Building a Strong Future for European Science: Brexit and Beyond

Wellcome's recommendations from the Future Partnership Project

February 2018

Summary

Brexit presents the UK and EU with choices about their future relationship on research and innovation. This report sets out Wellcome's view on the structure of a new EU–UK research partnership and how this could be delivered. Our findings draw on what we have learned from the evidence and views of the 200 organisations and individuals who contributed to the Future Partnership Project. Through this project with the Royal Society, we brought together the views of European and UK experts through an evidence synthesis, a consultation, and discussion meetings.

A vision for research in Europe

European nations have created a world-leading location for research and innovation. Europe will need to adapt to maintain this position as the challenges, tools and global context of research change. To achieve this, **the EU and associated countries should accelerate and deepen development of the European Research Area (ERA), to help Europe and EU Framework Programmes capitalise on the strengths and talents of a wider group of nations.** Delivering a stronger ERA will require greater investment and commitment from participating countries. In turn, associated countries − which closely participate in Framework Programmes through an agreement with the EU − may need greater influence over the strategic development, policies and standards of the ERA and its Framework Programmes. This would ensure that associated countries can justify their investment and play a full part in increasing the impact of these programmes.

An EU–UK research and innovation agreement for Brexit

Evidence and views gathered through the Future Partnership Project showed the importance of finding a way for the EU and UK to maintain their important partnership on research and innovation after Brexit. There was a strong view that cooperation through the EU Framework Programmes is the best way to maintain this partnership. However, cooperation on funding is not sufficient; cooperation is also needed on regulation and research policy and on the movement of people.

Some of the solutions we propose will need to be included in a formal agreement, which could be a chapter within an EU–UK trade deal or a stand-alone research and innovation agreement.

Funding

The EU's Framework Programmes are the most effective multilateral funding schemes in the world, and are therefore a practical and efficient way to support excellence in international collaboration. There would be major challenges to the UK setting up replacement bilateral arrangements, for example with the USA or individual EU Member States. UK participation in the Framework Programmes would also deliver financial and non-financial benefits for existing members. **The UK should therefore secure Associated Country status in an excellence-focused Framework Programme 9 (FP9), as this would be the best way to participate in European research.**

To achieve this, the UK should be pragmatic about the cost of a good deal to access FP9, and the EU should be pragmatic about the terms of FP9 association for the UK.

The UK should continue to engage as a full, constructive and reliable partner in European research funding, research policy and science advice. This should include engaging with the development of FP9 to ensure the programme is efficient and excellence-focused.

Regulation and research policy

Shared standards reduce the cost of collaboration and resource-sharing and give a larger number of people the opportunity to participate in research, generating more useful results. After Brexit, the EU and

UK should **continue to cooperate on pre-competitive research regulation** because of their shared values and regulatory leadership. In particular:

- The EU and UK should agree on how to **maintain the free flow of personal data for research**. This would ideally be achieved through a comprehensive 'adequacy' agreement (where it is agreed that there are adequate levels of data protection to allow personal data to be transferred without more safeguards). A practical alternative is agreeing sector-specific safeguards to allow the free flow of personal data for research as part of a research and innovation agreement.
- A research and innovation agreement should **enable the UK to participate in the EU's harmonised clinical trials system on a similar basis to Member States**.
- A research and innovation agreement should **cover continued cooperation on the implementation of rules to protect animals used for scientific purposes**.

Research policy also has an impact on the way research is carried out. In collaboration, the EU and UK will be able to achieve more to promote responsible research. **A research and innovation agreement should promote dialogue on areas of research policy where the EU and UK can provide global leadership, for example on open research.**

Movement of researchers

Collaboration and international partnerships are the basis of great science. The overwhelming majority of those who participated in the Future Partnership Project stressed the need for easy mobility for researchers between the EEA and the UK after Brexit.

A research and innovation agreement should support full researcher mobility between the EEA and UK. This agreement should remain as close as possible to current arrangements, to maintain the benefits that free movement has delivered to European research.

Expansion of the current UK migration system for non-EEA workers – an option reportedly being considered by the Government – would not deliver a successful post-Brexit migration system for EEA researchers. This system is not quick or agile enough and relies too heavily on salary and qualifications as a proxy for skill.

Introduction

Brexit presents the UK with a series of fundamental choices about how it works with the EU and the rest of the world. One of these is the UK's relationship with the EU on research and innovation – currently the fifth largest area of EU expenditure[1].

The EU also has a choice about whether and how it wants to partner with the UK on research and innovation in the future, including the terms it would offer the UK to do this. However, both sides share the risk of not agreeing on a suitable model and the damage that this would create.

Over the last three months, Wellcome and the Royal Society have undertaken the Future Partnership Project to explore what "a more ambitious and close partnership"[2] could look like. We have heard from over 200 organisations and individuals from across Europe, through an evidence synthesis, a consultation[3,4], discussions in Brussels and London, a roundtable on scientific advice[5] and a conference with senior European and UK experts at Chicheley Hall in January 2018[6].

