The Relationship between EU Membership and the Effectiveness of Science, Research and Innovation in the UK

A response from the Royal Society of Biology to the House of Lords Select Committee on Science and Technology

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The Royal Society of Biology is a single unified voice, representing a diverse membership of individuals, learned societies and other organisations. We are committed to ensuring that we provide Government and other policy makers, including funders of biological education and research, with a distinct point of access to authoritative, independent, and evidence-based opinion, representative of the widest range of bioscience disciplines.

The Society welcomes the House of Lords Science and Technology Select Committee consultation on The Relationship between EU Membership and the Effectiveness of Science, Research and Innovation in the UK. We are pleased to offer these comments which have been informed by specific input from members and Member Organisations from across the biological disciplines.

Executive Summary

i. EU science and innovation funding streams and mechanisms have been beneficial for UK bioscientists and for bioscience infrastructure. EU funding is competitively awarded and the UK performs well receiving 15% of funds across recent Framework Programmes (FPs). UK research income from the EU averaged €1bn per year in FP7, equivalent to about 15% of the national science budget at current exchange rates. Horizon 2020, the largest ever EU research FP with a budget of €74.8bn, aims to remove innovation barriers and ensure that Europe produces world-class science across public and private sectors. EU funding is deemed increasingly important and complementary to UK research funding. EU funds support some long-term research and the management of larger scale projects and are particularly important for fundamental research.

ii. The UK contributes to the total EU budget in proportion to its share of EU GDP. On a net basis the UK is the fourth largest contributor to the EU budget (behind Germany, France and Italy). Allocation of the UK budget contribution specifically to Science R&D is not easy to quantify. Should the UK leave the EU there is no guarantee that the same funds currently allocated to the R&D budget would be allocated back to the national R&D budget. If the allocation was less than currently earned this would be a significant risk to the research community and innovation landscape.

iii. As a member of the EU the UK benefits from the free movement of researchers across borders enabling easier connection and collaboration. Working across the EU facilitates shared knowledge, infrastructure and resources, allowing UK scientists to utilise facilities not otherwise available. The mobility of researchers enables the UK to freely recruit and hire the best researchers on an international scale. EU researchers are in some cases able to provide specialist skills that are not readily available in the UK. If unable to do this then the maintenance of UK scientific research excellence is likely to be inhibited. Researchers reported little doubt that the UK innovation landscape is influenced by the networks and access to EU researchers facilitated by EU membership. International collaborations enable countries to achieve in ways not possible at national level, providing opportunities to address and answer international questions at an appropriate scale. A key motive for researcher participation in EU funding programmes was access to researcher networks, extending their knowledge base and accessing essential scientific skills and capabilities.

iv. The UK's position as a leading research nation within the EU makes it attractive to external collaborators and business partners seeking a European gateway. The UK has taken a leading role in projects such as the European Molecular Biology Laboratory/European Bioinformatics Institute (EMBL-EBI) and European Life-Science Infrastructure for Biological Information (ELIXIR), based in Cambridge. Access to EU Infrastructure and Networks offers pan-European platforms for education and training. UK researchers recognise the requirement for funding of large Research Infrastructure (RI) projects on a European basis.

v. EU legislation aims to support a parity of standards, enabling cross border cooperation for science projects. Directives can provide a framework to prioritise applied research, offering guidelines as to why research should be conducted and benchmarks to facilitate study design; therefore increasing the impact of research. The UK has played a leading role in shaping EU directives and harmonisation with national policies removes competitive disadvantage and facilitates easier collaboration. However, the evolution of directives is challenging.

vi. The EU has recently established the Science Advice Mechanism (SAM) which is now beginning to function. The societal impact of science demands that independent scientific advice be available to the EU and its member states.

vii. The questions posed in this inquiry act as an effective framework to gather information and inform discussion about the UK's relationship within the EU and the impact this has on the bioscience sector. However, in addition to the focus they bring on the financial assessment of research funding, its regulation and use, it is essential that the debate includes the many other broad and important qualitative aspects of EU membership that are more difficult to measure in quantitative terms.

Response to consultation questions

Funding

Q1. What is the scale of the financial contribution from the EU to science and research in the UK? How does the financial contribution the UK receives compare with other member states in terms of, for instance, population, GDP, scientific strength or any other relevant indicators?

1. EU funds are competitive and the UK competed well receiving on average between 14.2 and 15.9% of Framework Programme (FP) funds across FP5-7[1]. The UK ranked second behind Germany in terms of successful receipt of total FP7 EU funds[2]. In 2014 (Horizon 2020) the UK reversed this and secured 15% of EU research and development (R&D) funds (vs 10% for Germany); more than double the EU average[3]. With regards to R&D and innovation budgets the UK performs relatively well among our comparator nations (Germany, France etc.)[4]. The UK performs better than predicted by its population total, gross expenditure on R&D (GERD) or its number of full-time equivalent researchers (FTE researchers), but less well than predicted by its share of EU GDP. This latter statistic is similar for Germany and other large EU member states which also under-receive on this measure. However, relative UK performance has improved between FP6 and FP7, with UK funding share rising from 7% to 1% below expected levels[5].

2. UK Universities in particular show a strong orientation towards and success in competitive funds and have performed well[6] representing >20% on average of a large study sample of recipients of European Research Council (ERC) grants (2007 – 2014)[7]. UK research income from the EU averaged €1bn per year in FP7, equivalent to about 15% of the national science budget at current exchange rates[8]. In all funding programme areas with a strong science component, including the ERC, Life Sciences, Marie Skłodowska-Curie and Research Infrastructure (RI) funding the UK research community secured close to double the expected share of total EC income based on the size of the UK economy[9].

