://www.mrc.ac.uk/Newspublications/Publications/EIRF/index.htm
[12] http://www.nerc.ac.uk/about/perform/documents.asp
[13] http://www.stfc.ac.uk/2424.aspx
[14] http://www.rcuk.ac.uk/Publications/reports/
[15] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32478/10-1356-allocation-of-science-and-research-funding-2011-2015.pdf

and social reasons for public investment in science and research. Investments in the national research base provide the problem-solving capacity and high level skills required to sustain a knowledge driven economy and are key to building and maintaining long term economic growth.

The many reasons for public investment in science and research underpin recent Government decisions. The last Comprehensive Spending Review provided a Research Resource Budget that was a ring-fenced, flat cash settlement at £4.6bn per year. More recently, Spending Round 2013[17] saw capital funding increased in real terms from £0.6 billion in 2012-13 to £1.1 billion in 2015-16, and set a long-term capital budget for science in the next Parliament growing in line with inflation to 2020-21.

These investments in the research base have thus far been matched with international reputation and remarkably good performance in times of fierce competition. With just 3% of global R&D and 4% of the world's researchers, the UK accounts for 10% of downloads and 12% of citations, and 16% of the most highly cited articles. The UK continues to rank second to the US in international rankings of research excellence and efficiency, attracts more foreign direct investment for research than other comparable European countries and remains a net beneficiary in the global competition for talent[18].

Autumn 2014 will see the publication of a Science and Innovation Strategy which will set out the future shape and scale of the UK's science and innovation system. It will look at how we measure the system's performance and the key challenges for the UK to address to maintain a global leadership position in face of increased competition. This report will contribute to the evidence base for that strategy.

Inputs

The seven Research Councils together manage the "forward-looking" element of the dual funding system for research prevailing in the UK. Each Council has a disciplinary UK-wide remit assigned by Royal Charter.

Differences in the activities and investments funded by each Council are generally a result of discipline-specific features and do not reflect relative worth or efficiency. Research in one discipline will have different requirements to that in another across various factors – eg. size of team, specific equipment needed, travel arrangements. As a

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[16] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32450/11-1387-innovation-and-research-strategy-for-growth.pdf

[17] https://www.gov.uk/government/publications/science-and-research-funding-2015-to-2016

[18] International Comparative Performance of the UK Research Base 2013 (https://www.gov.uk/government/publications/performance-of-the-uk-research-base-international-comparison-2013)

result, investment patterns across categories of spend and the resulting outputs will differ for reasons intrinsic to the nature of the research funded by each Council.

Income

Total nominal income for the seven Research Councils fell in 2012/13 to £3.47bn. It has fallen every year since 2009/10 when income peaked at £3.62bn; in real terms this is a fall from £3.86bn, a drop of 10.2% (or 3.5% annualised), as shown in Figure 1[19].

Figure 1 also shows that the share of the total Research Council income has been relatively consistent across the Councils through this time with some minor deviations, notably that the BBSRC and the EPSRC have seen their incomes go up in the most recent period[20].

Figure 1: Real Income by Research Council

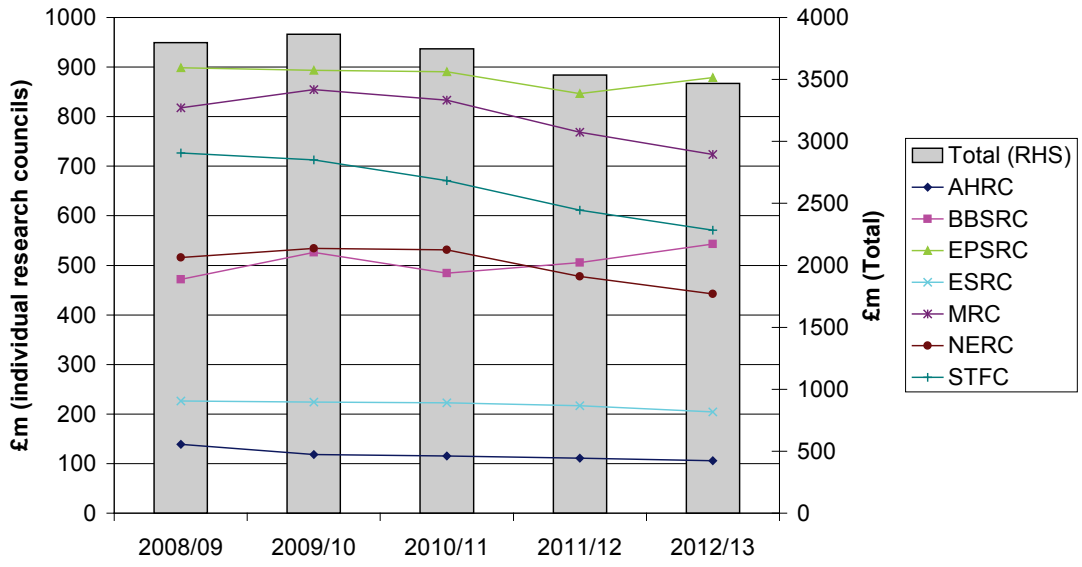


Figure 1: The total real terms income of the Research Councils is displayed in bars measured on the right hand side, and for each Research Council individually in lines on the left hand side. All numbers in 2012/13 prices.

Figures 2 and 3 show the level of external (non-BIS) income and the proportion of income that is external for each Research Council, and the Research Councils in aggregate. External income differs by Research Council and by year, but can include income from other government departments, foreign or international research institutions, and private sector or not-for-profit organisations. Note that external income does not include: sale of

[19] 'Real terms' in this report always take 2012/13 as the base year. The real figures for earlier years are calculated using the government's GDP deflator figures.

[20] As regards total income there have been no major changes to the proportionate split between RCs over the period of the BIS ring-fenced research resource budget (£2.6bn per annum); variations are largely due to funding changes outside the ring fence – eg. Capital (from BIS) and non-BIS activity.

intellectual property (IP); cross-Council transfers; or most significantly the cash or in-kind contributions of external research funders, or the research institution itself, towards research grants.

Figure 2: Real terms non-BIS income by Research Council

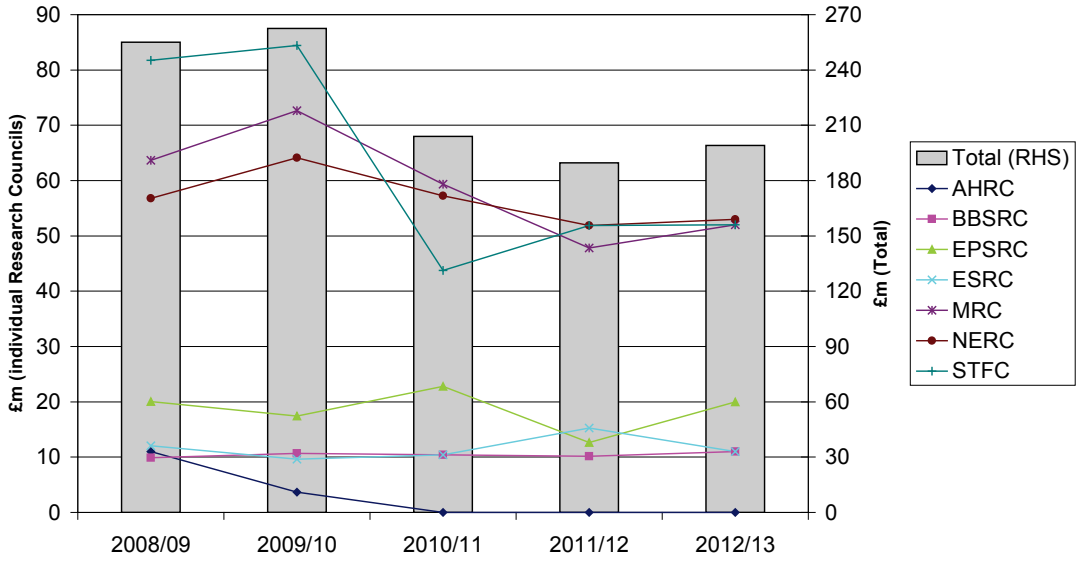


Figure 2: Total non-BIS income (excluding IP sales, cross-council transfers or contributions from collaborating research partners) is displayed in bars measured on the right hand side. External income for each Research Council individually is represented in lines measured on the left hand side. All numbers in 2012/13 prices.

Figure 3: % of income which is non-BIS

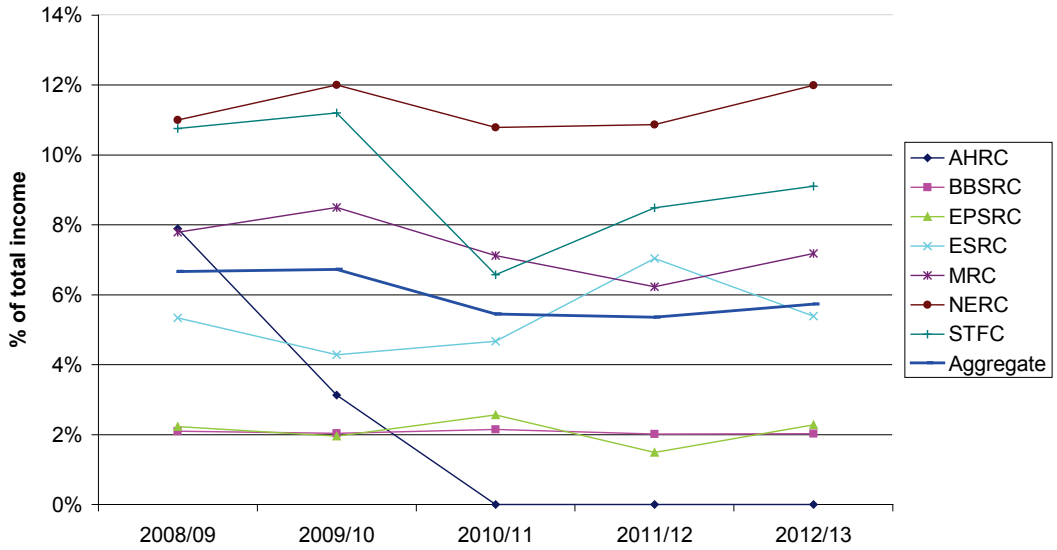


Figure 3: The proportion of income which comes from non-BIS sources is measured for each Research Council individually and for the Research Councils in aggregate.

