Legacy of the 2010 Science Budget Cash Freeze

A report prepared by **Science is Vital**
for the Rt Hon David Willetts MP,
Minister of State for Universities and Science

with support from

17 June 2013

Foreword

Dear Mr Willetts

This report was compiled after surveying 868 UK scientists about how their ability to perform research has been affected since the ring-fenced cash freeze of the science budget announced in 2010. Also, in collaboration with the British Science Association, we have consulted a focus group of science students to obtain the views of the next generation of UK researchers.

As far as we are aware, these consultations represent the only attempt to address the question of how spending decisions made in 2010 have affected researchers at the coalface up to the present moment, as well as the confidence of future researchers. We are pleased to provide this report and we hope to be able to discuss this important matter with you in person before the next spending review.

With best wishes

Science is Vital

Chair: Dr Jennifer Rohn, Head of Basic Science, Centre for Clinical Science and Technology, University College London

Vice-chair: Professor Stephen Curry, Department of Life Sciences, Imperial College London

Treasurer: Shane McCracken, Gallomanor

Secretary: Dr Richard P. Grant, Remedica

Executive Committee Members:

Dr Prateek Buch, Postdoctoral Fellow, Institute of Ophthalmology, University College London

Dr Tom Hartley, Lecturer, Department of Psychology, University of York

Dr Paula Salgado, Lecturer, Institute for Cell and Molecular Biology, Newcastle University

Dr Andrew Steele, Postdoctoral Researcher, MRC Centre for Developmental Neurobiology, King's College London

The views expressed by the authors are not necessarily those of their employers.

Contents

Executive Summary

Science is vital for the UK economy, and its health in turn is clearly dependent on government investment. In the Comprehensive Spending Review of 2010, however, the science budget disbursed by the Department of Business, Innovation and Skills was frozen, and since then, the cumulative effects of inflation and cuts to capital and departmental spends have significantly eroded science funding overall.

Science is Vital, a grassroots campaigning group with the aim of protecting and championing science in the UK, recently conducted a consultation amongst a wide range of scientists in the UK to determine whether their ability to do effective research had been affected by this decline in funding. We received 868 complete responses from a range of people: from postgraduate students and early-career researchers to fellows, senior professors and former researchers. In collaboration with the British Science Association, we also consulted a focus group of science and engineering students to gauge the mood of future researchers in the current climate.

This exercise uncovered the widespread view that the ability of UK scientists to perform excellent research has been significantly impaired since the 2010 announcement. Our respondents reported:

- a decrease in the number of grants funded
- a decrease in money awarded even when grants were funded
- difficulty in recruiting the necessary staff
- difficulty in recruiting PhD students
- difficulty in obtaining necessary equipment or consumables to perform research to modern standards
- a lack of confidence in the trajectory and promise of UK science which has led some scientists to abandon their research careers
- a recognition that higher levels of investment among major UK competitors is inducing some researchers to leave the UK.

If the current funding decline is not soon reversed, we risk seriously damaging our research base, with all the knock-on effects to the economy and to industrial interests that this could induce. Therefore we make two recommendations to redress the situation:

1. A long-term commitment of scientific support by Government, eventually reaching a level of support comparable to 0.8% of GDP – the current G8 average. Such a commitment will allow for the long-term planning that is essential for strategic and intelligent scientific research.
2. In the short term, and with particular regard to the 26 June 2013 budget decision, a reversal of the decline in the UK science budget. A modest increase will be an important signal to the research and business communities that the UK is determined to remain an internationally competitive, knowledge-based economy.

Background

The United Kingdom has a long and proud history of excellence in scientific research. Despite our relatively small size, we generate more publications and citations per pound spent on research than any other G8 nation. Home to 1% of the global population and 3% of global public spending on science, the UK nonetheless publishes 8% of the world's papers, and garners 12% of citations[1]. The UK is second only to the United States in its total number of Nobel laureates for Medicine, and ranks third for Chemistry and Physics (behind France)[2]. A recent report by the Royal Society describes the many and far-reaching aspects of our scientific excellence in great detail[3].

Scientific research takes place within a complex, global ecosystem, often with long lead-times from basic discovery to return. However, there is good evidence that robust public investment in research is highly beneficial to a nation[3]. An influential study published in 2001 by Salter and Martin[4] demonstrated that its returns include an increase in the stock of knowledge, the development of novel instruments and techniques, a positive influence on the training of skilled graduates, the spinning off of start-up companies and the promotion of networks. What is more, public spending on science is strongly associated with industry's research and development (R&D) investment in kind within a particular nation[5,6]. Consistent with the UK's relatively low investment in science compared with our competitors, an analysis by the Royal Society of Chemistry finds that industry's involvement here appears to lag behind accordingly[7].

UK public expenditure on scientific research is in a state of managed decline. Research is funded by a number of different mechanisms in the UK, and all of them have experienced real-term cuts since the Comprehensive Spending Review in 2010:

- The 'science budget' disbursed by the Department for Business, Innovation and Skills was ring-fenced and frozen in cash terms, and it has been significantly eroded by inflation since 2010. It is estimated that it will have been reduced by 12% by the end of this budget period in 2015.[8]

- The capital spending and administrative budgets (labelled 'other' on the figure below) were explicitly cut by over a quarter[9].
- During the financial years 2010–11, 2011–12 and 2012–13, a series of one-off windfalls earmarked for specific projects has largely compensated for the other two sources of cuts. However the shortfall in the Research Base Budget is projected to be around £300 million by 2015[8].
- Analysis by the Campaign for Science and Engineering[10] shows that other departments' research budgets are being cut disproportionately with respect to overall spending, leading to further reduction in the funds available for research.

