HOUSE OF LORDS

SCIENCE AND TECHNOLOGY SELECT COMMITTEE

A time for boldness: EU membership and UK science after the referendum

Oral and written evidence

Contents

Academy of Social Sciences (AcSS), Research Councils UK (RCUK) and Elsevier – Oral evidence (QQ 11-19)

Evidence Session No. 2 *Heard in Public* *Questions 11 - 19*

TUESDAY 19 JULY 2016

Members present

Earl of Selborne (Chairman)
Lord Cameron of Dillington
Lord Hennessy of Nympsfield
Lord Hunt of Chesterton
Lord Mair
Lord Maxton
Baroness Morgan of Huyton
Baroness Neville-Jones
Viscount Ridley
Lord Vallance of Tummel
Baroness Young of Old Scone

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Examination of Witnesses

Sharon Witherspoon, Policy Chief, Academy of Social Sciences (AcSS); **Professor Philip Nelson**, Chair, Research Councils UK (RCUK), Chief Executive, the Engineering and Physical Sciences Research Council (EPSRC); and **Ron Mobed**, Chief Executive Officer, Elsevier

Q11 The Chairman: Could I welcome our three witnesses for the second session this morning? Thank you for joining us. As always, we are being broadcast, so I am going to ask you if you would like to introduce yourselves for the record. If you would like to make any introductory statement at this stage, feel free to do so.

Professor Philip Nelson: Good morning. As an introductory statement it is clear that Brexit has put a precious national asset at risk. Undeniably, there are some opportunities, too, but at the moment the focus has to be on managing the very severe risks that we face to UK science.

Sharon Witherspoon: I am Sharon Witherspoon. I am here for the Academy of Social Sciences, which is a national academy of academics, learned societies and practitioners—it goes beyond the university sector—in the social sciences. On this issue, as with many, we have worked alongside other bodies and certainly we are prepared to talk about the relationship with the Higher Education and Research Bill and to lay out the implications, both

positive and negative as we see them, of the referendum result. I believe the Committee has seen the professional briefing paper that we used to draw together the facts as we define them currently. The day after the referendum result we published one of two prepared briefing papers on the different models, and it might be worth talking about that.

Ron Mobed: Thank you for inviting us to present to the Committee. I will break with the other members and take the opportunity to make an opening statement.

I am the chief executive officer of Elsevier and, as such, I am not representing a research body itself but one of the largest providers of research information to the research community. As background, Elsevier is a business. We are headquartered in Amsterdam, but we are part of RELX Group, which is headquartered in London, and is one of the 20 largest publically quoted companies in the UK. About 10 million researchers access our data every month. That gives us an enormous perspective on the world's research and some ability to put the UK's research into context.

You have heard already about the UK's strength in research. The UK has about 1% of the world's population; 3% of the world's R&D expenditure; 4% of the world's researchers; and 16% of the world's most highly cited articles. That gives some kind of perspective about the current reach of UK research.

We have been asked to talk about funding and collaboration. You have heard already from others earlier this morning about the link between research volumes and quality and how that correlates with funding and economic benefit. One of the observations I would like to offer you is that as we look around the world in developed countries, particularly in the post-financial crisis period, many of these developed and developing countries examined their research spending as a source of reduction, and almost all of them took the step to continue with research funding or even to increase it because of its correlation with economic growth.

The second topic that you have asked us to talk about is collaboration. There has been a lot of talk about that and we have done a lot of research around collaboration and mobility in the UK and elsewhere. The UK has extremely high international collaboration rates. There are about 250,000 researchers in the UK at the moment. About two-thirds of them in the last five years have worked outside the UK. Forty-six per cent of UK researchers published articles with non-UK researchers. That gives you a sense of both the mobility and international collaboration that the UK currently enjoys.

However, to understand short-term linkages in the topic under discussion, these longer-term connections between research funding and output need to be looked at. You have heard the anecdotes. We hear them, too, but we would also like to support the idea that some of them are short-term responses to short-term uncertainty which may have long-term consequences. We heard right at the end a very good example of that. As we go into this, we would like to give you more examples. To understand what these short-term activities are, we need to supplement the data that we currently hold with the data that was talked about earlier this morning and, as a convening house or as a participant in other research and data-gathering activities in the UK, Elsevier stands ready to participate.

Q12 The Chairman: Thank you for that. I am going to start with a very general question which may get us into the discussion. I think you were sitting in on the earlier session and you will have heard the thoughts on the Higher Education and Research Bill which will receive its Second Reading today in the Commons—and, of course, we are starting the

negotiations on Brexit. Do you think that the two will run alongside each other harmoniously or do you think we should stall on the Higher Education and Research Bill?

Professor Philip Nelson: I think it is very important and I agree with the previous witnesses that we should press ahead with UKRI. We have been on this direction of travel for some time in the research councils and have been intimately involved with government in shaping that future. They have listened to us very carefully. We are heading towards a solution that can be made to work very successfully. It has the elements that will preserve the good things that research councils deliver at the moment while enabling the vision that Paul Nurse so clearly articulated of a stronger voice for science. Now more than ever we need that strong voice. So I am quite clear in my mind that we should be pressing ahead with that.

I echo the comments made earlier about the appointment of Sir John Kingman as our interim chair. He has already engaged with us very positively at the Research Councils, so that is definitely a step in the right direction. We also welcome the reappointment of Jo Johnson as Science Minister. The words "listening" and "thoughtful" were used earlier, and I would absolutely echo that sentiment. He has engaged very positively with us through this whole reform agenda. Finally, having Greg Clark, who has real experience as the Science Minister, as the new Secretary of State, is also a very helpful appointment. So we firmly believe that it would be mistake not to press ahead with the recommendations.

Sharon Witherspoon: The Academy of Social Sciences also welcomes the strategic viewpoint that the formation of UKRI would add and the explicit recognition of the importance of interdisciplinary research, because many of the challenges facing us—behaviour change in response to global warming, health-related behaviour change and so on—involve science and social science. I speak as someone who was a statistical social scientist. We need more of those skills.

I would point out that the Higher Education and Research Bill has three parts: two about teaching, one about research. It will be important, particularly in the light of higher education being split departmentally, that those are still considered in tandem and still have detailed parliamentary scrutiny. We have not yet put in a submission on the teaching excellence framework because it is not only the technical issues of the metrics but how you use the metrics to ensure a proper regulatory framework, particularly in plans for new providers, while not assuming that the world is simpler than it is in a multidimensional model that does not give added value.

We have produced a briefing paper which I believe many of you have on the part 3 research aspects of the Bill. Again, we welcome the strategic steer, but I think it is important to say that we have a number of detailed points which we had before the referendum decision that are strengthened by that. The current model brings a strong strategic voice but without the same duties to consult the wider research community. By that I mean to make sure you are taking a wide range of views rather than a small number of views about UK social science. We say that not just as social scientists but because we believe that it is true of all the sciences.

We have proposed a number of ways in which we hope that there will be consideration of the need for consultation and of the remit for public-benefit science. All of this takes place against not just the referendum decision but the real uncertainties about what that will mean for resources in the face of 150 years' experience of underinvestment comparatively

by the United Kingdom in science. It would be much easier to assuage fears about what this would mean if it was very clear soon that those budgetary difficulties are understood.

Q13 Baroness Morgan of Huyton: You were present for the previous session when we talked about this and you heard the anecdotes. Can you bring to our attention today any assessment that you have made yet or that you are proposing to make about the immediate impacts of the UK vote on UK science and, regarding this session, any impacts on business investment in R&D?

Professor Philip Nelson: The anecdotes are real, if I can put it that way.

Baroness Morgan of Huyton: Sure.

Professor Philip Nelson: There are multiple anecdotes. They are being collected by Universities UK. We have been engaged at the Research Councils with Universities UK, the Russell Group and the other representational groups across higher education. We have a meeting fixed fairly soon to bring us together still further. We have had conference calls about this issue. The data I have seen—turning anecdotes into data—is fairly compelling. Large numbers of these events are being recorded. However, as Lord Stern rightly articulated, it is too soon to tell whether this is significant when put into the scale of the activity. Remember, we have 1,366 ERC grants in this country at the moment, to give you an idea of the scale of activity. The stories we are getting in are in the tens, not in the hundreds or thousands.

Baroness Morgan of Huyton: Are the stories you are getting about staff, students or research funding?

Professor Philip Nelson: There is a range of things. For example, people declining offers of employment: that is certainly happening. The sorts of stories coming through are of people being asked to stand down from co-ordinating collaborative bids and being edged out from collaborative bids. The extent to which this is a knee-jerk reaction to the referendum is hard to tell. We have to let things settle and start looking at definitive data on quite what is happening out there in the bids that are going into Horizon 2020. The Prime Minister and the Science Minister were very clear that nothing has changed as of now—but clearly, in the minds of many, it has, so that is the risk we have to manage.

Sharon Witherspoon: It may be helpful to think about a distinction between anecdote, alleged facts, facts and statistics. Your Lordships know the general situation and that there are real grounds for concern. I view anecdotes as what is reported in the papers. Alleged facts are when you have an individual case and the allegation is that it is because of the referendum decision. Universities may then look at facts and say, “Looking at this, we think that is right”. Statistics are the aggregation of those facts. Facts will be easier to establish with collaborations on EU projects that are either already funded or well under way in their development. Writing the research bid takes several months, up to a year, maybe more. It is when researchers can say with confidence that they have been asked not to join a partnership or not to host or that they have been edged out. In the case of one of the larger social science infrastructures—the European Social Survey, which is an EU ERIC infrastructure project—there have already been discussions about what would happen to a project that has not only been funded but is the basis for a large-scale statistical social science collaboration across Europe.

In the case of potential new collaborations, where the lead time can be months or years, and assessment is another year or 18 months later, collaborators are looking to a future that may put them outside the Brexit timetable. In those cases, it is also harder to establish the facts about an individual case, such as who would have been asked. It is hard to use a counterfactual to establish that there has been any contravention of legal duty or any discrimination. So while I welcome—and while the Academy welcomes—the efforts that the Minister for Universities and Science has made about clear statements and working with the EU Commissioners about the legal situation, my colleague Ashley Lenihan and I have referred to this type of problem as "planning blight". It will be very hard to establish facts on individual cases. That is why we need statistics about outcomes, and we need them in a very timely fashion.

Up-to-date monitoring of applications going in, success rates, the proportion of cases where UK institutions are hosts and so on should be in place now. Our view is that it needs to be done in an official way through BEIS perhaps and collaboration with Universities UK, and I am sure organisations such as Elsevier, so that we are getting monthly or quarterly figures. I hate to use this trope but it is still the case that the owl of Minerva will fly out after dusk. You will find out what is going on afterwards, but at least it can be kept in public debate. This is one of many areas—and, again, I hope to get a chance to talk about it—where it is absolutely important that those figures are fed into the Brexit negotiations on a continuing basis with a strong voice.

Q14 Baroness Neville-Jones: I apologise for not being here at the earlier session. I need to declare my membership of the Engineering and Physical Sciences Research Council, Foundation for Science and Technology and the Quantum Technology Strategic Advisory Board.

I wanted to ask a follow-up question to yours, Chairman. I quite understand the thesis that you need to wait until you have some hard facts, but the trouble is that by the time those facts have hardened, so has behaviour. An interception of this behaviour is needed. This is not a research project; it is real life. I hope the notices have gone out to the universities telling them actively to input to various bodies. Secondly, is there any thought, presumably via the Government and the Brexit Ministry, about having early discussions with the European Commission on a code of conduct in the transitional period? I know that these things are difficult, but it seems to me that is where we need to be going extremely soon. Do any of the witnesses have a comment on this?

Professor Philip Nelson: I know that our Science Minister has been in contact with Commissioner Moedas on this very issue and he has issued a helpful statement—but, again, the difficulty here is indeed about new consortia being formed. As someone in the press put it, "If you're not invited to the party you don't know there's a party on". That encapsulates the idea. It is really hard to say what is happening out there. In terms of taking action now, certainly in Research Councils we look at the applications coming our way. There may well be a shift to research council applications in the light of the Brexit event. We are expecting the number of folks who apply to us to go up. We can capture that data very quickly and we will be doing that on a regular basis. So we can get some lead indicators from that point of view, but it is very hard to tell from the European Union end of things quite what is going on. We have a very effective office in Brussels—the UK Research Office—which is well staffed

and provides a great service to our community. It has already been gathering an awful lot of concerns and facts and feeding those into BIS. So far they have put three sets of questions into BIS. That sort of activity is being undertaken. We are taking all the steps we can at the moment.

At government level I have already discussed with the Minister the need for a very clear message making it crystal clear to people applying for Horizon 2020 grants now that they will be honoured in full in the future. The former Prime Minister made a statement in the House of Commons to the effect that all Horizon 2020 bids will be honoured, but it needs to be made clear that if you are applying for an ERC grant, which may last five years, that will be honoured in the future. Making statements such as that would be enormously helpful to researchers on the ground when they are considering where they should apply for research funding. So there are things that could be done to alleviate that situation.

Sharon Witherspoon: I certainly did not mean to imply that this would only be a research project. Getting statistics on a monthly basis would be very helpful in practical deliberations. It is also important that universities are in touch with the Minister for Universities and Science to ensure that specific cases—and I think we know of some specific cases of well-advanced research grants—are taken up swiftly. A lot of the planning blight will happen on the basis of those specific cases. There are many other things—and I am sure we will get to them in other questions—that I think government and others can do to protect not only EU collaborations and make use of what advantages there are.

I would also point out that even in the social sciences there are a number of existing plans for joint collaborations on framework programmes: for instance, programmes on the dynamics of income inequality, extended working life and health, welfare models and demographic change and a joint programme on sustainable cities and health, all being led by the ESRC. Again, it is very important that those continue during the period that those collaborations are in place.

Baroness Neville-Jones: I want to make two comments on what we have heard. On the whole I have to say that the two answers rather increase my level of anxiety if anything. The problem with statements from current or previous Ministers is that they are not entirely in control of the situation, so when they say grants will be honoured, what does that mean? It may mean—it could mean—that the UK will make up the difference. I would like to hear that but I have not.

The second thing I would like to say is what Professor Nelson said about not knowing what is going on is very important. That is why collection of evidence in this country will not in itself be enough. This is why I think we need to talk to the Commission. We need some rules laid down by it about future behaviour, with our agreement. I press the point that talking to the Commission in detail about a code of behaviour is going to be very important.

Ron Mobed: Could I answer this question and the previous one? It goes to the migration from anecdote to data that was covered earlier on. One of the things that we have a very strong perspective on is not only what happens in the longer cycle from research funding to research output into economic growth but some of the shorter-term activities both in the UK and the EU. We have a number of areas in which we can move a little from anecdotal evidence to data in the shorter term because it is these shorter-term decisions when uncertainty is high that may have longer-term impacts. For example, a few years ago we

convened eight universities in the UK to look at what would be an adequate set of credible research metrics to evaluate research quality and output over time. We called it Snowball Metrics. It was a programme that ran for about two years and ended up getting quite a high degree of alignment not only for the original eight but then expanded to others. That same mechanism could be used to look at ways in which we could systematically understand decisions being made on individual researchers' mobility or willingness to move. We could look at edited communications. We have something like 700,000 editors working with Elsevier today, of whom about 2% are based in the UK. Those networks operate on a daily basis. They are not long-cycle. We talk to our editors all the time. Those signals can be very immediate, high-frequency signals. They may not be precise at the beginning but over volumes they will become more and more precise.

We also conduct in-product polls on our platforms—I mentioned the 10 million researchers interacting with the platforms—to ask individual researchers to see if they are willing to give us data in volume about what they are seeing today. This could be in the UK or from EU researchers talking about their experience or non-UK researchers wondering about whether to come into the UK or where to source funding. We have already created a site on one of our platforms which is open for a two-week window to solicit from researchers their own experience over the last few weeks around any post-Brexit consequence that they have been facing. So we have a range. I do not want to take too much time, but I want to point out there are high-frequency, immediate signals that could be gathered which, when accumulated in volume, could give quite useful pointers to immediate activity which, when combined with the already established longer-term metrics that the world of research everywhere relies upon, could be very helpful.

Q15 Lord Vallance of Tummel: I would like to push a little further the question Baroness Neville-Jones asked you. Let us suppose that the anecdotes are indeed facts. We have a pretty good hunch as to what the problems will be. The issue is what the Government are going to do about it. Do the Government have an action plan and have you been able to influence an action plan? On the assumption these anecdotes are right, what do you want them to do?

Professor Philip Nelson: There are multiple dimensions to this. The first real issue for us is the people. It is about making sure that we can keep that very beneficial free flow of people into the UK research base. That is absolutely critical. We have already discussed that. We benefit enormously from having that cohort of EU staff in UK universities, as has already been articulated. There are 43,000 of them there at the moment. This is a crucially important population of staff, all making great contributions to our science base. The point was made earlier that the distribution of those staff may well be more concentrated into more research-intensive institutions. For example, in the Crick Institute in London, 34% of its group leaders and 56% of its post-doctoral researchers are non-UK EU nationals. We have a real issue in ensuring the continuity of employment of those people and reassuring them that they have a future here. That is number one.

Number two, the funding, as has already been articulated, is clearly very important. It amounts—and again I am in accord with Lord Stern on this—to getting on for £1 billion a year. That is a big chunk of money when you think about a system that is run on a knife-edge regarding financial sustainability. Lord Stern articulated it beautifully: 0.5% of GDP is what we spend and it is half of what other developed nations—our competitors—spend. That

reduction in funding is critically important to the whole risk picture. Mitigating that risk by some means is clearly going to be very important. It speaks for itself. Those are the two main issues: the people and the funding.

Lord Vallance of Tummel: Can I push slightly further on the people issue? Are you really saying that what you want is free movement of people across Europe in the research operation?

Professor Philip Nelson: As I said, we have benefited hugely from that as a policy. I can see that this is all tied up with much bigger politics, and that is one of the real problems here. We would absolutely recognise how well this has worked for us in the UK research base. It has been enormously beneficial.

Lord Vallance of Tummel: But if you do not ask, you do not get.

Professor Philip Nelson: We have to somehow enable the very easy movement of people through that research base in Europe.

Sharon Witherspoon: I would like to first welcome protocols for good practice. However, it is urgent that over the next days some cases are assembled that can be taken up very actively with the Commissioner and examined and dealt with. There are some large cases pending.

Secondly, we have talked about research funding and one point that perhaps did not come through in Lord Stern's excellent evidence is in the case of social sciences it has not just been the flat funding from research councils; it has been a real decline in government direct spend on social science. There has been a very hard evaluation of science, understandably, partly as a result of the fiscal crisis and the fact that research budgets are quick and easy to cut. So EU funding played a large role there.

Statements about funding will be important and it would be nice to see statements in principle that it is a high priority for this Government, recognising the role of research, for public benefit and for economic growth, to consider what would happen with the loss of the EU budget and the money we put into the EU research funding, bearing in mind that we are a net beneficiary. We get more money out than we put in. So there is a set of issues there about funding.

One of the big issues—and I will come to staffing in a second—is the collaborations, infrastructures and partnerships that again were spoken about in the last session. It is clear that Brexit negotiations will be very complex. I understood the discussions about Norway versus Switzerland as compared to Tunisia, Israel, Georgia and Bosnia-Herzegovina. There is a problem in that there is no existing template for retaining access to collaborations, partnerships and infrastructures that involves not only a funding contribution but a link to freedom of movement. In our briefing paper we go through the differences between the Norwegian model, where it is a member of the European Economic Area, and the Swiss model, where it is currently having negotiations because of a decision taken in 2014 to limit freedom of movement. The other models are all bilaterally negotiated, some for very specific aspects of EU funding such as capability funding or very particular programmes. Each of those other partners not only represents a far smaller amount of research money given by the EU but comes with very clear limits to what they can take part in.