3. EU bioscience funds have steadily increased in successive FP budgets[10]. Approximately 40% of the UK FP7 competitive science funding was awarded to the biosciences, receiving €2.9 bn to fund over 2,000 projects. Natural and life science projects (encompassing food and agriculture, evolution and ecology, climate change and environmental challenges) received 30% of these awards[11]. The UK led coordination of 20% of the grants awarded in FP5-6. The UK therefore participates in and coordinates a high proportion of the health-related projects by comparison with other EU members[12].

4. Funds are also received through Life Science Infrastructure and Marie Skłodowska-Curie Scholarships; with UK life sciences, genomics, and biotechnology and sustainable development named as some of the most

[1] The impact of the EU RTD Framework Programme on the UK, (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 27)
[2] Creating the Future a 2020 Vision for Science & Research: A Department for Business Innovation and Skills Consultation on Proposals for Long-Term Capital Investment in Science & Research (2014) (pp 32-33)
[3] EU budget at a glance: "In 2014 the UK received €6.98 billion in EU funding. Of this, €3.95 billion, or 57%, went on farm spending, which is above the EU average of 42%. Regional policy accounted for €1.72 billion (25%), well below the EU average of 42%. Research and development accounted for €1.02 billion (15%), more than double the EU average of 7%. In 2014 Germany received €11.48 billion in EU funding. Of this, €6.15 billion (54%) went to agriculture, well above the EU average of 42%. Regional policy accounted for €3.54 billion (31%), below the EU average of 42%, but nonetheless a significant share for an "old" member state. Research and development took €1.13 billion (10%), slightly more than the EU average (7%)."(accessed 13/11/15)
[4] The impact of the EU RTD Framework Programme on the UK, (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 28)
[5] The impact of the EU RTD Framework Programme on the UK, (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 28)
[6] European university funding and financial autonomy (EUR 24761 EN – 2011): A study on the degree of diversification of university budget and the share of competitive funding (p 1, pp 13-14)
[7] European Research Council Statistics Country of Host Institution per Year (accessed 03/11/15)
[8] Overview of EU funds for research and innovation (2015), European Parliamentary Research Service
[9] The impact of the EU RTD Framework Programme on the UK, (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 2)
[10] Budgets:30 years of EU Investment in Research and Innovation (accessed 07/10/15)
[11] European Research Council Statistics Country of Host Institution per Domain (accessed 03/11/15)
[12] An analysis of subject areas and country participation for all health-related projects in the EU's FP5 and FP6 programmes (2013) Galsworthy *et al, European Journal of Public Health*, 24;3, 514–520 (pp 515-16)

significant areas to receive funding in terms of volume[13]. The European Regional Development Fund (ERDF) Convergence funding has had a big impact upon the environmental biosciences at the University of Exeter's Penryn Campus. The funding supported the development of the Centre of Ecology and Conservation and the Environment and Sustainability Institute, providing undergraduate and postgraduate course infrastructure, lectureships and research positions. The EU investment bank can also fund loans for science and research projects on a project-by-project basis[14].

5. Whilst the UK science budget has remained ring-fenced, and reduced in real-terms, EU funding received by the UK has risen. Case studies indicate EU funding is therefore increasingly important and a complementary component to UK research funding. This is believed to be particularly important for fundamental research within the context of a perceived focus on applied research across UK funding. For Government Research Institutes that cannot access UK Research Council (RC) funds, EU research funding is critical. FP funding has in some cases crucially supported the national capability in areas not well covered by UK national funds; and some researchers[15] rely heavily on EU and other non-national funding sources[16].

Q2. What is the scale of the financial contribution from the UK to the EU that supports science and research activities?

6. The UK contributes to the total EU budget in proportion to its share of EU GDP. On a net basis the UK is the fourth largest contributor to the EU budget (behind Germany, France and Italy)[17]. Allocation of the UK budget contribution specifically to Science R&D is not easy to quantify.

7. At present the UK invests in science and research at a lower rate than many of our competitor countries in terms of percentage of national GDP. The UK spend is below the average for EU and Organisation for Economic Co-operation and Development (OECD) countries[18].

Q3. What is the effectiveness and efficiency with which these funds are managed in the EU compared to the management of science funding in the UK? Particularly, when administrative overheads, quality of decision-making and advisory processes are considered?

8. UK Government and EU research funding streams are not readily comparable. EU funds are managed across many large scale projects and therefore incur increased administrative burden. The ERCs decision-making, allocation of funds and advisory processes are in outline similar to those of the UK RCs and similar national bodies. These frameworks therefore operate relatively effectively. The streamlining of Horizon 2020 protocols may encourage more applications from UK scientists.