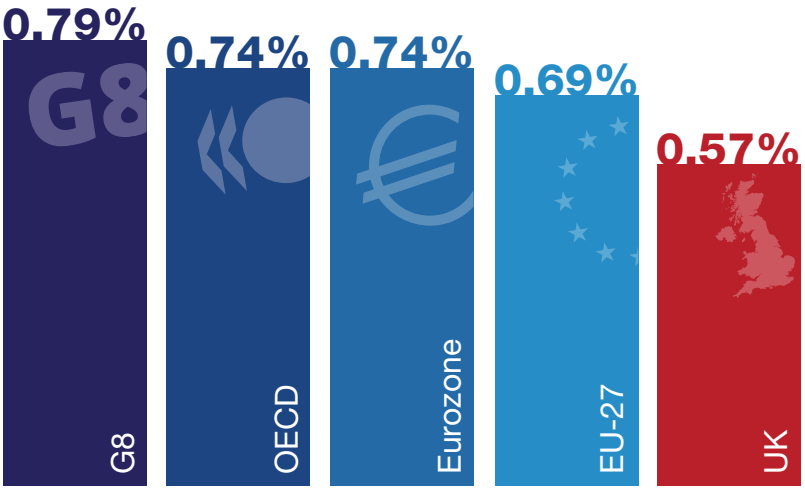
Cumulatively, the erosion of the real value of the BIS science budget and the cuts to capital expenditure and the R&D spend of other government departments will leave UK science much worse off by 2015.

UK government direct funding of research per person per year (2010 GBP)

Science is Vital

This decline in UK science funding stands in stark contrast to other major economies around the globe. The UK has the eighth largest economy in the world by purchasing power parity, and yet our public investment in science as a fraction of GDP, some 0.6%, places Britain 27th globally. This is significantly below average compared to the G8, OECD, Eurozone and even the EU-27 group of nations (see figure below). As noted recently by the Royal Society and other national academies, a number of our competitors across the world are increasing their investment in science[11], which will only serve to increase this disparity if we do not act now.

The UK scientific community is understandably concerned about this recent decline in funding, and what it might mean for the UK's ability to compete and to produce excellent discoveries and innovations, as well as to attract companies and private investments in science and engineering to our shores. In March of this year, Science is Vital organized a letter to the *Daily Telegraph* signed by more than 50 prominent scientists including seven Nobel laureates, such as Sir Paul Nurse, Sir Andre Geim and Sir Tim Hunt, and many Fellows of the Royal Society (reference 12, reproduced in Appendix A).



Public funding of scientific research as a percentage of GDP

Specifically, the *Telegraph* letter called on the Government to reverse the present policy and to declare a strategy of long-term support for UK science, signalled by a commitment to increase the public R&D spend to 0.8% of GDP — the current G8 average. This campaign is also backed by a number of scientific organizations and medical charities, including The Association of Medical Research Charities, Parkinson's UK, the British Science Association, The Biochemical Society, the Campaign for Science and Engineering and many others.

Although the 2010 settlement represented a funding cut in real terms, to our knowledge no formal studies have assessed how this decline may have affected the performance ability of researchers.

We recently performed a survey to find out how the practice of science in the UK has weathered this reduced level of investment over the past few years. We also consulted, in collaboration with the British Science Association, a focus group of students in science, technology and engineering to gauge the mood of the next generation of researchers in the context of the current funding climate.

Taken together, our findings are sobering, and indicate that the spending decisions made three years ago have caused real damage to scientific research in the United Kingdom.

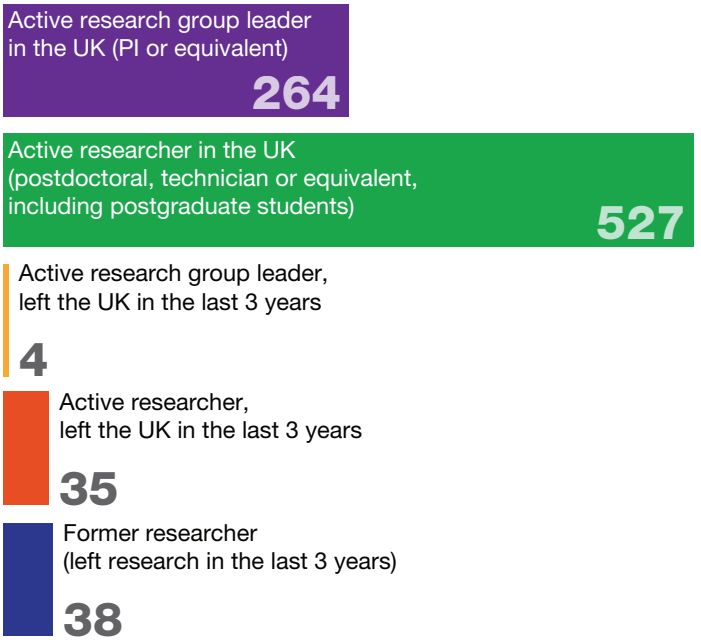
Survey Results

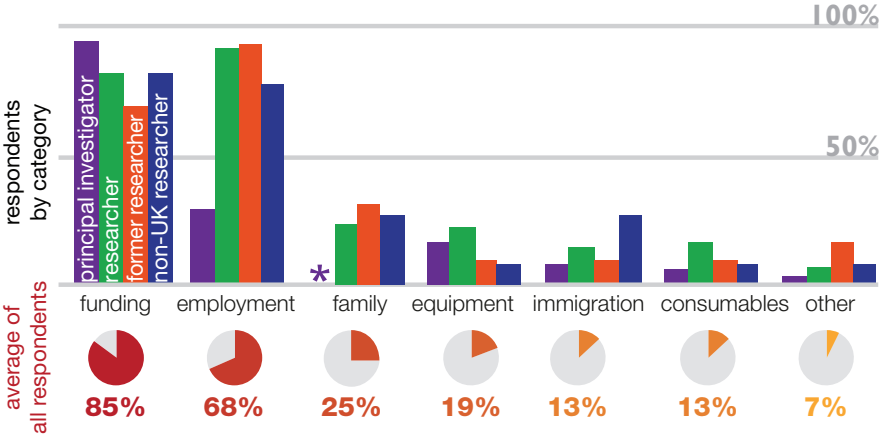
Summary

We posted a survey online, from 21 March to 7 June 2013, soliciting responses from researchers who had been active in the UK at the time of the 2010 Comprehensive Spending Review (CSR).