Figure 2 shows how real terms total non-BIS income has moved in the same direction as total Research Council income, except for in the most recent year where it has increased whereas BIS income (and hence the total income across the Councils) fell. Real terms external income fell from £255m in 2008/09 to £190m in 2011/12, an annualised fall of 9.4%. It rose in 2012/13 to £199m, or by 4.9%. The real terms fall between 2008/09 and 2012/13 is 22% (6% annualised). Figures 2 and 3 show that, with the exception of the AHRC (and to a lesser extent the STFC), the level and proportion of income that is external for each Research Council has changed relatively little over time. The same point, therefore, applies to Research Councils in aggregate.

Figure 4: Real terms BIS income and non-BIS income

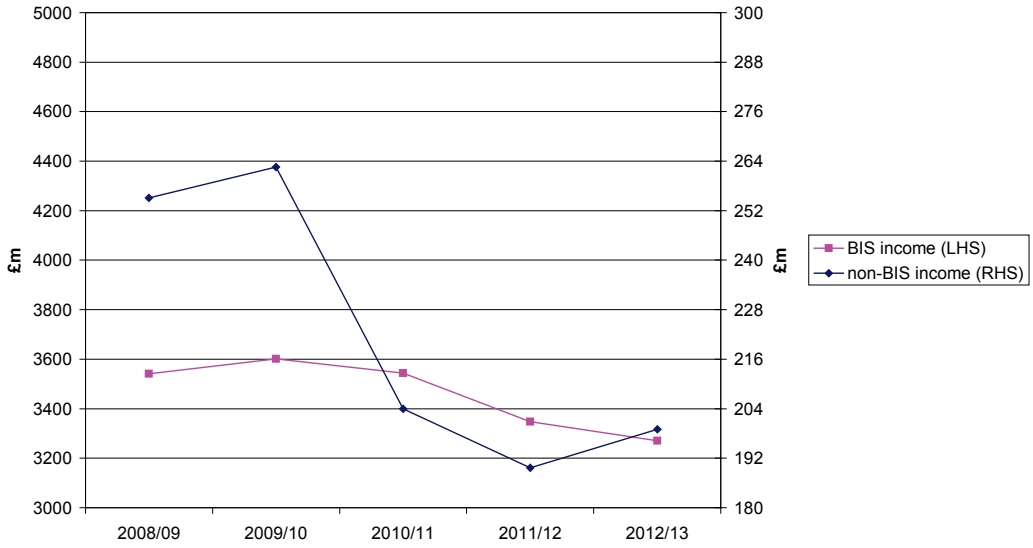


Figure 4: The movement of BIS income and income from other sources (for the Research Councils in aggregate) is shown here, with the latter measured on the right hand axis. Note the *proportional* (not the absolute) differences on the two axes are the same.

Figure 4 shows how up until 2011/12 total non-BIS income and BIS income for the Research Councils moved in the same direction, suggesting that non-BIS income complements rather than crowds out other sources of income. However, between 2011/12 and 2012/13 BIS income fell, whereas external income rose. It is too early to assess whether this is a sustained trend, but it is possible that Research Councils initially struggled to replace the loss of income from BIS, but have this latest year either improved their processes for this or found it easier with improving economic circumstances. With some exceptions, these general movements can also be observed at the Research Council level. Appendix C shows the movement of BIS and non-BIS income for each research council.

Expenditure

Because the Research Councils cover different disciplines, and have varying remits and responsibilities, the distribution of their expenditure varies across different categories. For the purpose of providing a split of their expenditure across different types, expenditure is divided into three categories (for reporting purposes): expenditure on research grants and fellows; expenditure on post-graduate sponsorship; and 'other' which includes funding of sponsored institutes, subscriptions to international facilities, and other expenditure.

Figure 5 shows the distribution of spend in aggregate across the Research Councils for the past five years. The seven charts in Appendix D show the same information for each Research Council individually (and indicate how type of expenditure varies across the Councils, even at this relatively broad level).

Between 2008/09 and 2012/13, there have not been large changes in the distribution of expenditure across the categories for the Research Councils in aggregate. However, a small shift is discernible from the "Other" category to "Research Grants" over the period - the proportion spent in the "Other" category fell from 46.2% to 40.9%, offset by a rise in spending on research grants, as shown in figure 5. The proportion spent on post-graduate funding was identical in 2008/09 and 2012/13, although it rose and then fell in the intervening years. This protection of Research Grants means that it is the only area which has seen a real terms rise over the period.

This small change in the overall composition can be explained by two factors. First (and marginally more significant), it is due to the drop in the share of the total Research Council budget taken by Councils who have a relatively large share of their expenditure allocated to the "other" category, such as the STFC, the MRC and NERC. Second, within Research Councils there has been a slight drop in the average share of expenditure falling in the "other" category.

Looking at the Figures for individual Research Councils (Appendix D) it can be seen that for several Councils which sponsor institutes, such as the BBSRC, the MRC and NERC, this is reflected in the size of their "other" category of spend. Similarly, STFC has a very large proportion of spending on "other" owing to their subscription to international scientific facilities, and funding of their large science facilities in the UK. The size of the Research Council appears to have very little impact on how it distributes its expenditure across the categories.

Figure 5: Expenditure by category, aggregated across Research Councils (£m 2012/13 prices)

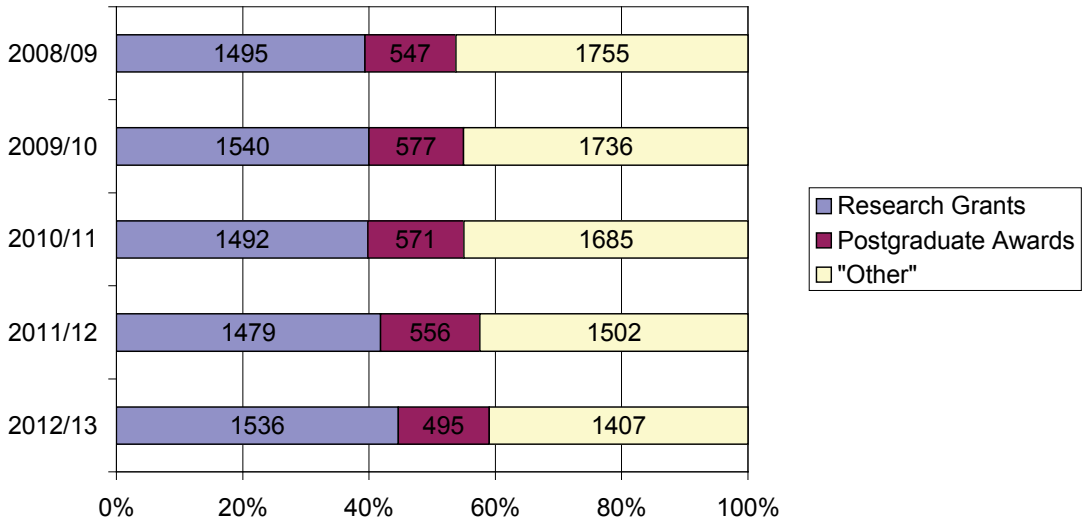


Figure 5: The distribution of expenditure across the three categories is shown for each year for the Research Councils in aggregate, and labels show the absolute amount spent (£m) in real terms, in 2012/13 prices.

Human Capital

Research Councils have human capital in both their inputs and their outputs. Researchers are key human capital inputs to the production of research, and are funded in a variety of ways.

Research proposals are submitted in the name of a Principal Investigator (PI), who will lead a particular piece of research and take responsibility for it. They are rarely the only researcher that a research grant is funding. The number of PIs therefore is indicative of research leaders being funded, but is necessarily an underestimate of the total number of researchers supported. Furthermore, differences in the number of PIs supported over time (as shown in figure 6) is a useful indication of changes in research activity, but is less useful as a comparison of the number of researchers supported by the different Research Councils as different disciplines are likely to have different typical sizes of research teams. Where appropriate, research leaders in sponsored institutes are added to the PI count in figure 6 (rather than the research fellow count), as they lead teams of researchers rather than working individually as research fellows do.

