

30 September 2016

Royal Society response to the House of Commons Business, Innovation and Skills Committee inquiry into the Government's Industrial Strategy

Introduction

1. Outstanding research and innovation advance our economic, social and cultural well-being and our health. In modern economies, they are a key source of competitive advantage and can help increase productivity. The UK has created a world-leading research base, which provides the foundation for new ideas and discoveries, and fuels economic growth and the creation of high-value jobs and skills in our knowledge-driven economy. Research and innovation should be at the heart of the Government's Industrial Strategy.
2. The Royal Society is the National Academy of science in the UK. It is a self-governing Fellowship of many of the world's most distinguished scientists working in academia, charities, industry and public service. It draws on the expertise of the Fellowship to provide independent and authoritative advice.
3. Given the EU Referendum result, an industrial strategy cannot be developed in isolation of the wider political environment. The result of the EU Referendum presents a challenge. The UK National Academies have published a joint statement highlighting areas the Government should consider to ensure the UK's continued success¹.
4. Summarised below are some issues the Society believes the Committee may wish to consider in this Inquiry. These have been grouped under the following headings: the need for long-term investment; increasing productivity; supporting excellence across the UK; building up the national skills pipeline; attracting and retaining key talent; and increasing the UK's ability to identify and respond to new opportunities and challenges. References to more detailed positions are included throughout.
5. The Society has begun a programme of work to develop more detailed positions in this new political and economic context. We stand ready to advise and support Parliament and Government as the Industrial Strategy is developed over the coming months.

Long-term investment

6. To fully realise the economic and social benefits of research and innovation, the Government needs to provide a consistent policy and investment environment over time. Long-term timeframes are required to realise the full potentials of new scientific discoveries, whether that is bringing a new drug to market or developing technologies to meet challenges such as energy or climate change². It is important that new policies and programmes are robustly evaluated using long-term economic and social benefit metrics.
7. The commercialisation of research often takes many years and requires patient and sustained investment. With UK investors commonly expecting returns within two to five years, there is a financial returns timeframe mismatch between these expectations and what most products of research can deliver. For example, it typically takes 12 years to take a new drug from discovery to market authorisation. Meanwhile, 'flat cash' settlements over the last Parliament have meant

¹ The Royal Society, The Royal Academy of Engineering, The Academy of Medical Sciences, The British Academy, July 2016.

UK national academies joint statement on research and innovation after the EU Referendum.

<https://royalsociety.org/-/media/policy/Publications/2016/19-07-16-eu-referendum-statement.pdf>

² The Royal Society, The Royal Academy of Engineering, The Academy of Medical Sciences, The British Academy, February 2015. *Building a Stronger Future: Research, Innovation and Growth.*

<https://royalsociety.org/-/media/policy/Publications/2015/building-a-stronger-future-research-innovation-growth.pdf>

that the cumulative erosion of the ring-fenced science resource budget grew to over £1 billion. As budgets declined across government during the last Parliament, some departmental R&D budgets declined particularly steeply and disproportionately to other funding lines³.

8. It is vital that Government funding and policies effectively facilitates innovation and commercialisation. Tax-relief schemes such as the Enterprise and Seed Enterprise Investment Scheme (EIS and SEIS), Innovate UK grants, and procurement programme Small Business Innovation Research (SBIR) can separately and in combination support businesses throughout the research commercialisation pathway. The Society's response to this Committee's Access to Finance Inquiry provides detailed recommendations on what further measures the Government could consider to ensure great British discoveries and innovation translates into economic benefits for the UK⁴.
9. Industry funds 48 per cent of R&D in the UK, more than double the Government's contribution⁵ (see Annex). Compared to OECD countries with a similar economic profile, the UK ranks last in both Government and industry investment in research and development (see Annex). As we have previously stated, the Royal Society believes the Government is underinvesting in R&D, and should at least match the OECD average of 0.67% of GDP by 2020⁶. It should also seek to create an environment that attracts more industrial and charitable investment. Closing the investment gap with other knowledge economies will help build an environment in which research and ideas will prosper and our country flourish⁷.
10. EU research programmes have been a significant and growing contributor to UK research. In Framework Programme 7 from 2007-13 the UK received €6.9billion and is a net beneficiary from EU research programmes⁸. The Society has welcomed the Government's announcement that it will underwrite the value of any European grants awarded to UK researchers for the full award period⁹. Urgent discussions are still needed on how to address any funding gap in the longer term, as unpredictable funding risks internationally mobile researchers, companies and capital switching country or sector¹⁰.
11. However it is not only the scale of EU funding that is significant, but also the intrinsically collaborative nature of EU programmes that allow UK researchers to achieve more than they