We received 868 responses from researchers across the career spectrum: from postgraduate students and early-career researchers to fellows and senior professors, and from former researchers. We received replies from across the whole of the United Kingdom, as well as from Japan, the United States, and other European Union countries.

The 2010 cash freeze would be expected to have different effects on different career groups as a result of differing responsibilities and concerns within each group. To help us understand these different concerns and effects, we stratified the survey by career group and asked questions that were relevant to each group. The results presented here are grouped accordingly. Numbers of respondents by career category are given in the figure below.





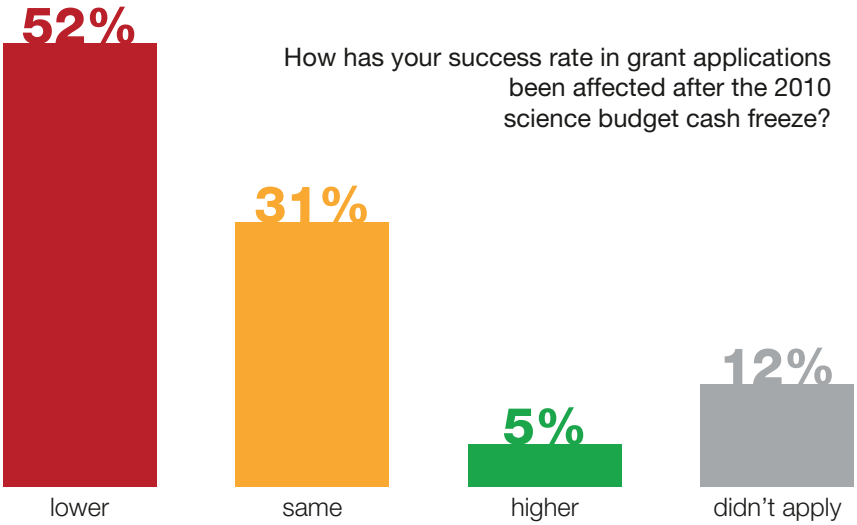
*This question was not asked of active PIs still in the UK.

We also solicited more detailed comments on what effects the 2010 CSR might have had on individuals' research and careers. The responses fall naturally into several themes, which we have identified as funding availability, employment, immigration, access to equipment and consumables, family, and other topics. In the interests of confidentiality we have redacted identifying information: [...].

The majority of comments related to funding availability and its effects on employment. Equipment and consumables funding were also clear concerns, mentioned not only by Principal Investigators (PIs) but also by other active researchers. Many respondents were also concerned about recent changes in immigration rules. Finally, family was an important factor in research options and career choices.

Active research group leader in the UK (PI or equivalent)

Most respondents (88%) had applied for funding since the 2010 CSR. Of those, 59% (138 respondents) reported a lower success rate in applications in this period (2011–2013) than in equivalent periods before the cash freeze. Only 5.5% (13) reported a higher success rate, with the remainder reporting no difference.



Some investigators put specific values on their decreased success rates.

"65% success rate previously; currently 22% success rate"

"Prior to 2010, 1 of 3 grants were successful. After 2010, 1 of 5 grants were successful."

"Hit rate down from 50% to 20%"

Of those that reported being successful in any grant application (71% of respondents), 44% (81) reported that cuts had been applied by the funding body, mostly affecting staff (48%), followed by equipment (21%) and consumables (15%).

"Lack of personnel and infrastructure to perform work. My lab runs with PhD students only, as I have no income to employ a postdoc and lab equipment breaking cannot be replaced for lack of funds. We struggle to compete internationally as we have no means to perform the types of approaches required to do high quality science."

"Difficulty getting specialised equipment and qualified PhD students, considered moving to US universities, where I would

receive about twice the amount of funding."

> *"one of our members is among the UK's best hopes of winning a Nobel Prize in Physics. ... my university has considered closing the group*

Regarding recruitment of staff, 100 respondents had attempted to recruit since the CSR. Of these, 38 reported not being able to recruit at all; 42 reported success but in reduced numbers; eight reported lower qualification levels of staff recruited; and 12 reported both reduced numbers and lower qualifications of staff recruited.

Only five respondents reported no effect on recruitment.

"Lack of funding has prevented recruitment for some projects. In others, even where funding has been available for high-priority, long-term projects, it has come in short-term contracts which have prevented recruitment of high-quality personnel."