Figure 6: Number of Principal Investigators by Research Council and in total

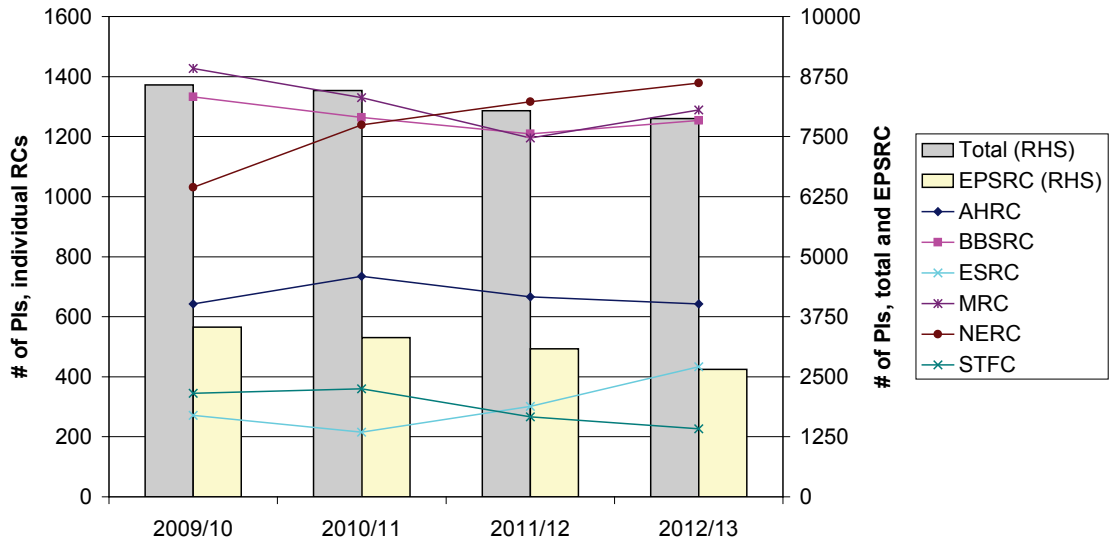


Figure 6: The total number of Principal Investigators supported, and those supported by the EPSRC are shown in bars measured on the right hand side, with the other Research Councils shown in lines and measured on the LHS.

Figure 6 shows a slight fall in the total number of PIs from 8579 in 2009/10 to 7877 in 2012/13, a fall of 8.2% (2.8% annualised). However, these trends should be treated as indicative only; changes in data collection methods, in particular for NERC and the ESRC, make growth look greater than it actually is. On the other hand, the EPSRC numbers do not take account of co-investigators - when these are added to PIs EPSRC have in fact seen growth in the past year.

It is important to emphasise that reduced numbers of PIs or other inputs need not lead to fewer or lower quality research outputs. Indeed, metrics for the volume of research outputs, ie. number of publications, show an increase (see 'New Knowledge' section below); and lower measured outputs may not mean worse research if Research Councils increase the concentration of research towards excellence. Furthermore, a fall in the number of PIs does not necessarily mean a drop in overall human capital input if it is accompanied by larger teams and longer research projects. It is also important to note that the effects of lower research inputs may not yet be observable. There will be a lag between inputs and outputs because most research projects take place over several years.

Whereas PIs and other researchers on a project are usually only partially funded by the Research Council grant they receive, research fellows are fully funded by a Research Council fellowship. This allows them to dedicate their time to the pursuit of knowledge, either for specialisation, the development of a research career, or for changing research direction. Figure 7 shows the number of research fellowships over time.

Figure 7: Number of Research Fellowships by Research Council and in total

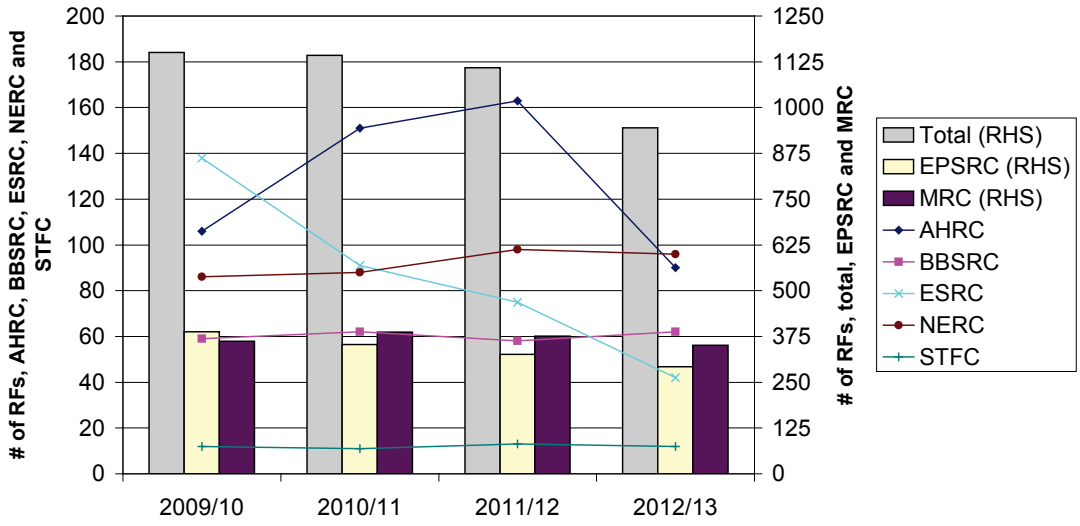


Figure 7: Total research fellowships, research fellowships funded by the EPSRC and research fellowships funded by the MRC are represented by bars measured on the right hand side. Research fellowships funded by the other Research Councils are represented by lines measured on the left hand side.

Figure 7 shows that the total number of research fellowships funded by the Research Councils fell from 1151 in 2009/10 to 945 in 2012/13, a fall of 17.9% (6.4% on an annualised basis). All of the Research Councils saw either falls or very modest rises in the number of fellowships they were funding over the period.

Outputs

The New Metrics Framework (outlined in Appendices A and B) acknowledges a range of outputs from investments in the research base that can be quantified, not all of which apply to every Research Council to the same extent. This report highlights some aspects of the knowledge, skilled people and business opportunities that are directly generated as a result of research funding. The Impact Reports provide additional case study evidence of outputs that are more difficult to quantify systematically.

New Knowledge

New scientific knowledge has proved to be and will continue to be vital in improving the lives of British citizens, and to the rest of humanity. Academic discoveries lead to new technologies, new ways of organising society and new understanding of the world which improves and enriches lives.

It is not possible to accurately measure the amount or value of new knowledge generated in any one year that is attributable to the UK research base as a whole, never mind to the Research Councils. However, the number of refereed academic publications attributable to the Councils is one proxy for their contribution. Whilst academics publish in other forms such as books, monographs and through digital media, refereed articles remain the primary repository through which new academic knowledge is disseminated in most disciplines[21].

[21] Note that AHRC is a notable exception in that whilst much of the research in their disciplines is published in refereed journals, other forms of publication are more prevalent than for the other Councils.

Figure 8: Number of refereed publications by Research Council and in total

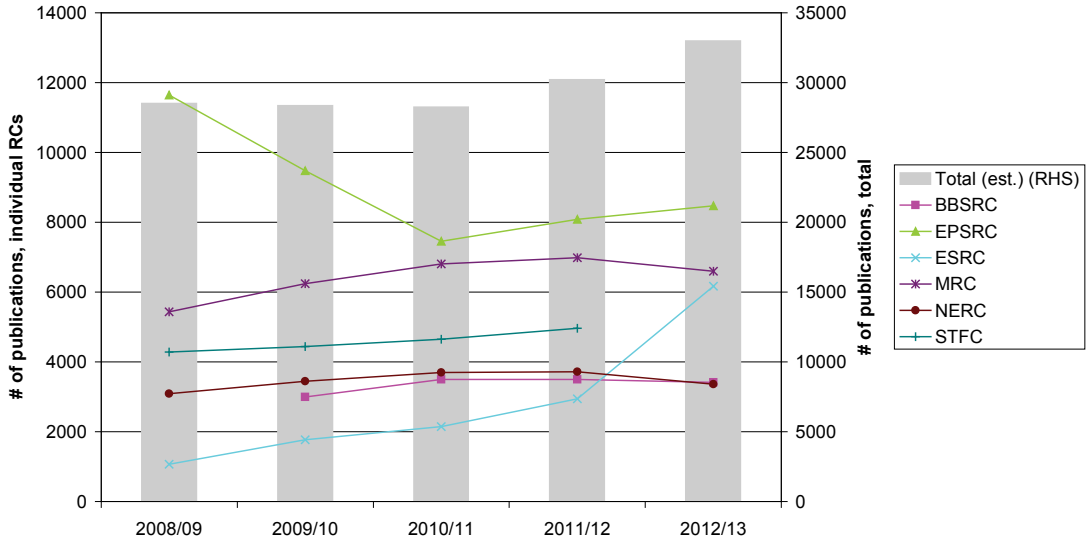


Figure 8: The estimated total number of refereed publications (excluding the AHRC) is displayed in bars, measured on the right hand axis, and the number of refereed publications for each Research Council (excluding the AHRC) is represented in lines, measured on the left hand axis. For the purpose of calculating the total, it has been assumed that the figure for the BBSRC in 2008/09 is the same as the number for the following year, and that the figure for the STFC in 2012/13 is the same as the previous year (so the first and last bars represent estimates).

Figure 8 shows that since 2008/09 the (estimated) total number of refereed publications for these six Research Councils has risen from around 28500 to around 33000, a rise of around 16% (4% on an annualised basis).

Whilst this is an undisputed increase, and one to be welcomed, there are several points that should be noted here. First, quantity is not everything, and quality is important as well – though the recent BIS report on the comparative performance of the UK research base does suggest that the quality of UK research has been maintained, if not increased in some areas[22]. Second, the general increase seen across the Councils can in part be explained by the notable recent increase in internationally co-authored papers[23]. Third, the research leading to some of the publications will not always have been solely supported by a single research council - other sources of funding will have contributed, and there may also be some double-counting across Councils. Fourth, changes in reporting systems can have an impact – this is part of the reason for the large increase for the ESRC in 2012/13, for example. Finally, it is important to emphasise again that there is a lag between research inputs and outputs; given the recent fall in research inputs, it is not clear that this rate of growth will continue.