There was a strong view that partnership through EU Framework Programmes is the best way to accomplish research cooperation. But achieving such a partnership will not be easy. Both the EU and UK have set out their broad expectations for the wider negotiations, and these pre-conditions create challenges to agreeing a future partnership. Effort is needed to rebuild trust, with many of those we spoke to calling for the negotiation to rise above politics and national interests and find a solution.

Choosing to continue in partnership would be significant. Such a decision would have lasting implications for where and how research is carried out at a global level. It would also provide an early and positive outcome from negotiations, which could help to build trust on issues where there is less common ground.

This report draws on what we have learned through the Future Partnership Project. It sets out Wellcome's view on the structure of a new EU–UK research partnership, why this is important and practical suggestions on how we can reach a viable agreement. Many individuals and organisations have generously shared their time and views, but the recommendations set out here are Wellcome's alone.

We hope our recommendations will promote debate and take us closer to an outcome that strengthens European science through Brexit and beyond.

Part 1: A vision for research in Europe

Through cooperation spanning several decades, European nations have created a world-leading location for research and innovation (see Box 1). Six of the world's top 20 universities are in the European Research Area (ERA), and Europe produces a third of the world's scientific publications with just 7% of the global population[7,8,9]. Together, Europe has built a world-class funding agency in just a decade – the European Research Council (ERC) – and invested in unique research facilities, from CERN to the European Laboratory of Molecular Biology.

Box 1: Impact of EU-funded research

WHOLE NEW WORLDS

EU funding has led to the discovery of seven Earth-sized planets. The SPECULOOS project, headed by the University of Liège, is supported by the ERC and is partnered with NASA, the European Southern Observatory in Chile and with universities across Europe. The TRAPPIST-1 system it discovered hosts rocky planets with more water than Earth.

HEALTH IN DEVELOPING COUNTRIES

Research is at the heart of Europe's approach to international development and challenges facing developing nations, such as pandemics. The EBOVAC project is one of the largest initiatives in Horizon 2020, with €58 million bringing together partners like the pharmaceutical company Janssen, the French national medical research funder (INSERM), the London School of Hygiene and Tropical Medicine and others to develop an Ebola vaccine. These projects also provide a platform to engage with charitable funders such as Wellcome to better prepare the world for future outbreaks.

FUTURE OF MANUFACTURING

Graphene is 200 times stronger than steel, yet also ultra-light, incredibly flexible and so thin it is almost 2D. It could revolutionise transport, medicine, energy and electronics. Graphene was first isolated at the University of Manchester, and a third of the funding for the newly established National Graphene Institute in the city came from the European Regional Development Fund. Individual research projects at the institute have been supported by the UK Research Councils and the ERC. The European Commission's Graphene Flagship has pledged €1 billion over a coordinated 10-year research plan. So far, this has combined 150 partners in 23 countries to make Europe the global centre for graphene production.

International collaboration is becoming ever more important as the challenges, tools and global context of research change. In 1981, only 5% of publications had international coauthors; now over half do[10]. But Europe's leadership position cannot be taken for granted and action is needed to address multiple challenges, including:

- **Communicating the social, cultural and economic benefits of European research.** Many sources, including the European Commission's *LAB – FAB – APP* report, have highlighted the need to "better communicate impact"[11]. New and creative ways should be used to engage citizens, to ensure that research and innovation can continue to occupy a trusted and valued position in society.
- **Nurturing the next generation of researchers, innovators and entrepreneurs.** The world's research workforce is rebalancing – China now produces a quarter of all STEM graduates[12]. To retain the pool of talent required to sustain world-leading research and innovation, Europe must invest in developing the skills of its citizens and attracting skilled people from across the world to live, work and study in Europe.
- **Investing at levels that match Europe's ambitions for research and innovation.** China's investment in research is growing over three times as fast as the EU's, increasing by a factor of 30 from 1995 to 2013[13]; 36.8% of global investment is now in East and South-east Asia[14]. It is more important than ever that Europe invests for future growth and keeps pace with the dramatically expanding global research capacity.

- **Ensuring that new discoveries lead to improvements in the quality of life of citizens.** When we consulted research leaders from across Europe, we heard that "research is the only way to maintain our standard of living in the future". The EU must get better at transforming research into tangible benefits – the USA has five times as many startup companies valued over $1 billion, and top R&D businesses in the USA and Korea invest around twice as much in research and innovation than those in the EU[15]. Concerted effort is needed to incentivise industry and venture capital investment to deliver the benefits of research in Europe. This could include exploring approaches such as the use of tax credits and the Patent Box scheme pioneered in the UK[16] and public–private partnerships like the Innovative Medicines Initiative.