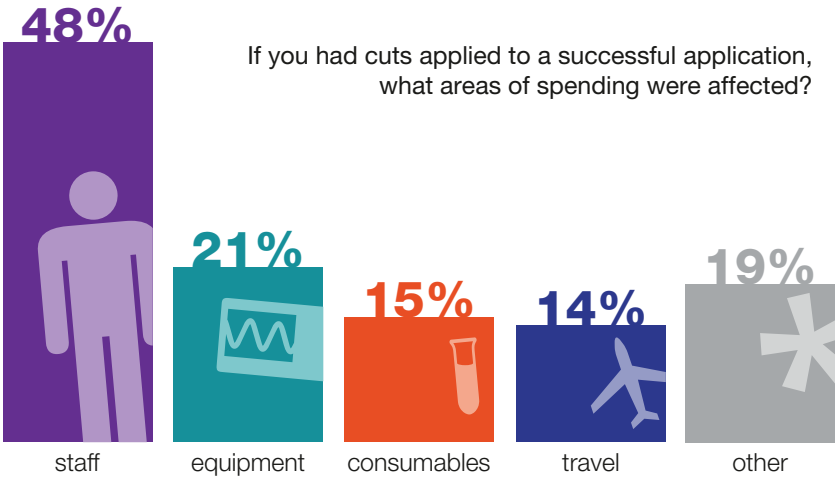
"The funding climate has affected my ability to recruit top level staff from the international community; the UK has built a reputation for having a vibrant and successful scientific community, but that is

being threatened by this Government's policies [which have] already reduced that reputation. The funding climate has also reduced the ambition level of future research goals."

There has been a clear effect of recent changes to PhD funding: of those who attempted to recruit PhD students, 73% (156 respondents) reported negative effects; 49% (101) recruited fewer than required; and 24% (50) said they were not able to recruit any students.

"The lack of funding for PhD students is short-sighted and is causing difficulties in maintaining momentum with research. Since my main source of funding (EPSRC) no longer supports graduate studentships in my next proposals I will be forced to seek funding for additional postdocs. This increases the cost of the research project. Further, in a few years it will become difficult to find suitable postdocs since fewer (UK) graduate students will be available."

"Largely, it has cut off certain promising directions of research because of the unavailability of PhD students. The concentration of PhD studentship funding in the UK in CDTs has been the biggest problem. It is no guarantee of concentration of excellence: rather, it is a reward for past performance."



> *this is all done "on the hoof" so the best long-term decisions are not being made*

Cuts in the capital investment budget, not protected by the cash freeze in 2010, have also had a negative effect: out of 140 respondents who applied for specialist equipment, 72% reported difficulties in securing funding.

"It is becoming increasingly difficult to apply for necessary equipment after the RC's decision to fund no more than 50% of equipment costing above £10000."

"Because of the limited funding available I currently have no laboratory space. I cannot apply for funding if I cannot have space as I cannot demonstrate the ability to conduct the research. Funding to build and upgrade laboratories is essential to increase the capacity for research in the UK."

> *the stark disparity between numbers of proposals which "should be funded" and which are funded is profoundly depressing*

"The biggest issue is equipment: this funding was massively reduced but has been brought back up to its original level via specific projects favoured by govt. Because of the way things have been done, this is not widely appreciated (to the govt's cost, perhaps). The problem is that this is all done "on the hoof" in response to impending budget statements, party conferences etc. so the best long-term decisions are not being made. The money typically has to be spent "in year", so certain quick-spend projects (such as IT) are inevitably favoured. The consequence is that we are not always funding the best science and many excellent science areas are being starved of capital and equipment funds."

> *basic research is being eroded as direct consequence of the funding freeze*

Many survey respondents (60%) also provided more detailed comments on the effects of the funding climate since the 2010 CSR. We cannot report all the comments here, but some main themes can be identified.

Enthusiastic but wary: view from the next generation of scientists and engineers

In collaboration with the British Science Association, we encouraged young people to participate in a youth focus group to feed into this report. We believe it is important to include the views of young people; ultimately, the decisions made now will have a significant impact on their careers in the future, so they should have the chance to voice their opinions on matters that affect them.

The cohort consisted of fifteen talented UK science and engineering students, members of either of two established groups of students who are strongly engaged in STEM, the CREST Youth panel[1] or the National Science + Engineering Competition volunteers[2]. The group ranged in age from 14 to 21 with a median age of 17, and was evenly split between male and female, with a professed interest distributed roughly evenly among the various scientific disciplines.

When asked to indicate which career paths they would look to pursue, the majority indicated that research was their primary career interest (67% in the case of academic research or engineering, rising to 80% if including industrial research)[3].

Our survey first examined the students' views on the UK as a place to start a research career in STEM. When questioned, only three of the 15 students thought the UK offered an "excellent" environment in which to start a STEM research career, although most were fairly positive in response, with over half considering it "good".

However, their personal comments clearly indicate that they have some concerns:

> "Good university base, reasonable amount of industry, generally well supported. However potential for greater salary etc and more opportunities in the US and maybe a few other places."
>
> "A lot of the advancements that interest me are engineering, mostly based in Europe and America, typically where there is more funding."

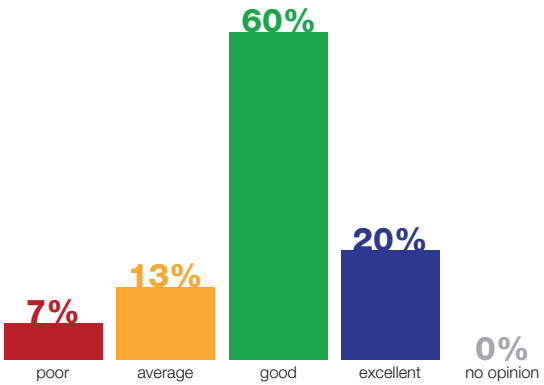


Figure: Student responses when asked to rate the UK as a place to carry out research

> "I have heard from many people in industry there is a lack of investment in this country compared with others."
>
> "The resources aren't as good as in some other countries."