I have seen discussions about an EEA-minus option and there will be a question about whether that is going to continue to be the case. If it is, those questions of international

collaborations elsewhere, or what negotiations may need to be made separately for the UK, need urgent attention. They cannot wait and be an afterthought in the Brexit negotiations.

One of our recommendations—I have seen it elsewhere—is that there should be very strong and early input of a voice in the EU Brexit negotiations on these issues. The Minister of Universities and Science or the Secretary of State for Exiting the European Union could become part of those deliberations. It will not be enough to add them on later.

Finally on staffing, it is clear that this is a major issue. Again, from the social science point of view, which shares features and statistics very similar to those of other sciences, there are particular issues, for instance with quantitative social sciences and with survey methodology, where EU staff have played a disproportionately important role. I would say whatever other discussions are going on around general freedom of movement, one of the opportunities, or certainly one of the requirements as a result of the referendum, is that there are very clear discussions between what will now be DfE, BEIS and the Home Office about what the visa regime for skilled university and science staff should be.

Ron Mobed: Can I offer an example from the world of business, and also an observation? First, the observation. In countries that have gone through much more severe disruption in the world of research funding than we are facing today in the UK, we have observed a few things where Governments and research universities have tried to navigate through uncertainty, which is where we are today. One of the things that we have observed is the consistency of message from government and from the institutions, even in the face of some uncertainty, around what is not changing: the commitment to research, the commitment to excellence, or whatever those messages, agreed and aligned, might be. That repetition and alignment of message seems to play a great part in reassuring individuals as they are trying to make their own personal decisions.

Secondly, there is the ability to eliminate extremes. During these periods of uncertainty, one of the things that tends to happen is to go to the extreme. To the extent that the messages can be brought closer towards the centre, it also tends to have a reassuring effect.

On a business example, Elsevier employs about 1,100 people here in the UK. One year ago we opened the largest of our research and development centres, which is a software development and technology centre for building research platforms here in London, in Finsbury Square. We have 200 software developers, computer scientists and data scientists working in that location. Sixty per cent of them come from non-UK EU countries. I was there last Friday talking to them, and they had already had a series of messages to try to create some kind of reassurance without overpromising. What we found when we went there on Friday was that having that consistency of message, even though there remained some uncertainty and anxiety, and the fact there was some principle or idea being put forward—a recognition of the uncertainty that was being created, not just from a business standpoint but from an individual standpoint—seemed to be helpful. It is early days. People will make their own individual decisions. They may not tell us about them until after they are made but certainly we are finding that communication, even in uncertainty, is extremely important.

Q16 Lord Maxton: First, may I say I have no interests to declare except to say that I voted remain in the referendum. By the way, I voted the other way in 1975. One of the big issues in the referendum was immigration: the free flow of people from Europe. One of the problems science has always had in this country, or so I have been told, is that we are very

good at research and creating ideas but we are not very good at producing the technicians and the people who can then put them into practice. To what extent does Brexit mean that the flow of people from Europe to do the technical jobs lower down the scale from the scientists doing the research is going to be affected? Is a problem that we are going to have? In Scotland there has been a major cutback by the Government in further education colleges, and therefore a cutback in the flow of those particular people. Are they going to be coming from Europe or not?

Professor Philip Nelson: It is a good question. The extent to which we convert science into economic well-being has been transformed in this country in the last 20 years during my career. We have got an awful lot better at that. If you look at the spinouts generated per pound spent or the number of patent applications filed per pound spent, when we normalise it on that small denominator we end up being really high up the list. We are right at the top of the world in some of these measures as a consequence of some very sensible interventions by Governments in the last 10, 15 or 20 years. So I would certainly challenge the idea that we no longer convert science into economic benefit. Again, as Lord Stern articulated very clearly, it is at the heart of modern economic growth; a knowledge-based economy is going to be essential for our well-being.

When it comes to skills, as time goes on the skills required become more and more sophisticated, and our system has been very effective at training graduates at masters and doctoral level to go out and work in very high-technology employment. That is a massive risk that we face through not being able to sustain that sort of supply if we are cutting off an awful lot of talent from coming here. I do not have any facts further down the list of levels of skill, but I take the point that technician skills are very important to these activities across the board, and we need to pay attention to that.

Q17 Viscount Ridley: Most of my question has been discussed fairly comprehensively in the last few minutes, but I would like to press one particular point a little further. Before we got into the argument about the referendum, one of the big concerns of universities was the lack of easy access to talent from around the world—the way that this Government had cracked down on migration in an attempt to control it and, because they could not control EU migration, they were controlling non-EU migration, and that was making it hard to get visas for professors, engineers and so on. As Sir James Dyson put it, “You can’t get a visa for a physicist from Taiwan because baristas from Bucharest can come in in such numbers”. At this moment is it not very obvious that we need to be pushing the Home Office very hard and to say, “Brexit is happening and at some point that is going to cause a diminution of non-skilled migration from the European Union. This is the moment to open up and make it much easier to get visas for skilled migrants from elsewhere in the world”—because, after all, 80% of STEM graduates in the world are not EU educated?

The Chairman: Mr Mobed, would you like to answer that as it is specific to your business?

Ron Mobed: As I mentioned, we have about 1,100 employees in the UK. We have 7,000 around the world and the group itself has 30,000 spread around the world, of which fewer than 5,000 are in the UK. So we are quite comfortable placing our activities where we can find business and where we can find the right types of people. In the last few years we have been able to expand our operations in London quite a bit, partly because of the local labour pool and partly because we have been able to find people to come in either from the EU or

from outside the EU with visas. To the extent that that continues, we continue to be comfortable. To the extent that it becomes severely compromised, of course, any business makes exactly the same calculation every day of the week as to where to place its activities related to the business opportunity and the resources that are required to take advantage of that business opportunity.

Sharon Witherspoon: Irrespective of views about whether there is a direct trade-off, it is absolutely essential that the Home Office has discussions with both DfE and BEIS, putting forward the need to change the general view about visas. The Academy of Social Sciences has seen evidence about the number of hoops that people have to jump through, particularly in shortfall areas.

In addition to the well-known issues of international migration, this also goes to a long-standing debate about the quality of scientific, mathematic and technical education in the United Kingdom. Successive Governments have made various attempts, perhaps less evidence driven on all sides than they should be. I cannot help but observe that it is a pipeline which starts in primary school. A lot of our attention right now is on the universities and higher education. It is important in maths education that you think about the pipeline through primary school and whether the qualification system in secondary school, which is still—and perhaps increasingly—narrowly focused on three A-level subjects, is the right way forward. I am sorry that Lord Hunt is not here to hear this. There are a number of ways in which, in the medium and longer term, this will pose challenges for what the UK should be doing for its own education of those skilled subjects.

Q18 Lord Mair: My question is for Professor Nelson. We have talked a lot about funding and people, but we have not spoken very much about facilities. There are some major EU research facilities that we host here in the UK. There are also a lot of EU research facilities to which our scientists and engineers have access. What do you think will happen in respect of those facilities?

Professor Philip Nelson: It is vital that access to those is sustained. There are two types of facility. There are those funded by the European Union. This Committee's excellent report on the subject highlighted five or so research infrastructures that we host here in the UK. It is going to be critical to sustain our involvement in those by some means. There are other facilities to which we subscribe and in which we take part. CERN is a classic example. It is not run by the European Union, but many of these get large amounts of funding from the European Union. I think this is absolutely critical. The UK earned about €273 million of investment into this country for research infrastructures in the UK in Framework 7, for example. So this is another very important consideration. Frankly, it is going to be difficult to disentangle all this from the bigger negotiations—which goes back to the point made earlier that it is absolutely critical that science has a seat at the negotiating table here. It really is very important that we are involved. Again, your own excellent report pointed to the fact that 18.3% of the money that comes back to the UK is for research and innovation. That is a big chunk of the money that was coming back our way from the European Union, and it is absolutely critical that we are represented in those negotiations through the forthcoming months.

Lord Mair: What do you mean by "seat at the table"?

Professor Philip Nelson: I think we need to see what the shape of the table is first, if I can put it that way. I am not sure how this is going to work. It is all very early days. Clearly we have a Minister in charge. Again, it was suggested that our Science Minister and indeed our Secretary of State are well qualified to participate in those sorts of discussions. They both have a good grasp of UK science and are great supporters of it. I would hope that something like that might be done to ensure that we have a strong voice at ministerial level.

Baroness Neville-Jones: There will have to be official-level negotiations on the detail, so I think it will be at all levels.

Q19 Baroness Young of Old Scone: The question I was going to ask has been answered in the previous discussions. Mr Mobed, you have done work in the past on the international comparative performance of the UK research base. How quickly does that body of information bring to the surface some of the lead indicators of what is really going on?

Ron Mobed: The traditional and most well-established metrics around research effectiveness tend to have a three to five-year time lag between the activity and the output. Over the last five years, every second year BIS has commissioned a report on the UK's research competitiveness. That report has been compiled by Elsevier, and the reason Elsevier was chosen is because of the body of data that we have. These reports end up having something like 3 billion data points in them, which are then analysed using high-performance computing to extract the insights by department: for example, how strong is UCL's linguistics department compared to MIT's linguistics department? That can be aggregated at country level and compared with any country or institution in the world. But these have relatively long lags and the data can be supplemented by shorter-term data that give earlier signals as to what might be happening today. While these signals are gathered in a less systematic way today, the opportunity is to use existing networks, some of which I have described already, together with organisations such as the ones represented here, to create for the UK a set of short-term data points that have much more immediacy, which, when combined with the medium and longer-term data with which we are already relatively familiar, can give an insight as to what is happening today, what consequences we are seeing today, and can also help us understand a disturbance happening today and the impact it might have in three, five and seven years' time.

We can look at this data going back over time in other countries. We did a study a few years ago of a country that had decided to significantly reduce its emphasis on scientific research and the information around that. In the first year they saw no impact whatever. In the second year they saw a slight drop in output: the number of research papers being produced. In the third year they saw an enormous drop in the quality of those research papers. The reason it took so long was that the quality had already dropped but the visibility of the drop was only apparent two years on. In the situation we are talking about today—as Lord Stern said earlier—waiting for two years to see the impact means that we have lost two years. On top of that, long-term decisions have been made by individuals and institutions which then extend the period of consequence significantly beyond the two years.

The Chairman: Unless any of my colleagues have further questions to put to you, we have probably reached the end of this session. It has been a very helpful session and has complemented very well the earlier session. I know we all echo Professor Nelson's concern that science should take a seat at the Brexit negotiation table. We are all a bit puzzled as to

what the shape of the table is, as he is, but nevertheless it is a critical part of the EU negotiations and we hope that the Government will put that to the front of their mind. We will do all we can to make sure that it remains there. We are going to start a summer recess but we will return to subjects allied to what we have been talking today in September, and indeed in October, and I am absolutely certain that we will wish to keep a close watch thereafter. Thank you to the three of you for your help this morning.

Alzheimer's Research UK and Alzheimer's Society – Written evidence (EUF0007)

Summary:

There are currently 850,000 people living with dementia in the UK, with very few effective treatments and no cure for this devastating disease. Until recently, research into dementia has been largely neglected, with the amount spent on dementia dwarfed by what is spent on comparable conditions such as cancer and heart disease. We desperately need long-term, sustainable research funding that is proportionate to the economic and social impact of the condition.

The UK has been a world leader in the fight against dementia over the past six years. In the foreword to the Prime Minister's challenge on dementia 2020 David Cameron stated that he wanted Britain to be the best place in the world to undertake research into dementia and other neurodegenerative diseases. Our political efforts have placed us at the forefront of countries working on dementia – leading the first ever G8 summit on dementia in 2013 being a good example. However we must now ensure that our role as global leader on dementia research is not lost as we start negotiations to exit the European Union (EU).

UK membership to the EU has been broadly favourable for the dementia research environment across a number of important factors. As negotiations to depart begin, it is essential that minimal disruption occur to the current research environment, as advances in dementia research could potentially be delayed and avenues of inquiry abandoned as a result. Alzheimer's Research UK and Alzheimer's Society urge policy makers to make supporting dementia research in the following areas a top priority:

- **Scientific representation during Brexit negotiations**
- **Continued access to EU funding programmes and schemes which are vital for dementia research**
- **Scientists and other staff supporting the research environment must have continued mobility – both UK nationals to Europe and vice versa**
- **Continued support for collaboration and allowing the UK to remain a positive force in developing a harmonized research environment across the EU**
- **Access to new treatments when they become available as part of a continued relationship with the EMA**

About Alzheimer's Research UK:

1. Alzheimer's Research UK is the UK's leading dementia research charity, and the second largest charity funder of dementia research in the world. We are funding £33 million in world-class research at leading universities and research institutions across the UK and to date have funded £61 million in research projects. As research experts, we are committed to finding new ways to diagnose, prevent, treat and cure dementia.

2. Our research strategy is targeted to deliver research that offers the most potential for health benefit. Increased and sustained investment in research is critical to help deliver the treatments and outcomes that will offer hope to people living with dementia and reduce the massive societal and economic burden.

3. Our Defeat Dementia campaign to raise £100 million over five years will make a significant impact on the research landscape, adding capacity and expanding promising avenues of discovery. However, we will not defeat dementia on our own. Organisations and governments across the globe need to share a vision of a world free from dementia, and support policy and funding that fosters the best research environment. The UK has a unique combination of resources in leading scientists and research infrastructure, and in public support for dementia research. With growing support from government, the private sector and charities, this environment is fertile for progress against this devastating condition.

About Alzheimer's Society:

4. Alzheimer's Society is the UK's leading dementia care and research charity. We are the only dementia research charity to fund research into the cause, cure, care and prevention of dementia, to improve treatment for people today, and search for a cure for tomorrow. Since 1990 we have funded £30 million in dementia research projects and we have pledged a further £150 million to dementia research over the next decade.

5. Alzheimer's Society and Alzheimer's Research UK are founding partners of the new Dementia Research Institute (DRI) and have contributed £50 million each to the establishment of the Institute. The DRI is being led by Medical Research Council and the UK Government have pledged £150 million towards the Institute.

Priorities for Government negotiating a new relationship with the EU

6. *Continued access to EU funding schemes and programmes*: The UK is a world leader in dementia research, funding more in the area relative to other disease areas than other EU member states.[1] In the historically underfunded field of dementia research, EU investment is particularly critical. EU funding has become an important source of support for the research environment in the UK, and the loss of access to EU funding programmes could have a significant impact for major and pilot projects as well as grants for equipment for dementia researchers. Funding through just one of the strategic budget areas of the EU in 2013 produced over 20,000 publications in prominent peer-reviewed journals, including 909 in the area of neuroscience.[2]

[1] Alzheimer's Society Research Report. Table B3. 2015. https://www.alzheimers.org.uk/site/scripts/download.php?type=downloads&fileID=2767

[2] Seventh FP7 Monitoring Report 2013. European Commission. 2015. http://ec.europa.eu/research/evaluations/pdf/archive/fp7_monitoring_reports/7th_fp7_monitoring_report.pdf

> "Over the last 10 years, around 70% of my funding for research has come through EU grants. If the UK loses its access to EU funding, the government will have to compensate for this or UK research will lose out financially, on top of losing out by not being able to engage in large EU projects in which collaboration with the top labs in Europe is essential…Collaboration is a two-way process, the UK was gaining by being able to be part of EU consortia and the research in European consortia was stronger by having top UK labs in them, both parties will end up losing out." – *Researcher from an EU member country, currently working in the UK*

7. The EU FP7 investment strategy (the most recent for which data in this area has become available) included a funding stream for brain research with a particular emphasis on the translation of basic discoveries into clinical applications. In the first three FP7 calls, 30 neuroscience projects were funded totalling €135 million (£115 million.) Projects ranged from basic to clinical research, including the identification of genes and molecules present in brain diseases, the pathophysiology of diseases, and the development of new therapies and diagnostic tools.[3] Research relevant to neuroscience was also funded in other health priority areas, leading to an additional €247 million (£210 million) dispersed to an additional 49 research projects.

8. Dementia researchers in the UK, supported by funds from Alzheimer's Society and Alzheimer's Research UK, have been successful in leveraging significant additional investment from the EU for cutting edge dementia research projects. Pilot, equipment and major project grants have all been means to strategic collaborative funding from the EU research funding frameworks:

- An Alzheimer's Research UK funded researcher acts as the co-coordinator of the Innovative Medicines Initiative (IMI), a €48 million EU-funded public-private partnership. This came as a result of over £850,000 from an Alzheimer's Research UK major project grant on combinatorial biomarkers for dementia prodromes, prediction, pathology and progression.
- An Alzheimer's Research UK pilot study granted to investigate alpha-synuclein in plasma as a possible diagnostic marker for synucleinopathies led to further funding to participate in the EU-wide project NEUROSCREEN – Early, differential and progressive blood and cerebrospinal fluid test for neurodegenerative dementia – and Marie Curie Training Network NEURASYN – Alpha-synuclein-related brain diseases – worth a total of €7,570,000.
- An Alzheimer's Research UK grant awarded to in 2007 to purchase laboratory equipment, including a microscope for live cell imaging and a plate reader, helped a UK research group to secure a total of €1.3 million from the European Commission to work on stem cells as models for biological assays of new drugs and predictive toxicology.

[3] European Commission. Major and Chronic Diseases. Website accessed February 2016. http://ec.europa.eu/health/major_chronic_diseases/diseases/dementia/

- Alzheimer's Society has awarded two grants to the PREVENT Research Programme which is a cohort that feeds into the €54 million EU-funded European Prevention of Alzheimer's Dementia consortium (EPAD). EPAD is an initiative to improve the understanding of the early stages of Alzheimer's disease. It is creating a virtual European register of around 24,000 people who are then invited to join a research cohort. The first person to be recruited to a prevention clinical trial in EPAD was from PREVENT.
- Alzheimer's Society has contributed to a clinical trial of the rheumatoid arthritis drug etanercept as a potential dementia treatment. This trial (InMiND) is funded through an €11 million EU Horizon 2020 framework grant.
- The EU has prioritised neurodegeneration research including dementia, recognising it to be an area of dispersed activity and low funding compared to other disease areas. This has led to Joint Programming in Neurodegenerative Research (JPND) funded by the EU in 2011 to produce a co-ordinated strategy that addresses the challenge of neurodegenerative diseases and to align actions and strategies across countries. Whilst calls issued by JPND are funded by contributions from participating countries rather than central EU funds, the JPND initiative has seeded a large number of UK collaborations with EU countries.
- Alzheimer's Society awarded specialised Knowledge Exchange grants in 2015 so that researchers in the UK and the Netherlands can share ideas, techniques and protocols. The fellowships involve the researchers travelling between the two countries. These 7 fellowships (4 awarded by Alzheimer's Society and 3 by Alzheimer Netherlands) cover a range of different areas of dementia research, including both biomedical and care research. Alzheimer Nederland is one of the world leaders in care research. Being able to continue collaborations with them is vital to care research in the UK which benefits people living with dementia today.