Recommendation: The EU and UK should accelerate and deepen development of the ERA, to help Europe and EU Framework Programmes capitalise on the strengths and talents of a wider group of nations.

To capture the full benefits of cooperation, EU Framework Programmes should seek greater participation from across the ERA, including from countries outside the EU. After Brexit, the value of these partners will further increase – if the UK were to secure Associated Country status (and assuming a flat budget from Horizon 2020 to Framework Programme 9), the share of funding from non-Member States would almost double.

Accelerating the development of the ERA would benefit EU members. It could help to deliver:

- more streamlined application processes to European funding schemes
- lower barriers to movement for researchers in more countries
- shared research regulations and policies with the critical mass to set global standards
- access to wider expertise to enrich activity within the EU area
- strategic cooperation needed for efficient funding and infrastructure
- coordination to tackle major research challenges for greater impact (see Box 2)
- the broader political and popular support to reach the long-term European target of 3% of GDP invested in research and innovation[17].

Box 2: Value of future ERA collaboration and coordination to tackle major research challenges

RID THE WORLD OF PLASTIC POLLUTION

Both the EU and UK have committed to tackling plastic pollution. A complementary UK national strategy alongside the EU's Strategic Research and Innovation Agenda could coordinate actions to tackle this urgent problem. So far Horizon 2020 has provided €250m for R&D, with a commitment of a further €100m before 2020. Aligning these strategies is vital to produce the scale of research and action to be globally effective.

A CANCER FREE FUTURE

We don't always know the route we're going to take to solve global challenges. Europe has made great progress in reducing the burden of cancer, but a cancer-free future is still some way off. Europe working together will take us to this goal more quickly. A joint European mission to tackle cancer could draw on the breadth and depth of the continent's expertise and infrastructure, such as pan-European biobanking, UK strength in genomics, Estonian leadership in digital healthcare, and French, German and Polish basic research.

Achieving a stronger ERA will require greater investment and commitment from both Member States and those outside of the EU. To ensure accountability over these additional resources, the EU may need to reconsider the model for participation of associated countries. In particular, participating countries may need greater influence over the strategic development, policies and standards of the ERA and its

Framework Programmes. This would allow experts and ideas from associated countries to make valuable contributions to ERA development.

Ideally, associated countries would move towards participating on a similar basis to Member States, with full voting rights. However, our consultation presented models that could be adopted in the shorter term, including the precedent of a mixed committee, where non-Member States could participate fully in European Council discussions on research policy and Framework Programmes, but without a vote.

In the longer term, finding a sustainable and inclusive approach could allow for the expansion of the ERA to countries outside Europe's borders, to harness talent and opportunity from further afield.

Part 2: A research and innovation agreement for Brexit

This section considers three specific issues that need to be addressed in Brexit negotiations. Some of the solutions we propose will need to be included in a formal agreement, which could be a chapter within an EU–UK trade deal or a stand-alone research and innovation agreement. There are precedents for the latter – for example, Israel is associated to Horizon 2020 through a scientific and technological agreement with the EU, but also has an overarching association agreement with the EU. There are arguments for and against both options, and our consultation did not favour one option over the other.

Funding

Recommendation: The UK should secure Associated Country status in an excellence-focused Framework Programme 9 (FP9), as this would be the best way to participate in European research.

The multilateral basis of Framework Programmes makes them a practical and efficient way to support excellence in international collaboration, according to our consultation. While many of those consulted saw opportunities to further streamline their operation, the Framework Programmes were considered to have improved considerably over recent years and several key benefits were highlighted. Individual researchers noted the importance of a common funding pot to avoid 'double jeopardy' – where multiple funders must each independently agree to back a project for it to receive any support. For participating nations, the administrative costs of Framework Programmes compare favourably with schemes that require multiple bilateral agreements, such as the UK's Newton Fund[18]. Respondents also noted that since Framework Programmes are at the heart of national research spending plans across Europe, limited budget is left for additional bilateral deals in the short term.

A central strength of Framework Programmes is their ability to accommodate associated countries as well as diverse EU Member States. After Brexit, the UK could participate in European science in a range of ways – from third country collaboration on specific projects to Associated Country status spanning entire programmes (see Table 1). None of these options would prevent Member States or the UK from pursuing other complementary international partnerships.

We believe that Associated Country status would be the best outcome for both the EU and UK. Over several decades, EU programmes have grown to become an integral part of the UK funding system, accounting for 11% of UK universities' research income in 2015/16[19]. Securing access to FP9 would deliver much-needed security to both UK researchers and potential collaborators across the rest of Europe for at least a seven-year period. Our consultation highlighted how important this is, especially for European industry, with GlaxoSmithKline noting that "as an international company, we particularly value the ability to work with a range of partners to ensure that we are conducting the best and most relevant research". A timely settlement is essential – collaborative partnerships inevitably start to form many years before funding is awarded, and there has already been a fall in Horizon 2020 participation rates from UK-based researchers since the referendum[20].