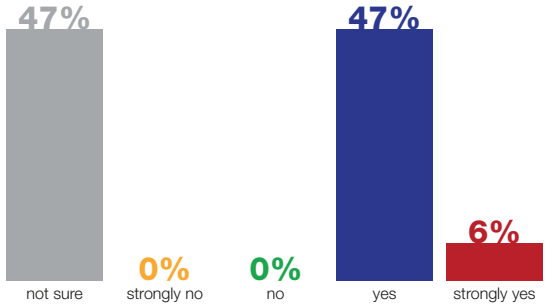


Figure: Student responses when asked how likely they were to move abroad to pursue a research career

When asked whether they would consider moving outside the UK to start on their research career in STEM, none of the students answered 'no'; more than half answered 'yes', with the rest undecided.

This raises concerns that the UK environment may not be as enticing to this group as we would like it to be, especially if our aim is to nurture and foster local talent in the sciences. Although some students, not surprisingly, indicated they'd like to move abroad just for the life experience, or would do so for the "perfect" job, for others, emigration was about better funding and job opportunities.

For example, one student felt that

> "there are a number of well-funded positions in fields that I'm interested in outside of the UK. The funding opportunities seem better in some Australian universities."

These responses suggest that while these students still perceive the UK as being top-notch, some of the insecurities about funding and support for science reported by practicing scientists may be trickling down to the younger generation.

1. **The CREST Youth Panel**. Formed in 2009 as part of the Association's commitment to involve young people in dialogue and to help with decision making where reasonably possible, the Panel is made up of people aged between 13 and 19, who have undertaken CREST Award projects. They feed back to the scheme and its partners about projects aimed at their age group, to help make them more relevant and supportive to their peers. www.britishscienceassociation.org/crestyouthpanel
2. **The National Science + Engineering Competition volunteers**. These are students aged over 18 who have participated in the Competition previously, and come back each year to support the competitor care at both regional and national level. They are all studying STEM subjects at university and are keen to remain engaged with the sector. www.nsecuk.org
3. Available careers to choose from were Industrial research; Sales; Academic research; Engineering; Teaching; Publishing; Science Communication; Something nothing to do with science; Non-research role in business or industry

Both senior and junior PIs referred to the increasing difficulty early career scientists and smaller groups have in securing funding in the current, highly competitive climate.

"It has been extremely difficult to secure funding for junior postdoctoral researchers with a clear interest and enthusiasm for independent and joint research, but at too early a stage in their publication record to compete with others."

"The perception is that the (smaller) amount of money available is increasingly being funnelled toward the large groups and big names. Unfortunately this is squeezing some excellent science, particularly amongst younger researchers."

"The cuts to the science budget has caused a reorganisation of the allocation of funding. As a result, investment is directed to individuals with established careers and longer track record of funding. This has limited the funding available to emerging scientists, particularly outside of the top universities. As a result, the progress of my projects has slowed because access to funding has been from outside the research councils"

"Polarisation of funding towards a supposed elite leaves pockets of excellence in 'modern Universities' struggling to compete. This diminishes the breadth of the science base, affecting training for the future and will soon have disastrous consequences"

> *"I fear that a generation of young women will be lost from UK science*

"[...]more recently I have had to spend a lot of extra time writing 'strategic grants' to help junior staff get funding because there are not the same schemes now that allowed me to start my independent career 13 years ago. This is extending a feudal, pyramid structure that stifles junior scientists' careers (they feel 'beholden' to me and other professors) […]. Other staff, particularly younger female scientists, see the effort on grants leading to a complete lack of work-life balance and ask whether they want to continue in science if this is what is needed to keep a job, let

alone progress. Hence we spend a lot of time training people up to do science at a high level, then show them a world in which they can't succeed unless they are lucky or are prepared to sacrifice any semblance of a life outside work."

Several commenters pointed out that they had proposals classified as outstanding, but that they had not been funded due to financial constraints.

"It is harder to get grants. Proposals that are rated as excellent and internationally highly competitive [are] rejected due to lack of funds and extreme competition. It is very demoralising to see good ideas built on years of preliminary analysis rated as excellent and important but then not funded and therefore not carried forward."

"I work in a relatively new University; against our competitor market we fare well in league tables and go from strength to strength. Establishing a research profile is key to this continuing but in the current climate, I'm struggling to see how this is possible. Despite positive peer reviews of our applications, support from stakeholder groups, etc, our projects are just not being funded."

These views were supported by this comment from a member of a research council panel:

"As a research council panel member, the stark disparity between numbers of proposals which "should be funded" (panels are tough-minded about this) and which are actually funded is profoundly depressing - doubling responsive mode budgets would simply double the amount of world-class research done in the UK, with all its long-term benefits."

Another major concern expressed by many of those taking part in the survey was the current focus on "translational" research, deterring many from blue skies or basic research as they would struggle to secure funding.

> ***"Once the success rate for lengthy grant applications drops below a certain point, applying becomes a false economy***

"The way in which I have been able to maintain funding for my group [...] is by making the strategic decision to drop the area of basic science in which I had worked (fairly successfully) for >20 years, and move lock stock and barrel into translational science. There are substantial funds out there, through the TSB, DPFS and DSC schemes, Wellcome Trust SDDI etc., that are expressly translational. I am comfortable doing this kind of work, but it is a serious problem for UK science that basic research is being eroded as direct consequence of the funding freeze."

"The greatest problem is lack of capital spending and also the idea that other people know best what we should be spending on - i.e ring fencing money. So it looks like funding is maintained but in fact, for fundamental research, the pool is ever smaller. It is from the basic research that we will make the greatest discoveries."

"My research group does theoretical condensed matter and materials physics. Much of our work is practically important and will have significant industrial impact in the longer term. We are internationally well regarded and responsible for one of UK science's greatest success stories of the past decade; in fact, one of our members is among the UK's best current hopes of winning a Nobel Prize in Physics. Despite our scientific success, however, it is so difficult to obtain funding for theoretical physics in the current climate that my university has considered closing the group altogether."