³ The Royal Society, September 2015. *Investing in the UK's intellectual capital*.

<https://royalsociety.org/~media/policy/Publications/2015/09-15%20Spending%20review%20representation%20-%20the%20Royal%20Society.pdf>

⁴ The Royal Society, February 2016. *Royal Society response to the BIS Select Committee inquiry on Access to Finance*. <https://royalsociety.org/~media/policy/Publications/2016/02-10-16-royal-society-response-to-the-bis-select%20committee-inquiry-on-access-to-finance.pdf>

⁵ ONS, 2014. *UK Gross domestic expenditure on research and development: 2014*.

<http://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/ukgrossdomesticexpenditureonresearchanddevelopment2014>

⁶ The Royal Society, September 2015. *Investing in the UK's intellectual capital*.

<https://royalsociety.org/~media/policy/Publications/2015/09-15%20Spending%20review%20representation%20-%20the%20Royal%20Society.pdf>

⁷ The Royal Society, September 2015. *Investing in the UK's intellectual capital*.

<https://royalsociety.org/~media/policy/Publications/2015/09-15%20Spending%20review%20representation%20-%20the%20Royal%20Society.pdf>

⁸ For more information, please see our report: "UK research and the European Union The role of the EU in funding UK research", December 2015. <https://royalsociety.org/~media/policy/projects/eu-uk-funding/uk-membership-of-eu.pdf>

⁹ Royal Society, August 2016. *Royal Society response to guarantees on EU grant funding*.

<https://royalsociety.org/news/2016/08/royal-society-response-to-guarantees-on-eu-grant-funding/>

¹⁰ The Royal Society, September 2015. *Investing in the UK's intellectual capital*.

<https://royalsociety.org/~media/policy/Publications/2015/09-15%20Spending%20review%20representation%20-%20the%20Royal%20Society.pdf>

would alone. Similarly, these programmes provide opportunities for industrial competitors to collaborate with each other and work together towards common goals, often for societal benefit. For the UK to remain world-leading, it is essential that the Government appropriately addresses the international dimensions of research and innovation within the new political landscape. A long-term Industrial Strategy could drive confidence in UK PLC, attracting investment in infrastructure, industry, and talent.

Increasing productivity

12. Research creates new knowledge and technological innovations, which can improve productivity by supporting the development of new processes and approaches. Evidence shows that 51% of UK productivity growth between 2000 and 2008 was due to innovation, with 32% attributable to changes in technology resulting from science and innovation¹¹. The government has done much to support specific sectors, such as aerospace and manufacturing. It is equally important that the role of enabling platform technologies, such as data and software, as well as infrastructure, talent and expertise that cut across disciplines, industries and sectors is recognised and supported.

Supporting excellence across the UK

13. There are opportunities for research funders, institutions, cities and businesses to work together to cluster facilities and expertise and embed strategically important research networks across the UK. However, if UK funding becomes increasingly regionalised, the risk of duplication and unhelpful competition grows. Aligning the planning and resourcing of science and regions could help turn regions into hubs of excellence with distinctive opportunities for growth¹².
14. The UK public landscape for research, higher education and innovation is currently undergoing major reforms at a national level. Under the right leadership and strategic direction, the proposed creation of UK Research and Innovation (UKRI) offers opportunities to make more efficient and strategic investment in national research programmes and capabilities. This could help address disconnects between capital investment and funding for operational costs (the “batteries not included” problem), which has led some publicly funded research facilities not being used to full capacity due to shortfalls in the budget available to cover running costs.
15. Excellence should generally be the primary criterion for research funding but there is also the need for approaches that allow the development of capacity building in areas of national strategic importance, such as defence and energy, so our ability to respond to new developments is increased.