9. The perceived link between EU-level spending on research and innovation and growth-enhancement in the eyes of a number of participants and analysts is noted in the BIS report on the balance of competencies relating to research and development[19]. A target spend of 3% GDP on R&D was officially adopted by the ERC

[13] The impact of the EU RTD Framework Programme on the UK, (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (pp 2, 26–27, 30-31)
[14] Creating the Future a 2020 Vision for Science & Research: A Department for Business Innovation and Skills Consultation on Proposals for Long-Term Capital Investment in Science & Research (2014) (pp 33-34)
[15] A selection of bioscience research topics reported to be missing from, or insufficiently addressed by, the UK's national research funds: Agricultural research in developing countries, Fisheries genetics/ biodiversity/climate change, Low input agricultural systems for developing countries, Microbiological aspects of food safety, Multi-disciplinary approaches to medical interventions, Multi-sectoral climate change impacts within ecosystems, Plant cell wall research, Plant health policy e.g. Control of non-statutory diseases, Prion diseases, Genomics for Sustainable Animal Breeding, Global monitoring for environment and security, Infectious disease networks, Soil Sensing; Robotics in Agriculture, Sustainable energy technologies, Telomerase/telomere research (cancer and ageing) The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (pp 58-59)
[16] The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 2)
[17] How does the UK contribute to the EU budget? (accessed 13/11/15)
[18] Campaign for Science and Engineering: Spending Review Representation (2015) (p 9)
[19] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (p 35)

in 2002. However this has not yet been achieved; in 2002 spending was at 1.9% GDP having only risen to 2% by 2013[20]. To achieve the target, greater investment in or reallocation of the EU budget will be needed.

10. EU policies relating to research funding programmes decide many of the priorities and general research agendas for the wider community and are therefore regarded as important to UK researchers; particularly in the fields of environmental sciences and ecology. EU grants often incorporate within their budgets capacity for management costs and overheads to support applications and reporting. Marie Skłodowska-Curie Fellowship grant schemes provide guidance for management of the grant relating to finances and training deliverables without directing scientific output. UK Institutions' research and enterprise offices aid and guide applicants for these external grants, highlighting the importance placed upon securing EU funding.

11. Long-term (5-year) support is offered by ERC fellowships for both early career researchers and professionals in areas of environmental and ecological sciences that do not have equivalent opportunities in UK funding. Researchers report to us that these EU funds therefore allow researchers to build their own groups and tackle in-depth questions. ERC flexibility in grant programmes is reported as particularly welcome by the scientific community[21]. UK funding has been assessed by some as short term and therefore the balance of EU funds offers more opportunity and scope. High-risk funding is not easily available through either EU or national funding streams[22].

12. Researchers expressed that UK RC funds are easier for recipients to administer than EU funds. Conversely EU funding was seen as more attainable, especially for early career researchers. Overall, the competitive nature of funding applications in the EU and the UK ensures that the best research is funded for the right purposes and there is recognition that national funding schemes are also subject to regulations and requirements. The collaborative nature of EU funded projects promotes a skilled and accessible workforce that demonstrates efficiency in spending.

13. Should the UK leave the EU there is no guarantee that the same funds currently allocated to the R&D budget (from the UK contribution) would be allocated to the national R&D budget[23]. Allocation of less than is currently earned would be a significant risk to the research community and innovation landscape.

Collaboration

Q4. What are the benefits to UK science and research of participation in EU collaborations and funding programmes such as Horizon 2020 and the European Research Council?

14. Collaborations across the EU demonstrate the international reach of UK science. EU programmes involve a wider community of science and practice than is common in UK RC programmes. The scale and ambition of EU projects is reported as much higher (with upwards of 10 - 20 interdisciplinary partners across EU countries). EU collaborations can therefore help to create the environment for more applied bioscience innovation with some of the best minds in Europe able to engage with UK science. International collaboration provides an invaluable resource in building the effectiveness of science, research and innovation in the UK. The House of Lords European Union Committee reported that EU R&I programmes represent an excellent financial and networking opportunity for UK businesses as well as higher education institutions[24].

15. The EU is a world leading knowledge block; through membership the UK can influence this knowledge and in turn draw strength from it[25]. The diversity of member states is a resource for researchers across the EU and provides a broad range in perspective and approach. Interdisciplinarity and multicultural participation is essential when addressing societal issues in Europe. Scientific discovery and technology are often a

[20] Campaign for Science and Engineering: Spending Review Representation (2015) (p 25)
[21] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (pp 34-35)
[22] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (pp 28, 31,33)
[23] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (p 28)
[24] House of Lords European Union Committee, The Effectiveness of EU Research and Innovation Proposals (2013)
[25] Dame Julia Goodfellow speaking at Universities for Europe launch (accessed 07/10/15)

component of these issues; and innovation and implementation of solutions requires societal adoption. The EU R&D funding programmes not only enable multidisciplinary research but also the free movement of researchers across member states.

16. By supporting collaboration and breaking down international barriers the EU facilitates cutting edge research, enhancing UK global influence. Collaboration breeds further collaboration and Horizon 2020 offers funding opportunities for large scale collaborations as well as more blue-sky research. The benefit of EU funding extends beyond monetary worth and is valued by our researcher community as facilitating the UK innovation landscape.

17. International collaborations enable countries to achieve in a way not possible at the national level[26], providing opportunities to address and answer international questions at an appropriate scale. The EU research landscape contains an enlarged pool of world-class researchers beyond that available nationally[27,28]; the UK must operate in this arena to maintain momentum as a leading research base. International collaboration can lead to more robust scientific output with demonstrable scientific impact[29]; it has been asserted that a quarter of REF (the UK Higher Education Research Excellence Framework) submissions drew upon EU partnerships[30]. Facilities can be shared and there is greater access to resources, thereby adding strength to UK research and innovation in bioscience. Ninety percent of researchers agreed a key motive for participating in funding programmes was access to European networks, extending their knowledge base and accessing essential scientific skills and capabilities[31]. The coordination of complementary researcher skill-sets between those that would otherwise not have collaborated is possible, and has demonstrated successful outcomes.