"It is becoming increasingly difficult to apply for funding for smaller, pilot-type blue skies research, particularly after NERC discontinued the Small Grants competition. I believe this is detrimental to the development of novel ideas."

> ***"I have no real options in the UK despite publishing strongly and having strong support from senior members of my field***

The extra time involved in preparing grant applications that are then unsuccessful was also the focus of several personal comments.

"The time spent on failed applications is expensive. A few of us in our dept calculated these costs and they are greater than we assume. Once the success rate for lengthy grant applications drops below a certain point, applying becomes a false economy."

"The introduction of submission of 'outline proposals' by RCs and for these to be peer reviewed and approved before one can even submit a full application has significantly extended the time lines for getting any funding and has added to the bottlenecks in the process, but it has not improved the quality of the science that is funded."

Finally, many respondents seem to feel that the current funding situation in the UK is worse than in other countries, and are leaving the UK to pursue their research interests. Some are considering abandoning – or even have abandoned – a research career, with the concomitant waste of resources and training.

"As a junior PI, I have realised that I have no real options in the UK; this is despite publishing strongly and having strong support from senior members of my field. I have therefore accepted a faculty offer from a high ranking university in the US and will be leaving the UK within the next 6 months."

"[...]I worry that within two years I will have no funds and no capacity to perform research. What a waste considering the time and money to bring me to this stage of my research career."

> *"My colleagues are leaving the profession in droves*

"As jobs have become more competitive it has become harder for women to gain permanent positions as scientists. I fear that a generation of young women will be lost from UK science."

"Low RCUK success rates, the difficulty in funding new PhD students, and the strong policy focus on commercial returns are together making it almost impossible to continue our fundamental research. I have been able to keep the laboratory running only by accepting the odd contract to carry out

conventional, commercial work marginally related to our focus area. This is certainly not an efficient use of world-leading research facilities and capability, but I was left with no alternative. As a consequence, I am actively looking to relocate my research team outside of the UK."

"The climate makes it very difficult to plan out a serious research path. It feels more like treading water than making progress."

Active researcher in the UK (postdoctoral, technician or equivalent, including postgraduate students)

Of the 527 non-PI UK-based researchers, some 70% reported being less confident regarding their career in research, with only 5.5% feeling more confident since the last CSR. Most of this latter group ascribed their increased confidence to personal circumstances, while still identifying the funding climate as having a negative effect in their long-term ability to stay in academic research. This long-term worry was shared by 57% of survey respondents.

Many commenters displayed a lack of confidence in the future, thanks to issues of funding and limited career prospects. Concerns were also expressed regarding the poor career prospects of and long-term investment in the next generation of researchers.

"With the continuous cuts of funding for research I feel less and less attracted by a career in academia."

"Applying for a new job is now an annual exercise. Can't get any good science done on a one year contract."

"The funding climate and the general incoherence of the science career structure has increasingly lead to me believing I am rapidly approaching a career and wage dead end."

> *"I can no longer do the best experiment... I do the best experiment that we already have the materials for*

"Across science, whether academia, biotech or pharma [...] there are increasingly short

cycles of funding. With the complexities of modern science, this short-termist view leads to poorer capability to perform necessary scientific advancements."

"The increased lack of funding for early career scientists has increased instability, competition and uncertainty – is academia now a viable career option for my cohort? My colleagues are leaving the profession in droves and it is hard to justify not doing the same despite a great passion for scientific research."

The funding climate was identified by 58% (306 respondents) as a contributing factor to thoughts of leaving the UK to pursue a research career.

"Less money in the industry I want to remain in. The pharmaceutical companies are all leaving in droves, thus the UK is now becoming a poor place to carry out scientific research both in academia and even worse in private industry. An industry in decline, but should be booming..."

"Despite 10 successful years in research, due to the lack of jobs & funding I am planning to move on – either out of the UK or out of science altogether – within the next two years."

> ***"I am seriously considering not returning to the UK, unless the funding situation changes***

"In the UK in particular the prospects are definitely worse. In fact I am moving to the USA for a postdoc, and I am not setting my heart on coming back to the UK."

"The only way to continue my research career is to leave the UK. The USA and Australia are particularly attractive."

"I'm leaving the UK […] The lack of funding in the UK means lots of people aren't hiring and academics are stretched. The UK government has wasted money subsidising the university education of many science undergraduates and postgraduates who are largely either disheartened and not employed in science. For many of those employed in science they are now paying tax to foreign governments. The UK is exporting its scientists at a significant loss."

"I am a foreign/non-EU student, finishing my PhD this year. I find it increasingly difficult to get a post-doc job in the UK in spite of a successful PhD research project. Most PIs I have contacted across the UK feel helpless about the situation and cite "lack of funds and space" (to quote one of them) as a principal reason for not considering my application. In my present situation I feel it is comparatively easier to get post-doc funding in countries like India, Australia, Singapore and Japan. In spite of facing HUGE developmental challenges, governments in these countries realise the long term socio-economic benefits of scientific research and are committed to boost % GDP investment in the coming years. This is in stark contrast to the myopic view of the UK government that is bent upon driving competent and bright researchers out of the UK with its financial and (increasingly ineffectual & deluded) immigration policies."

"I am from China and my own country is offering more generous funding and better research environment. I am now considering leaving UK, and many other Chinese researchers are thinking the same."

"Although I have a research position, and several Post grad students, team of technical staff etc. I am currently looking for opportunities in Scandinavia or more stable economies."

"[CSR] made me more aware of opportunities abroad, including Asia. Starting to consider research places and science jobs in Asia. Less confidence in research funding and research prospects and possible discoveries in the UK."

Many researchers in laboratories across the country say that due to lack of funding they have to revert to outdated methods and techniques.