[22] https://www.gov.uk/government/publications/performance-of-the-uk-research-base-international-comparison-2013

[23] See footnote 23

Human Capital

As noted above, human capital enters both the input and the output measures in this report. Whilst funded researchers count as an input to the production of research, the Research Councils also fund PhD students, and completed PhDs represent a significant increase in human capital. Given the high finishing rates for Research Council funded PhDs (an estimated weighted average finishing rate across six of the seven Research Councils was 83% this year) which have been fairly consistent over time, we can use the inflow of PhDs as an indication of the human capital output for the economy in the future when these PhDs graduate.

Figure 9: Total PhD starters and PhD starters by Research Council

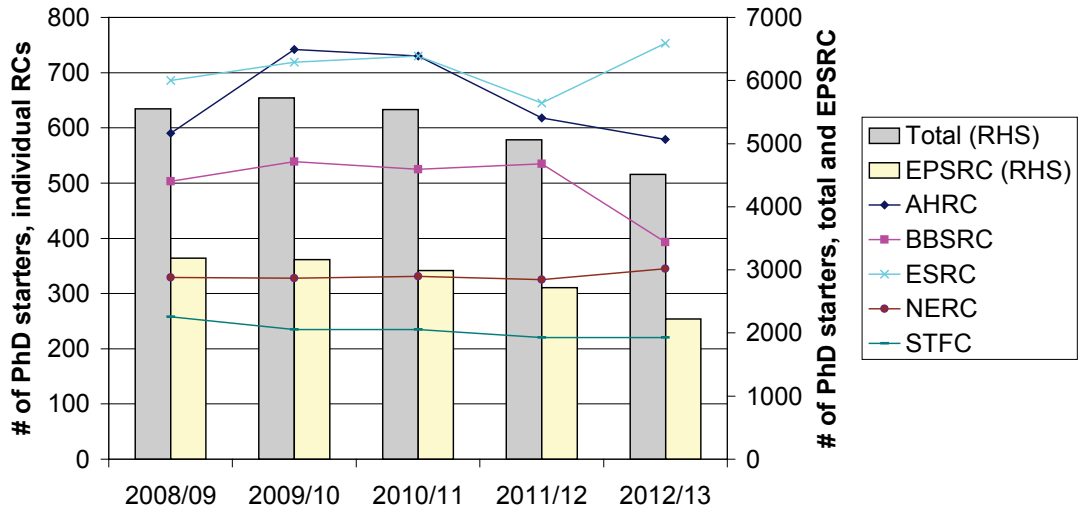


Figure 9: Total PhD starters and EPSRC funded PhD starters are represented by bars, measured on the right hand axis. PhD starters funded by the other Research Councils (except the MRC) are represented by lines, measured on the left hand axis.

Figure 9 shows a fall in the total number of PhD starters (excluding the MRC) since the peak of 5723 in 2009/10, down to 4513 in 2012/13, a fall of 21.1% (7.6% on an annualised basis). The EPSRC plays a large role in this - without it the fall would be about half that level. It is worth noting that the fall in EPSRC and BBSRC funded PhD starts has been driven in minor part by an increased prioritisation and focus on the best students through Centres for Doctoral Training.

Combining finishing rates with PhD inflow suggests that currently the Research Councils are delivering around 5,000 PhDs into the economy each year. However it should be noted this is likely to fall in future with the recent drop of PhD starters funded by the Research Councils.

Intellectual Property and Spinouts

The commercialisation of new scientific knowledge is a major way in which the Research Councils have economic impact. It can be difficult to trace new commercial activity directly back to scientific outputs. Often there is no intellectual property (IP) created, or the commercial activity takes a long time to materialise, or it is difficult to attribute a particular commercial activity to one academic output.

However, it is possible to track the IP (measured by patents) and spinouts back to the funding and hence attribute them to Research Councils. This is more useful as a through-time comparison than as an inter-council comparison because different disciplines will exhibit varying levels of formal IP which lead to commercial activity or other types of impact. However, even through time it is important to take care when making comparisons - variations across disciplines, or other economic factors, may mean that formal IP and spinouts become more or less significant at different times as the channels through which research outputs lead to commercial activity.

Figure 10 shows a recent drop in patent applications, patents granted, and a drop this year in the number of spinouts. Note that this analysis is only indicative in nature - the relevant data is not available for all the Research Councils so it does not provide a full picture, and it should be interpreted in that light. Moreover, even with the data we do have, it is clear that these metrics can fluctuate from year to year, so it is hard to predict how they might change in the future.

Figure 10: Total Patent applications, Patents granted, and Spinouts attributable to Research Councils

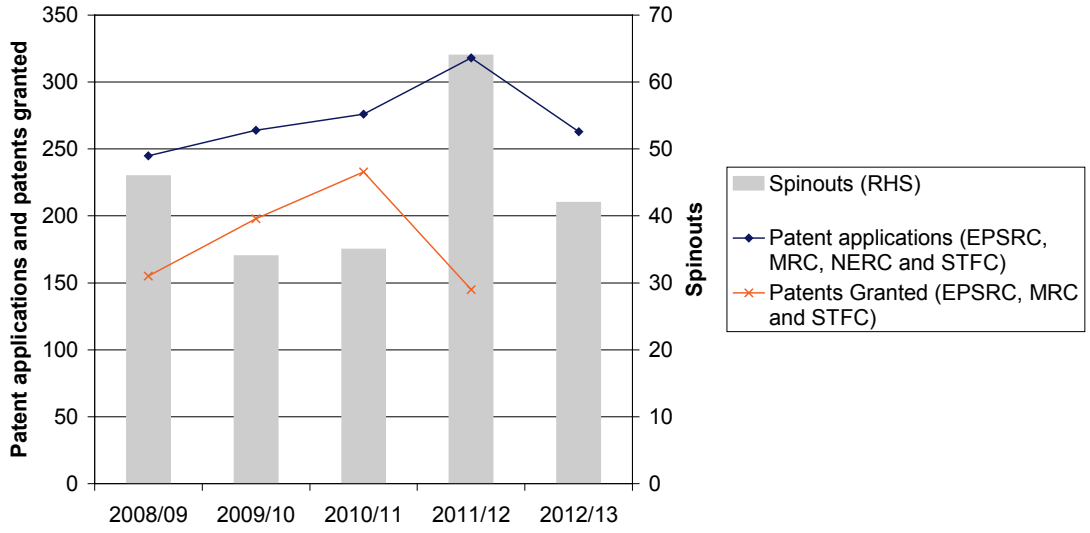


Figure 10: Patent applications for the EPSRC, MRC, NERC and the STFC, and patents granted for the EPSRC, MRC and the STFC are represented in lines, measured on the left-hand side. The number of spinouts are represented in bars measured on the right-hand side. The patent measures do not cover all the Research Councils as they do not all count them throughout the period.

Outcomes

The outcomes and impacts of investments in Science and Research are substantial, but they often take years to accrue, are difficult to quantify and attribute, and may draw on research which itself draws on other research. Since this report focuses on metrics to identify trends, many economic and social outcomes are excluded because they cannot be systematically assessed over time. Nevertheless such outcomes are well-covered in the individual Impact Reports.

Human Capital

Employment outcomes for PhD graduates provide an indication of the impact PhDs are having in the economy. It is a measure which is consistent through time and across the councils.

The annual Destinations of Leavers from Higher Education (DHLE) survey asks about the activity of recently qualified PhD holders, around 6 months after they have graduated. It indicates whether they have entered employment, are unemployed, or are doing something else. If they are in employment it is possible to determine whether this is in the HE sector, somewhere else in the public sector, in the private sector, or in the third sector. By linking up the DLHE data with information held by the Research Councils, PhD qualifiers supported by each Council can be.

The most frequent destination for PhD leavers is consistently employment, and most of these enter the Higher Education (HE) sector – for PhD leavers in 2011/12 who were supported by the Research Councils 48% found employment in the HE sector (approximate average across the Councils). These PhDs become inputs into the science and research system as researchers.

The second most common employment outcome for PhD graduates is entry into the private sector (Figure 12). Whilst this is clearly not the only route to impact, entering private sector employment provides a fairly direct path to economic impact.

Figure 11: % of PhDs who are not unemployed 6 months after completing

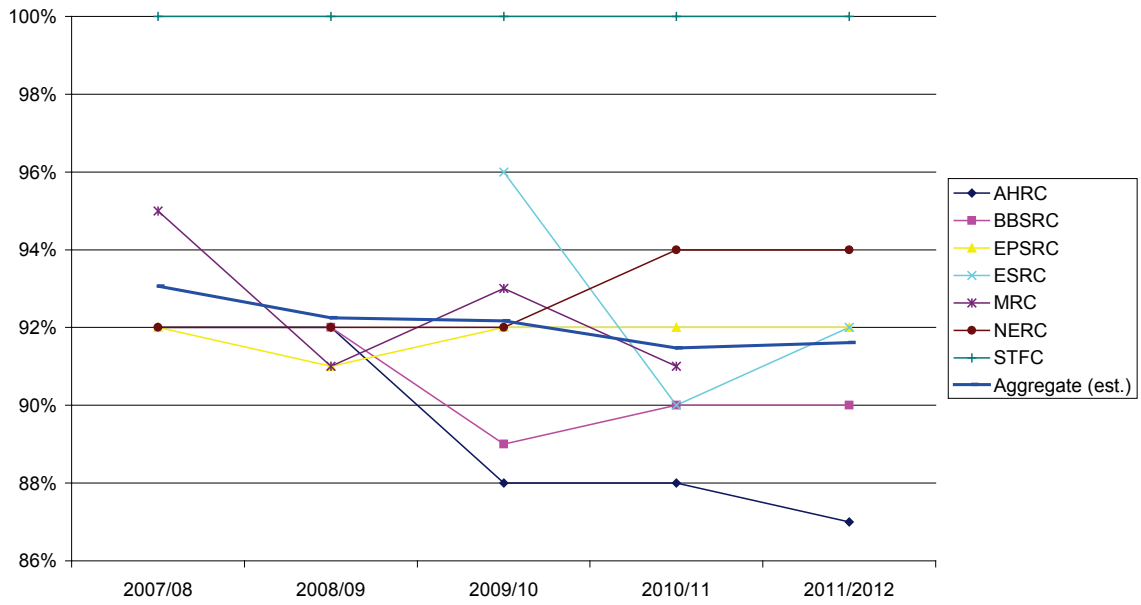


Figure 11: The proportion of PhD students who are not unemployed within 6 months of graduating (based on the DHLE survey). The aggregate figure is estimated in 2007/08, 2008/09 and 2011/12 owing to the fact that there are not data for all the Research Councils in these years. Year represents academic year of graduation.