The UK has a long history of international collaboration beyond Europe, including with the USA, which should continue irrespective of the future direction of the EU–UK partnership. Measured by joint research publications, the USA is the UK's largest collaborator, but the UK has more joint publications with the EU27 as a whole[21]. Other relationships provide a reference point for evaluating the benefits and costs of FP9 participation. Creating a deeper relationship between the USA and UK poses several challenges: differing rules present barriers to cooperation, for example on clinical trials; the scale of investment in research in the USA far outweighs that of the UK; and the UK could not expect to have a significant impact on research funding strategy and policy in a partnership with the USA.

Table 1: Benefits and costs of potential models for UK participation in European research

	Industrialised third country status	Associated Country status
Examples	South Korea, Canada	Switzerland, Norway, Israel
Cost	Third country partners cover their own participation costs directly	Negotiate a financial contribution to the shared pot, based on GDP
Access to funding	Largely use their own funds, but some examples of limited access to other partners' schemes	Access to the entire Framework Programme, with cooperation in other areas of research funding
Influence	Joint annual committee sets shared priorities	Rights and obligations of a Member State, but without a formal vote at the Programme Management Committees
Regulation	Varies according to wider relationship	Dependant on criteria of association (eg EFTA/EEA or European Neighbourhood Policy)
Administration	Each participating country must cover at least their own administrative costs	Largely centralised and cost is covered within contribution
Mobility	Not covered	Varying degrees of visa liberalisation and free movement, with individual agreements on wider barriers to mobility (eg pensions)

Recommendation: The UK should be pragmatic about the cost of access to FP9.

In 2007 to 2013, the UK received €8.8 billion of direct EU funding for research, which was an excellent return on an estimated contribution of €5.4bn[22]. However, when considering the cost of participation as a non-Member State, the UK should take into account the non-financial benefits of the Framework Programmes and the costs to administer the scheme. Based on current Associated Country contribution models and excluding the UK's current rebate, we estimate that associating to FP9 would place the UK somewhere between being a small net beneficiary and a moderate net contributor. When this is taken in the context of the wider package of non-financial benefits, this range represents a good deal for the UK.

As the most effective multilateral funding scheme in the world, the Framework Programmes are highly valued by existing associated countries. Norway is a significant financial contributor – paying €447 million per year for membership of EU programmes including Horizon 2020, while having received only €473m from Horizon 2020 since 2014[23,24]. Yet the wider benefits of association mean that the Research Council of Norway says "[this] is without any doubt our country's most important international partnership within research and innovation"[25].

Participating in joint EU research funding currently requires a role for the European Court of Justice (ECJ) and the European Court of Auditors. This role does not affect national laws, but mediates disputes between individual researchers. Respondents to our consultation considered that the limited scope of this jurisdiction would not affect the UK's sovereignty. In our own review of ECJ rulings over the past ten years, we found no examples of it arbitrating pre-competitive research disputes between collaborators under Framework Programmes.

Recommendation: The EU should be pragmatic about the terms of FP9 association for the UK.

Associated countries contribute to the pool of expertise within the Framework Programmes and increase Europe's global links and influence. When considering the terms of any UK association, the EU should recognise that UK participation would deliver financial and non-financial benefits for existing members.

The variety of existing models of association reflects the diversity of countries involved – for example, the agreement with Israel does not include freedom of movement. Carlos Moedas, the EU Commissioner for Research, Science and Innovation, has noted that it is important to find a way to ensure UK involvement in Framework Programmes post-Brexit, but that the UK is not comparable to other associated countries as it is so much bigger[26].

Recommendation: The UK should continue to engage as a full, constructive and reliable partner in European research funding, research policy and science advice.

The window to shape FP9 is still open, with a formal legislative proposal expected in the next few months. Until it leaves the EU, the UK should fully and constructively engage with the development of FP9 through its role in the European Council and seats in the European Parliament.

Wherever possible, UK-based researchers should continue to play a mutually beneficial role in supporting research funding and policy across the EU and its Member States. This cooperation takes many forms, such as providing science advice through formal and informal routes, as we heard at an event hosted by the International Network for Government Science Advice as part of the Future Partnership Project[27]. For example, 17% of expert members on the Scientific Advisory Boards at the Max Planck Institutes are UK-based researchers, more than any other EU country[28].

In the longer term, the UK should continue to contribute to dialogue on research and innovation in Brussels, where this would add value for partners. To foster trust and accommodate an evolving partnership with the EU, the UK should also consider if and how its evolving national funding system can remain compatible with EU counterparts, particularly on major 'mission-driven' projects. This could include aligning application windows, funding requirements and reporting systems.