18. Marie Skłodowska-Curie funding develops international experiences and collaborations, also providing funding for the Institutions that host these research activities. ERC awards allow collaborative exploration into new fields of fundamental research. European Cooperation in Science and Technology (COST) also provides collaboration opportunities for those who can't access Horizon 2020 funds; this is not restricted to EU member states but complements EU Programmes to bridge COST-inclusive countries, and supports increasing researcher mobility across Europe[32].

19. Non-member states can incur considerable difficulties when applying for EU scientific grants. Following the Swiss adoption of the mass immigration limitation initiative in 2014 they now only have partial association with Horizon2020 (as an industrialised third country). Under the scientific excellence pillar Swiss researchers can apply for ERC grants, Marie Skłodowska-Curie Actions, Future and Emerging Technologies (FET) and RI (subject to change in 2017 to prevent participation[33]). However under the Industrial Leadership and Societal Challenge pillars, Swiss researchers are not entitled to EU funding, and cannot be counted toward the required minimum three research partners from different EU member states or associated countries. SMEs cannot participate[34]. If collaborative projects are EU funded, Swiss partners must apply for their funding from the Swiss State Secretariat[35].

[26] Chuka Umunna MP speaking at Universities for Europe launch (accessed 07/10/15)
[27] The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 4)
[28] A selection of bioscience research areas where respondents believe FP activities have strengthened previously weak UK capabilities: Health related systems biology, hypothesis free research of high impact which is completely ignored in the UK, Gene and genetic therapies; rare diseases, In vitro protein synthesis in the UK was relatively weak, Molecular diagnostics, Cellular engineering approach for cancer, I have been impressed with FPs in that they are often ahead of the curve in terms of funding areas with a lot of potential. The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (pp 58-59)
[29] Collaboration: Strength in diversity (2014) Freeman and Huang. *Nature News.* 513 p 305
[30] Professor David Richardson speaking at Excellent Research in the UK: Do we need the EU? (accessed 07/10/15)
[31] The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (pp 3-4)
[32] COST Countries (accessed 27/10/15)
[33] The Partial Association of Switzerland in Horizon 2020, EU Research: Swiss Guide to European Research & Innovation
[34] Fact Sheet on the Status of Switzerland in Horizon 2020, EU Research: Swiss Guide to European Research & Innovation
[35] Swiss Transitional Measures for Horizon 2020, Funding of Swiss partners (accessed 10/11/15) The Swiss Government is required to finance Swiss inclusion in collaborative projects with other EU nations, this may be the case for future UK collaborations with EU member states if the UK were to leave the EU.

Q5. What is the influence of EU membership on bilateral collaboration between the UK and other EU member states? Are collaborations with member states stronger than with non-EU countries as a result of EU membership? Or, are bilateral collaborations with member states inhibited by requirements to work through EU mechanisms?

20. UK collaborations between EU and non-EU partners have increased with the UK only choosing to engage in initiatives when they represent a good opportunity for the UK[36]. Within the EU the free movement of researchers enables ease of connection and collaboration.

21. The UK is involved in a number of international groups that discuss the priorities and proposals for long-term, large-scale, strategic international collaborations in science and research. Both EU and non-EU countries participate in the G7, the European Strategy Forum on Research Infrastructures (ESFRI)[37], OECD[38] and the Consultative Group on International Agricultural Research (CGIAR)[39] amongst others. EUREKA[40] is a predominantly European initiative, but not an EU one, within which an intergovernmental network coordinates national funding for innovation. These programmes enable agreement on joint research priorities, leading to coordination of investment amongst international partners[41].

22. The UK is a leading research nation within the EU, and as a member, the UK can compete globally with larger states. Opinions suggest that the UK gains advantage as the gateway nation to international collaborations between English speaking countries and the EU. Many UK research programmes alone could not recruit global participation on such a large scale. An additional benefit is the opportunity to showcase UK research excellence across networks that extend beyond UK and even EU.

23. Selected research themes within EU programmes facilitate strengthened EU collaborations and can produce research of improved quality. Outside these programmes, collaborations within the EU are more easily facilitated than with non-members, due to transnational funding mechanisms. EU research programmes can provide funding for collaboration beyond the EU, with USA, Russia, Australia and Eastern economies able to participate on an opt-in basis; these collaborations are subject to bilateral agreements[42]. Some international collaborations allow the establishment of links but do not tend to fund the research; whilst travel and exchange visits may be compensated, researcher salaries are not, whereas this is possible through EC funding. Where transnational funding streams do not exist collaborators must apply for local funding as part of joint research projects.

24. EU funding support is as wide-ranging as UK national funding, and can in addition significantly address gaps in the national provision. The UK domestic portfolio of international projects is considerably outweighed by EU funded international projects; owing to the greater availability of large-scale project funds from the EU[43]. EU funding mechanisms simplify process in some cases; dealing with a single entity avoids reliance on a combination of in-country funding mechanisms and renegotiations of contracts and intellectual property (IP) between collaborators[44]. Member states outside the EU encounter considerable difficulties with joint applications for EU grants; it is reported that these collaborative applications are subject to considerable preparative paperwork and bureaucracy.