Education and skills

16. The future strength of the UK economy will depend on a strong supply of skilled workers, particularly in the STEM sector.
17. In its “Vision for Science and Mathematics Education” report, the Society made a number of recommendations that would build up the UK’s essential STEM skills pipeline at school level. These include: compulsory mathematics and science education up to the age of 18; supporting excellent teaching through continuous monitoring and updating of the curricula by subject experts; addressing the shortage of STEM teachers¹³; improving STEM career awareness and guidance; reviewing assessment and accountability measures for students, teachers, and

¹¹ The Royal Society, September 2015. *Response to the Business, Innovation and Skills Committee’s inquiry on the Productivity Plan*. <https://royalsociety.org/~media/policy/Publications/2015/10-09-15-hoc-bis-productivity-plan.pdf>

¹² The Royal Society, May 2016. *Response to the Department for Business, Innovation and Skills call for evidence for the National Innovation Plan*. <https://royalsociety.org/~media/policy/Publications/2016/05-27-16-response-to-BIS-survey-on-the-national-innovation-plan.pdf>

¹³ The Royal Society, November 2016. *Consultation response to Migration Advisory Committee call for evidence to inform their ‘Partial review of the Shortage Occupation List: Teachers’*. <https://royalsociety.org/topics-policy/publications/2016/consultation-response-MAC-teacher-supply/>

education systems; improving the collection and use of high-quality evidence in education policy¹⁴.

18. The Society's response to the higher education, research and innovation reforms further recommends that links between teaching, research, and industry should be strengthened. Strategic collaboration between higher education providers and research and industry partners would help students develop key skills and better equip graduates for employment¹⁵.
19. Furthermore, education providers should recognise the importance of supporting personal development as crucial in a world where individuals have portfolio careers, and where many post-graduate students choose to pursue careers outside of academia¹⁶,

Talent

20. Following the referendum result to leave the European Union, it is essential that UK immigration policies and rules support the mobility of skilled people¹⁷. The immigration system should support all relevant types of mobility from recruitment to permanent positions, short visits, studentships, exchanges and support for emergency responses. UK industry and academia must be able to compete to attract the people they need from the global talent pool, from the brightest young researchers through to world-leading experts, as well as those with technical skills that are crucial to the health of the research and innovation system.

Knowledge exchange and interdisciplinary challenges

21. Applied investigation and discovery research feed off each other, and need effective flows of ideas and people between academia and industry. Encouraging and supporting knowledge exchange between industry, academia, and the public sector will be essential to enabling the translation of knowledge into economic return and social good. Bringing Innovate UK together with the Research Councils as part of UKRI could catalyse the development of programmes and practices that facilitate more effective interactions between business and the research base and between disciplines and sectors. However, for these benefits to be delivered, it is essential that Innovate UK's unique business-facing focus and links to its customer base are not put at risk¹⁸.
22. As the UK faces ever more complex global societal and research problems, interdisciplinary working will be key to developing effective solutions. The creation of UKRI offers opportunities to deal better with cross-cutting issues and increase appropriate support for interdisciplinary research¹⁹.

Emerging technologies

¹⁴ The Royal Society, June 2014. *Vision for science and Mathematics Education*.

<https://royalsociety.org/~media/education/policy/vision/reports/vision-full-report-20140625.pdf>

¹⁵ The Royal Society, September 2016. *Reforms to the UK higher education, research and innovation system*.

<https://royalsociety.org/~media/policy/Publications/2016/position-on-reforms-to-UK-higher-education-research-innovation-reforms-september-2016.pdf>

¹⁶ The Royal Society, September 2016. *Reforms to the UK higher education, research and innovation system*.