Regulation and research policy

The EU and its Member States influence how research is done through law and policy. Some areas of research are more tightly regulated than others – for example, where there is a potential for harm or an impact on individual rights or animal welfare. Those we consulted emphasised the importance of shared standards to reduce the cost of collaboration and resource sharing. For example, Cancer Research UK reported that differing standards had made some EU–USA trials unfeasible. Wellcome has direct experience of the time, cost and effort needed to ensure European animal welfare standards are met for research taking place in the USA, which is a requirement of our funding.

Shared standards give a larger number of people the opportunity to participate in research, generating more useful results. This is particularly important for the UK, which has a relatively small population of 66 million compared to the EU27, USA and China, which have populations of 446m, 327m and 1.4 billion respectively.

After Brexit, researchers in the UK will need to be able to collaborate easily with researchers in other countries. The UK could achieve this by aligning research regulation with another part of the world. The EU also has a choice on whether or not to agree to future regulatory cooperation with the UK after Brexit. However, there are good reasons why the EU and UK should choose to continue to align on research regulation:

- **The EU and UK share important values that underpin a common approach to research regulation, including individual rights, data privacy and animal welfare.** For example, the EU strongly values animal welfare and requires that macaque monkeys have a minimum cage size of 2 m^2 compared to 0.2–1.4 m^2 in the USA.
- **The EU and UK will be in a stronger position to promote these values across the world if they continue to collaborate.** For example, working together, the EU and UK could achieve greater progress on spreading higher animal welfare standards for research outside Europe.
- **The EU is a global leader in developing regulation that supports research while protecting individuals, animals and the environment.** For example, EU data protection law sets the gold standard for sharing personal data in health research[29] and creates a trustworthy environment for the use of individuals' data. The EU has also taken a leading role in ensuring that the outcomes and data from clinical trials are shared.
- **The UK has made an important contribution to EU legislation through its well-respected regulators and pragmatic approach to regulation.** For example, the UK's regulator, the Medicines and Healthcare products Regulatory Agency (MHRA), was "instrumental in designing and delivering a robust regulatory environment across the EU", which "ultimately leads to faster access to innovative medicines for patients across Europe"[30].

Recommendation: The EU and UK should continue to cooperate on pre-competitive research regulation.

In particular:

- The EU and UK should agree on how to **maintain the free flow of personal data for research.** This would ideally be achieved through a comprehensive 'adequacy' agreement (see below for details). A practical alternative is agreeing sector-specific safeguards to allow the free flow of personal data for research as part of a research and innovation agreement.
- A research and innovation agreement should **enable the UK to participate in the EU's harmonised clinical trials system on a similar basis to Member States.**
- A research and innovation agreement should **cover continued cooperation on the implementation of rules to protect animals used for scientific purposes**.

Personal data about individuals is an essential resource for health and social research, for example for understanding the links between lifestyle and disease or education and life outcomes. Researchers often use fully anonymous data, but in some cases identifiable data is needed in order to identify significant patterns or to link datasets. Using personal data therefore supports research that saves and improves people's lives, for example by better diagnosing disease. To deliver these benefits, researchers need to be able to exchange personal data across borders. For example, there are typically around 2,500 requests a year from EU27 countries for access to data from the UK 1958 Birth Cohort[31].

Personal data can be transferred in the EU without barriers. It is vital that these cross-border flows of data can continue after Brexit to support EU and UK collaboration. A comprehensive 'adequacy' agreement between the EU and UK would be the simplest way to achieve this, where it is agreed that there are adequate levels of data protection to allow personal data to be transferred without more safeguards. The EU already considers that countries including New Zealand, Israel and Switzerland meet adequate data protection standards. The UK has committed to implementing the EU General Data Protection Regulation (Regulation (EU) 2016/679), which provides a stepping stone towards an adequacy agreement.

If an adequacy agreement is not possible, a practical alternative to support research is for the EU and UK to agree sector-wide safeguards to allow the free flow of personal data for research. This could be included in a research and innovation agreement.

The other options available to transfer data between the EU and UK, such as standard contractual clauses or binding corporate rules, would create a heavy legal, time and resource burden. Meeting these requirements would make data transfers for academic research difficult, compromising collaborations and making it harder to share Europe's world-leading data resources.

The EU's clinical trials rules (Regulation (EU) 536/2014) will make it easier to set up and run **interventional clinical trials of medicines** in more than one EU country[*]. Ensuring the UK can participate in this system on a similar basis to Member States will be important to maintaining European strength in clinical trials. The UK is a major location for clinical trials in Europe: currently the UK has a share of around 25–30% of the total number of trials in the EU, and around 40% of trials running in the UK also have sites in the EU[32]. The MHRA is a leading voice in trial regulation and contributes important expertise to clinical trial assessment in Europe[33]. Continued cooperation is also essential for the UK, where the population is not big enough to run large-scale trials or those for rare diseases. In turn, the UK contributes significant expertise on rare diseases, where it leads and participates in more pan-EU clinical trials than any other country[34].