25. There is a contrary view that collaboration between UK and EU research groups would still occur regardless of EU membership, owing to the strong scientific merit of the UK science base. Some researchers also felt some

[36] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (p 30)
[37] Includes Bioscience Initiatives: The European Mouse Mutant Archive (EMMA), GÉANT (high-speed knowledge exchange network) and The European Molecular Biology Lab (EMBL), RI in the EU with information describing the EU Landscape and Map (accessed 21/09/15)
[38] The Organisation for Economic Co-operation and Development covers Bioscience Topics (accessed 21/09/15)
[39] CGIAR (accessed 21/09/15)
[40] EUREKA (accessed 04/11/15)
[41] Creating the Future: A 2020 Vision for Science & Research: A Department for Business Innovation and Skills Consultation on Proposals for Long-Term Capital Investment in Science & Research (2014) (pp 41-42)
[42] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (p 19)
[43] The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 4)
[44] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (p 30)

EU funding encouraged collaboration for collaboration's sake, potentially leading to partnership with less research innovative member states.

Q6. How is private investment in UK science and research influenced by EU membership? Is international investment leveraged on the basis of this membership? How does EU membership affect the growth of research-intensive UK companies?

26. The UK's position within the EU makes it attractive to external collaborators and business partners seeking a European gateway. The UK successfully competes within EU funding programmes, obtaining 22% of the total funding offered by the ERC[45]. Around 20% of UK domestic R&D funding comes from abroad, this is a far greater proportion than our comparator countries such as the USA, Japan, China and Germany[46,47]. This in part must be attributed to UK excellence in research.

27. As a platform ERDF and funding awards and collaborations have helped secure new research grants and follow-on-funding. EU Convergence funding has been fundamental to the University of Exeter's Penryn Campus[48]. In particular the MSc course in Conservation and Behavioural Ecology is well respected at international level, with attendance by international students. Continued investment maintains this addition to UK infrastructure. Communication from colleagues in SMEs have noted that EU income was critical to their proprietary research programmes and, moreover, that these awards have helped to leverage secondary investments[49]. These exemplify the additional benefits of EU membership that enhance the access, experience and contacts needed to develop scientific careers and businesses.

Q7. How does the UK participate in the creation and operation of international facilities that are available as a consequence of our EU membership? Are there any restrictions in the creation and operation of international facilities outside the EU as a consequence of our EU membership?

28. Researchers and businesses appreciate that funding of large RI projects requires a European basis. International research facilities come under a number of different institutional arrangements and funding models. In most cases, EU funding covers the planning, coordination and networking of infrastructures, but the construction costs are borne by participating countries. Making better use of existing large facilities within the EU will also be more beneficial to the UK. The UK often contributes a leadership role in establishing international facilities, without necessarily a leading role in financing.

29. The UK competed well for FP6-7 funded RI projects[50]. These include The European Molecular Biology Laboratory/European Bioinformatics Institute (EMBL-EBI) in Cambridge, which is home to other bioinformatic resources such as, the European Life-Science Infrastructure for Biological Information (ELIXIR), Serving Life-Science Information for the Next Generation (SLING), Impact and BioMedBridges. BioStruct-X is also at the EMBL covering genomics and proteomics research. The Transnational Infrastructure for Plant Genomic Science (transPlant) is also within the EMBL. Imperial College London is home to the Infra-Structure for Systems Biology (ISBE) and the Mosquito repository INFRAVEC. The University of Oxford is home to Instruct, the Integrated Structural Biology Infrastructure[51].

30. Without EU membership the UK would not have access to the Innovative Medicines Initiative (IMI) the world's biggest public-private partnership in the life sciences. As an EU led partnership with the European pharmaceutical industry the IMI budget is funded thorough Horizon 2020 and consortia of EU Pharmaceutical

[45] Joint National Academies Submission to the Department of Business, Innovation & Skills Call for Evidence on Research and Development (p 1)
[46] Universities UK Submission to the 2015 Comprehensive Spending Review (p 5 taken from: Economic Insight (2015). What is the relationship between public and private investment in science, research and innovation?)
[47] Leverage from public funding of science and research, Department for Business, Innovation and Skills (BIS) (2013)
[48] Universities in Cornwall contribute more than £490 million to the Cornish economy (accessed 10/11/15)
[49] The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 2)
[50] European Commission Research Infrastructure (accessed 04/11/15)
[51] Enabling science, EU support to research infrastructures in the life sciences (2013) Directorate General for Research and Innovation Research Infrastructures

companies with the aim to improve the drug development process[52]. Similarly access to the European Medicines Research Training Network (EMTRAIN) provides a sustainable, pan-European platform for education and training[53].

Q8. What contribution does EU membership make to the quality of UK science and research through the free movement of people? How does this compare with flows of people between the UK and non-EU countries such as the USA, India, China and Singapore?

31. As a member of the EU, the UK benefits from the free movement of scientific researchers across borders. Working across the EU facilitates shared knowledge, infrastructure and resources, allowing UK scientists to utilise facilities not otherwise available. Free researcher movement is essential to carrying out field work and provides the capacity to share and transport samples across borders. Researchers are able to attend and present their research at international conferences across the EU enhancing their collaborative networks.