Figure 11 shows a drop in aggregate of around 2 percentage points in PhD qualifiers who are not unemployed after 6 months. It is highly likely that this reflects changing economic conditions over the period.

Figure 12: % of PhD graduates entering the private sector, by Research Council and in aggregate

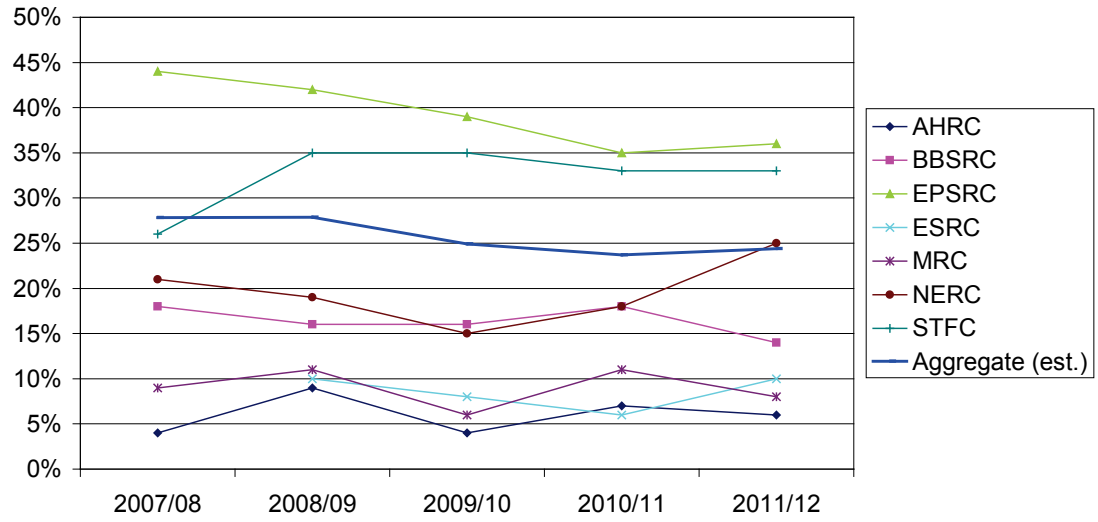


Figure 12: The proportion of PhDs funded by each Research Council, and in aggregate across the Research Councils, who enter the private sector within 6 months of graduating (as measured in the DLHE survey). Year represents academic year of graduation.

Figure 12 shows that, in aggregate, there has been a slight fall in the proportion of PhD graduates entering the private sector across the period, although this has tentatively began to recover in the most recent year. It is likely this represents general hiring trends in the labour market as a whole. However, the drop in PhDs entering some form of employment is smaller (around 2 percentage points) than the drop in those entering the private sector (around 4 percentage points). The rising proportion of new PhD holders employed in the HE sector suggests another explanation for some of the drop in those entering the private sector. This could either be down to an increase in hiring in absolute terms into the HE sector, or constant hiring in absolute terms, but a smaller number of PhDs completing each year.

Whilst the largest proportion of PhD qualifiers enter the HE sector after graduating, it is important to note that some of these will later move to careers outside of HE, often in the private sector.

Concluding Remarks

This report has reviewed the evidence on trends in a selection of inputs, outputs and outcomes contained in the quantitative element (metrics) of the Impact Reports returned by Research Councils covering 2012/13.

In as far as activity is captured by these metrics they demonstrate various features of the system of research funding managed by Research Councils.

- The time series shows recent changes in the overall funding with a reduction in the total but little difference in the relative allocations to each Council over time.

- The evidence suggests that in response to reductions in income the Research Councils have generally been managing funds so as to maintain or increase investment in research grants.

- The evidence also suggests that Research Councils are endeavouring to concentrate the more limited resources among excellent research and students.

Appendix A: New Metrics Framework

INPUTS	OUTPUTS	OUTCOMES
Structure of Income and Expenditure Income from BIS and by source Expenditure by category: Research Grants, Post Graduate Support and Other	**Knowledge Generation** Bibliometrics Other publication outputs Co-authorship with industry and abroad	**Public Policy** Where available account for instances of policy influence – possibly illustrate with case studies
Human Capital (Input) Principal Investigators and Research Leaders in Sponsored Institutes Research Fellows	**Human Capital (Flow and Stock)** Students supported Finishing Rates	**Human Capital (Stock)** Destinations of leavers Placements in user organisations
Other Inputs Income contributed by non-BIS entities	**Commercialisation** IP activity IP income	**Impact Case Studies** Examples of how past research is improving the life of citizens in the present

Appendix B: List of Metrics

NEW METRICS FRAMEWORK –BIS

CATEGORY / METRIC	UNITS	DEFINITION
Income and Expenditure		
Total Funds Available	£m	Total funding available to the research council - Sum of Grant in Aid and Leverage
Budget Allocation	£m	Research council Grant-in-Aid
Leverage	£m	Funding other than Grant-in-Aid. Sum of components below
of which Private	£m	Funding Leveraged from the Private Sector
of which from other Research Councils	£m	Funding Leveraged from other research councils
of which from other source	£m	Funding received from all other sources.
of which Private	%	As a percentage of Total Funds Available
of which Other Research Councils	%	As a percentage of Total Funds Available
of which Other	%	As a percentage of Total Funds Available
Total Expenditure		
of which Research Grants	£m	Accounts Expenditure on Responsive Mode Grants
of which Postgraduate Awards	£m	Accounts Expenditure on Postgraduate Student Support
of which Other components	£m	Residual Expenditure on other components as Total funding minus two above
of which Responsive Mode Grant	%	As a percentage of Total Funds Available
of which Postgraduate Awards	%	As a percentage of Total Funds Available
of which Other components	%	As a percentage of Total Funds Available
Human Capital		
Principal Investigators	#	Total number of principal investigators directly supported on DATE
Research Leaders in Sponsored Institutes	#	Total number of research leaders in sponsored institutes where applicable on DATE
Research Fellowships	#	Total number of Research Fellowships on DATE
Knowledge Generation		

NEW METRICS FRAMEWORK –BIS

CATEGORY / METRIC	UNITS	DEFINITION
Number of Grants assessed for reporting	#	Number of grants assessed to which the outputs reported refer
Refereed Publications	#	Number of papers published in peer reviewed journals
Non Refereed Publications	#	Publications OTHER THAN those included under Refereed Publications
Co-authorship of refereed publications - International	#	
Co-authorship of refereed publications - Industry	#	
Human Capital		
Number of PhD Students Supported	#	Number of NEW PhD students supported on DATE
Finishing Rates	%	Percentage of PhD students submitting within 4 years of commencement of support (for example row 2007/08 refers to students who began in 2003/04)
Commercialisation Activities		
Patents applications	#	Patent Applications to RC investments
Patents granted	#	Patents Granted to RC investments
Spinouts/new businesses created	#	Number of new spinouts created from RC investments
Income from IP activity	£m	Income from IP including areas such as licence income and receipts from sales of shares in RC funded companies.
Human Capital		
Destinations of leavers		Total Number of leavers from Doctoral Programmes in this academic year (DLHE)
Of which University	%	
Of which Wider Public Sector	%	
Of which Third Sector	%	
Of which Private Sector	%	
Of which Unknown or Other	%	
Of which Unemployed	%	
Placements in user organisations	#	Count instances of funded placements in user organisations
Public Policy		
Instances of influence		Examples of influence in policy

NEW METRICS FRAMEWORK –BIS

CATEGORY / METRIC	UNITS	DEFINITION
Value/changes induced		Examples of measured impact

Appendix C: Movement of BIS and non-BIS income through time by Research Council

These figures shows the movement of BIS and non-BIS income in real terms (2012/13 prices). Note that for all graphs the axes are set so that proportional (but **not** absolute) changes are represented with the same slope.