To maintain cooperation, a research and innovation agreement should enable the UK to participate in the harmonised clinical trials system on a similar basis to Member States. The agreement should ensure that UK organisations can sponsor trials and the MHRA can be the lead country in reviewing applications, known as a 'reporting Member State'. It should also cover how the UK can access the IT systems and data that the system relies on. This cannot be achieved through legislation alone, but it will require the UK to implement the Clinical Trials Regulation, which is not covered by the UK's European Union (Withdrawal) Bill.

The alternative options for the UK are not attractive. Outside a harmonised system, researchers setting up a trial in the EU and UK would have to go through an additional UK application process. This would add burden to an already lengthy process: the Medical Research Council's Clinical Trials Unit reports that it takes three to six months for a half-time employee to complete an EU clinical trial authorisation dossier[35]. While the UK could seek to reduce application requirements while maintaining patient safety standards, any benefit would be offset by the need to duplicate applications. Alternatively, the UK could seek to align

[*] EU clinical trial legislation covers only specific types of clinical trials. Other studies with human participants are regulated under national law.

with a different jurisdiction through trade negotiations. However, it is difficult to envisage any other country agreeing to this, and this could not be achieved in time to replace the EU system.

Together the EU and UK have developed some of the highest welfare standards in the world for the **use of animals in research** (Directive 2010/63/EU). Horizon 2020 rules require researchers using animals to comply with this law. In addition, these high welfare standards were championed by the UK and lead to better science. A research and innovation agreement should therefore cover continued cooperation on the implementation of law to protect animals used for scientific purposes.

A research and innovation agreement could also cover other pre-competitive research regulation. For example, the Government could explore whether it would be valuable to include agreement on: the transport of animals; the sharing of tissues or cells in research; aspects of the regulation of genetic modification of organisms in research; and the research components of Euratom.

Recommendation: A research and innovation agreement should promote dialogue on areas of research policy where the EU and UK can provide global leadership, for example on open research.

Outside formal regulation, research policy has an important impact on the way research is carried out. The UK has promoted responsible research policy, working closely with other Member States. In collaboration, the EU and UK will be able to achieve more on the following issues:

- building approaches to **open research** so that outputs and data can be shared as widely and usefully as possible
- encouraging **gender diversity to foster scientific excellence**
- supporting the **development of early career researchers**
- delivering **robust ethical reviews** of research.

Finally, research doesn't operate in a vacuum. We heard in our consultation that cross-border innovation benefits from shared standards for trade, including customs arrangements. Fraunhofer UK noted that "a simple lens may be pre-formed in one country, finished in a second, coated in the third, tested in a fourth, assembled in a fifth and deployed in a sixth". A strong trade agreement is therefore important to the European research and innovation system as it will support companies and industries that are involved in both trade and research and innovation.

Movement of researchers

Recommendation: A research and innovation agreement should support full researcher mobility between the EEA and UK.

Collaboration and international partnerships are the basis of great science, with collaborative publications generally having more impact[36]. Against a backdrop of increasing international collaboration in research, EU–UK partnerships are critical: over half of the UK's collaborative papers are with EU partners[37]; countries that are geographically close are more likely to collaborate[38]; and respondents to our consultation noted that physical proximity can enhance collaboration. Britain is also a popular location for EU scientists – from 2007 to 2016, 22% of ERC grantholders chose to work in the UK[39], and the UK is the top destination for researchers receiving Marie Skłodowska-Curie fellowships[40].

International partnerships will be even more important as researchers work together to tackle the complex problems of our time. From climate change and epidemics to the growing burden of dementia, it is hard to see how any one individual, team or country could take on these challenges alone.

The research workforce is highly mobile – for example, nearly half of the research population in the UK have either stayed in Britain for less than two years or moved abroad for a similar period[41]. Research teams are typically international: Sir Mark Walport, Chief Executive of UK Research and Innovation, recently commented that "in any good lab you will find researchers from all over the world"[42]. However, in the wider context of international migration, the number of researchers moving between the EU and UK is small: in 2016 the total number of EU nationals in the UK's academic workforce was 31,635[43] and the annual flow is considerably smaller than this.

The overwhelming majority of those who participated in our Future Partnership Project stressed the need for easy mobility for researchers between the EEA and the UK after Brexit. Expansion of the current UK system for non-EEA workers – an option reportedly being considered by the Government[44] – would not deliver a successful post-Brexit migration system for researchers. This existing system is not quick or agile enough and relies too heavily on salary and qualifications as a proxy for skill.

It is therefore vital that the EU and UK agree a mutual, simple and quick approach to support full researcher mobility. This agreement should remain as close as possible to current arrangements, to maintain the benefits that free movement has delivered to European research. This can be consistent with public views: in post-referendum polling in the UK, only 12% of those polled wanted a reduction in highly skilled migration and nearly four times as many wanted to see more[45]; 70% believed 'special work visas' should be offered to academics from the EU[46]. Combined survey data from across 15 European nations, including the UK, similarly showed that 70% of those polled supported high-skilled migration to their country[47].