32. It has been reported that prior to EU membership, considerable restrictions applied to UK researchers' residencies working within Europe, which also created uncertainty. For example, the need for annual registration and renewal of documents with authorities was common. Membership considerably relieved such restrictions and facilitated ease of mobility across Europe. Within the EU at present there are essentially no barriers, and added to the fact that English is universal in science, UK researchers have exceptional professional and private mobility. As well as removing barriers to the mobility of single scientists between the UK and the EU, conditions for scientists' families would otherwise be more complicated, regarding regulations, education and development. This ease of movement is crucial for science and if these facilities were not available to UK scientists, EU employers would be effectively discouraged from collaborating with or hiring from within the UK.

33. The absence of visa restrictions across the EU is a major benefit when compared with international collaborations particularly in Asia and Africa. We have heard of UK companies that under freedom of movement legislation now spend less time and money on visa applications, and redirect these resources back to research. The mobility of researchers is significant in enabling the UK to freely recruit and hire the best researchers on an international scale. If unable to do this then the maintenance of UK scientific research excellence is likely to be inhibited.

34. The recruitment and contribution of researchers from EU countries has enabled further development of STEM subjects in the UK. The loss of experts from UK research disciplines, often due to retirement, can lead to the loss of knowledge within certain fields, reported particularly in systems biology and physiology. The Confederation of British Industry (CBI) has also reported that 63% of their members view the free movement of staff across the EU as beneficial to business; only 1% of members felt this impact was negative[54]. In addition EU researchers are in some cases able to provide specialist skills that are not readily available in the UK. It is more difficult and more complicated to recruit from beyond the EU.

35. The ERASMUS (European Community Action Scheme for the Mobility of University Students) programme provides a very efficient framework regarding the administration and regulation of collaborations between EU universities[55]. Similarly, Marie Skłodowska-Curie Fellowship grants provide a beneficial framework within which to arrange researcher movement. The 125,000 EU students studying at UK universities during 2012-13 generated £2.27 bn for the UK economy[56]. Continuing to remain attractive to EU students will be important for universities and the economy.

[52] The Innovative Medicines Initiative (accessed 28/10/15)
[53] EMTRAIN (accessed 28/10/15)
[54] CBI Factsheet: Benefits of EU membership outweigh costs (accessed 18/11/15)
[55] Professor David Richardson speaking at Excellent Research in the UK: Do we need the EU? (accessed 07/10/15)
[56] Dame Julia Goodfellow speaking at Universities for Europe launch (accessed 07/10/15)

Regulation

Q10. What are the key EU regulatory frameworks/mechanisms that directly affect the science and research community in the UK?

36. EU legislation supports a parity of standards, enabling cross border cooperation for science projects and harmonising standards. EU competency on environmental legislation has increased in line with the environmental standards in the UK leading to improved performance in addressing environmental issues[57]. Directives including Water, Birds and Habitats (including the Natura 2000 network of protected areas) and Marine Strategy provide a framework to prioritise applied research, offering benchmarks to facilitate study design and therefore increasing the impact of research. Directives such as the Environmental Impact Assessment offers guidelines as to why research should be conducted, helping to inform the research questions. REACH legislation guides use and exposure to chemicals.

37. With multinational legislation, the UK can maintain expertise at the international level, aiding the UK's international competitiveness in these sciences. The Protection of Animals for Scientific Purposes Directive 2010/63/EU set out to harmonise standards across the EU. This is an area in which the UK has played a leading role and harmonisation can remove any competitive disadvantage and facilitate collaboration and respond to leading opinion and expertise[58].

38. The UK life sciences industry views the European Medicines Agency (EMA)[59,] and the Unified Patent Court (UPC), both based in London, as providing beneficial regulation regarding scientific advice on medicinal products. Advanced Therapy Medicinal Products (ATMPs) including cutting edge cell and gene therapies are governed by a European framework for assessment and marketing. Pooled expertise at the European level and direct access to the EU single market are beneficial[60].

39. The EC has been conducting a more flexible programme, whereby participants from member states determine their research agendas and investment portfolios. The European Technology Platforms and ERANETS are strong examples, and there is interest in the proposed Joint Programming method with EU frameworks in place to help with IP[61]. UK RCs have expressed that funding programmes have not shaped their research priorities or budgets[62]. Involvement as a partner in EU projects offers valuable insight when applying for coordinator funding. Once funded, coordinating organisations provide guidelines into reporting mechanisms and navigation of administrative requirements.

40. The EU commission has committed to reduce bureaucratic load on participants of its programmes, in particular within Horizon 2020[63], with explicit plans for the inclusion of better mapping and monitoring[64], greater transparency, centralized open-access and equivalent incomes across member states[65].

41. A recent change in EU law has made the participation of non-EU countries in Horizon 2020 grants more difficult. It was reported that this has had direct effect on scientists in more advanced countries like Switzerland (refer back to Q4: paragraph 19).

42. Acknowledged as an area for improvement, the administrative and bureaucratic burden of EU funding has been a commonly cited theme. For larger ERC grants, many Institutions employ external consultants, at cost