> 'Social care is generally neglected, both in terms of practice and research. Withdrawal of additional funding streams is likely to reduce our ability to research dementia care in the UK.' – *Care Researcher from an EU member country, currently working in the UK*

> "A pause of funding will leave excellent researches stranded which will lead to a decreased research output. This will be noticed by the general public in 10 years as there will most likely a drop in new breakthroughs and potentially treatments." – *Researcher from an EU member country, currently working in the UK*

9. There is no foundation to assume that additional funds would be directed from the UK Government to medical research to support losses to current EU-funded projects. Further, centralised EU-level funding facilitates international collaborations and centres of excellence that are a complement to UK funding streams, but which could not be easily replaced by a domestic funding stream. Therefore, access to EU funding must be maintained in order to provide the greatest opportunity to accelerate advances in the dementia research field.

> "I and many colleagues are EU citizens, and we have some concerns about our future rights in the UK. Without freedom of movement, I might not have come to the UK in the first place (over 10 years ago), but may have pursued my career elsewhere (e.g. Canada or US)." - *Researcher from an EU member country, currently working in the UK*

10. *Maintaining mobility for researchers and staff*: Some 26% of academic staff in UK universities are non-UK nationals,[4] filling essential functions within the research environment. Twenty-nine per cent of Alzheimer's Society funded fellows have undertaken work or study in the EU and 11 out of 15 researchers surveyed stated that the loss of potential future opportunities for collaborative research with EU members following leaving the EU was of the 'greatest concern'. Academic and industry employer groups have voiced serious concern over current immigration policy for non-EU citizens, particularly in light of skilled worker caps and issues within the existing visa system. Extending these issues to include the current EU workforce within the UK would have wide-ranging implications for the research sector and almost certainly negatively impact the small dementia research field. For every seven scientists working in cancer, there is only one working in dementia research,[5] and the loss of even a fraction of the workforce could have an enormous impact on progress.

> 'There are a great many talented dementia researchers in the EU. While arrangements may emerge to ensure they can work here, the message they are currently receiving is that the UK does not welcome foreign workers (and I say this as a non-UK, EU citizen).' – *Care Researcher from an EU member country, currently working in the UK*

11. Both UK and EU researchers may already be experiencing professional obstacles, and a protection for their ability to remain in the UK and receive funding in their field should be considered at the forefront of negotiation. The UK must support mobility for those who contribute to the advancement of science and research to maintain the UK's world-leading environment. While there is an opportunity to address migration issues for both EU and non-EU staff in research settings, it must be achieved with minimal burden or disruption for those EU nationals already engaging in research in the UK.

> 'I am considering moving my family (which includes UK and EU nationals) out of the UK, as our future is uncertain here. Other researchers I know are thinking the same thing – *Care Researcher from an EU member country, working in the UK*

[4] Immigration: Keeping the UK at the heart of global science and engineering. Campaign for Science and Engineering. 2016. http://www.sciencecampaign.org.uk/caseimmigrationreport2016.pdf

[5] Marjanovic et al. A review of the dementia research landscape and workforce capacity in the UK. Report by RAND Europe for the Alzheimer's Society. 2015. www.rand.org/t/rr1186

> "Many UK labs are funded on the transfer of staff and skills across Europe. Without this we risk stagnation and isolation. In my view, there is not sufficient talent in the UK to sustain our current global position. Increased visa costs will also impact on this problem. Recruitment is definitely proving more difficult since Brexit, at all levels." - *Researcher from the UK, currently working in the UK*

12. *Ensuring harmonised regulation of research*: Recent areas of consideration for the EU, including the use of health data and animal models, have had important implications for dementia research where the slow progression of diseases in the brain present unique and difficult challenges to the development of treatments. In both cases, the UK has been a leader in good policy and been effective in influencing EU regulation to responsibly support medical research. A regulatory landscape that remains aligned in the near future, though potentially cannot be maintained long-term, provides the greatest stability for dementia research and in the current environment is the most advantageous relationship for UK scientists.

> "Now we can order and ship goods and samples seamlessly across the EU, just as easily as within the UK. In contrast, ordering materials, equipment, or biological samples and materials from outside the EU is far from seamless - because of the time taken for Customs clearance, delivery always takes longer, there are always additional costs, we often have to deal with additional queries from Customs or the shipping agent before goods can be released, and sometimes even harmless materials (e.g. antibodies) are held up for so long that they arrive unusable." - *Researcher from the UK, currently working in the UK*

13. Researchers in the UK currently benefit from the ease and reliability of ordering goods such as materials, equipment or biological samples as part of the Single Market. Should customs processes between the EU and UK be reintroduced, the speed and efficiency of research could be impeded. An associated increase in costs could also necessitate that a proportion of research funding be deflected away from research itself and towards administrative burdens.

> "The UK risks a decline in the number of patients that can be recruited for participation in multi-centre trials. Many of the Alzheimer's patients that have taken part in my research have been tested in other EU countries." - *Researcher from the UK, currently working in the UK*

14. Additionally, the EU has prioritised addressing some of the technical, linguistic and cultural barriers that exist in research, making previously unavailable data sets and resources accessible to UK scientists. A portion of the diseases that cause dementia

are rare or ultra-rare (each affecting less than 0.1% of the UK's population[6]) and the ability to study large population groups has numerous benefits. Large data sets that advanced the study of genetics and cancer have begun to unravel complex risk factors for dementia, informing public health initiatives across Europe. The availability of EU survey data also facilitates longitudinal studies, which have a critical role in understanding long term conditions like dementia. While alternative data sets and population groups exist outside of the EU, there would be a period of disruption to the medical research environment as a whole if researchers were to no longer be able to access EU resources of this type because of regulatory barriers.

15. *Protecting access to patients*: It is vital there is no delay for UK patients as a result of the exit negotiation in accessing new treatments for dementia when they become available. For the biomedical industry, the UK is only 3% of the global market, whereas Europe is the largest single global market.[7] The EMA collaborates closely with MHRA in conversation with other regulators around the world to support advancing treatments for dementia. However, the EMA is positioned to take forward conditional licensing and parallel review processes alongside the US Food and Drug Administration that would bring increased efficiency to the European market, making licensing authorisation attractive to industry.

> "I cannot see anything but increased costs associated with administration related to drug trials, ethics and regulations via Brexit changes. This could impact on the ease of access to new treatment trials and new drugs for patients in the UK." - *Researcher from the UK, currently working in the UK*

16. Treatments for dementia are still in the development stage, but drug development experts and others in the field anticipate specific challenges for the licensing and uptake of the first generation of disease-modifying treatments because of the expense and difficulty in showing efficacy. Delay and expense in accessing treatments could be caused by a departure from the EU that separates the UK Medicines and Healthcare products Regulatory Agency from the close working relationship it maintains with the EMA.

5 September 2016

[6] The UK Strategy for Rare Diseases. Department of Health. 2013. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/260562/UK_Strategy_for_Rare_Diseases.pdf

[7] EU Impact on Life Sciences. Fresh Start Project Inquiry with George Freeman MP. 2014. http://www.eufreshstart.org/downloads/lifesciences2.pdf

Association of Innovation Research and Technology Organisations (AIRTO) – Written evidence (EUF0008)

AIRTO, the Association of Innovation, Research & Technology Organisations, welcomes the House of Lords Select Committee's follow-up investigation on EU membership and UK Science. I see that the Committee has included in the volume of evidence (published on its website) AIRTO's written evidence submitted to the Committee in November 2015.

However, since June 2016 the outcome of the EU Referendum has significant implications for UK science and innovation. Our immediate concern as the representative body for the UK's £8Bn[8] Innovation, Research and Technology (IRT) sector is to limit any negative impact on both the sector, and on UK science and economic growth more widely, and ensure that UK science and innovation remains well-resourced - both in terms of ability to access established partners and sources of finance. AIRTO is keen to assist in this process and to provide any necessary understanding of the vital issues now likely to affect innovation, jobs and the economy, together with the continuing strength and competitiveness of the UK's IRT sector. Attached is a summary of key topics of particular immediate importance.

IMPACT OF LEAVING THE EU – Key threats and opportunities identified by AIRTO

Collaborations
There will be an impact on the UK's capacity to partner with: i) other Research & Technology Organisations (RTOs) and academic institutions in the EU; ii) large business partners; iii) SMEs. In the long run, there will also be an impact on key regions through lost opportunity to leverage EU structural funds. **Action: the UK needs to plan additional outreach activities to EU partners, e.g. via UKTI, to ensure that the UK continues to benefit from collaboration, especially in large consortium opportunities.** The UK government guarantee to underwrite funding for those participating in EU projects at the point at which the UK leaves the EU is welcome, **but needs to be well communicated to EU partners**. **Arrangements for permitting continued participation in new projects thereafter need to be clarified very soon if a damaging hiatus in UK involvement is to be avoided**. **Clear guidance is urgently needed on whether UK organisations should be planning further funding applications to the EU ahead of the anticipated invocation of Article 50. The risk to businesses of engaging in new activities without clarity and assurance of continuity are mounting. This all needs as much clarity as soon as possible and deeds from government, as well as encouraging words.**

The exploitation of results and outcomes from collaborations in the research arena
This also needs careful attention. Without access to the single-market and agreements on passports and/or equivalence of regulation and certification procedures, it is likely that the UK will be unable to exploit collaborative research outcomes fully and will find itself barred from significant procurement opportunities from within the EU. This will be particularly damaging to strategically important high technology, high value adding products and service

[8] The impact of the Innovation, Research and Technology sector on the UK Economy; Oxford Economics, November 2014

businesses. The complexity, cost and time required to set up the necessary arrangements and regulatory systems from outside the single market should not be underestimated.

Free movement of researchers and students
The scarcity of skills to underpin innovation is a major challenge for the UK. The free movement of people is currently a benefit of EU membership, but may be negatively impacted, and this would be very detrimental to IRT sector organisations wishing to attract EU talent. This would impact negatively on our capacity to work collaboratively with many of the world's leading EU partners. **Action: the UK needs to ensure the continued free movement of people coming to the UK to study and work in UK science and industry. In addition, the UK needs to see free movement of British nationals across EU borders for the purposes of study, research and innovation endeavours**.

Continued access to funding *and* EU-funded research facilities
Continued access to, or replacement of, EU multi-annual Research and Innovation Framework Programmes must be ensured. The UK currently benefits by receiving over £1bn per year from these programmes, getting back far more than it contributes via its membership subscription. This incoming funding from the EU also leverages vital UK private sector investment in research & development which will almost inevitably diminish further without access to such programmes.

There is a very immediate concern for clarity in the transitionary period leading up to exit; AIRTO's members are seeing that European partners are now reluctant to engage with UK-led projects given the future uncertainty over relationships. This is damaging and could start to threaten jobs in the IRT sector. **Actions: to sustain the capacity and vibrancy of innovation in the UK either: i) the new arrangements being negotiated with the EU must maintain access for the UK to Europe's Framework Programmes; or ii) some of the EU subscription money reallocated on exit to UK national priorities must go to support innovation, ideally via Innovate UK. An opportunity exists to capitalise more advantageously on deployment of such UK national innovation funding by dropping the EU's state aid and procurement rules.**

Science, research and innovation should be high on the list of priorities for the UK government in negotiating a new relationship with the EU
In the short term, barriers to accessing EU research and innovation funding for UK organisations with current applications and those wishing to submit new applications must be assured – as noted earlier, guidance and clarity is needed to avoid uncertainty in the way these will be handled by the EU and to give confidence to potential collaborators. Damage is already being done and repeated positive statements about the UK's continued engagement are needed to reassure the UK's European industrial and research partners and to ensure that applications are being fairly assessed and progressed by the Commission officials and expert examiners. The quick response of government to these difficulties by promising to underwrite the cost of participation in Horizon 2020 incurred up to the point of exit is very welcome; it will be important this is followed through and that implementation does not fall short of participants' expectations.

In the medium term, continued access to key programmes such as Horizon 2020 is essential.

Science and technology-related legislation, regulations and projects will need to be reviewed in the run up to the UK leaving the EU

The ability to shape and influence EU regulations remains extremely important as our members and their clients seek to collaborate with and export products and services to the EU. Some AIRTO members are Notified Bodies and are very concerned that the decision to leave the EU will potentially affect their businesses, because Notified Bodies need to be based in an EU state to operate with EU clients. We are already aware that some customers are already contemplating their long term certification partners and are considering transferring to Notified Bodies outside of the UK. Some members are having to set up operations outside the UK at considerable cost. **Actions: every effort needs to be made to ensure that the UK has a voice in shaping relevant EU regulation going forward. BSI must act to ensure routes are negotiated by which non-EU countries can host (and retain) EU recognised Notified Bodies, as a matter of urgency.**

Assurance of the status of overseas researchers, scientists and students working and studying in the UK when the UK leaves the EU

The UK needs to ensure the continued free movement of people coming to the UK to study and work in UK science and industry. All those EU nationals currently working or studying here should be given reassurance about their continued ability to do so. **In addition, the UK needs to ensure free movement of British nationals across EU borders for the purposes of study, research and innovation endeavours.**

Opportunities that the UK's exit presents for research collaboration and trading with non-EU countries

There is the potential for the UK to benefit from being exempt from EU state-aid and procurement rules. This could give the government much more flexibility to support business and industry, and indeed innovation, including through public sector procurement. **Action: the government should identify what opportunities will now exist to use public procurement to support innovation. Dropping EU state aid and procurement rules could allow much more flexibility and this potential advantage should not be sacrificed in any deal to retain complete or partial access to the single market. AIRTO's non-university members already do twice as much business with the rest of the world than they do with the EU. There are opportunities to build on this and to create a UK IRT sector strategy to channel innovation support into extending still further this reach beyond the EU in order to capture new areas of the global marketplace for science and technology based products and services.**

Other steps the government should take to keep UK science and research on a sound and adequately funded footing after an EU exit

The changes ahead will make generating research revenue harder for UK institutions, including Catapult Centres, RTOs, and Public Sector Research Establishments (PSREs) and their industrial partners and clients (e.g. both large businesses and SMEs) who benefit from EU funding opportunities. The government was already planning to introduce alternative funding arrangements to replace some grant funding from Innovate UK with loans. This too will put pressure on some partners wishing to enter into collaborations, placing even greater strain on their financial resources for engaging in such activities. **Action: the UK government**

needs to make more national funding available via Innovate UK to compensate for the fall in funding available from EU sources. Consideration should also be given to delaying the introduction of alternative loan-based financing mechanisms via Innovate UK until there is greater certainty in the overall funding landscape for research and innovation.

The UK government is already in the midst of reorganising much of its strategy for stimulating research and innovation with the advent of UK Research & Innovation (UKRI). There is a risk that key staff in BEIS and other departments will be overburdened by the implications of the referendum vote. **Action: the government should ensure that additional resource is drafted in to avoid delays in the development of the National Innovation Plan and the establishment of UKRI.**

5 September 2016

Declaration of interests:

This submission is made by the Association of Innovation, Research and Technology Organisations (AIRTO). The organisation represents research and technology organisations operating in the space between the academic research of universities and the commercial needs of industry. AIRTO members undertake research and development, and knowledge/technology transfer. This submission does not necessarily represent the views of individual member organisations. AIRTO currently comprises organisations employing more than 40,000 scientists and engineers, with a combined annual turnover in excess of £5Bn (AIRTO Ltd is a company limited by guarantee registered in England No 1217006. Registered office address: National Physical Laboratory, Hampton Road, Teddington, Middlesex, TW11 0LW. AIRTO is a not-for-profit organisation funded by membership subscriptions, and managed under contract by NPL Management Ltd). The members of AIRTO currently are

AFRC
Agrimetrics Ltd
AHPA
AMRC
Axillium Research
BCIS
BHR Group
BMT Group
BRE
BSRIA
Campden BRI
CIRIA
City University London
CPI
Digital Catapult
C-Tech Innovation
Fera
FloWave TT
Fraunhofer UK Research

Association of Innovation Research and Technology Organisations (AIRTO) – Written evidence (EUF0008)

Fripp Design & Research
Future Cities Catapult
Health & Safety Laboratory
High Value Manufacturing Catapult
HR Wallingford
LGC
Lucideon Limited
Manufacturing Technology Centre
Medilink (Yorkshire & Humber)
HORIBA MIRA
National Composites Centre
NIAB EMR
National Nuclear Laboratory
National Physical Laboratory
National Non-Food Crop Centre
Nuclear AMRC
Offshore Renewable Energy Catapult
Organic Research Centre
PA Consulting
QinetiQ
Satellite Applications Catapult
SATRA Technology Centre
Science and Technology Facilities Council
STC
Smith Institute
Thatcham
Scotch Whisky Research Institute
The European Marine Energy Centre
Transport Systems Catapult
TWI
University of Greenwich
University of Surrey
WMG

Brightwake Ltd – Written evidence (EUF0016)

Author: Paul Browning, Head of Regulatory Affairs

Medical Device SME Impact on UK science and EU membership

1. Executive Summary

a) UK has over 3000 companies employing 76,000 people in medical technology
b) Valued at £17 billion and growing at rates exceeding 6%
c) UK contributes 3.3% of the £118 billion Global medical device market
d) The UK is the second highest employer of medical technology companies, beaten only by Germany.
e) 38 million people contact a medical device every day in the UK
f) European Medical Device regulation offers the best balance between safety & risk, with early access to new innovation.
g) European medical device legislation is recognised across the globe and allows easier and more affordable market access, not just throughout Europe, but in a significant number of countries across the Globe.
h) We, along with many SMEs in the medical device sector have concerns that leaving the European Union will have a detrimental effect of UK businesses where EU legislation is used for market access. With the cost of regulation increasing, and the cost of products being forced to decrease, many UK businesses will no longer find it viable to innovate and manufacture within the UK.

2. Introduction

Paul Browning is a clinical scientist, and industry leader in European medical device legislation and quality management. Currently Head of Regulatory Affairs for Brightwake Ltd, an innovative UK based medical technology organisation. Fellow of the Chartered Quality Institute, and Member of The Organisation for Professionals in Regulatory Affairs. Listed as an Expert from the University of Worcester (Univeristy of Worcester, 2015), he also participates in UK Parliament Outreach programmes.