Figure 4a: AHRC BIS income and non-BIS income (£m, 2012/13 prices)

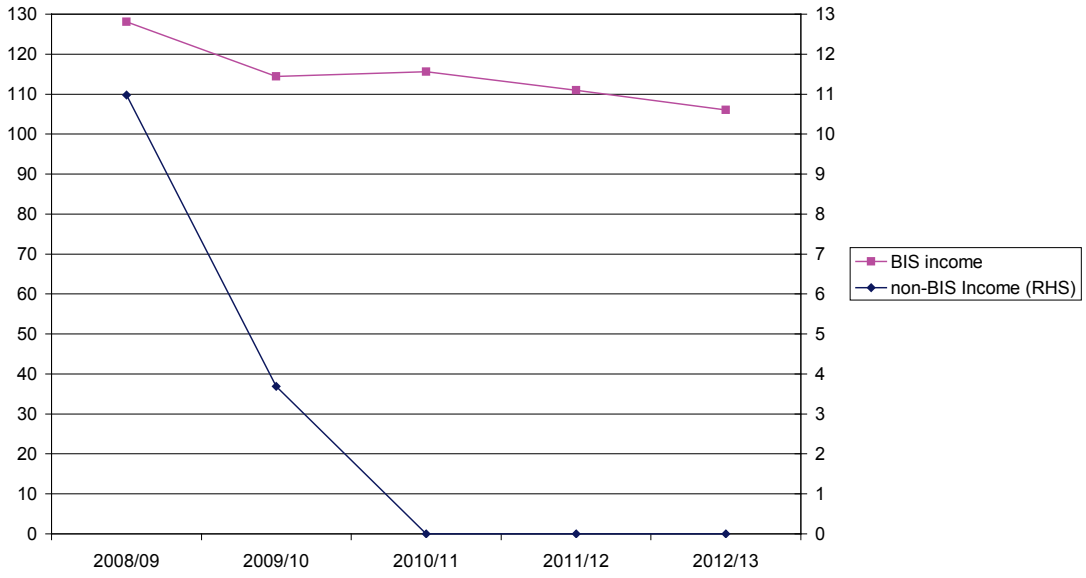


Figure 4b: BBSRC BIS and non-BIS income (£m, 2012/13 prices)

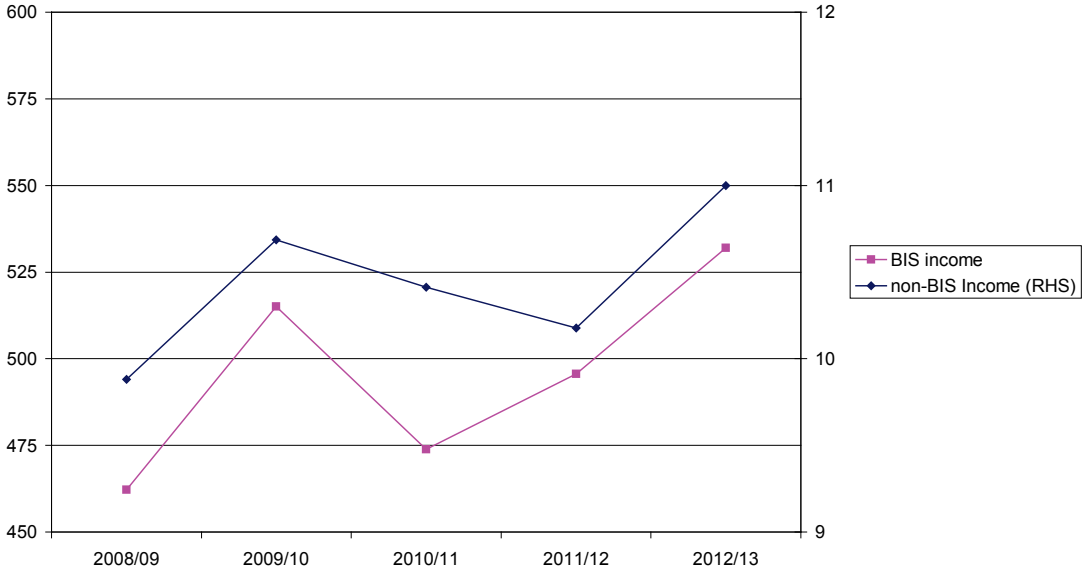


Figure 4c: EPSRC BIS and non-BIS income (£m, 2012/13 prices)

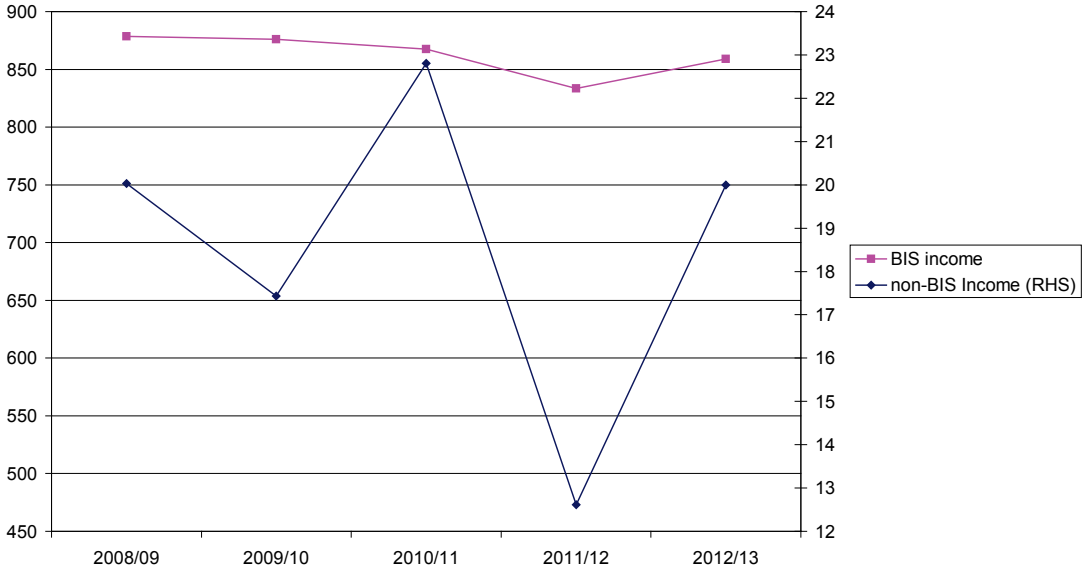


Figure 4d: ESRC BIS and non-BIS income (£m, 2012/13 prices)

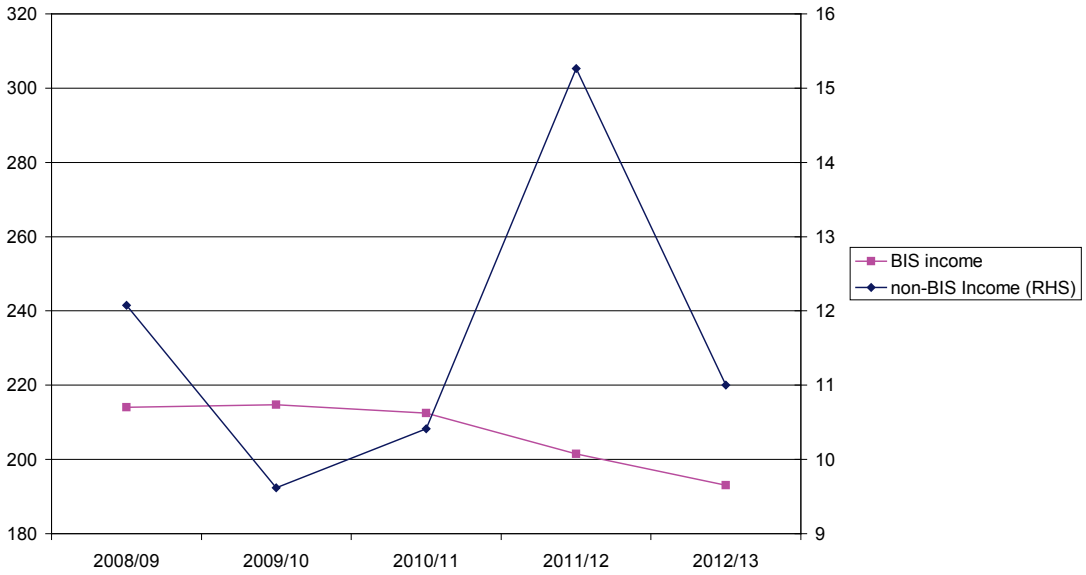


Figure 4e: MRC BIS and non-BIS income (£m, 2012/13 prices)