[57] Review of the Balance of Competences between the United Kingdom and the European Union Environment and Climate Change (2014) (p 7)
[58] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (p 44)
[59] BIA UK Life Sciences Manifesto 2015-20
[60] BIA Briefing Paper: Advanced Therapy Medicinal Products and Regenerative Medicine
[61] European Commission webpages on Intellectual Property (accessed 04/11/15)
[62] The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (pp 2-4)
[63] An analysis of subject areas and country participation for all health-related projects in the EU's FP5 and FP6 programmes (2013) Galsworthy *et al, European Journal of Public Health*, 24;3, 514–520 (p 514)
[64] Horizon 2020 – Impact Assessment Report.(2011) (5 March 2013, date last accessed in paper)
[65] An analysis of subject areas and country participation for all health-related projects in the EU's FP5 and FP6 programmes (2013) Galsworthy *et al, European Journal of Public Health*, 24;3, 514–520 (p 518)

and feel the lengthy process is further burdened by the requirement to report back to the EU on deliverable milestones relevant to that funding. Others report the employment of consultants as an expression of the value placed on these grants. In some cases a seemingly arbitrary requirement for collaborations between countries to attract specific funding was said to compromise the focus on excellence. Collaboration for collaboration's sake was viewed as having a negative impact on productivity. The cost-to-income ratio of national funds, and the extended timetable of the funding programmes compared with national schemes are additional hindrances reported as reasons for non-involvement in application for EU funds. This appears to be particularly challenging for businesses (SMEs) and for policymakers[66]. Bureaucracy associated with national funds is however also felt, and a level of burden is unavoidable and beneficial to avoid fraud[67].

Q11. If the UK were not a member of the EU, could regulations be reformed to give greater benefit to UK science and research? For example, in areas such as data regulation, VAT on shared facilities, and the use of the precautionary principle?

43. The Campaign for Science and Engineering (CaSE) has highlighted concern about tax policy affecting collaboration between UK institutions, and business activity in new research institutes[68]. Recommendations were made to reassess how EU (and UK derogated) legislation is interpreted and ensure that it is compliant with government science and innovation policy to promote innovation to drive economic growth[69].

44. A report by the Working Group on Expanding Access to Published Research Findings[70] recommended a reduction of the VAT burden on online access to e-journals. Restricted access to e-publications acts against research efficiency whilst also raising research institute expenditure[71].

45. Commercial R&D in Europe has declined as a consequence of the EU regulatory environment. Recent amendments to allow decision-making about the cultivation of GM crops in Europe on a national basis may alter the landscape for research.

46. Current UK legal frameworks come from EU legislation. If the UK were to leave the EU the same legislation could be followed, but with the UK having significantly less influence over subsequent development. If the UK were outside the EU there would be an increased regulatory burden regarding compliance for those who operate in both UK and remaining EU markets.

Q12. How is the innovation landscape affected by EU membership?

47. Horizon 2020 is the largest ever European funding programme for research and innovation, with a budget of €74.8 bn that will run until 2020. Horizon 2020 aims to remove barriers to innovation and ensure that Europe produces world-class science across public and private sectors. A main area of focus is scientific excellence; supporting and developing European talent with the encouragement of private investment and industrial leadership in innovative R&D whilst reflecting societal challenges through policy priorities of the EC[72].

48. Access to the EU single market is a key reason for global biopharmaceutical companies to establish their European headquarters in the UK; investing in UK R&D and therefore the innovation landscape[73].

49. The EU has supporting competence with regard to innovation; therefore competency is shared between the EU and member states[74]. Researchers reported that there is little doubt that the innovation landscape is facilitated by the networks and access to EU researchers facilitated by EU membership.

[66] The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 4)
[67] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (pp 28, 39)
[68] CaSE Briefing on tax policy concerns in the science and engineering sector (2015)
[69] Our Plan for Growth: Science and Innovation (2014)
[70] Accessibility, sustainability, excellence: how to expand access to research publication (2012)
[71] Accessibility, sustainability, excellence: how to expand access to research publication (2012) (pp 9, 64)
[72] Innovate UK: Horizon 2020: what it is and how to apply for funding (accessed 03/11/15)
[73] BIA UK Life Sciences Manifesto 2015-20

Scientific advice

Q13. How does the quality and effectiveness of scientific advice on matters of public policy compare between the EU and the UK? What are the effects, if any, of differences in the provision of scientific advice between the EU and the UK?

50. Centrally administered EU policies face challenges because of the differing research structures across the EU, and the variations in public, private and grant based funds. Within the EU 2015 budget the spend on external policy has been increased by 22%[75]. Coordination as well as amplification of member state activities is seen as an important EU policy strategy; actions taken at the European Level can add significant value to actions taken by member states[76].

51. The UK has clear formal advisory structures relating to provision of evidence and advice for policy formation. The government chief scientific advisor (GCSA) as the most senior figure[77] and in principle each Government department has a chief scientific advisor (CSA) (some departments have vacancies or an advisor with additional roles). The core role of CSAs is to ensure that departmental decisions are informed by the best science and engineering advice[78]. In addition the UK has specific protocols for the provision of scientific advice in emergencies[79]. The focus on evidence-informed policymaking in the UK is long-standing. There is recognition that science will ultimately be considered with other aspects in final decisions which are taken by Parliament.

52. The UK is one of three EU member states to appoint CSAs (Ireland and Czech Republic also having positions)[80]. Some EU member states instead have advisory bodies, councils or committees with representatives from academia, industry, higher education and civil society. The UK has a number of strong learned societies that are active in the promotion of independent evidence for policy-making. Following a decision not to appoint a successor CSA to the President of the Commission the EU has instead established the Science Advice Mechanism (SAM) with a core group of seven experts drawn from across the EU and across specialisms[81]. This process is just beginning. Scientific advice must be available to the EU and its member states because of its profound societal impact. Developing a trusted relationship with policy makers, while maintaining transparency and accountability in the eyes of the public and the science community, is a common challenge[82].

Q14. To what extent does EU membership enable UK scientists to inform and influence public policy at EU or international levels? To what extent does EU membership inhibit UK scientists from influencing public policy at EU or international levels?