3.0 Discussion – economic impact of medical device regulation and market penetration.

i) **UK Landscape for Medical Technology.**
In Britain, medical technology companies make a vital contribution to the British economy. With over 3000 companies employing 76,000 people the sector is valued at some £17 billion and growing at rates exceeding 6% (Association of British Healtcare Industries, 2015). The UK is the second highest employer of medical technology companies, beaten only by Germany.

j) A significant proportion of companies are working closely in partnerships with UK Universities and research institutes resulting in close collaboration and rapid development of ideas into inventions, and subsequently onto market. With significant investment from Government including Knowledge Transfer Partnerships seek to facilitate the cross-pollination of skills from academia to industry and visa versa. Furthermore, our National Health Service is dependent on British business to

improve treatments, diagnostics, service enhancements and the like to drive continuous improvements in both budgetary controls and patient wellbeing.

k) It is estimated that 38 million people contact a medical device every day in the UK (SEHTA, n.d.). In 2000, the Global market for medical technology stood at £118 billion, with Europe accounting for 25% of that total. The UK medical device market makes up 12.8% of the Western European market and 3.3% of the world market. The UK market continues to be one of the strongest performers in the region, with growth of around 6.8% per annum forecast to 2018.

l) There are around 500,000 medical technology products, grouped into 20,000 groups available today (EUCOMED, 2014). These technologies rely on multi-disciplinary experts including; regulatory & legal, electronics, mechanical engineers, polymer science, chemistry, biochemistry, optics, software and more.

m) United Kingdom exports 5 billion Euros outside of the European Union (Epsicom, 2014). American industry supplied 25 percent of imports and accounted for 12 percent of the total $3.4 billion medical equipment market in Britain in 2002 (Topham, 2003). Current market growth has been slow, and the lack of domestic investment in new product development in recent years has created a demand for imported high-tech equipment. Requirements include lasers, endoscopes, medical imagery and dental equipment.

n) The UK market is dominated by the NHS, which accounts for more than 80% of expenditure (Association of British Healtcare Industries, 2015) (Klien, 2014). The private sector remains small—if well equipped—and largely based in England. The reorganization of the NHS under the Health & Social Care Act 2012 has already seen a structural shift; Primary Care Trusts have been abolished and replaced by Clinical Commissioning Groups, giving general practitioners a greater role in budgeting and, therefore, spending.

o) The innovation that Britain is famous for, is supported by systems which encourage and support small and medium sized enterprise (SME), for which we all benefit from both in improved health, care and economically. That is not to say, far more needs to be done to improve the efficiency and effectiveness of innovation to commercialisation.

p) Development of improved medical devices supports improved health in the British population, and good health is a prerequisite for well-being and economic prosperity. These medical technologies help people live longer, healthier, more productive, socially active and independent lives. Including improved employability, where medical technology contributes to ensuring economic growth through improved workforce health.

q) **EU Landscape for Medical Technology.**

r) Throughout Europe, medical devices are placed onto the market under strict regulatory control. Currently this is conducted in accordance to Directive 93/42/EEC for medical devices, 98/79/EC for *in vitro* medical devices (IVDs) and 90/385/EEC for active implantable medical devices (AIMD). These form part of the 21 New Approach Directives which apply to products that can bear CE marking. CE marking is not a quality mark, but indicates to EU regulators that these devices meets all requirements of the appropriate Directive. CE marking is not used solely for medical device manufactures, but applies to many other British industries. Regulation and

patient safety are the single biggest drivers across all medical technology organisations (Topham, 2003).

s) The European Union's regulatory system for medical devices has proved highly successful, and is recognised as providing the 'gold standard' globally; it has demonstrated its efficiency in rapidly bringing the benefits of innovation to people. According to independent studies, people in the European Union on average benefit from advances in medical technology 3-5 years earlier than in Japan and 3 years earlier than in the US, without compromising safety. By avoiding excessive delays, the European regulatory system provides an incentive for innovation. Designers and manufacturers are encouraged to develop better products that address patient and healthcare needs more quickly.

t) In 2013, over 10,000 patent applications where filed with the European Patent Office in medical technology. 41% of these were filed from European countries (EUCOMED, 2014). In terms of context, in the same period around 5400 application were field in pharmaceutical fields and 5400 in biotechnology (European Patent Office, 2014).

u) The current economic troubles within European Union members will likely result in slow market growth from 2014-2019, especially within southern European states. With the increased regulatory challenges with recent and forthcoming regulation, medical device manufactures in Britain will face increased cost-containment measures, and focus on smaller areas in order to show business growth. This is at the cost of innovation.

v) As a result of recent and very public failings (e.g. PIP and metal-on-metal hip), European Legislation has already responded with Notified Bodies affording more control and longer review times – which is paid for by manufacturers. Although you can not legislate to prevent law being broken, the new legislation is set to offer more rigorous, but more transparent review of medical device manufactures where stricter and more detailed monitoring and enforcement activities from both Notified Bodies and National Competent Authorities (like the MHRA in the UK). More stringent approval procedures with additional clinical evidence requirements for high-risk devices will also increase the regulatory burden on manufacturers. Longer and more costly approval procedures threaten to undermine the competitiveness of the European medical device industry, which comprises largely small and medium-sized companies (Klien, 2014) (Topham, 2003).

w) Intellectual Property is also protected by a single EU catch-all. With single cost and single registration for UK IP, providing protection throughout Europe.

4. Recommendations:

x) UK must ensure mutual recognition agreements are in place to allow UK businesses already invested in the EU conformity assessments (which affect several core UK industries - CE marking) to apply here within the UK

y) The current European medical device regulation is already costly and difficult for UK innovation. The draft legislation will increase the control, scrutiny and enforcement, but at large cost to UK industry.

z) Compliance to the appropriate EU legislation via the CE route of conformity, enables unrestricted trade for UK industry throughout Europe.

aa) A large number of other countries accept CE conformity for medical devices, allowing a simpler and less financially challenging route to these markets.

bb) The European Medical Device Regulations provide the ideal mix between control and innovation, ensuring citizens of Europe are afforded faster access to new healthcare technologies.
cc) The UK, via the MHRA must ensure that CE conformity is accepted here in the UK.

26 October 2016

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British Academy, Royal Society of Edinburgh (RSE) and Royal Society – Oral evidence (QQ 1-10)

Transcript to be found under Royal Society

British Council – Written evidence (EUF0012)

1. SUMMARY

1.1 The UK's world leading science and research sector has helped establish Britain as one of the most globally connected countries of the 21st century. We believe science and research collaboration and partnership, as well as international mobility for students, researchers and innovators, will be crucial in maintaining relations between the UK and other European countries during the negotiation period and beyond.

1.2 There are three key issues that we identify as being threats arising from leaving the EU: the UK's ability to attract and retain talented researchers and students from abroad, the UK's access to EU funding, and international collaboration and movement of researchers, students and staff. These risks could lead to greatly diminished global competiveness and weakened soft power for the country.

1.3 In the very immediate term, students, staff and researchers will want to get unambiguous reassurance that 'business as usual' will apply until such time as the official status of the UK changes, or at the very least get clear and binding statements on the UK's position for this transitional period. In the medium term, the UK will need to consider carefully visa regulations and fees for researchers and students, in order to prevent the UK from becoming an unattractive place for EU citizens to study, work and collaborate.

1.4 It is crucial in the longer term that the UK makes every effort to create legal and funding frameworks that will allow the country's research base and higher education system to prosper. The Treasury's commitment to underwrite the payments of awards such as Horizon 2020, even when specific projects continue beyond the UK's departure from the EU, is welcome and provides much needed clarity to the sector. The UK should aim to maintain access to mechanisms such as Horizon 2020, and the subsequent Framework Programme as part of its new relationship with the EU, in order to ensure that UK researchers can continue to work with and attract the best researchers across Europe and beyond.

2. THE BRITISH COUNCIL

2.1 The British Council was founded to create 'a basis of friendly knowledge and understanding' between the people of the UK and wider world. We do this by making a positive contribution to the countries we work with, using the cultural resources of the UK such as art, sport, education, science, culture, language, innovation, creativity and the sharing of the UK's values and ways of living.

2.2 Our work makes a lasting difference to the UK's international standing by increasing the country's influence and networks with key decision makers, influencers and the wider public globally. It increases UK prosperity by encouraging more trade, investment and tourism. It helps keep the UK safe and secure by reducing extremism and improving stability in

strategically important countries. It also increases influence by growing the number of people who know and trust the UK.

2.3 We work in over 100 countries worldwide. These include all of the places of major importance for UK trade and security, from China, India, Brazil and Russia, to North America and the EU, the Commonwealth, the Middle East and North Africa. We are at the forefront of the UK's international networks and soft power.

2.4 Each year we reach over 20 million people face to face and through our events, and more than 500 million online and via broadcasts and publications.

3. THE ROLE OF THE BRITISH COUNCIL FOLLOWING THE REFERENDUM

3.1 The British Council will continue to use the cultural resources of the UK, including its world leading science and research sector, to ensure a stronger global role for the UK, helping to establish Britain as the most globally connected country of the 21st century.

3.2 It is more important than ever that we help to extend the UK's international influence, ensuring strong connections with leaders, policymakers and influencers globally.

3.3 We believe science and research collaboration and partnership, as well as international mobility for students, researchers and innovators, will be crucial in maintaining relations between the UK and other European countries during the negotiation period and beyond.

4. THE BRITISH COUNCIL AND SCIENCE

4.1 Scientific research is more global than ever before, with collaborations between research groups across countries critical to innovation. Science is no longer a solitary pursuit - the greatest contemporary advances in human knowledge are the result of cross-border partnerships and co-operation whether it is the advances in our understanding of fundamental particles at CERN or scientists working together to understand and respond to emerging infectious diseases. Partnerships pool risk and costs but also talent and expertise. The research community is a global one, with academics and students in different countries working together on shared projects. Enabling the flow of resources - financial and human - to create the best conditions for success is in the UK's national interest.

4.2 Science has been a core part of the British Council's work since its foundation 80 years ago; the UK's excellence in scientific research is an extremely attractive soft power asset that is of huge value to the UK's international standing and influence. We have a proven track record in building the international links vital to the sharing of expertise and knowledge. Today we play a pivotal role in supporting the development of major bilateral education and research partnerships such as UKIERI (the UK India Education and Research Initiative), and BIRAX (the Britain Israel Research and Academic Exchange Partnership). Along with other UK organisations, we are playing a key role in the £735m Newton Fund that brings together partners in 16 countries including Brazil, China, Indonesia, South Africa to use science and innovation to support economic development and social welfare. These are multi-million pound programmes that are bringing researchers and innovators together to develop new

research and technologies that push the boundaries of scientific knowledge and improve the lives of people around the world.

4.3 We act as a convener for the sharing of knowledge and expertise by organising conferences and policy dialogues that position the UK as a world leader for science and research. Through our network of in country offices, we provide on the ground support in country for initiatives that use UK expertise to build the infrastructure on which science and research can grow. This work not only builds the global science base, but also places the UK in a strong position to benefit as partner of choice for research projects and destination of choice for scholars looking to develop their careers overseas.

4.4 The British Council plays a key role in promoting the international mobility of students, scholars and academics. We work very closely with UK higher education institutions (HEIs) to help attract international students, and facilitate international experiences for UK students. Through our international network in over 100 countries and digital resources like the Education UK website for students, and the EuraxessUK website for researchers (which we run on behalf of the UK Government), we present the UK as an attractive destination to prospective students and researchers. Our education exhibitions are the number one international recruitment tool for the HE sector. The British Council runs over 120 education exhibitions in more than 50 countries annually, attracting over 250,000 visitors a year.

4.5 The British Council also places a great emphasis on bridging the gap between science and society, and ensuring that non-academic audiences are engaged with research. We support public engagement activities that add to the impact and reach of UK and international research, as means of positioning the UK's reputation for science and developing relationships with aspiring scientists and young people around the world. These activities include science communication training programmes, competitions and science festivals in many parts of the world. We highlight the UK's expertise in science and technology, build international networks of skilled science communicators and strengthen the science and society interface.

5. THREATS TO SCIENCE POSED BY LEAVING THE EU

5.1 Ability to attract and retain talented researchers and students from abroad

5.1.1 The UK's EU membership allows UK-based researchers and students to access a range of European funding instruments, world-leading research groups and unique research facilities. Along with the fact that the UK has a strong and internationally highly competitive research base and is renowned for a research support system that is based on transparency and merit-based competiveness, this is a likely key driver attracting talent to the UK.

5.1.2 European Research Council (ERC) grants and Marie Skłodowska-Curie Fellowships are considered the most prestigious EU funding instruments enabling the most talented researchers from around the world to be embedded in this highly attractive and productive research environment. Between 2007 and 2013, the UK was the country awarded the highest number of ERC grants overall and has also greatly benefitted from Marie

Skłodowska-Curie actions, with access to a total of €1 billion in funding for over 3,000 UK-based researchers.

5.1.3 There is a great risk that in the medium- to long-term the UK's attractiveness to the most talented incoming researchers as a hub for world-leading research in a well-resourced, linked-up and enabling environment, a place where they can flourish and develop their careers, will become much reduced should the UK lose continued access to Horizon 2020 and its successor framework programmes.

5.1.4 In the short term, the greatest danger to the health of the UK research base is the lingering uncertainty about what forms of support will be available to UK-based researchers and what the fate will be of on-going and nascent pan-European research they would greatly benefit from getting involved in. In other words, not having clarity now about whether or not UK-based researchers will be able to have access in the future to these prestigious and high-profile EU research support instruments is far from neutral, with reports increasingly indicating that there is mounting reluctance of some world-class academics from abroad to relocate to, or remain in, the UK and some concern that involving UK researchers in European consortia is potentially a risky strategy.

5.1.5 The viability of the UK research base and the country's success in the global economy are underpinned by international STEM students, with the majority of full-time taught postgraduate students in biotechnology and some engineering programmes being from abroad and EU students forming the largest cohort of non-UK students in the UK. Our world leading position in research relies heavily on the skills, perspectives, ideas and experience that international research students bring to academic departments, and is supported by the income from fees that our universities raise from taught postgraduate programmes.

5.1.6 If there were to be a reduction in the number of international student numbers after the UK leaves the EU, and an associated decline in income from fees, this would result in a funding shortfall for universities, with a direct negative impact on their research programmes as well as the loss of innovative thinking, intellectual challenge and the experience of different methodologies these students bring to academic departments. It would also affect the diversity and plurality of the UK's academic offer, reducing the attractiveness of the sector and potentially creating a cycle of decline. Any reduction in the range of courses on offer also restricts the choices on offer to UK students with potential implications to the skills base for the UK economy in key industrial sectors.

5.1.7 Arguably more important to the continuing economic success of the UK than the implications for individual courses is the reliance of UK universities on their postgraduate taught programmes to support their research programmes. The income from these courses are in many cases what keeps an academic department as a whole viable, if that income falls significantly a department will simply not be able to sustain the same number of academic staff, research students and postdoctoral researchers. A significant reduction in the numbers of international students coming to the UK to take STEM courses would severely impact the viability UK's institutes of science and engineering damaging UK industries and businesses.

5.1.8 While there are a number of potential reasons why in the wake of leaving the EU students may not choose to come to the UK, key attractors for those coming from EU countries to study in the UK currently are that their movement will not be constrained by visa regulations, they have access to UK student financial support mechanisms and they pay home fees for UK university courses, making studying in the UK much more affordable to them than if international student fees, which are often only affordable to the richest (rather than the most talented) ones, applied.

5.1.9 Even if these attractors remain in place for now, there is a risk that students are already beginning to perceive the UK as a less welcoming place than before, not least because of often divisive and non-inclusive public discourse around the UK's relationship with the EU. With countries like Australia, Canada and New Zealand becoming more attractive alternative destinations for students and a growing number of university courses outside of the UK being taught in English, there is a risk that potential students increasingly decide against the UK as a study destination. There are early indications that this is not only the case for EU students, but that the departure of the UK from the EU would also dissuade non-EU international students from studying or working here.

5.2 Access to EU funding

5.2.1 EU research support, which the UK has accessed through Horizon 2020 and other EU funding streams, is the UK's main source of international research income, with the UK being one of the main beneficiaries of EU funding from within the EU. 18.3% of EU funding to the UK is spent on research and development[9] and the government will need to consider issues around funding, access to research facilities and infrastructure, and influence on policy and regulations during the negotiation period.

5.2.2 In the period before leaving the EU, there is some anecdotal evidence that the UK is already being adversely impacted, as reports arise of researchers in other EU member states being reluctant to include UK researchers as lead researchers on proposals, in the view that they would be either less likely to be successful, or would lose funding at the point when the UK leaves the EU[10] [11].

5.2.3 Many UK institutions benefit from funding to support the establishment of joint master degrees under the Erasmus Mundus Joint Master action of Erasmus+. These grants provide funding to the university consortium established to run the degree, and also provide generous scholarships to successful applicant students. These awards are highly competitive and the degrees bring considerable *kudos* to their consortium.

[9] Higher Education Statistics Agency (2016) Higher Education Statistics from the UK 2014/15. Available online: https://www.hesa.ac.uk/pubs/heuk

[10] Guardian (2016) UK scientists dropped from EU projects because of post-Brexit fears. Available online: https://www.theguardian.com/education/2016/jul/12/uk-scientists-dropped-from-eu-projects-because-of-post-brexit-funding-fears Accessed 19 August 2016.

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5.2.4 If the UK were to lose grants such as this and others, the UK could face a deficit in funding, and a loss in its competitiveness in science and research in relation to EU member states, which have access to these programmes. The UK's research talent may stall or move overseas without such opportunities, and the loss of collaboration grants would mean the UK loses the opportunity for input from EU talent into UK research.

5.2.5 The British Council is undertaking further research on the impacts of leaving the EU and potential scenarios for future access to EU funding programmes including in areas related to science, scientific collaboration and research and researcher mobility.

5.3 International collaboration and movement of researchers, students and staff

5.3.1 The UK currently leads the world in research productivity. While the UK represents just 0.9% of global population, 3.2% of R&D expenditure, and 4.1% of researchers, it accounts for 9.5% of downloads, 11.6% of citations and 15.9% of the world's most highly-cited articles[12]. The UK needs to remain innovative to be globally competitive and that requires drawing on global rather than just national talent and resources. More than 50% of articles produced from the UK have an international co-author, and 60% of these are co-authored with other EU countries[13]. Likewise, UK researchers are highly mobile, with 72% of UK-based researchers publishing in another country over a 16 year period. Both research collaboration and mobility require the movement of researchers, for either short term or longer periods, and these international experiences are very beneficial, exposing researchers to new sources of expertise, ideas, facilities and techniques. It has been shown that mobile researchers are more productive, and collaboratively produced publications achieve greater reach and impact.

5.3.2 Likewise, UK students are becoming more mobile, with the numbers of students taking up international opportunities through the Erasmus scheme doubling over the past seven years. The mobility of these students and the corresponding inbound mobility of their European counterparts contribute not only to the personal and academic development of the individuals concerned, but also to the development and strengthening of academic relationships between universities. The mobility of academic staff for teaching and training (currently more than 2,000 per annum) makes a similarly important contribution to the nurturing of academic networks. Scientific and technological disciplines represent an increasing proportion of student mobility in the programme.

5.3.3 Potential visa restrictions could negatively affect researchers' ability to work in the UK and uncertainty about the future of the UK may dissuade researchers from choosing the UK as a destination or as a collaboration partner. Likewise, UK researchers may become less likely to travel to European countries if new visa regulations are too restrictive. It is

[12] A report prepared by Elsevier for the UK's Department of Business, Innovation and Skills (2013) International Comparative performance of the UK Research Base. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263729/bis-13-1297-international-comparative-performance-of-the-UK-research-base-2013.pdf

[13] Royal Society (2016) UK research and the European Union: The role of the EU in international research collaboration and researcher mobility. Available online: https://royalsociety.org/~/media/policy/projects/eu-uk-funding/phase-2/EU-role-in-international-research-collaboration-and-researcher-mobility.pdf

therefore imperative that future entry regulations for EU nationals allow EU researchers to come to the UK to work and vice versa. If a points-based or work permit system for EU nationals is introduced in the future, it should continue to ensure that Post-doctoral researchers are able to come to the UK to undertake research.

6. OPPORTUNITIES

6.1 New Opportunities for Global Collaboration

6.1.1 If the UK were to lose access to collaboration projects with other European countries, an indirect consequence may be that UK scientists may seek wider opportunities for collaboration with other scientists around the world. This could be a good opportunity for the UK to redefine relationships with countries such as the USA, Canada, Australia and New Zealand while at the same time developing closer links with Commonwealth countries, ASEAN and other emerging economies – for example, through expansion of scholarship schemes and initiatives such as the Newton Fund – to widen its knowledge base and explore partnerships with less traditional partners, which could in turn lead to innovations in research and potentially new partnerships in other areas such as higher education and trade. However, this should not be seen as a replacement for collaborations with EU countries where there is strong research capacity. The primary drivers for collaboration need to remain research excellence and potential for impact.