Any UK migration system or wider agreement with the EU must also support visa-free visits, temporary work, formal study in approved education establishments, and a clear and simple route to residency for those working here longer term. Our consultation identified the importance of including provisions for families in the future migration system so that the UK is an attractive place to move to. Businesses across Europe also called for simple continuation of intra-company transfers, and there must be simple provisions for science innovators and entrepreneurs, who may not be sponsored by an employer.

[1] House of Commons Library (2018), A Guide to the EU Budget, http://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN06455
[2] UK Government (2017), Collaboration on Science and Innovation – a Future Partnership Paper, https://www.gov.uk/government/publications/collaboration-on-science-and-innovation-a-future-partnership-paper
[3] Future Partnerships Project (2018), Consultation Report, https://wellcome.ac.uk/sites/default/files/consultation-on-future-eu-uk-relationship-on-research-and-innovation.pdf
[4] Future Partnership Project (2018), Consultation Submissions, https://wellcome.ac.uk/sites/default/files/future-partnership-project-submissions.pdf
[5] Future Partnership Project (2018), Roundtable Meeting on Scientific Advice, https://wellcome.ac.uk/sites/default/files/shaping-ambitious-eu-uk-partnership-for-scienctific-advice-roundtable.pdf
[6] Future Partnerships Project (2018), Chicheley Hall Meeting, https://wellcome.ac.uk/sites/default/files/future-partnership-project-chicheley-hall-meeting-attendees.pdf
[7] QS Top Universities (2018) World University Rankings 2018, www.topuniversities.com/university-rankings/world-university-rankings/2018
[8] Science Europe and Elsevier (2013) Comparative Benchmarking of European and US Research Collaboration and Researcher Mobility, www.elsevier.com/__data/assets/pdf_file/0019/53074/Comparative-Benchmarking-of-European-and-US-Research-Collaboration-and-Researcher-Mobility_sept2013.pdf
[9] European Environment Agency (2016), Population Trends 1950–2100: Globally and Within Europe www.eea.europa.eu/data-and-maps/indicators/total-population-outlook-from-unstat-3/assessment-1
[10] Universities UK (2017), International Research Collaboration After the UK Leaves the European Union www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2017/international-collaboration-uk-post-exit.pdf
[11] High Level Group on Maximising the Impact of EU Research and Innovation Programmes (2017), LAB – FAB – APP: Investing in the European Future We Want, ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/hlg_2017_report.pdf
[12] Bruegel (2017), The Challenge of China's Rise as a Science and Technology Powerhouse, bruegel.org/2017/07/the-challenge-of-chinas-rise-as-a-science-and-technology-powerhouse/
[13] Observer (2018), China's Great Leap Forward in Science, https://www.theguardian.com/science/2018/feb/18/china-great-leap-forward-science-research-innovation-investment-5g-genetics-quantum-internet
[14] Bruegel (2017), The Challenge of China's Rise as a Science and Technology Powerhouse, bruegel.org/2017/07/the-challenge-of-chinas-rise-as-a-science-and-technology-powerhouse/
[15] European Commission (2017), European Innovation Scoreboard 2017, http://ec.europa.eu/DocsRoom/documents/24829
[16] UK Government (2007), Corporation Tax: The Patent Box, www.gov.uk/guidance/corporation-tax-the-patent-box
[17] European Council (2002), Barcelona EUCO Recommendations, ec.europa.eu/invest-in-research/pdf/download_en/barcelona_european_council.pdf
[18] British Academy (2016), Annual Report, 2015–16, www.britac.ac.uk/sites/default/files/British%20Academy%20Annual%20Report%202015-16.pdf
[19] Universities UK (2017), Patterns and Trends in UK Higher Education, www.universitiesuk.ac.uk/facts-and-stats/data-and-analysis/Documents/patterns-and-trends-2017.pdf
[20] Observer (2017), Fears Grow Over EU University Funding as Grants Deceline Even Before Brexit, www.theguardian.com/education/2017/dec/03/eu-university-funding-grants-decline-brexit-horizon-2020
[21] Universities UK (2017), International Research Collaboration After the UK Leaves the European Union www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2017/international-collaboration-uk-post-exit.pdf
[22] Royal Society (2015) UK research and the European Union: The role of the EU in funding UK research https://royalsociety.org/~/media/policy/projects/eu-uk-funding/uk-membership-of-eu.pdf ,
[23] Mission of Norway to the EU (2018), Financial Contributions, www.norway.no/en/missions/eu/areas-of-cooperation/financial-contribution/
[24] Technopolis (2012), Norway's Affiliation with European Research Programmes, www.regjeringen.no/globalassets/upload/kd/vedlegg/forskning/rapporter/eu-forskningeng.pdf?id=2305819
[25] Future Partnership Project (2018), Consultation Submissions, wellcome.ac.uk/sites/default/files/future-partnership-project-submissions.pdf
[26] Commissioner Carlos Moedas (2018), ITRE Plenary, 23 January 2018, vimeo.com/252340730?ref=tw-share
[27] Future Partnership Project (2018), Roundtable Meeting on Scientific Advice, https://wellcome.ac.uk/sites/default/files/shaping-ambitious-eu-uk-partnership-for-scienctific-advice-roundtable.pdf
[28] Technopolis (2017), Impact of Collaboration: The Value of UK Medical Research to EU Science and Health, www.cancerresearchuk.org/sites/default/files/uk_and_eu_research_full_report_v6.pdf
[29] Stoddart et al. (2016), The European Union's Adequacy Approach to Privacy and International Data Sharing in Health Research. J Law Med Ethics 44(1):143–55
[30] Technopolis (2017), Impact of Collaboration: The Value of UK Medical Research to EU Science and Health, www.cancerresearchuk.org/sites/default/files/exec_summary_v11.pdf
[31] Technopolis (2017), Impact of Collaboration: The Value of UK Medical Research to EU Science and Health, www.cancerresearchuk.org/sites/default/files/main_report_v8.pdf
[32] Communication from the MHRA