<https://royalsociety.org/~media/policy/Publications/2016/position-on-reforms-to-UK-higher-education-research-innovation-reforms-september-2016.pdf>

¹⁷ For more information, please see our May 2016 report. *UK research and the European Union: The role of the EU in international research collaboration and researcher mobility*. <https://royalsociety.org/~media/policy/projects/eu-uk-funding/phase-2/EU-role-in-international-research-collaboration-and-researcher-mobility.pdf>

¹⁸ The Royal Society, September 2016. *Reforms to the UK higher education, research and innovation system*.

<https://royalsociety.org/~media/policy/Publications/2016/position-on-reforms-to-UK-higher-education-research-innovation-reforms-september-2016.pdf>

¹⁹ The Royal Society, September 2016. *Reforms to the UK higher education, research and innovation system*.

<https://royalsociety.org/~media/policy/Publications/2016/position-on-reforms-to-UK-higher-education-research-innovation-reforms-september-2016.pdf>

23. The Society has undertaken work on a number of new technologies. This includes cybersecurity²⁰, data governance²¹, machine learning²², and genetically modified plants²³, and a major series of conferences on breakthrough science and technology²⁴.
24. Key messages from this work have included:
- Stable and joined-up funding from government and research councils.
 - The need for test-beds and assets at scale to appropriately test new technologies in “real-world” environments²⁵.
 - The growing importance of data in industry to support decision making and inform the development of new technologies. The need for skilled data professionals and appropriate governance that balances supporting innovation while maximising public benefit.
 - The need to consider and address the impact of new technologies on the workforce, and implications for education and training.
25. As new technologies emerge, the scientific community will play a vital role in helping policy makers clarify to what extent existing regulations apply and where new regulations are required. To prevent regulation acting as a barrier to applications that have public support, it is essential that legislation regulating the research and innovation sector is designed to respond effectively to future challenges and account for fast developing technologies. For example, the British Academy and the Royal Society are conducting a rapid review of the implications of data-driven technologies such as machine learning, and making a holistic consideration of the governance landscape, in order to make recommendations for data governance arrangements that can ensure the UK remains a world leader in digital technologies and data science. Research funders should increase horizon scanning of UK and international science to identify areas of discovery research which could be developed in the UK²⁶.
26. The common rules and standards of regulations across the EU provide a strong platform for the exchange of people, ideas and data for research. A movement away from common rules may increase the time and cost to UK research, scholarship and innovation. It is critical that we identify those areas of regulation where alignment with EU rules is most important for the UK’s competitiveness, and that UK experts remain fully engaged in shaping the development of standards and regulations²⁷.

For further information, please contact Becky Purvis, Head of Public Affairs on becky.purvis@royalsociety.org

²⁰ The Royal Society. “Progress and Research in Cybersecurity”. <https://royalsociety.org/topics-policy/projects/cybersecurity-research/>

²¹ The Royal Society. “Open science and data”. <https://royalsociety.org/topics-policy/open-science-and-data/>

²² The Royal Society. “Machine Learning”. <https://royalsociety.org/topics-policy/projects/machine-learning/>

²³ The Royal Society. “Genetically modified (GM) plants: questions and answers”. <https://royalsociety.org/topics-policy/projects/gm-plants/>

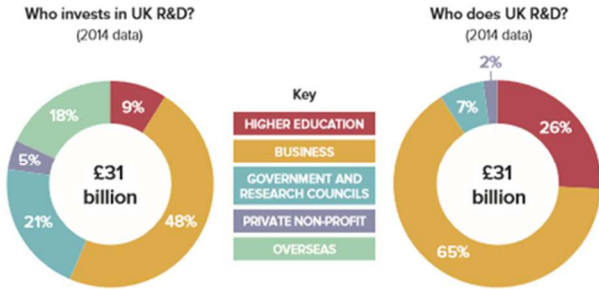
²⁴ The Royal Society. “Breakthrough science and technologies: Transforming our future”. <https://royalsociety.org/topics-policy/industry-innovation/transforming-our-future/>