7. ISSUES TO BE ADDRESSED BY THE END OF 2016

7.1 As outlined above, a lot of the negative impact in the short-term will be due to the continued uncertainty around the UK's future position in terms of access for UK-based researchers to EU support (and benefits associated with that such as access to European research facilities and groups); continued course diversity and eligibility of EU students under UK 'home' conditions; the ease of mobility within the EU of students, researchers and staff which enables highly-productive collaboration and exchange.

7.2 In the very immediate term, students, staff and researchers will want to get unambiguous reassurance that 'business as usual' will apply until such time as the official status of the UK changes, or at the very least get very clear and binding statements on the UK's position for this transitional period.

7.3 For researchers and staff from the EU who are currently based in, or considering relocating to, the UK, this means that their status and right to work in the UK has to be firmly guaranteed at least until that point, i.e. including during any period of negotiation prior to actually leaving the EU. UK-based researchers will have to be reassured that until an official change to the relationship between the UK and the EU they will remain eligible to bid for and participate in EU-funded collaborations and that their continued participation is welcomed both by the UK and by other EU countries.

7.4 Students already in the UK or considering study here need to be reassured that their status will remain unchanged at least until the official status of the UK changes. For EU students, this includes their right to access the UK's student financial support mechanisms,

the right to remain in the UK without a visa and the right to be regarded as 'home' students in terms of tuition fees.

7.5 Less tangible are issues around the perception of the UK as a less welcoming place than prior to the referendum and the potential decline of the quality of the UK higher education system and research base as a result of leaving the EU. This can only be addressed through strong messaging that reassures international students, researchers and staff that everyone's rights and privileges will be protected until the UK's status changes and that we continue to welcome, value and rely on international exchange.

8. ISSUES TO BE ADDRESSED IN NEXT THREE TO FIVE YEARS

8.1 It is crucial that the UK seeks to maintain UK access to existing EU mobility and research funding streams following its exit from the European Union. If this is not possible, every effort must be made to create legal and funding frameworks that will allow the country's research base and higher education system to prosper despite the loss of income streams and benefits directly attributable to our EU membership (including student and researcher mobility and access to facilities and EU collaborations which enable high-quality/high-impact research to take place). Importantly, these efforts have to be visible and underpinned by firm, concrete commitments in order to allay already emerging fears and mitigate against a perception of increasing isolationism.

8.2 The UK should consider developing funding mechanisms that not only make up for any of the projected losses due to limited or no continued access to Horizon 2020 and its sister and successor programmes, but also explicitly encourage and enable international research collaboration and exchange with the EU and the wider world. These will have to be underpinned by a legal framework that allows mobility of the researchers, staff and students involved without being too constrained by visa regulations and limiting conditions when residing in the UK. However, only if these alternative mechanisms achieve similar prestige and convey a similar sense of sustainability to the current suite of EU funding programmes they are trying to replace will they be able to succeed and ensure continued excellence and global competitiveness of the UK's research and higher education system.

8.3 Maintaining strong and friendly relations with research funders and organisations from the EU will be crucial. The engagement with bodies such as Science Europe (through the UK Research Councils) should be strengthened to ensure that the UK maintains some influence and insight into research policy at the European level. Communication across the world that the UK is open to scientific collaboration will be key in ensuring the UK attracts funding and, where possible, the UK should continue to be involved in EU initiatives, such as Euraxess, in order to support and attract mobile researchers.

8.4 In terms of maintaining a healthy student intake from abroad with resulting benefits for science and the wider HE sector and UK economy, the UK will have to consider revising its visa entry requirements for those seeking to study here. Maintaining a simplified route for EU students to come to the UK will be desirable, even if this means granting them special privileges unilaterally without being able to secure a reciprocal arrangement for UK students wanting to study in the EU. Equally, while full access to the UK's student financing

mechanisms is unlikely to be preserved, the UK will have to consider if there are ways to maintain competitive fee rates for EU students to remain a leading study destination.

9. MONITORING HEALTH OF UK SCIENCE AND WHEN IMPACTS WILL BE DETECTED

9.1 Indicators that should be monitored include the number of incoming researchers on UK, European and international grants and fellowships (e.g. EMBO and Marie Skłodowska-Curie fellows) and those directly appointed by UK universities, including to high-profile academic positions. While there are robust records of numbers of incoming students, postdoctoral early and mid-career researchers are perhaps the most mobile cohort, but tracking their movements is less straightforward. It will also be important to capture the number and destination of UK researchers and students relocating – temporarily on mobility grants and permanently – to institutions abroad (in the EU and internationally). With perceptions on the UK's ability and willingness to support its internationalised student and research base already beginning to shift, we are likely to observe the first changes in numbers and patterns over the next 1-2 years.

9.2 A crucial element in monitoring the health of UK science will also be changes in research outputs, for example the number of highly cited publications – those with joint international authorship, and those that are UK-only – and the number of patents applied for (by UK institutions, but also those by others but based on UK research). Any effects on these indicators of research quality – and those specifically designed to assess the economic, academic and societal impacts of research, some of which are addressed in the REF exercises – will take a number of years to manifest, in some cases probably 5-10 years down the line.

9.3 Impacts that are more challenging to quantify are changes in perception of the UK as a good place to work, study or collaborate. Also less visible will be how many nascent research collaborations went in a different direction when decisions were made – consciously or subconsciously – not to include a relevant UK partner.

5 September 2016

Campaign for Science and Engineering (CaSE) – Written evidence (EUF0005)

Summary

The Prime Minister, Theresa May, has expressed her commitment to science stating "the government's commitment to ensuring a positive outcome for UK science as we exit the European Union[14]." In this submission we set out the role of science and engineering in a strong UK, how science and engineering can help shape the UK's place in the world, and emerging priorities for the EU negotiations and domestic policy to ensure a positive outcome for UK science.

As an area of UK competitive strength, as a feature of our relationship with Europe that currently works well and brings mutual benefits, and as an endeavour attracting broad support from the UK public, science and innovation should be a pillar of the EU negotiations. In parallel, the government should be considering how domestic policy and funding can work together support a thriving science and innovation base.

In particular this submission considers three broad and overlapping priorities that are broadly shared across the science and engineering sector, talent, funding and regulation, exploring the risks and opportunities leaving the EU raises in each area.

Introduction

The Campaign for Science and Engineering (CaSE) is the leading independent advocate for science and engineering in the UK. CaSE believes the UK government should support a healthy and thriving science base in which all parts of this integrated system are well funded and performing optimally.

CaSE works to raise the political profile of science and engineering, and ensure that the UK has world-leading research and education, skilled scientists and engineers, and successful innovative business. It is funded by around 800 individual members and 100 organisations including businesses, universities, learned and professional organisations, and research charities. Collectively our members employ 350,000 people in the UK, and our industry and charity members invest around £19.3bn a year in R&D globally[15].

In August CaSE convened a discussion forum bringing together around 45 CaSE members and key collaborators spanning academia, industry, charity and professional bodies from farming to pharmaceuticals and manufacturing to digital industries where we began the work of identifying shared priorities ahead of EU negotiations that will contribute to a positive outcome for science. This submission draws on the outcomes from that discussion forum.

[14] http://www.bbc.co.uk/news/science-environment-36915846
[15] Figures taken from latest available years of data

Science & Engineering's place in the UK

The UK science base is an integrated ecosystem which encompasses all disciplines of science, engineering, innovation and technology, and a wide range of sectors including higher education, industry, Small and Medium Enterprises (SMEs) and investors.

A wide range of industries, from manufacturing and agriculture to digital technology, rely on science and engineering to innovate, grow, and create high-value jobs[16]. The R&D-intensive aerospace and pharmaceutical industries, for example, generated a trade surplus of more than £5 billion and £3 billion, respectively, in 2013. And the higher education sector, where a large proportion of publicly funded research is performed, generated more than £73 billion of output and contributed 2.8% of UK GDP in 2011/12[17].

Investment and support for science and engineering is essential for the future of the UK as a high-tech and knowledge-based economy. R&D and human capital are universal drivers of productivity[18]. Government investment in R&D 'crowds-in' further private sector investment[19] as well as other productivity boosting effects such as contributing to raising the level of the skills base in the UK, boosting human capital. Research commissioned by CaSE has shown that every £1 of public investment in R&D raises private sector output by 20p each year in perpetuity[20].

The UK cannot compete on cheap labour, capital reserves, or natural resources. As the UK prepares to leave the EU, more than ever we must instead play to our advantages in science and engineering. In an increasingly competitive global economy, they will be the drivers of future innovation, productivity gains, and high-value job creation. The UK government's Industrial Strategy also provides a timely opportunity to create a long term framework to support a thriving business and innovation environment built on the UK's competitive strength of its science and innovation base.

The fruits of science and engineering enrich all our lives in countless ways. Nurturing a strong science base is vital for preparing the nation for future challenges, from climate change, food security and future cities, to antimicrobial resistance, national security and meeting the needs of an ageing population. Technology helps make the air we breathe cleaner by using new energy sources and waste-filtration systems, machines leave us more leisure time by reducing domestic work, and a better understanding of our environment helps us preserve the woodland and animals that we treasure.

With all the benefits that it brings, it's no wonder the public are supportive of scientific research and value scientists and engineers. The UK public overwhelmingly see science as beneficial. Research by Ipsos MORI and commissioned by the Department for Business

[16] The Science Council, The current and future UK science workforce, 2011
[17] Immigration: Keeping the UK at the heart of global science and engineering, CaSE (2016)
[18] "On the Robustness of R&D" , Kul, Khan and Theodorodis, Journal of Productivity Analysis, vol. 42 (2014), 137-155
[19] 'The Economic Significance of the UK Science Base: a report for the Campaign for Science and Engineering', Haskel, Hughes and Bascavusoglu-Moreau, April 2014
[20] *Ibid*

Innovation and Skills, found that over 80% of those asked agree that science will make people's lives easier, and around 90% believe that scientists and engineers make a valuable contribution to society[21]. The same survey found that two-thirds (65%) see investment in science as a priority for the Government and 81% think that the UK needs to develop science and technology in order to enhance its international competitiveness. The UK public also demonstrates this support for science and research through their giving. Medical research is the UK's favourite charitable cause, with 7.6 million people donating in a typical month[22].

As an area of UK competitive strength, as a feature of our relationship with Europe that currently works well and brings mutual benefits, and as an endeavour attracting broad support from the UK public, **science and innovation should be a pillar of the EU negotiations.**

In parallel, **the government should be considering how domestic policy and funding can work together support a thriving science and innovation base**. Doing so will support many of the government's wider aims of creating high-value jobs across the UK, increasing productivity, driving sustainable economic growth, along with wider aims in education, security and resilience, and health.

The UK's place in the world

Science is global. This is a phrase that has particularly resonated with the science community following the EU referendum. It recognises the reality that those who work in academic research or science and engineering companies take for granted, science is a global endeavour.

The UK enjoys a central position in this global network of scientists and engineers. It is reflected in the nationalities represented in laboratories and research teams up and down the UK. Similarly UK nationals are working across the world. According to a study by Elsevier, almost 72% of UK-based researchers[23] spent time at non-UK institutions between 1996 and 2012[24]. This mobility is not because scientists and engineers are particularly fickle about where they live. It is because it is integral to their work; internationalism brings huge benefits to their own research and the productivity of science and engineering as a whole.

This global connectedness is also demonstrated in R&D funding nationally[25]. In just over 2 decades, there has been a change in the profile of how UK R&D expenditure has been funded. In 1990, £1.4 billion (12%) in current prices of R&D funding came from overseas. Since then, there has been a steady increase in the value of funding for UK R&D expenditure from overseas, from £2.3 billion (16%) in 1996 to £5.4 billion (18%) in 2014. The bulk of this

[21] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/348830/bis-14-p111-public-attitudes-to-science-2014-main.pdf
[22] http://www.amrc.org.uk/blog/medical-research-the-uks-favourite-cause
[23] Includes UK and non-UK nationals. Only published researchers from academia and industry were able to be analysed.
[24] Elsevier, International comparative performance of the UK research base, 2013
[25] http://www.ons.gov.uk GERD 2014 (2016)

overseas funding is for R&D performed in business, but around £1.5 billion is for R&D performed in universities or public research institutes.

Business is the largest investor in UK R&D, accounting for £19.9 billion of expenditure in 2014, representing 65% of total expenditure on R&D performed in the UK. The pharmaceutical industry was the largest business investor at £3.9 billion, computer programming and information service activities was second at £2.4 billion and the automotive industry was third at £2.3 billion[26]. These are global industries choosing to invest in the UK. And at present the UK is an outlier in the proportion of its funding for R&D that comes from overseas sources.

Our industry members tell us that the strength of the UK's research base is a defining attractor. The most direct evidence of this effect in the UK is that multinational pharmaceutical firms locate their laboratories near to universities with excellent chemistry research[27]. Across sectors, access to expertise and world class facilities are repeatedly cited as key attractors along with the international reputation of the UK's research and innovation institutions. Together this suggests that the UK is a connected, global hub for science and engineering.

Securing a positive outcome for science

CaSE along with others in the sector will be working hard in coming months to evidence, develop and articulate priorities for science & engineering as well as potential risks to mitigate and opportunities to capitalise on as the UK leaves the EU. We began this work by holding a discussion forum in August bringing together around 45 CaSE members and key collaborators spanning academia, industry, charity and professional bodies from farming to pharmaceuticals and manufacturing to digital industries to identify shared priorities across this broad group ahead of EU negotiations.

There are sector specific challenges, concerns and opportunities that leaving the EU raises. However, there was a high degree of consensus about the emerging top level priorities across the broad sector represented at the meeting.

- **Talent** – retention, access and movement of global talent
- **Funding** – access to EU funding and facilities, and ambitious domestic funding
- **Regulation** – continuity and harmonisation of regulations and standards

Each of these is considered in more detail below, however, none of the three should be considered in isolation. They are not ends in themselves but work together to support vital collaboration, trade and influence that contribute to the UK being a strong, connected, global hub for science and engineering.

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26 http://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/ukgrossdomesticexpenditureonresearchanddevelopment/2014#expenditure-on-rd-performed-in-the-uk

27 The Economic Significance of the UK Science Base, Haskel et al for CaSE, 2014

TALENT

Companies, universities, charities and research institutes alike see the ability to retain, access, move and attract skilled people as an essential pillar of securing a positive outcome for science as the UK leaves the EU. This came across strongly in our member discussion meeting.

Across all sectors, around 6% of employees in the UK are from the EEA[28]. Science and engineering tends to be far more international than the average. A quarter (26%) of academic staff in UK universities are non-UK nationals[29]. In 2013/14, there were more than 22,000 academic workers (12% of the total) from outside of the EU and more than 29,000 from within the EU (16% of the total). Looking specifically at those working in STEM, the percentages are slightly higher, with 13% from outside the EU and 17% from within. The numbers are more difficult to aggregate across industry, however, sectors that are particularly dependent on workers from the EEA include manufacturing, where over 10% of employees are from the EEA[30].

There is fierce global competition for talented people and an active transfer market of scientists, engineers and technicians across the world. Therefore as the UK goes through a period of substantial uncertainty and change there is no room for the UK to be complacent in assuming that global talent, including UK nationals, will continue to see the UK as an attractive place to work or study. Instead **negotiations and domestic policy must work together to create a migration system and environment that actively supports a healthy science and engineering sector.**

Immigration was a major feature of the EU referendum debate, we therefore recognise that this will be a major area of consideration and contention as negotiations develop. We also know from the example of other nations that how the UK decides to manage migration will have knock on effects to other aspects of the UK's relationship with the EU including trade, access to research programmes and funding. An overly restrictive migration policy was therefore one of the major risks raised at the CaSE discussion forum, for the impact it would have on access to talent and how it could lead to a narrowing of the funding, collaboration and trade opportunities open to UK-based individuals and organisations in future.

We recognise the willingness of the Home Office to work closely with the sector to refine and develop migration policy in recent years to ensure it is fit for purpose. This has been very welcome and resulted in tangible improvement to processes and policy. We hope to build on this productive engagement during this period of substantial change. Regarding domestic migration policy, CaSE will be working with others in the sector to examine and articulate what principles would underpin a transparent, fair migration system and the types of movement it would need to support to contribute to a positive outcome for science.

[28] http://www.smf.co.uk/publications/working-together-the-impact-of-the-eu-referendum-on-uk-employers/
[29] Engineering Professors' Council analysis of HESA data from the Higher Education Database for Institutions (HEIDI), accessed September 2015
[30] http://www.smf.co.uk/publications/working-together-the-impact-of-the-eu-referendum-on-uk-employers/

Scientists in both academia and industry are motivated by the desire to work with great researchers and in institutions where the science is of the highest quality[31]. A 2013 study of more than 16,000 international scientists supports this conclusion, with career prospects, the quality of the faculty and colleagues, and the scientific excellence of the institution being the top three motivating factors for emigrating to another country for research[32]. These longer term moves are complemented by, and often contribute to, myriad cross-border collaborations on joint research programmes and projects.

Part of ensuring that the UK is a destination of choice for scientists of all nationalities (including British nationals) to build a career is to ensure this is a place where they can participate in the best science. Access and retention of talent therefore cannot be divorced from access to funding, regulation and ability to collaborate with the rest of the world, including Europe.

FUNDING, COLLABORATION AND FACILITIES

At the CaSE forum for most, discussion about funding was inseparable from discussing collaboration due to the collaborative nature of much of the EU funding and programmes. Overall the shared priorities in this area could be articulated as:

- continued access to EU funding programmes and collaborative opportunities
- conserving and growing overall investment in UK science and research in the longer term

Risks to mitigate

The most overwhelming result in a CaSE survey of scientists and engineers ahead of the EU referendum[33] was that 96% agreed that EU funding supported new academic collaborations (66% strongly agreed). 67% also agreed that EU funding supports new industry collaborations. These figures were backed up in the discussion at the CaSE forum where it was a strongly held view that the collaborations formed and facilitated through EU funding were invaluable. This is a view held right across academia and industry. They leverage additional value above and beyond the funding itself. For instance, some industry members present raised that they indirectly benefit from academic collaborations as academics they work with in the UK are part of wider EU projects making UK academics more attractive as partners. There was a strong view that the **UK should look to negotiate continued access to EU programmes and collaborative opportunities.**

In the CaSE survey, 69% of respondents agreed that EU membership facilitates access to specialist facilities and 77% agreed it facilitates access to specialist skills. In the discussion at the CaSE forum, access to facilities was raised alongside collaboration and access to

[31] DEMOS, Knowledge nomads: why science needs migration, 2009

[32] Chiara Franzoni, Giuseppe Scellato, and Paula Stephan, Foreign-born scientists: mobility patterns for 16 countries, 2012

[33] Survey undertaken October, 2015 by CaSE and the EPC. 403 respondents from UK HEIs and industry as part of 2015 report, The role of EU membership in UK science and engineering research

programmes and funding as an important feature of the current benefits EU membership brings to the UK. Due to the nature of research, access to facilities is particularly pressing in certain disciplines and sectors. An interesting risk raised at the meeting related to UK large facilities. There is the risk that UK facilities could become more difficult for colleagues based in other EU countries to access meaning they could run below capacity. This is currently just a risk that has been raised and further investigation would be needed to identify the extent to which this could be an issue both economically and for disruption to collaborations and partnerships.