"...some experiments have had to go back to methods popular 20 years ago as we don't have the money to use current techniques"

> ***"The climate makes it very difficult to plan out a serious research path.***

"This has had a direct impact on the research which I have been able to undertake, reducing the amount of equipment and consumables to an almost unworkable level. It is not possible to undertake research 'on the cheap' as many of the pieces of equipment and consumables are very expensive."

"I can no longer do the best experiment to answer each question; I do the best experiment that we already have the materials for, or the cheap version of the 'best' experiment."

> *"I am from China and my own country is offering more generous funding and better research environment.*

"Unable to get equipment funding which means I have to spend out of my own pocket to travel 2+ hours to get use of a machine I need."

> *"I am now considering leaving UK, and many other Chinese researchers are thinking the same*

Active research group leader or other researcher, left the UK in the last 3 years

We received 4 replies from PIs, and 35 from active researchers at non-PI equivalent positions, who left the UK since the 2010 CSR. Despite being at different stages of their careers, they all moved to pursue an active research career. In this cohort, one PI moved from an academic to an industry position. The current funding climate was identified as a contributing factor by three-quarters of both PI and non-PIs.

"I moved to the UK in 2003, naturalized as a British citizen in 2009, and by 2011 I was job hunting. I ended up back in the US" [PI]

"After failed application for a BBSRC fellowship I decided to go to Switzerland to take a position with funding available" [PI]

"I had no desire whatsoever to leave the UK, but the only way I could pursue my career was to move abroad. Now I find myself 4,000 miles away and can only get home once or twice a year. It's lonely,

isolating and depressing. I'd move back in half a heartbeat if I could."

"I moved to another European country around 18 months ago and the difference in funding strategy was immediately apparent. In contrast to the UK (where I obtained my doctorate) I was not concerned by the level of either consumables funding or my personal fellowship, which was increased in the past 12 months. […] the level of research that I can conduct here means I am seriously considering not returning to the UK, unless the funding situation changes. I imagine many young British scientists feel the same way."

"Left the UK for the Baltic, primarily because of restrictive research funding, monstrous bureaucracy and increasingly bizarre funding agendas (e.g. 'impact'). Currently happily leading my own research project, funded for four years with good prospects. Given the state of UK research, I expect others will join me."

"I have left UK science and now work for a R&D based company in a competing country."

Former researcher (left research in the previous 3 years)

Of the 38 respondents who said they had left research since the 2010 CSR, 74% identified lack of funding as a contributing factor.

As in the other groups, the main concerns in the comments were funding and associated job security, no clear long-term investment, strategy and lack of opportunities.

"The lack of job security and funding in the UK made me unwilling to pursue further career opportunities..."

"A direct lack of funding results in lack of jobs. The academic funding structure is failing everyone. Both students and individuals wishing to follow such a career path."

"I now work in engaging academic researchers with industry and I am seeing a significant move towards utilising commercial funding streams. Such collaborations have some positive aspects, as it allows academics to work on applied problems close to commercialisation and both partners can benefit from the knowledge exchanged. However, the industrial supply is limited, particularly in tough economic times, and projects are specific rather than broad. There is also the risk that industry may soon perceive Universities as holding out the begging bowl rather than being constructive partners.

Government funding should facilitate and support both fundamental and applied research and the academics who are interested in doing either."

"Lack of science jobs in the UK mean more and more colleagues are retraining after PhD and postdocs in totally unrelated fields: childcare, physician, teacher, gym instructor, tree surgeon. Such a waste of scientific talent. I also fall into this category. Those that find jobs in science often have to emigrate. The life appears to be so much better abroad none of them show any inclination to return."

> ***"In spite of facing HUGE developmental challenges, governments in [other] countries realise the long term socio-economic benefits of scientific research and are committed to boost % GDP investment in the coming years***

Conclusions

Science is Vital recognizes that a successful UK science policy depends not only on funding, but also on productive interactions with policies on innovation, industrial development, education and immigration. We have not therefore attempted to produce a comprehensive analysis of the impact of the decline in UK spending on research and development since the 2010 CSR. Nevertheless, our survey has captured a valuable ground-level snapshot of the effects of the CSR on UK science over the past three years. The results provide serious cause for concern.

In both academia and industry, the majority of respondents reported a negative effect on the amount and types of research that they are able to carry out, and a decrease in their overall confidence in the future of science in the UK. Increasingly, UK-based scientists consider other countries such as the USA, China and Australia to be more attractive places in which to pursue research. The funding climate has induced some to consider leaving to UK, or to abandon research altogether. Some of these fears appear to be trickling down to the next generation of UK researchers, as highlighted by our youth focus group.

Our findings provide evidence that the declining spend on R&D has begun to erode the quality and quantity of UK research, a trend that can only continue if the present funding decline is not reversed. Therefore,

1. We call for a long-term commitment of scientific support by Government, eventually reaching a level of support comparable to 0.8% of GDP – the current G8 average. Such a commitment will allow for the long-term planning that is essential for strategic and intelligent scientific research.
2. In the short term, and with particular regard to the 26 June 2013 budget decision, we ask the government to reverse the decline in the UK science budget that it has overseen in the past three years, given how detrimental this survey suggests it has been to researchers at the coalface. A modest increase will be an important signal to the research and business communities that the UK is determined to to remain an internationally competitive, knowledge-based economy.