²⁵ Royal Society, July 2016. *Consultation response: UK testing ecosystem for connected and autonomous vehicles*. <https://royalsociety.org/-/media/policy/Publications/2016/07-29-16-royal-society-consultation-response-on-UK-testing-ecosystem-for-connected-and-autonomous-vehicles.pdf>

²⁶ The Royal Society, September 2015. *Investing in the UK’s intellectual capital*. <https://royalsociety.org/-/media/policy/Publications/2015/09-15%20Spending%20review%20representation%20-%20the%20Royal%20Society.pdf>

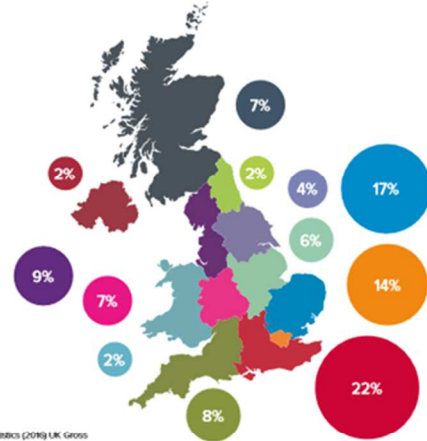
²⁷ To find out more, please see our report, April 2016. *UK research and the European Union: The role of EU regulation and policy in governing UK research*. <https://royalsociety.org/-/media/policy/projects/eu-uk-funding/phase-3/EU-regulation-and-policy-in-governing-UK-research.pdf>

Who invests in UK R&D



Note that figures are rounded.

Where is R&D investment made in the UK?

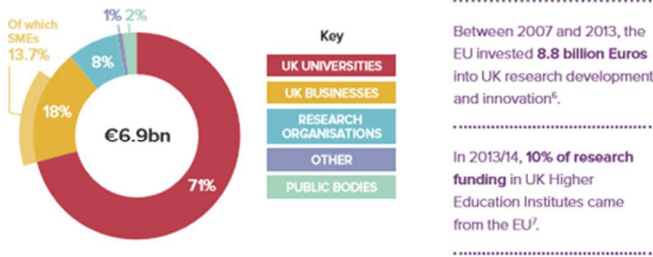


Office of National Statistics (2019) UK Gross Domestic Expenditure on R&D 2014.

How much does the EU invest in UK R&D?

The UK currently has 15% of all awarded grants in Horizon 2020 – the current EU research funding programme – the largest share among participating countries⁴.

Who receives EU research funding? (distribution of Framework Programme 7, 2007 – 13, in the UK)⁵

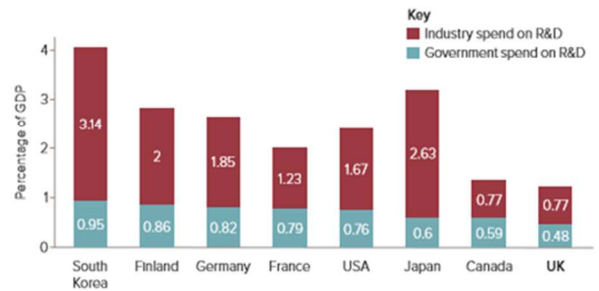


Between 2007 and 2013, the EU invested **8.8 billion Euros** into UK research development and innovation⁶.

In 2013/14, **10% of research funding** in UK Higher Education Institutes came from the EU⁷.

4. European Commission (2018) Horizon 2020: First Results.
 5. European Commission (2018) Seventh FP7 Monitoring Report 2012.
 6. European Commission (2018) Seventh FP7 Monitoring Report 2012.
 7. European Commission (2018) Cohesion Policy Data.
 7. Royal Society (2018) UK research and the European Union – the role of the EU in funding UK research.

How does UK investment in R&D compare globally?



Reference: OECD Main Science and Technology Indicators 2018.