Overall, the UK is a net contributor to the EU, but it is a net receiver of EU funding for research; receiving €8.8bn between 2007 and 2013 compared to an indicative contribution of €5.4bn. Moreover, the importance of EU funding to research is growing, with half of the increase in UK university research budgets over this period coming from EU government sources. In an environment of financial strain it is clear that the EU has provided a valuable source of funding for the sector[34]. It is possible to participate in EU programmes as a non-member state, however the amount of funding received by all non-member states combined does not equal the current level of funding received by the UK. Only 7.2% of the research funding awarded by the European Union and the European Research Council has been allocated to non-member states in the last decade – a total of £3.5bn – mostly to Norway and Switzerland[35]. So for the UK to receive even a fraction of its current level of funding would be a substantial shift in the balance of research funding going to members and non-members. It is also politically improbable that continuing EU member states would agree to a non-member state being a net receiver of funding for research as we are now.

There is therefore a risk that without intervention by the UK Government the overall level of investment in UK science and innovation will decrease. Due to the benefits UK science brings to the economy and society the **government should ensure that the negotiations and subsequent domestic funding settlements result in conserving and growing the overall investment in UK science and research in the longer term.**

Attendees at the CaSE forum raised that leaving the EU poses the risk of losing access to certain types of funding if the UK no longer has access to EU research programmes, including Horizon 2020 and any future framework programmes. This also featured in the survey of individual scientists and engineers CaSE undertook ahead of the referendum where three quarters of respondents agreed or strongly agreed that EU funding fills a gap where other funding isn't available due to the research subject. Due to the intertwined nature of UK and EU funding streams in recent years, a situation has developed where some fields of research are more dependent on EU funding than others, both for competitive research funding but also for facilities and networks.

This is also true of some universities where up to two thirds of total research income is from EU sources, although most universities receive between 15-35% of their competitive funding from Europe[36]. Also, while all parts of the UK are reliant on EU research & development

[34] http://www.sciencecampaign.org.uk/resource/CaSEEPCEUReport2015.html
[35] Digital Science, Examining the implications of Brexit for the UK research base, 2015
[36] Digital Science, Examining the implications of Brexit for the UK research base, 2016

funding to some extent, the areas with the highest dependency overall are South West England, outer London and parts of North England and Scotland[37]. **In the negotiations and in developing domestic policy and funding, the government should assess and be mindful of the disproportionate dependence on EU research funding in some disciplines, sectors, universities and regions.**

Opportunities

In our survey[38], 78% agreed that EU funding and programmes bring a longer term perspective to research activity. At the CaSE forum, members raised that EU funding tends to be more long term in nature that UK funding and that the framework programmes spanning seven years and being agreed in advance mean that they provide some stability. This, in part, enables EU funding and structures to support research on a greater scale and to support higher risk research than a single government is able to. However, members at the CaSE discussion forum raised that **the creation of UK Research and Innovation (UKRI) if supported by additional funding could provide opportunities for new funding programmes that are more ambitious, that cross disciplines and support collaboration.** Alongside this**, the Industrial Strategy could provide a long-term, ambitious framework and programmes to support collaboration, knowledge exchange and build on the UK's competitive strength of its science and innovation base**.

REGULATION

Although not directly covered in the scope of this follow up inquiry, across science and engineering in academia and industry leaving the EU presents complex challenges for the future of regulations, standards and legislation that affects and governs our sector from data protection to environmental codes and clinical trials. This is also an area where leaving the EU could provide real opportunities to create a distinctive, attractive environment for research and innovation in the UK. However, this is balanced by the need to first and foremost ensure continued alignment and compatibility with EU regulatory frameworks to support cross-border collaboration, participation in programmes and trade.

The risks and opportunities raised in the CaSE forum are outlined below. Overall, the appetite across the sector for taking the opportunity of leaving the EU to change regulation and legislation affecting the sector was mixed. Some expressed the view that they wanted to see all regulation continue as before to reduce disruption to working practices and trade. The majority wanted to see continued alignment and compatibility with EU regulatory frameworks where necessary and where beneficial but could also see leaving the EU as an opportunity to try new approaches. What is clear is that the process will require very careful management, communication and detailed working with experts within the sectors and industries involved to ensure that regulation is fit for purpose and to avoid unnecessary disruption and damage to the UK's competitiveness during the transition period.

[37] http://sciencecampaign.org.uk/CaSEVATbriefing2015.pdf
[38] http://sciencecampaign.org.uk/CaSEVATbriefing2015.pdf

Risks to mitigate

Regulatory divergence between the UK and the EU could be an opportunity but is also a significant risk. This is an area where there will be significant technical and sector/industry specific expertise required to ensure regulation is fit for purpose. **Appropriate structures and processes should be put in place by the UK government and parliament to ensure scientific and technical expertise and advice is appropriately accessed throughout the process.** This includes ensuring that appropriate structures, processes and appointments are built into the Departments for Exiting the EU and International Trade where regulation and standards will be a significant feature of their work.

EU regulation is and has been heavily influenced by the UK. In its position as a scientific leader within the EU, and as a nation with comparatively developed and embedded mechanisms and structures for accessing and using scientific advice, the UK's influence on EU regulations has arguably contributed to ensuring countries across the EU benefit from an improved regulatory environment. Concern was raised at the CaSE forum that on leaving the EU the UK will lose influence at all levels, including within regulatory bodies. As the UK is likely to still have to abide by EU regulation in a broad range of areas due to conditions of trade, collaboration or funding, this could negatively impact on UK science. As a result, it was considered **crucial for the UK to be able to continue to provide evidence-based input to shape the direction of EU regulatory development**.

The uncertainty created by the decision for the UK to leave the EU is also a risk to the UK's competitiveness in the short term. For instance if you are looking to start or move a business or project, uncertainty over what the regulatory environment will be once the UK leaves the EU will make the UK a less attractive place to locate while uncertainty persists. **The timeline, scope and process for reviewing and developing the regulatory environment in the UK as a non-member state of the EU should be clarified as soon as possible.**

Opportunities

Leaving the EU could provide an opportunity for the UK to become a regulatory 'sandbox'; a place for trying new approaches. In 2013 a group of companies sent a letter to the Presidents of the European Commission, Council and Parliament stating they were "concerned by the negative impact of recent developments in risk management and regulatory policy on the innovation environment in Europe[39]." Their view was that the balance had become tipped in favour of precaution rather than a balance of precaution and proportion, advocating the adoption of an Innovation Principle in risk management and regulatory practice. If appropriately balanced with the need for regulatory alignment in many areas, leaving the EU could be used as an opportunity for the UK to foster an innovative, forward looking approach to regulation.

[39] http://corporateeurope.org/sites/default/files/corporation_letter_on_innovation_principle.pdf

In the UK we have a robust dialogue between the sector and government. This is a real asset. The UK also has a strong science dialogue and public engagement expertise which will need to be built on to ensure the UK public can feed into, and have confidence in the UK's regulatory environment. We've seen an exemplar of doing this for complex regulation in the contentious area of mitochondrial donation. Through concerted public and parliamentary engagement and care to ensure the regulations were suitably robust the UK was able to break new regulatory ground.

There is also an opportunity for regulatory refinement, finding more efficient ways to deliver EU regulation. A specific opportunity has been highlighted but academic and industry CaSE members regarding an aspect of the UK's VAT system as a current and significant barrier to research collaboration, particularly co-location within research institutes. In a recent CaSE briefing, the key issues and solutions to explore are set out in detail[40]. The primary issue is that publicly-funded research institutes are restricted to 5% commercial activity if they opt not to pay VAT or face costly tax bills to co-locate their researchers with industry colleagues. The Dowling Review[41] recommended that this be looked at as a matter of urgency. Leaving the EU provides an opportunity to do so.

24 August 2016

[40] http://sciencecampaign.org.uk/CaSEVATbriefing2015.pdf

[41] See recommendation 12 of the Dowling Review of business-university research collaborations, 2015

Cancer Research UK – Written evidence (EUF0003)

Government must ensure that in negotiating a new relationship with the EU it protects the strength of the UK's science base. We welcome the committee's focus on this issue and appreciate the opportunity to submit written evidence to its follow-up investigation.

Last year Cancer Research UK spent £432 million on research across the UK, including our £28 million contribution to the building of the Francis Crick Institute. Our ambition is to accelerate progress and see three in four cancer patients survive their disease by 2034. Research is at the heart of our plan to reach this ambition and see cancers diagnosed early and treated well. This is why it is so crucial that the UK maintains its excellent science base and that cancer researchers across Europe and around the world, can continue to work together to make the best use of our pooled talent and resources.

Medical research in the UK benefits patients here, as well as patients across Europe and worldwide. It's in the best interests of all patients that UK science remains strong and competitive.

In this submission, we have outlined the actions needed to ensure UK science continues to flourish following an exit from the EU, with a focus on four principal areas:

- Attracting and retaining talent
- Protecting investment in UK science
- Supporting collaboration through compatible regulation
- Building NHS research capability

Attracting and retaining talent

The UK's ability to attract, efficiently recruit and retain scientific talent from the EU must be protected to maintain the excellence of our science.

Cancer Research UK recruits post-graduate students and researchers from an international pool to ensure that we are working with the very best minds to conduct the highest quality research. The mix of UK, European and international researchers within our research community is vital for the sharing of best practice, expertise and skills.

The UK plays a key role in training young researchers; many of whom go on to set up labs elsewhere, but maintain important collaborative relationships with research groups in the UK (see case study 1). The UK also benefits from recruiting talented researchers who have received specialist training from centres outside of the UK. Such recruitment is particularly important and sometimes necessary in areas of science where we have a national skills shortage such as researchers working in computational biology and big data[42,43].

[42] 'Bio-informatician' and 'informatician' are included on the Shortage Occupation List, valid from 6th April 2015

In addition to the valuable contribution that international scientists make to our workforce, the movement of researchers between countries develops valuable networks. Networks are crucial for the building of collaborative partnerships which are common place and often necessary in many fields of science including cancer, where nearly 50% all UK research involves international collaboration[44]. In Feb 2016, CRUK researchers were partnering with over 400 different organisations based in EU countries [45].

These collaborations enable sharing of knowledge and expertise, as well as research materials, equipment and data. They also support training, the running of pan-EU clinical trials and establishment of consortia set up to inform policy. The importance of such collaboration is shown by its impact on the UK's research outputs: nearly 50% of the UK's scientific publications have non-UK authors and the impact of these papers is significantly higher than the average impact of UK papers[46].

EU nationals are a significant and valuable part of our workforce dedicated to beating cancer sooner: 33% of our PhD students and 39% of our research fellows are non-UK EU nationals[47]. Importantly, existing free movement rules, including the right to bring partners and dependents, enable us to recruit these talented researchers easily and cost-effectively. **Government must consider mechanisms that allow UK research organisations to recruit the best talent – protecting the ease with which we can do so for EU nationals and developing policies that allow for more efficient recruitment of international talent. Scientists should remain a priority group in the UK's points-based system.**

Many EU nationals in the UK are concerned about their ability to continuing working here, and the UK's vote to leave the EU has also made some feel unwelcome. Such concerns have been raised directly with us by researchers that we fund. We are also concerned that this message is being heard by the international research community and is affecting the attractiveness of the UK as a place to come and work. **In addition to tangible policies that enable us to recruit talent, the Prime Minister and key ministers in the Department of Business, Energy and Industrial Strategy and the Department of Health, need to ensure that a positive message is sent to the international research community, including those already based in the UK, to reassure that their contribution to UK science is valued and encouraged. Government should also consider additional incentives that could be applied in the medium term so that the UK remains an attractive place for the best researchers to come and work. Such incentives would serve to counter the uncertainty and disruption that these researchers may experience over the coming years.**

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[43] Medical Research Council and Biotechnology and Biological Sciences Research Council (2014) Vulnerable Skills Survey 2014

[44] https://www.ohe.org/publications/exploring-interdependencies-research-funders-uk

[45] Based on data from Researchfish, a self-reporting tool for researchers, including those receiving funding from CRUK

[46] Elsevier, International comparative performance of the UK Research Base, 2013

[47] The PhD student figure is based on data from Researchfish, a self-reporting tool for researchers, including those receiving CRUK funding

Protecting investment in UK science

Overall levels of investment in UK science must be protected and grown in the longer term to ensure the UK remains globally competitive.

The UK received significant funding for cancer research from the EU: In 2015, this investment totalled £40 million[48]. Although Cancer Research UK does not receive any direct funding for research, in 2015/16, Cancer Research UK's institutes across the UK received £7.5 million income from EU grants; this was more than 4% of their total research funding[49]. Furthermore, universities at Cancer Research UK centres are currently supported by EU grants totalling more than £110 million[50]. This funding provides crucial support for individual labs and promotes research collaborations with other EU countries (case study 1).

Cancer research is one of many fields of UK research that benefit from the financial support provided by the EU. Overall investment by the EU in UK science is significant: in 2014/15, UK universities attracted more than £836 million in research grants and contracts from EU sources. This represents 14.2% of all UK income from research grants and contracts in that year. The UK does disproportionately well in securing EU research funding, and successfully secured 15.5% of the funding allocated under the previous EU research and innovation programme (FP7).[51]

Beyond their financial benefit to UK researchers, EU grants offer prestige and promote global recognition owing to their competitiveness and broad pool of peer reviewers. Winning these grants therefore gives visibility to the UK's first-in-class science and research offer and promotes multi-national research collaborations.

Importantly, EU investment in UK research leverages further private investment: €4.4 billion invested in the UK through FP7 from 2007 to 2012, secured an additional €1.1 billion from other sources to meet total project costs of €5.5 billion[52]. This builds on evidence showing that UK public funding leverages significant investment from industry and charities[53].

Every pound invested in cancer-related research by the taxpayer and charities returns around 27p to the UK economy each year[54,55]. Government's investment in research supports the UK economy in a number of ways. It attracts private investment from overseas, builds a skilled workforce and contributes towards the generation of income from

[48] This includes all grants given to cancer-specific and cancer-related research. NCRI analysis using data derived from the Global Grants Award Database and corresponding Dimensions Software platform, provided by UberResearch.
[49] Funding data reported directly to us from CR-UK institutes, including the Francis Crick Institute
[50] Self-reported data from universities at current CR-UK centre locations. Includes total award of active grants in August 2016
[51] http://www.universitiesuk.ac.uk/policy-and-analysis/reports/Pages/economic-impact-on-the-uk-of-eu-research-funding-to-uk-universities.aspx
[52] Department for Business, Innovation and Skills, 2013, Leverage from public funding of science and research
[53] Economic Insight, What is the relationship between public and private investment in R&D?, 2015
[54] Health Economics Research Group (Brunel University), RAND Europe, and King's Policy Institute, medical Research: What's it Worth? Estimating the economic benefits of cancer-related research in the UK, 2014
[55] http://www.kcl.ac.uk/sspp/policy-institute/publications/SpilloversFINAL.pdf

commercialised products. Research fundamentally improves the nation's health and, as such, delivers savings to Government by reducing the incidence of disease or limiting its impact.

Government's new industrial strategy is an opportunity for the UK to put science at the heart of its plan for growth. UK Government has previously acknowledged the key role of science and innovation to drive growth and productivity in the UK[56] and made the important commitment to protect the budget for science in real terms at the last spending review. Recently, we were pleased to see the new Prime Minister give an early indication of her strong support for science in a letter to Sir Paul Nurse. **Government should now ensure that with a UK exit from the EU, overall levels of investment in UK science and the diversity of funding are protected and grown in the longer term. In developing the new cross-departmental industrial strategy, the Department of Business, Energy and Industrial Strategy and the Department of Health should set out plans that will enable the UK to grow its investment in science to strengthen the global standing of our research base. These departments should work with HMT to consider a range of measures to grow investment including tax-breaks and public-private incentives.**

Exiting the EU provides the UK with an opportunity to promote research collaborations between academia and industry and further attract inward investment. The extent to which charities and universities can currently partner with industry is limited by VAT rules on sharing of facilities, equipment and buildings. Although calls have been made for Government to address this issue[57] we understand that reform has not been possible because of EU membership. **In exiting the EU, Government should review current rules on VAT exemption on sharing of buildings, equipment and facilities for the purposes of R&D, to support industry, academia and charity collaborations and attract further inward investment.**

The Department for International Trade should also work to grow science funding in the UK by ensuring that it provides strong representation internationally to effectively communicate the value and opportunity of investing in UK science.

It is becoming increasingly important to draw together scientists from different countries and disciplines to solve today's biggest health challenges. That's why, in October 2015 Cancer Research UK launched our Grand Challenge, which will see international, multi-disciplinary teams collaborating to tackle some of the biggest problems in cancer research. The award is open to researchers across the globe, who will work in collaboration with UK-based scientists. We have had 56 applications from 409 investigators, spanning 224 institutes and 25 countries, and have shortlisted nine applications for further development. We anticipate awarding the first grant in late 2016.

Charity, industry and government funders of research need to work together to support multidisciplinary and international scientific collaborations. Such partnerships provide funders with the opportunity to leverage additional support and enhance progress through

[56] HM Treasury, Fixing the Foundations: Creating a more prosperous nation, 2015
[57] http://www.raeng.org.uk/policy/dowling-review/the-dowling-review-of-business-university-research

shared knowledge, resources and capabilities. **UK Government should develop the prestige and global recognition of its research grants and consider how these may facilitate and promote international collaboration and drive international research consortia. There is an opportunity for UK Research and Innovation to play a lead role in developing such grants.**

Case study 1 - Dr John Diffley, Francis Crick Institute

John Diffley is one of the world's leading experts in studying how cells grow and make copies of themselves - a process that goes wrong in cancer. Dr Diffley's discoveries will form the foundations for new ways to diagnose and treat cancer in the future.

John's world leading research has benefitted hugely from the European Research Grant (ERC) funding he was awarded in 2009. To date, this funding has supported 11 of his peer-reviewed research publications. Last year he was awarded another prestigious ERC Advanced Grant providing him with £1,455,294 for further research.

'The ERC is a fantastic scheme and has transformed my lab. The research I was able to carry out with the ERC grant enabled my lab to enter a new area of science, which would otherwise have been closed to us. It has had an enormously positive impact on our science.'
Dr John Diffley

Around 50% of the scientists in John's lab are from non-UK EU countries. Two of the current 15 are funded through the Marie Skłodowska-Curie actions - Research Fellowship Programme. This fellowship, which is part of Horizon 2020, encourages researchers to move between EU countries to conduct their research, sharing their knowledge and skills as they go.

Over the years, John has established strong collaborations with labs across Europe. Some of these have been the direct result of EU funding. Dr Monica Segurado was able to come and work in John's lab thanks to an EU Network Grant, awarded in 2002. Since establishing her own lab in Spain, Monica and John have continued to collaborate and have jointly published research.

<u>Supporting collaboration through compatible regulation</u>

UK standards and legislation governing the approval and conduct of research must be compatible with the EU to enable our continued participation in pan-EU research projects.

The compatibility of regulation and standards across member states brings benefits to UK medical research. In areas such as clinical trials, the use of personal data in research and medicines approval, it supports scientific collaboration across EU member states and can streamline approval for large studies.

Cancer Research UK supports over 250 clinical trials by providing funding, expertise and facilitating partnerships. These trials recruit more than 25,000 patients each year. Of the trials that we directly fund – currently over 200 - more than a quarter involve at least one

other EU country[58]. To set up and run pan-EU trials efficiently and effectively, it is important that the legislation, guidance and standards governing their approval and conduct is aligned across member states. Such trials are especially important for rarer cancers and childhood cancers, where trials are often only feasible because they are able to recruit from a large pool of patients across the EU (case study 2).

Case study 2 – Pan-EU pancreatic cancer trial

Pancreatic cancer is one of the hardest cancers to treat, and has one of the lowest survival rates[59]. The European Study Group for Pancreatic Cancer (ESPAC) wants to change this. ESPAC formed in 1989, and their research has contributed to accelerated improvements in survival and quality of life for patients. Since the 1980s, short term survival has increased by around 60%.