[33] In 2016 the MHRA acted as the Reference Member State for around 30% of the Voluntary Harmonisation Procedure clinical trial authorisations that the UK was involved in. Clinical Trial Facilitation Group (2017), VHP Metrics on Participation of National Competent Authorities, http://www.hma.eu/fileadmin/dateien/Human_Medicines/01-About_HMA/Working_Groups/CTFG/2017_CTFG_VHP_metrics_participation_NCAs_2015-2016.pdf

[34] Technopolis (2017), Impact of Collaboration: The Value of UK Medical Research to EU Science and Health, www.cancerresearchuk.org/sites/default/files/uk_and_eu_research_full_report_v6.pdf

[35] Personal communication

[36] Technopolis (2017), Impact of Collaboration: The Value of UK Medical Research to EU Science and Health, www.cancerresearchuk.org/sites/default/files/uk_and_eu_research_full_report_v6.pdf

[37] Royal Society (2015), UK Research and the European Union: The Role of the EU in International research Collaboration and Researcher Mobility, www.royalsociety.org/~/media/policy/projects/eu-uk-funding/phase-2/EU-role-in-international-research-collaboration-and-researcher-mobility.pdf

[38] Department for Business, Energy and Industrial Strategy and Elsevier (2017), International Comparative Performance of the UK Research Base, www.gov.uk/government/uploads/system/uploads/attachment_data/file/660855/uk-research-base-international-comparison-2016.pdf

[39] Technopolis (2017), Impact of Collaboration: The Value of UK Medical Research to EU Science and Health, www.cancerresearchuk.org/sites/default/files/uk_and_eu_research_full_report_v6.pdf

[40] Technopolis (2017), Impact of Collaboration: The Value of UK Medical Research to EU Science and Health, www.cancerresearchuk.org/sites/default/files/uk_and_eu_research_full_report_v6.pdf

[41] Department for Business, Energy and Industrial Strategy and Elsevier (2017), International Comparative Performance of the UK Research Base 2016, https://www.elsevier.com/research-intelligence/resource-library/international-comparative-performance-of-the-uk-research-base-2016

[42] Times of London (2018), Scientists 'Should Escape' Post-Brexit Migration Curb, https://www.thetimes.co.uk/article/scientists-should-escape-post-brexit-curb-cbhkb2sct

[43] Royal Society (2015), UK Research and the European Union: The Role of the EU in International Research Collaboration and Researcher Mobility, royalsociety.org/~/media/policy/projects/eu-uk-funding/phase-2/EU-role-in-international-research-collaboration-and-researcher-mobility.pdf

[44]Times of London (2018), Ministers Back Removing EU Citizen's Right to Work in Britain after Brexit, www.thetimes.co.uk/edition/news/ministers-back-removing-eu-citizens-right-to-work-in-britain-after-brexit-p7776g53f

[45] British Future (2016), What Next After Brexit?, http://www.britishfuture.org/wp-content/uploads/2016/09/What-next-after-Brexit.pdf

[46] Ipsos MORI and King's College London (2017), Half of Public Support More Immigration by Highly Skilled Workers, www.ipsos.com/ipsos-mori/en-uk/half-public-support-more-immigration-highly-skilled-workers

[47] E Naumann et al. (2018), Attitudes Towards Highly Skilled and Low Skilled Immigration in Europe – A Survey Experiment in 15 European Countries, onlinelibrary.wiley.com/wol1/doi/10.1111/1475-6765.12264/full