53. The UK is considered an influential member within the EU, and there is strong consensus that the UK plays an important role in shaping EU agendas. As an EU member the UK's voice is amplified globally[83] and the UK maintains a seat at the international leaders' table[84].

54. Projects involving UK partners produce a significant amount of policy benefit[85] and the UK has influenced and aided the improvement of EU codes of conduct. Long term negotiations over EU mechanisms have resulted in

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[74] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (p 5)
[75] EU budget 2016: Council ready to negotiate with EP (accessed 03/11/15)
[76] Review of the Balance of Competences between the United Kingdom and the European Union Health (2013) (pp 40, 58)
[77] Science Advice to Governments: Diverse systems, common challenges A briefing paper for Auckland conference (2014) (p 7)
[78] Science Advice to Governments: Diverse systems, common challenges A briefing paper for Auckland conference (2014) (p 42)
[79] Scientific Advisory Group for Emergencies (SAGE) (accessed 03/11/15)
[80] European Parliamentary Research Service: Scientific advice for policy-makers in the EU (2015) (p 3)
[81] The Scientific Advice Mechanism (accessed 20/10/15)
[82] Science Advice to Governments: Diverse systems, common challenges A briefing paper for Auckland conference (2014) (pp 7-8)
[83] Review of the Balance of Competences between the United Kingdom and the European Union (2012) (p 7)
[84] Chuka Umunna MP speaking at Universities for Europe launch (accessed 07/10/15)
[85] The impact of the EU RTD Framework Programme on the UK (2010) Technopolis Group carried out on behalf of the International Science and Innovation Unit within the Department for Business, Innovation and Skills (BIS) (p 5)

greater support to UK institutions[86] and it is considered important that the UK continues to influence EU agendas. The UK is therefore able to make a positive contribution to the EU policy landscape and benefitting in the process.

55. The UK has been active in promoting open access to research, encouraging access to publicly funded publications and data; the EU also acknowledges these perspectives within Horizon 2020[87]. Horizon 2020 requirements on embargo periods may be reviewed in its mid-point review; meanwhile there are disciplinary differences in capacity to comply. Any major changes to open access policies will affect learned societies, many of which own journals. In addition approximately 23% of global publications are published through UK journals; the international policies are highly relevant[88].

56. The League of European Research Universities (LERU)[89] and the Young European Research Universities Network (YERUN) have been established as mechanisms to highlight the role and activities of research intensive universities across Europe, promote joint initiatives in research and teaching (including the mobility of researchers) and act to influence EU research policy. LERU comprises 21 European Universities, 5 of which are UK based, and has a strong voice regarding the ERA, ERC, FPs and the EU innovation landscape. The development of supporting organisations helps to demonstrate the interest of UK institutions in EU engagement. EU members can offer scientific advice through European bodies; the new EU advice mechanism is untried and has yet to have effect. Within the EU the UK can seek to influence and shape European policies in line with UK ones.

[86] Review of the Balance of Competences between the United Kingdom and the European Union Research and Development (2014) (p 41)
[87] Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020
[88] Public access to publicly-funded research: Oral statement to Parliament (accessed 18/11/15)
[89] League of European Research Universities (accessed 23/11/15)

Member Organisations of the Society of Biology:

Full Organisational Members

Agriculture and Horticulture Development Board
Amateur Entomologists' Society
Anatomical Society
Association for the Study of Animal Behaviour
Association of Applied Biologists
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British Association for Lung Research
British Association for Psychopharmacology
British Crop Production Council
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British Lichen Society
British Microcirculation Society
British Mycological Society
British Neuroscience Association
British Pharmacological Society
British Phycological Society
British Society for Gene and Cell Therapy
British Society for Immunology
British Neuroscience Association
British Society for Matrix Biology
British Society for Medical Mycology
British Society for Neuroendocrinology
British Society for Parasitology
BSPB – British Society of Plant Breeders
British Society for Plant Pathology
British Society for Proteome Research
British Society for Research on Ageing
British Society for Soil Science
British Society of Animal Science
British Toxicology Society
Experimental Psychology Society
The Field Studies Council
GARNet
Gatsby Plants
Genetics Society
Heads of University Centres of Biomedical Science
Institute of Animal Technology
Laboratory Animal Science Association
Linnean Society of London
Marine Biological Association
MONOGRAM – Cereal and Grasses Research Community
Nutrition Society
The Rosaceae Network
Royal Microscopical Society
Science and Plants for Schools
Society for Applied Microbiology
Society for Endocrinology
Society for Experimental Biology
Society for General Microbiology
Society for Reproduction and Fertility
Society for the Study of Human Biology
SCI Horticulture Group
The Physiological Society
Tropical Agriculture Association
UK Environmental Mutagen Society
UK-BRC – Brassica Research Community
UK-SOL – Solanacea Research Community
University Bioscience Managers' Association
VEGIN – Vegetable Genetic Improvement Network
Wildlife Conservation Society Europe
Zoological Society of London

Supporting organisational members

Association of the British Pharmaceutical Industry (ABPI)
Association of Medical Research Charities
Astrazeneca
BASIS Registration Ltd.
Bayer
BioIndustry Association
Biotechnology and Biological Sciences Research Council (BBSRC)
The Donkey Santuary
The Ethical Medicines Industry Group
Food and Environment Research Agency (FERA)
Forest Products Research Institute
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