References

1. Adapted from UNESCO Institute for Statistics (UIS): http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=136, extracted retrieved 3 June 2013; and Scienceogram UK data, https://docs.google.com/spreadsheet/ccc?key=0AhGUIL_9zcIIdGdTUktxaS1qc1YxNUNZbVN3MFhjRUE, retrieved 12 June 2013.
2. "Which country has the best brains?" BBC News. 10 Oct, 2010. http://www.bbc.co.uk/news/magazine-11500373. Retrieved 3 June 2013.
3. The Scientific Century: securing our future prosperity. The Royal Society, 2010. http://royalsociety.org/policy/publications/2010/scientific-century/.
4. The economic benefits of publicly funded basic research: a critical review (2001). Salter, AJ and Martin, BR. *Research Policy*, Volume 30, Issue 3, pp 509–532.
5. Expenditures for R&D performed by universities are significantly positively related to business enterprise sector expenditures on R&D indicating that public sector R&D and private R&D are complements. Falk, M (2006) *Applied Economics*, 38, 533-547. http://martin.falk.wifo.ac.at/fileadmin/homepage_falk/files/Falk_2006_RAEF_A_139101.pdf. Retrieved 6 June 2013.
6. Main Science and Technology Indicators, OECD, 2013, http://stats.oecd.org/ Retrieved 6 June 2013.
7. Chemistry: We Mean Business: Creating growth by staying ahead in science (2013). Royal Society of Chemistry (UK). http://www.rsc.org/images/campaign_case_studies_tcm18-232087.pdf. Retrieved 6 June 2013.
8. Research investment welcome, but we need to aim higher. Campaign for Science and Engineering Blog. Beck Smith. 19 March 2013. http://sciencecampaign.org.uk/?p=12407. Retrieved 3 June 2013.
9. Public Funding of UK Science and Engineering – March 2013 update. Campaign for Science and Engineering. http://blog.sciencecampaign.org.uk/wp-content/uploads/2013/03/Public-Funding-of-UK-Science-and-Engineering-%E2%80%93-March-2013-update.pdf. Retrieved 3 June 2013.
10. Government R&D hit by disproportionate cuts. Campaign for Science and Engineering Blog. Beck Smith. http://sciencecampaign.org.uk/?p=11131. Published: 08/10/2012. Retrieved 3 June 2013.
11. Fuelling prosperity: Research and innovation as drivers of UK growth and competitiveness. Joint statement from the Academy of Medical Sciences, the British Academy, the Royal Academy of Engineering and the Royal Society. 22 April 2013. http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/publications/2013/2013-04-22-Fuelling-prosperity.pdf. Retrieved 2 June 2013.
12. The Government must increase funding for science and engineering in order to boost growth: 54 scientists call on the Government to increase research and development spending. *The Daily Telegraph.* 11 Mar 2013. http://www.telegraph.co.uk/comment/letters/9920713/The-Government-must-increase-funding-for-science-and-engineering-in-order-to-boost-growth.html. Retrieved 3 June 2013.

Appendix

Letter to the *Daily Telegraph*, 11 March 2013

(http://www.telegraph.co.uk/comment/letters/9920713/The-Government-must-increase-funding-for-science-and-engineering-in-order-to-boost-growth.html)

SIR – We urge the Government to demonstrate its long-term commitment to funding science and engineering as part of a strategy to boost growth and enable Britain to meet the social and technological challenges of the 21st century.

In 2010, the core research budget disbursed by the Department for Business, Innovation and Skills (BIS) was ring-fenced. However, the overall science budget has since been eroded by cuts in capital expenditure by BIS and to research and development in other departments, combined with the depreciating effect of inflation.

The Government has introduced some specific targeted funds since the 2010 settlement. These are welcome, but they only slow the reduction of scientific activity in Britain, when our economic competitors are boosting their research spending.

The Government understands that public funding of science is crucial to growth, but that understanding needs to be translated into sustained investment. It is vital that the policy of managed decline be reversed.

We call on the Government to increase research and development spending to at least 0.8 per cent of GDP – the G8 average – to enable us to compete more effectively with the leading economies of the world.

Signed

Dr Jennifer Rohn Chair, Science is Vital;
Professor Sir Andre Geim Nobel Laureate;
Professor Sir John Gurdon Nobel Laureate;
Professor Sir Tim Hunt Nobel laureate; **Dr Paul Nurse** Nobel Laureate;
Professor Venkatraman Ramakrishnan Nobel laureate;
Professor Sir John Walker Nobel laureate;
Professor Sir Martin Evans Nobel laureate;
Professor Stephen Hawking; **Professor Sir Roy Anderson**;
Professor Jim Al-Khalili; **Professor Alan Ashworth**;
Professor Frances Ashcroft; **Professor David Barford**;
Professor Sir David Baulcombe; **Professor Colin Blakemore**;
Professor Dorothy Bishop; **Professor Sir John Burn**;
Professor Jon Butterworth; **Professor Iain Campbell**;
Professor Nicky Clayton; **Professor John Collinge**;
Professor Brian Cox; **Professor Anne Dell**; **Professor Dame Kay Davies**;
Professor Dame Athene Donald; **Professor Eleanor Dodson**;
Professor Chris Frith; **Professor Jeff Errington**; **Professor Phil Evans**;
Professor Uta Frith; **Dr Matthew Freeman**;
Professor Sir Timothy Gowers; **Professor Peter Lawrence**;
Professor Xin Lu; **Professor Richard Morris**;
Professor Mark Miodownik; **Professor Dame Linda Partridge**;
Professor Laurence Pearl; **Professor Jordan Raff**; **Professor Martin Raff**;
Professor Martin Rees; **Professor Trevor Robbins**;
Professor Liz Robertson; **Professor Dame Carol Robinson**;
Professor Helen Saibil; **Dr Simon Singh**; **Professor Geoffrey Smith**;
Professor Brian Spratt; **Professor Dame Janet Thornton**;
Professor Gabriel Waksman; **Professor Sir Martin Evans**;
Professor Alan Baddeley; **Professor David Colquhoun**

Science is Vital