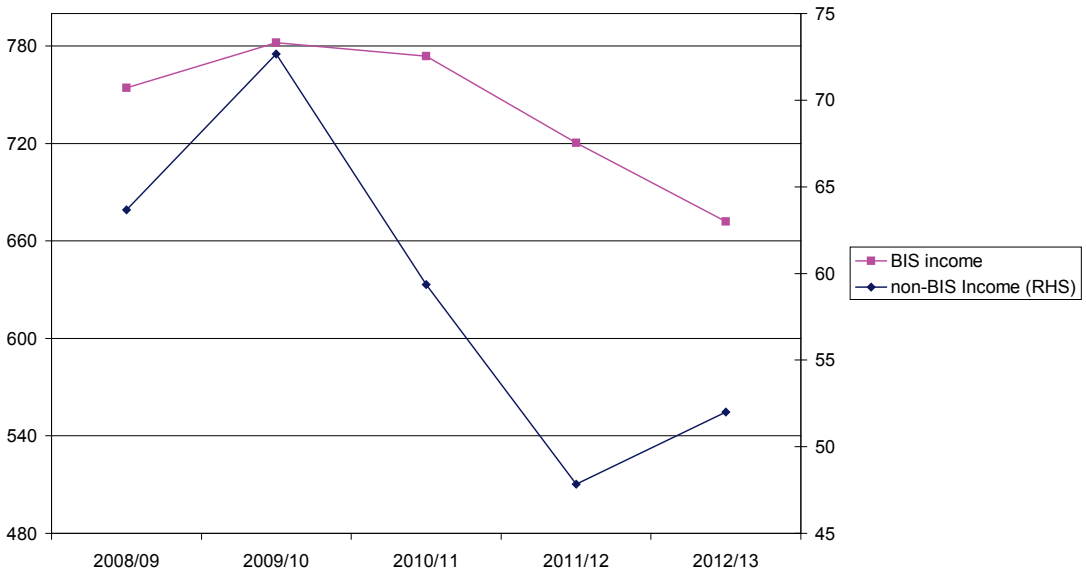


Figure 4f: NERC BIS and non-BIS income

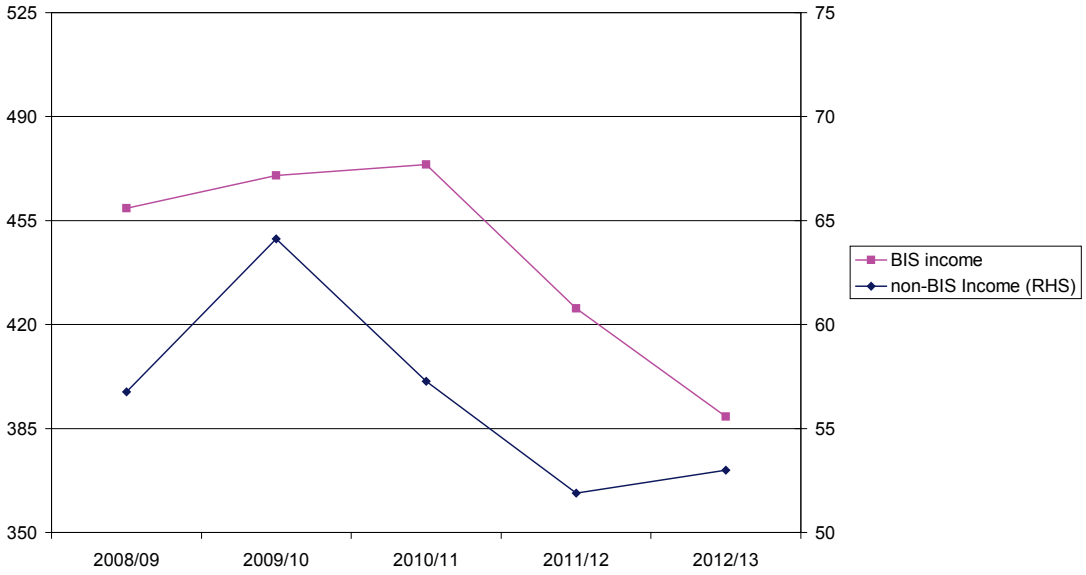
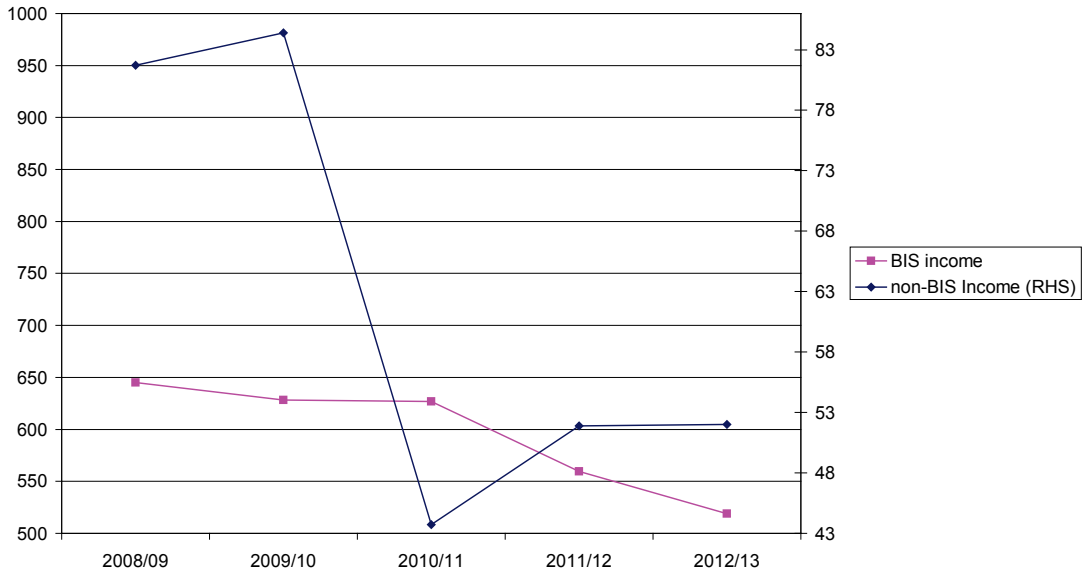


Figure 4g: STFC BIS and non-BIS income (£m, 20121/13 prices)



Appendix D: Expenditure by category for each Research Council, 2008/09 to 2012/13

Spend figures in £million, real terms (in 2012/13 prices)

Figure 5a: AHRC expenditure by category (£m, 2012/13 prices)

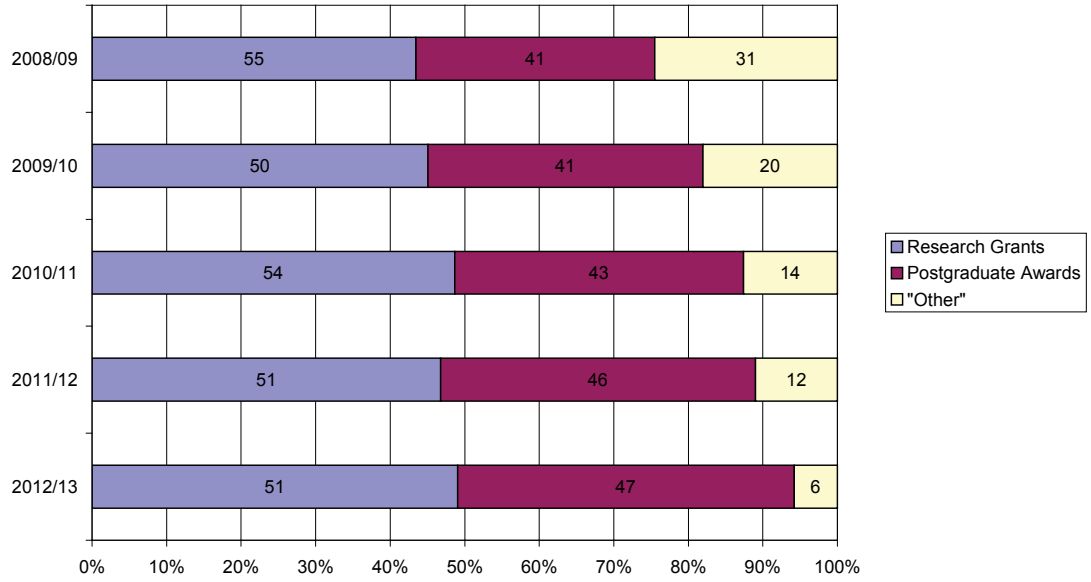


Figure 5b: BBSRC expenditure by category (£m, 2012/13 prices)

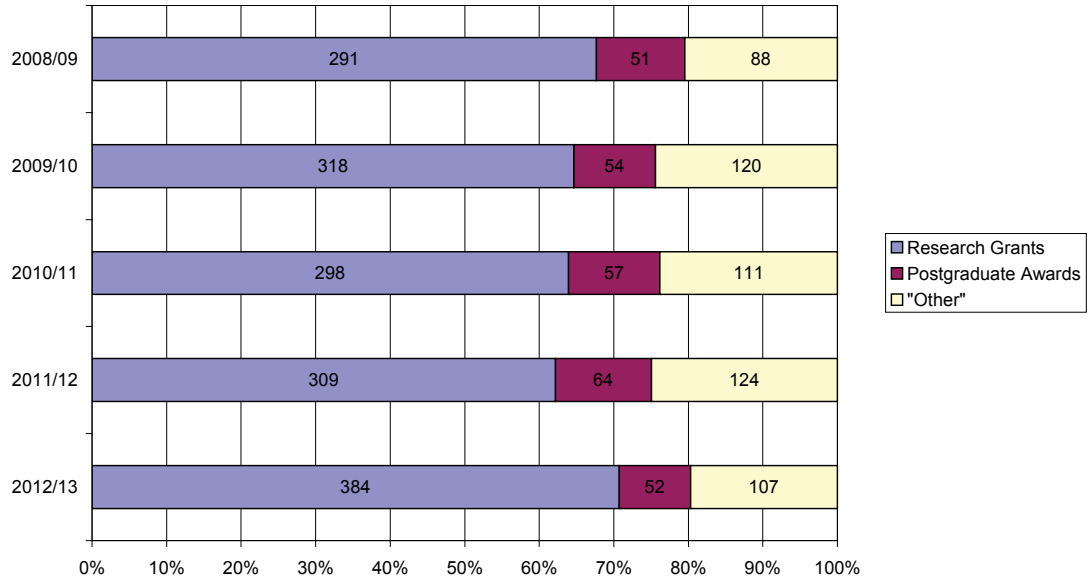


Figure 5c: EPSRC expenditure by category (£m, 2012/13 prices)