But ESPAC know there is more to do. Just 1% of people diagnosed with pancreatic cancer in England and Wales survive for ten years or more. In the UK in 2014 alone, there were around 9,400 new cases of pancreatic cancer, and 8,800 deaths.

In 2008, they set up the ESPAC-4 clinical trial. By 2014, it had recruited 732 patients from the UK, Germany, Sweden, and France[60]. Around half of trial participants received an innovative combination of chemotherapy drugs. The other half received the standard chemotherapy treatment.

An extra 13% of patients on the trial lived for five years when given the combination of chemotherapy drugs. This brings five year survival to almost a third, a huge result for patients.

The ESPAC is spearheaded by Professor John Neoptolemos from Liverpool University and the team includes experts from all over Europe [61].

Running trials for rarer cancers across the EU means we can develop new treatments that benefit patients in UK and across the continent. Groups like ESPAC need to be able to continue their life-saving work, in the immediate and longer term post-Brexit environment.

The new Clinical Trials Regulation, due to come into force at the end of 2018, represents a significant improvement on the current Directive. Importantly it provides for a new streamlined and coordinated system for approving trials that take place across different member states. The UK has played a key role in shaping this new legislation so that it works for research in the UK and enables us to effectively collaborate across the EU. **Government should ensure that the UK aligns with the new Clinical Trials Regulation and can take part in the coordinated, EU-wide system of trial approval. This will be necessary for the UK to**

[58] Statistics from CRUK's internal databases and include clinical trials from our Clinical Research Committee, New Agents Committee and Centre for Drug Development.
[59] Pancreatic Cancer Statistics – CRUK Website
[60] CRUK trial shows improved 5 year survival for pancreatic cancer patients – CRUK Press Release (2016)
[61] Changing the future of pancreatic cancer: The ESPAC trials – CRUK 'Milestones', Science Blog (2014)

easily set up, and take part in, pan-European trials; attracting industry investment and bringing benefits to patients in the UK and the rest of the Europe. If the UK does not align with this regulation, it may find itself closed to such trials, which would be bad for patients and for inward investment in UK science.

Building NHS research capability

Government should build the NHS' research capability to benefit patients and to effectively market the UK internationally as a single research hub; thereby attracting inward investment.

The existence of historic, universal healthcare puts the UK in a strong position to conduct clinical trials, promote the uptake of innovation and fully realise the value of our wide ranging and comprehensive data sets, for example the cancer registries. By optimising research in the NHS and marketing the UK as a single research hub, we will be in a strong position to attract industry investment and world-leading researchers, and can provide innovative treatments to patients faster. The UK should take the opportunity to build and capitalise on this national asset when exiting the EU.

Cancer Research UK partners with the NHS in order to bring treatments to patients. Our Centres drive local partnerships and high-calibre collaborations between universities, NHS Trusts and other cancer charities. We also fund the Experimental Cancer Medicine Centre (ECMC) network in partnership with National Institute of Health Research (NIHR) and the Departments of Health in Scotland, Northern Ireland and Wales. The ECMC network provides the infrastructure for early phase clinical trials that often receives support from pharmaceutical partners. In 2014/15, ECMCs in England alone leveraged over £72 million through partnering with industry.

Researchers' access to patient data is crucial to improving our understanding of disease and treatments at a population level. To ensure such access, effective data capture systems are needed and the UK's major data-holding bodies need appropriate analytical capacity.

In its Five Year Forward View, the NHS stated an intention to improve its ability to undertake research and apply innovation. **In order to achieve this, Government must continue to invest in clinical research infrastructure through the NIHR and ensure that NHS Digital is appropriately resourced to achieve its ambition of realising a truly digital NHS.**

24 August 2016

Cisco, Met Office and Science and Technology Facilities Council (STFC) – Oral evidence (QQ 35-44)

Transcript to be found under Science and Technology Facilities Council (STFC)

Professor Steven C. Cowley FRS FREng, University of Oxford – Written evidence (EUF0019)

Professor Steven C. Cowley FRS FREng, President, Corpus Christi College, University of Oxford

2017 is an opportune time on both sides of the Atlantic to grow and enhance the formal science and technological links between the UK and the US. Informal connections are already strong. For example, approximately 15% of the UK's scientific publications include co-authors from the US, -- more than from any other nation. And the UK is a peer to the US in terms of research output. However, compared to the current UK-EU axis, there are few formal UK-US collaborative research programmes or joint research institutes.

Given the success of EU collaborative research programmes and institutes, it is clear such research structures are effective. It would thus be prudent to explore the possibility of UK-US joint programmes and institutes. Such an initiative could either yield a "plan B" if the UK steps out of its role in EU programmes or offer an additional programme if the UK retains its role in EU research. In any case it would harness extraordinary capabilities in the academic and innovation sectors of both countries to forge a scientific and technological special relationship.

12 December 2016

Elsevier, Academy of Social Sciences (AcSS) and Research Councils UK (RCUK) – Oral evidence (QQ 11-19)

Transcript to be found under Academy of Social Sciences (AcSS)

GlaxoSmithKline (GSK), Russell Group and MillionPlus – Oral evidence (QQ 20-34)

Transcript to be found under Russell Group

Government – Jo Johnson, MP, Minister of State for Universities, Science, Research and Innovation, Department for Business, Energy and Industrial Strategy (BEIS) and Department for Education (DfE); and Gareth Davies, Director General, Business and Science, BEIS – Oral evidence (QQ 45-56)

Evidence Session No. 5 *Heard in Public* *Questions 45 - 56*

TUESDAY 25 OCTOBER 2016

Members present

Earl of Selborne (Chairman)
Lord Borwick
Lord Fox
Lord Hennessy of Nympsfield
Lord Hunt of Chesterton
Lord Mair
Lord Maxton
Baroness Morgan of Huyton
Baroness Neville-Jones
Viscount Ridley
Lord Vallance of Tummel
Baroness Young of Old Scone

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Examination of Witnesses

Jo Johnson, MP, Minister of State for Universities, Science, Research and Innovation, Department for Business, Energy and Industrial Strategy (BEIS) and Department for Education (DfE); and **Gareth Davies**, Director General, Business and Science, Department for Business, Energy and Industrial Strategy (BEIS)

Q45 **The Chairman**: Could I welcome you, Minister, and Mr Davies? Thank you very much for coming back. We are rather geographically challenged—there is a long distance between you and me—but I can see you clearly. We are being broadcast and televised so I would ask you, Minister, to introduce yourself and Mr Davies, for the record, and then if you would like to make any opening statement before we go into questions please feel free to do so.

Jo Johnson: Thank you very much. It is a pleasure to be back before the Committee. I am Jo Johnson, Minister of State for Universities and Science and I am with Gareth Davies, director-general of research and innovation in the Department for Business, Energy and Industrial Strategy. I will take the opportunity to make a short opening statement. Since I was last before you, which was shortly before the referendum, things have obviously moved on quite

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significantly. I recognise that the result of the referendum has introduced many challenges for the science and higher education sectors, but it has also created new opportunities, and I am glad that we will have the opportunity to discuss both before your Committee today.

I wanted to highlight that I thought your report, which I read again this morning, was an excellent summary of the issues, and I am really grateful to the Committee for its very thorough work in exploring the complexity of the issues involved in our relationship with the European Union science and research funding streams. I thought it was a helpful contribution to our understanding as Government of the nature of the issues we are dealing with. I also wanted to put on record some of the assurances that we have tried to provide to the sector in the weeks following the referendum to deal with not all but some of the uncertainty that has arisen as a result of it. Very briefly, and most importantly, they relate to the Horizon 2020 funding stream and the guarantee that the Treasury provided in its statement on 13 August that it would be good for any commitments and payments due to UK researchers and institutions that might fall due after the point of Brexit. That concern—the so-called shortfall—accounted for the considerable bulk of inquiries that the department had received following the referendum result. That guarantee of Treasury funding has helped lift quite a significant proportion of the uncertainty.

The other areas in which we provided guarantees relate to the ability of EU students to continue to access the student loan book, and we did that pretty quickly off the bat in relation to the 2016-17 academic year, which has now started, and in October we added to that by saying that EU students would be able to access the student loan book for the duration of their course of studies if they were to start courses commencing in the 2017-18 academic year. Taken together, the funding and the access of EU students to the loan book were two of the most important pieces of the jigsaw. We recognise that there are other outstanding issues, in particular relating to mobility and the rights of residents, and I am sure we will come to those issues in the Committee's hearing. Thank you.

The Chairman: Thank you very much, Minister. I can assure you that your short-term assurances—and they were short-term—on Horizon 2020 and the like were very much welcome, as indeed I know the science community welcomed them. As you say, challenges have been presented to science and higher education, to say the least. Do you think this is an opportunity to make a signature statement about how we, as a country, should establish ourselves assertively in the international science community? Should we, for example, host a major international research facility emphasising our new place in the world after Brexit? Do you think there are other bold ideas so we can no longer be reacting to short-term problems and challenges to demonstrate to the international science community that the UK is a place to do science and come and work?

Jo Johnson: Yes, it gives us an opportunity to look at how we do science and innovation and to position ourselves for the future as a country that is determined to stay at the cutting edge of science. We are already host to a number of important research facilities and we are continuing to develop our networks. The Square Kilometre Array, the radio telescope outside Jodrell Bank in Cheshire, is a good example of a new, exciting facility. We could point also to the Francis Crick Institute which will formally open next month, or the dementia institute that is under way at the moment. These are globally significant institutes which are new and will keep us at the cutting edge of science for decades to come.

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I was up in Birkenhead on Merseyside earlier this month for the keel-laying of our new polar research ship, a £200 million vessel. That is going to be delivering state-of-the-art marine science. That is a piece of infrastructure which will be floating the world's oceans, particularly around the poles. Again, that will be at the cutting edge of science for decades to come. We continue to analyse all the opportunities to make more such commitments when they present good value for money.

The Chairman: I take that as a very positive response. You are certainly prepared to look at proposals that we should indeed be hosting international science facilities over and above the ones you have mentioned.

Jo Johnson: Yes, absolutely.

The Chairman: Even if there will be a cost to it, as there invariably is to the host.

Jo Johnson: We definitely see value in being the host of globally significant research facilities. You can see it in the way they create ecosystems around them of businesses, spinouts and all the spillover activity that comes from having brilliant people doing science in your community. Yes, we value them but, clearly, you have to analyse each one on a value-for-money basis and make sure that the contribution cost the taxpayer makes will generate a sufficient return.

Q46 Lord Hunt of Chesterton: One of the ways in which scientists interact across Europe is through networks. We had a presentation last week at the Royal Society on polar issues and what is very interesting is that the Russells have a co-ordination centre for polar research and this, as it is at the moment, includes many countries outside the EU—America, North Africa, Japan and so on. They said, which was rather interesting, that they would continue to run this as a co-ordination activity, to which the Brits would be very welcome but of course the Brits would get no money. At the moment we can bid into the funds. As you know, comments have been made generally that a lot of our scientists and engineers are not as international as they should be. I believe that one of the important aspects of negotiation will be how we participate in these co-ordination activities.

It is about 20 years since the Royal Society had a meeting on co-ordination of research in the UK with Europe. May I say—I was a bit surprised you did not say it—that many of these existing international research facilities have strong business connections? In our paper for this meeting, fusion was one of them, and of course fusion is an important science but it is also important for the private sector, which we are investing in significantly. I have to declare an interest as being involved. What do you think about co-ordination? Will we be able to lead this or encourage British scientists and researchers to continue working?

Jo Johnson: Yes, we recognise that collaboration is an extremely important part of how science is done, and the frameworks that the EU is operating through, the Framework programmes, Horizon 2020 and its successor programmes, have been important drivers of collaboration. We continue to look for opportunities around the world to develop new relationships where we can. We are looking, for example, at a proposal under development in the US, which I believe John Womersley, chief executive of the STFC brought to your attention, for the Deep Underground Neutrino Experiment, DUNE. That is an example of an international collaboration with an important science power that we are actively looking at as an example of our continuing desire to drive collaboration wherever it will be useful.

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Baroness Neville-Jones: That was a very encouraging statement, Minister. Can I conclude from that that you would support the view that if we are not to become takers in a lot of these activities we need actively to be makers and need to be on the front foot ourselves, drawing activity to us rather than seeing it go elsewhere? That means being, I would dare to suggest, more active than we have been in the past in creating opportunities for science to take place on British soil. Take the polar ship, which is a very exciting development and will go on its maiden voyage, will it not, to the Antarctic? Could something not be built from that by way of increasing our presence in polar and Antarctic science, which is very important from the point of view of the climate?

Jo Johnson: Yes.

Baroness Neville-Jones: That is an example, but it is a more general proposition I am putting to you.

Jo Johnson: Do we want to be on the front foot and more active? Yes, that is definitely the case. The industrial strategy gives us real opportunity to do that. We are on the record in believing that science and innovation need to be at the heart of the new industrial strategy.

Baroness Neville-Jones: Will you seek scientific input into it?

Jo Johnson: Science and innovation will be at the heart of it, yes. We are getting a lot of input into it from the science community. We welcome it. We have had many excellent submissions from learned societies as to how exactly they see an increased role for science and innovation and how they see the industrial strategy as a big opportunity for the community that we should not miss.

Q47 Lord Fox: I was going to ask this question later but it comes under the industrial strategy. First of all, what is an industrial strategy? You say "industrial strategy" rather than "strategies". Secondly, what is the process? It seems to be floating around a number of centres with the Chancellor, your department and George Freeman's exercise all seeming to have fingers in it. Can you perhaps lift the veil slightly on the process for this thing to emerge?

Jo Johnson: Yes, I can do that. As a process, it is not for an industrial strategy to be dropped on the world from 36,000 feet without any consultation or the involvement of people who have important views. We are in a process now of gathering evidence and views from all the relevant communities—the research and business communities, employees and employers—to bring together a significant body of evidence. The first point is we are not going to drop it from government without any discussion. We are in the process now of trying to think very carefully about what a modern industrial strategy needs to be. We propose to produce a discussion paper around the time of the Autumn Statement later this year. We propose to follow that up with a policy paper. The discussion paper will raise a series of questions which we will then consider further and we will follow that up with a more considered response from the Government in the new year of 2017. That is the process.

The work is being led by the Department for Business, Energy and Industrial Strategy, in which I am a Minister. Obviously, there are other extremely important players across government, not least No. 10 and the Treasury, but the pen is being held, as it were, in BEIS. What is an industrial strategy? There are many different versions of industrial strategy. This

Government – Jo Johnson, MP, Minister of State for Universities, Science, Research and Innovation, Department for Business, Energy and Industrial Strategy (BEIS) and Department for Education (DfE); and Gareth Davies, Director General, Business and Science,
Government are developing their vision for industrial strategy. As I said, we do not want to pronounce now from on high until we have had a good chance to thrash through these issues, but it will not be any surprise to the Committee to know that we strongly believe that an industrial strategy has to be about making sure we have the skills base, the capacity to absorb research and innovation; it has to be about having the hard and soft infrastructure—we have to have the roads, the ports and the broadband—as well as the education and healthcare systems, and it has to be about science and innovation, so making sure, as I said, that we have a world-class research base that will keep us at the cutting edge of discovery for years to come. Those three broad elements are important.

We also have to ensure that we are continuing to create a business environment that will be attractive to inward investment and that will enable us to have competitive companies creating jobs and opportunities. That means preserving a feature of the last few years of the Administration: a deregulatory mind-set committed to continuing to reduce red tape and drive down taxes. Those sorts of broad principles are the ones informing our work as we gather evidence from relevant bodies.

Lord Vallance of Tummel: All this seems UK-centric. Does the strategy also look at the position of the UK elsewhere, including the trading opportunities?

Jo Johnson: Yes. Our export performance is clearly an important part of what is motivating this Government, like previous Governments, to focus hard on how we can make our economy more highly performing. The newly formed Department for International Trade—a bespoke department now—emphasises this Government's commitment to getting our trading performance in better shape.

Lord Vallance of Tummel: Will that have an input into the strategy, or vice versa?

Jo Johnson: I think it will be iterative and, yes, it most certainly will have an input into it.

Q48 Lord Borwick: Minister, many people are worried about future discrimination against British companies and firms when applying for funding from the EU. You have asked for people to report to you any such discrimination. Have you received any such reports? What would you do about it if and when you do?

Jo Johnson: We did set up a structure to enable us to capture the anecdotal reports we were receiving about discrimination against UK researchers and UK institutions. As I said earlier, we set this up early on in the summer before we made the Treasury announcement about the funding guarantee on 13 August. The bulk—about two-thirds—of submissions we had to the email system we set up related to those funding issues. We feel we have addressed roughly two-thirds of those. The remaining third of the 132 emails we had dealt broadly with the uncertainty people felt about their status in the country and whether they could continue to stay and what sort of welcome they would have if they were to choose to do so. While a lot of those issues remain outstanding we have provided a very high-level assurance from the Prime Minister that their status would be unchanged by the EU referendum result, so long as other EU countries did not change the status of UK nationals residing in their countries. We recognise there are still outstanding issues on that front.

Lord Borwick: Those are fears of future discrimination rather than fears—

Jo Johnson: We have not had hard, concrete evidence of actual discrimination, as with previous witnesses before your Committee. The EU Commission has been exemplary in

Government – Jo Johnson, MP, Minister of State for Universities, Science, Research and Innovation, Department for Business, Energy and Industrial Strategy (BEIS) and Department for Education (DfE); and Gareth Davies, Director General, Business and Science,
sending out reassuring messages to echo the messages that we, as a Government, are sending out. The research and innovation Commissioner, Carlos Moedas, has been extremely helpful in that respect. I might remind the Committee about the two assurances he gave in a speech at the ESOF Conference in Manchester, which I also attended. He said, "For as long as the UK is a member of the EU, EU law continues to apply and the UK retains all rights and obligations of a member state. This, of course, includes full eligibility for funding under Horizon 2020".

The second assurance was, "Horizon 2020 projects will continue to be evaluated based on merit and not on nationality, so I urge the European scientific community to continue to choose their project partners on the basis of excellence". That was exactly the kind of message we needed the Commission to send out. I understand it has had significant effect. Obviously, we are vigilant and we want to make sure that discrimination does not start creeping in around the edges the longer this process goes on. The Commission has been exceptionally helpful in making sure there continues to be a level playing field for the time being.

Lord Borwick: It looks as though this commitment by the Treasury will not cost them anything. We do not know yet.

Jo Johnson: Let us hope not.

Baroness Young of Old Scone: Could I explore a little further the aetiology of the way in which people involved in some of these projects approach the planning of their lives, as it were? Increasingly, it will be difficult to know whether we are seeing people shy away from being involved in our research effort because of the longer-term uncertainty. A young research graduate maps out their future as doing a postgraduate piece of work, possibly in collaboration with an industrial partner; seeing that as a way of getting into the job market for the future; being involved in longer-term programmes that, at the moment, are not given any assurance because they are not part of the transitional arrangements, and then, complicating that, all the issues about residency, families and the longer-term ability to stay in the UK. I wonder if I can press the Minister to tell us whether you think any of the current assurances we have had will be buttering parsnips for these people, who probably are shying away because they cannot see they have a longer-term future, because many of the assurances are pretty short term.

Jo Johnson: In all my meetings with stakeholders I always ask them for any evidence of greater than usual churn of academics or talented people of one sort of other leaving the UK at a greater than normal rate or of fewer applications coming in than they might usually expect. I am keen to get any evidence of this sort of exceptional kind of churn that might be linked to the referendum, but I have not yet been provided with any. Gareth, do you have any?