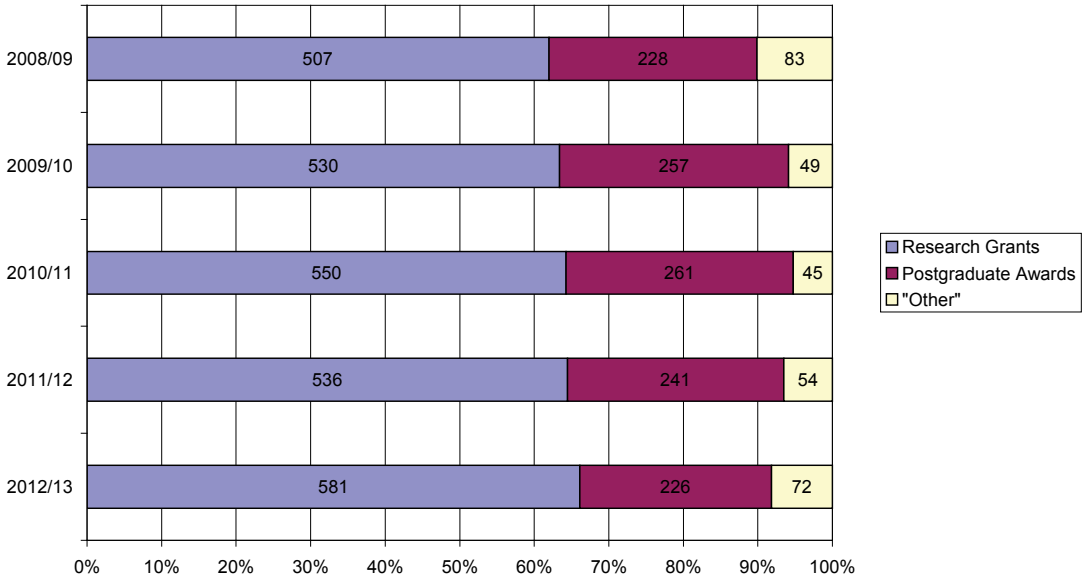


Figure 5d: ESRC expenditure by category (£m, 2012/13 prices)

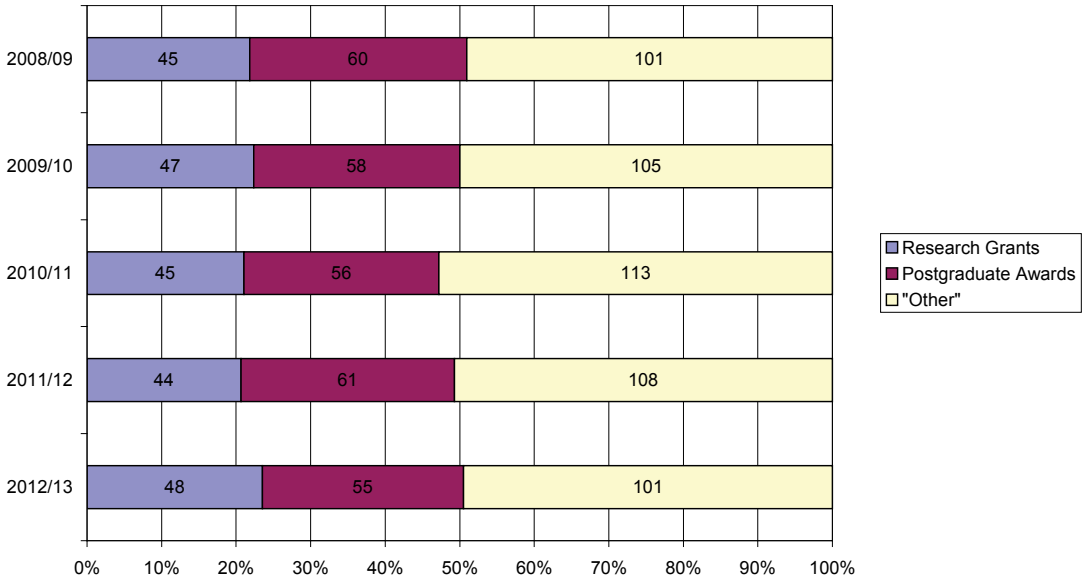


Figure 5e: MRC expenditure by category (£m, 2012/13 prices)

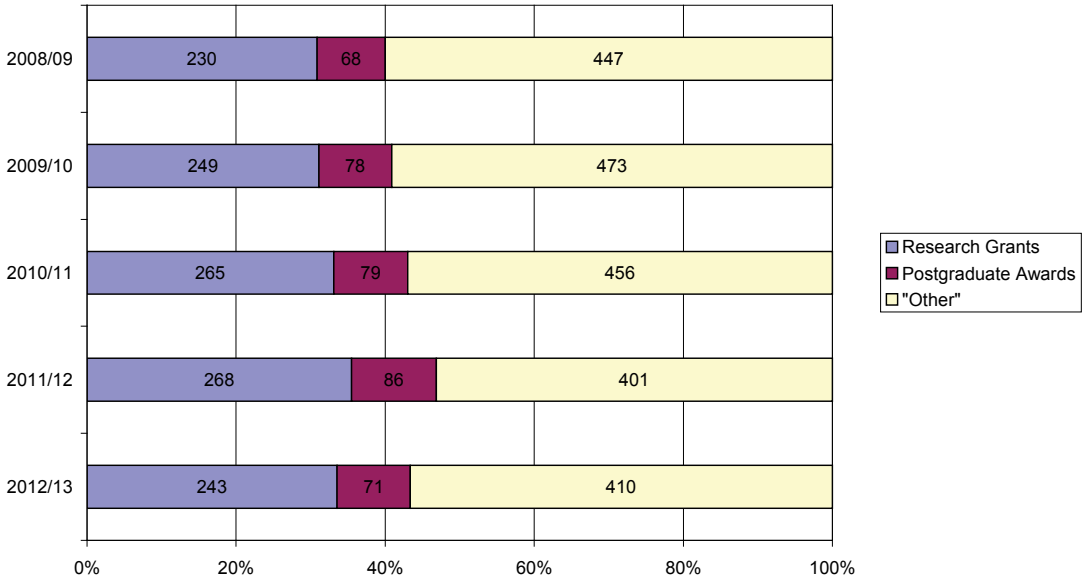


Figure 5f: NERC expenditure by category (£m, 2012/13)

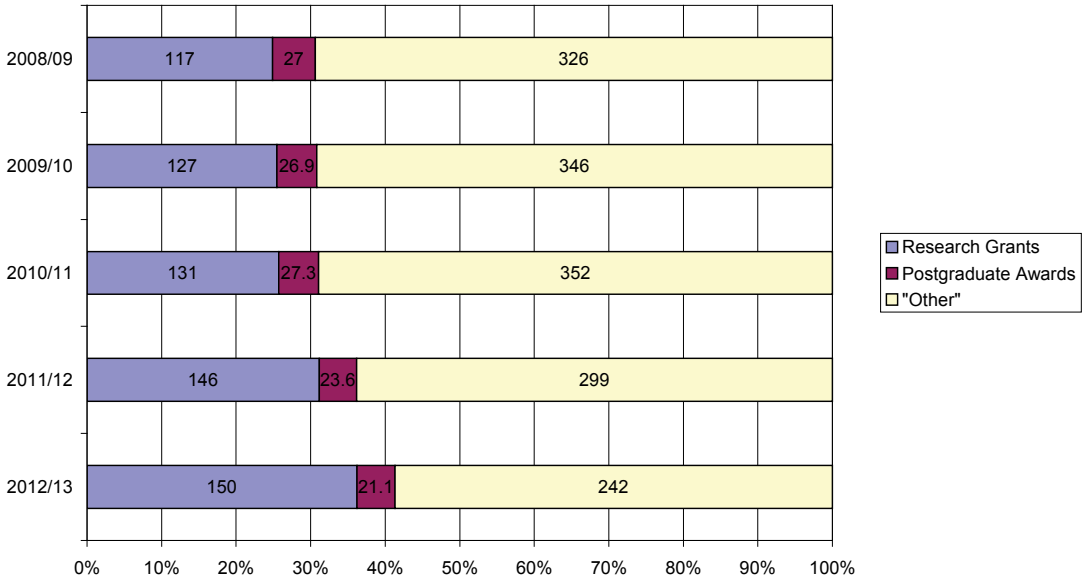
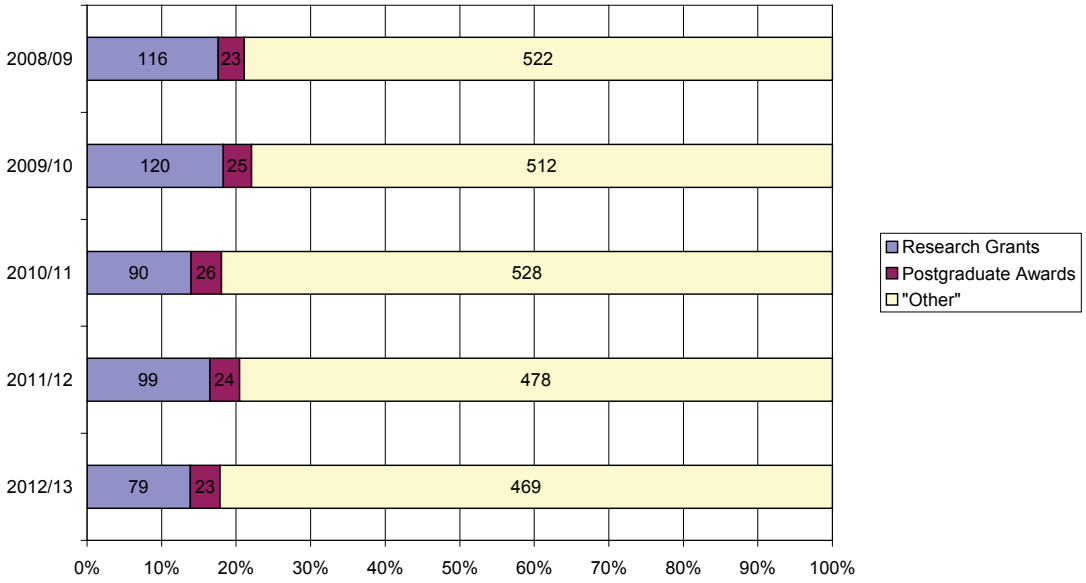


Figure 5g: STFC expenditure by category (£m, 2012/13 prices)



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