Gareth Davies: As ever on this issue it is a problem because the data is so lagged, so we will not have the next set of data until March 2017. However, we use the Horizon 2020 national contact network to try to get qualitative data about what is happening. It would not be a surprise if applications dipped in the immediate days after the referendum but since then we have seen the rate of referrals go back to pre-referendum levels. Again, I would not want to rest too much on that information but as you try to triangulate between different data sources—the meetings the Minister is having and the evidence coming through the contact

point network—you start to see a return to the pre-23 June levels of applications for Horizon 2020.

The Chairman: Baroness Morgan, would you like to come in on this point?

Baroness Morgan of Huyton: I was going to come in on the immigration point, in general.

The Chairman: Shall we come to that?

Q49 Baroness Neville-Jones: Minister, you say, and it is reassuring, that the applications dipped and then they have gone up again. That is, on the face of it, good news. Professor Philip Nelson is very concerned about this. He did say to us that there had been some rather unpleasant stories and he included in that people being invited to leave a consortium which had been formed. My worry, I think, is not so much the discrimination that we will hear about but the decisions that we will not hear about; the people who decide not to come—as much for family reasons as anything else—unless they get assurances that this is really not going to be a problem. The serious loss is the networking and the very senior people, some of the stars. The stars can go anywhere, so we have to have a really attractive proposition, and that must not include doubt about their status and their family's status and their freedom of movement.

Jo Johnson: We are keen to provide as much reassurance on this as we possibly can. We have had the Prime Minister herself address this question. I do not want to repeat the assurance that she gave but I would also point out that many EU nationals who are already in this country—if I recall correctly, the proportion is four-fifths—have indefinite leave to remain by virtue of the fact that they have been in this country for more than five years.

Baroness Neville-Jones: I am talking about the future.

Jo Johnson: I would point them, for the time being, to the Prime Minister's statement.

Baroness Neville-Jones: That takes us so far.

Jo Johnson: It takes us as far as it does. I think she said she had every expectation of being able to guarantee their status and would only envisage doing so in the event other countries discriminated or started to change the rules for UK nationals.

Baroness Neville-Jones: You make it a matter of reciprocity rather than a matter of national decision.

Lord Hunt of Chesterton: You have quite rightly emphasised Horizon 2020 but, as we see in our paper here, there are a lot of other activities going on, partly connected with small companies. I met a person running a small consultancy in Britain. His contract with the EU stopped in July because they were working on environmental problems across Europe and they did not want to have any Brits in this. Why should they, because we are leaving? The other point is that people are discussing beyond 2019-20. Many research plans are much longer term. As far as I understand it, the only promise we have is that it will go until 2020. There is some indication of the Treasury continuing Horizon 2020 projects beyond 2020 but what about all these other projects? Again, I declare an interest: I have a small company and we have EU projects, although none at the moment. There are many small businesses across Britain working and using EU contracts. Will those continue to be funded? We cannot keep focusing on the Royal Society and 2020, although I am a fellow of the Royal Society.

Government – Jo Johnson, MP, Minister of State for Universities, Science, Research and Innovation, Department for Business, Energy and Industrial Strategy (BEIS) and Department for Education (DfE); and Gareth Davies, Director General, Business and Science,

Jo Johnson: I would say, regardless of the relationship we end up having with the EU funding streams you mention, we will continue to be an attractive country to partner with in science, and our businesses will continue to be attractive as partners in these kinds of projects too. We need to be confident. We have been a science power since long before the EU came into existence. I am sure, whatever relationships we end up having with the EU, we will continue to be competitive as a science power in years to come, and the Government will provide what support they can to ensure that is the case.

Q50 Baroness Morgan of Huyton: Can I take us back to immigration and nationality, which will not be a surprise to you? As a Committee we have heard consistent and extremely strong messages from higher education, and particularly from industry, about talent now more than ever being the most important issue, particularly international STEM talent and postdoctoral talent. We want to know more clearly when we will hear stronger reassurance to those here now about working rights and immigration status. How do you think we could now send signals to those considering coming in the future? As Baroness Neville-Jones said, it is not about the next couple of years, it is people thinking about five, seven or eight years hence, who are thinking about coming to be postgraduate students and would normally be thinking about then staying to work here but will now be thinking, "Is this a good idea?" and "Should we be going somewhere else?".

In particular, do you agree that the messages and mood music people hear are extremely important even before we get to the hard policies? I understand the difficulties about timing on the hard policies. Bluntly, how can you get that understood across government? It is fine to say the Prime Minister has given this assurance but, let us be candid, some of the messages that came out of the conference about foreign workers were deeply unhelpful, and although they were then retracted you hear that all over the place. I am sure many of us end up saying, "If you read this, they have pulled back from it", but it is deeply damaging to the general feeling people have about whether Britain genuinely will be open in the future to talent coming here.

Jo Johnson: We completely understand that science, innovation and business are global, and that it is important that we have an ability to attract the brightest and best; everybody who can add real value to the activities being undertaken in our research and business communities, and so on. We completely agree with you on the need to send out a positive message in that respect. I am glad you understand the difficulties in making harder commitments; these are decisions which have to be sequenced very carefully in the context of the broader national interest at stake in the whole of the negotiation. We understand that science is global, that there are huge benefits from our ability to bring in brilliant scientists, technicians, and so on, to work in this country, and we want that to continue.

Baroness Morgan of Huyton: How do you think you can get that understood more clearly across government?

Jo Johnson: I think it is clearly understood across government. When you look at the statements from other government Ministers there is a clear recognition that these are global activities. Our ability to be part of this global market for the most highly talented is a crucial part of our ability to continue to generate the extraordinary returns we see on our science expenditure. We spend 3% or 4% of global research spend yet we generate 50% and 60% of the most highly cited articles. That is in part because we fund excellence and we are

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pretty ruthless about the projects we fund, but it is also because we have brilliant people in this country using the public funds we provide to huge effect. That extraordinary return on our investment is because of the leverage we generate through talent.

The Chairman: Lord Mair.

Lord Mair: I have no further questions; Baroness Morgan has covered them.

Viscount Ridley: I have a follow-up on something Baroness Morgan said, and I will maybe make a suggestion. Next time you are sending a memo to your equivalent in the Home Office, perhaps you could point out that the opinion-poll evidence is quite clear on this: the British people have concerns about unskilled immigration but are extremely enthusiastic about skilled immigration; that is to say, scientists, engineers, entrepreneurs, et cetera. Ipsos MORI had a recent poll showing that. I feel that distinction has not quite sunk in at the Home Office, but I might be wrong. You do not have to say you are going to send that memo but it is a suggestion.

Jo Johnson: The Home Office will be opening a consultation on its proposals around non-EEA migration, so I think everybody is at liberty to send their submissions in. If you feel they have not had the message enough, you are most welcome.

Viscount Ridley: It would be great coming from you.

Lord Hennessy of Nympsfield: Minister, can I put three things together? You have quoted the Prime Minister saying she wanted to ensure a positive outcome for UK science. You also gave those figures that always cheer us up about the proportion of world scientific papers and so on, and you expressed confidence that we will continue to be competitive as a science hub as we were before we went down our aberration of 43 years in the EU, as it turns out. I am not one for benchmarks—I think they are mainly nonsense on stilts—but can I offer you a thought? One of the tests of our success in coping with all this will be, in 2030, 10 years after we have come out, whether those statistics you have just quoted still hold. At least we have to maintain that if not surpass it. Would you like to pledge that is what the Government should aim to have as a position by 2030? We can call you back as Prime Minister by then to give us evidence.

Jo Johnson: Those statistics are exceptional and, as I said, they are testament to the extraordinary strengths of our science, research and innovation communities, which we want to preserve. In any new world we want to ensure we continue to have high rates, for example, of citations for UK research publications; we want to continue to punch above our weight. It would not be right for me to pin my shirt to a particular number, but if we continued to strongly out-perform our GDP share in global research that would be a measure of continuing success.

There are other interesting ones as well, other than looking at citation numbers. It is worth looking at whether we are continuing to take leadership roles in significant international collaborations linked to science and research and continuing to see our scientists working with the best and brightest minds wherever they are in the world. It will be important that we continue to see very strong levels of inward investment linked to R&D, as we do at the moment, and it is important that we continue to have a skills base, as I said before, with high levels of absorptive capacity so that we have the capacity to use the R&D we are supporting through the public purse. Those are all the kinds of benchmarks we want to use to help us

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ensure that, whatever the new relationships we put in place in the post-Brexit landscape, we continue to drive the outcomes we want from our investment in science and research.

Q51 Lord Maxton: As has been mentioned, the private sector is a very large investor in research. It depends on technology, as part and parcel of that research, because science depends upon decent computers able to do the sums rapidly. What is the impact on the private sector of Brexit? If you are a major pharmaceutical company or a major computer company, why would you go for a small market, which is what Britain is, as opposed to a large market outside, particularly when you have the pound declining in value, which means that costs of everything are going up if you import? Microsoft, for instance, has already said it is putting its prices up by 22%. How does the private sector deal with all this?

Jo Johnson: It is vital that the private sector plays its part in driving up our overall levels of R&D as a country. As the Committee knows well, we are at about 1.7% of GDP, public and private combined, as against an OECD average of 2.4%. The public sector is about 0.5% of that. We want to support the private sector in continuing to invest. We do it through the R&D tax credit system, which is increasingly popular—and costly for the Government to provide, by the way. We want to put in place the overall business environment that means it sees the UK as a great place to set up operations, and we do that in many, many ways.

Your Committee heard that the science and pharma community in particular sees a potential upside in a post-Brexit world. GSK pointed to some of the opportunities that might arise from our ability to look, from first principles, at some of the regulatory structures and frameworks that currently govern us and govern science; the activity, in particular, of pharmaceutical companies. Your Committee was right to look at the five broad areas which, again, looking from first principles, might be possible: animal research, GM research, clinical trials, data privacy and the REACH chemicals framework. Those are all interesting areas where we can look again from first principles and say, “Is this the right approach?”, whilst of course recognising that there are huge advantages from harmonisation and the regulations that the EU has provided and that there are benefits to us from being part of those sorts of broad frameworks. The private sector has a huge part to play in making Brexit a success.

Lord Vallance of Tummel: Prior to the referendum we had the chief technology officer of Siemens AG here to give us some views. If I boiled them down he said that, all other things being equal, he would prefer to see investment in R&D within the European Union rather than outside it, so that if we moved to being outside the European Union we would be rather less likely to get investment from Siemens and, no doubt, from other major German and other companies than would otherwise be the case. That implies that to attract the same kind of level of investment as we have now we have to produce an even more attractive environment than we have at the present. How would you tackle that? The things he is interested in, of course, are the free movement of staff, and the networks that go with them.

Jo Johnson: Can I ask Gareth to start with that and then I will come in?

Gareth Davies: What is really important here is to look at the different drivers behind some of the inward investment decisions that different corporates make. You are right that, obviously, market access and size of markets can be an important criteria. Often it is also the strength of our underlying science and research base. I was speaking recently with the Minister from Singapore for the Economic Development Board. Singapore is a much smaller

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country than the UK but with fewer trade and access relationships through free trade agreements than we have. However, they are very successful in attracting some of the major global, advanced manufacturing firms, such as Rolls-Royce, in particular. The reason for that is a combination of the talented workforce they have, particularly in STEM subjects, and the strength of their underlying science base, particularly around engineering and mathematics. There is a real question, coming back to the role of the industrial strategy, around how Britain prospers as an economy outside the European Union. We need to look at a range of things in front of us: where we have our sectoral strengths, the underlying strength of our science base and infrastructure and, as the Minister said before, the talent coming through and how we develop our own talent pipelines as well as ensuring we continue to attract talent globally.

Lord Vallance of Tummel: I should perhaps declare a past interest as a member of the supervisory board of Siemens, so I have seen the way that they look. It is not just that; it is partly to do with regulation. You know that regulation is predictable within the market of the union as a whole; you do not know whether it will be predictable in the future. You do not know what sort of markets you are going to access. It is the whole of that environment. You need to look very, very carefully, if you are going to attract inward investment, at what the terms are and how you can give companies, such as Siemens and others, reassurance that this is not going to be difficult, and it will have to be better than it is today.

The Chairman: Before you come back on that, would Lord Fox like to come in briefly?

Lord Fox: You are making that point and using your very good example of Singapore, where the absence of regulatory friction is really helpful for companies. Where might you see areas of friction that you can remove to ease people's ability to set up in this country?

Gareth Davies: The Economic Development Board in Singapore is excellent and we continually look to learn from it; the way in which they can corral different agencies of government is impressive, and the speed at which they can give offers to new inward investment opportunities is great. There is a fundamental trade-off here, which I think came through when Dr Patrick Vallance was giving evidence to you a few weeks ago, on tailoring the regulation so we can make the most of our underlying comparative strength and attract great international companies and inward investment opportunities versus the need for standardisation for market access. As we work our way through the negotiations we will need to think, sector by sector but as a whole for the country, what the right balance is for Britain's national interest. There are some important decisions there.

Lord Hunt of Chesterton: Singapore is a very good country but it has a terrible environment. It has the highest rate of childhood asthma of almost anywhere in the world because they have uncontrolled shipping and so on. It is not all easy. A significant part of the UK's research is associated with government agencies—I used to run the Met Office—and it seems to me we have had no clear picture about how the government agencies will be used effectively in this strategy. In fact, I am afraid to say, the Government chief scientist takes a very agnostic view—unlike previous ones—of his role in relation to government agencies, which surprises me. That is a very important part of our investment. Are we going to continue to have very significant public sector research laboratories, as they do in Germany? In Germany it is an extremely important part, and we have been privatising ours. I just ask that question. How are they going to be developed? Are you going to encourage continuing strong links

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between the UK public sector laboratories and institutions and those on the continent? It is a very important way in which you drive technology.

Jo Johnson: Yes, we continue to see a very important role for these agencies and I do not envisage this having any impact on that in any way.

Gareth Davies: I completely agree. On the work that, say, the Met Office is doing, which is incredible environmental science, Dame Julia Slingo, again when giving evidence, was saying that she has been proactively asked to participate in EU collaborations post-referendum rather than having to force her way in. I think there is still that demand from the EU to work with the excellent science base we have, both in the universities and our public sector research institutions.

Lord Hunt of Chesterton: It would be quite good to mention it sometimes in your documents.

Gareth Davies: Point taken.

Q52 Baroness Young of Old Scone: Can we talk about money? The Treasury assurance that Horizon 2020 awards that span the exit would continue to be funded was welcomed. That raises two questions, I think. The first is where the money will come from. Will it be one of these wonderful government, "Now you see it, now you don't"—the left hand and the right hand—transfers from existing science and innovation budgets, or is it genuinely going to be new money? Secondly, it is of course only a transitional arrangement and the big question is: if there is a €3.4 billion gap between what we gave and what we got out of European research and innovation budgets how is that going to be met for the future? Is there going to be a guarantee that that in fact will be met from UK sources? What is your reaction to those two points and are you asking the Treasury for guarantees of funding on both of them?

Jo Johnson: On the first of those, yes, this is new money, so it is not money from the existing science ring-fence; it is additional resources beyond the 26.3 billion we have already committed for the period 2016-17 to 2020-21. It is an additional commitment from the Treasury to underwrite EU research funding. Beyond that, no commitments have been given because, as you know well, we are still in the business of determining exactly what our future relationship to those funding programmes will be. At present, there are no further commitments beyond that.

Baroness Young of Old Scone: The Prime Minister has given a commitment to a positive outcome for science. It would be quite difficult to see a positive outcome if €3.4 billion was missing.

Jo Johnson: We will have a positive outcome for science from these negotiations and in our new relationship—I am confident of that—but it is going to be a process that takes time to conclude. The Prime Minister's letter to Sir Paul Nurse, written immediately after she took office, makes clear that she sees science and innovation as at the heart of this country's future success. You can assume that it will have the Government support that matches that commitment.

Baroness Young of Old Scone: Are you are pressing this point with the Treasury?

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Jo Johnson: Of course we want to ensure that we continue to support good outcomes from our science and research base.

Baroness Young of Old Scone: I do not think that was the question I asked. I asked whether you were pressing this point with the Treasury.

The Chairman: I think you have your answer.

Baroness Neville-Jones: Minister, there is a very close relationship between the scientific and research community and your department. I suppose it will now be rebuilt with the Education Department in its revised structure. Neither of those two departments will be, I take it, a lead department in the Brexit negotiations. My question to you is one that preoccupies the science and research community in this country: how their voice will be heard and how the important issues that arise will be really understood by the Department for International Trade but particularly by the Department for Brexit doing the negotiation. Do you have a plan for bringing the negotiators and the scientific community together, first of all, to prepare the dossier? Secondly, will there be any chance of there being scientific advice fed in during the course of the negotiation?

Jo Johnson: Yes, we are working very closely with colleagues across government, so in the FCO, the new Department for International Trade, colleagues in the DfE—I am also a Minister in the Department for Education with my universities hat on—as well as with Ministers and the Secretary of State from the Department for Exiting the European Union. We are going to meetings together with representatives from the research and innovation communities. I have had meetings with the heads of all the learned societies, with the Secretary of State for that department, David Davis, Lord Bridges and Robin Walker, and we continue to work together to try to ensure that the science and research community's voice and interests are properly represented in the Government's overview and understanding of where our national interest lies in these negotiations.

Baroness Neville-Jones: Have you invited comment from them?

Jo Johnson: Tomorrow, for example, I am giving evidence jointly with Robin Walker, the Parliamentary Under-Secretary from that department before the Commons Science and Technology Committee. It is an example of the joined-up working between the Department for Business, Energy and Industrial Strategy and the Department for Exiting the European Union.

Baroness Neville-Jones: Thank you. That is very reassuring.

Q53 Viscount Ridley: Minister, in your opening remarks you mentioned there were opportunities as well as challenges in Brexit, and you have since elaborated the point on pharma, GM, REACH and so on. You have also said that science and innovation will be at the heart of the industrial strategy and that there is a discussion paper coming shortly. Perhaps I could suggest a couple of specific things that could be in it: changing the role of Government in business innovation if the UK is not under state aid rules or doing without VAT charges on buildings cohabited by businesses and universities. Are these the sorts of specific things that you will be considering?

Perhaps I could follow that up with a more general question, which is the extent to which you are happy with the idea that the industrial strategy will be about picking technological

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winners if not corporate winners. I think we are all allergic to picking winners between companies but your predecessor, David Willetts, was quite keen on eight great technologies that we should champion. Perhaps you can think about that general point too.

Jo Johnson: On the opportunities point, you are right, there are broadly three big areas of opportunity for the community post-Brexit and you have mentioned two of them, picking up on points I made, around the regulatory environment and around making sure science and innovation is at the heart of the industrial strategy. I would add a third to that list, which is we now have an opportunity from first principles to think strategically about how we want to fund our international collaborations in science and research. I think this was a point which the Committee heard also from people who gave evidence before it at one of its previous hearings. We can look, again, from first principles, at where can we, to best effect, deploy the funds we want to make available for collaborations.

On analysing the role of Government in business innovation—

Viscount Ridley: Without state aid rules.

Jo Johnson: There will continue to be regimes governing government subsidies of one form or other to business in whichever scenario we might find ourselves. Even if we are no longer part of the EU state aid system, which I am not saying might the case—it may or may not be the case—we would still be governed by the WTO's subsidies and countervailing measures regime, which would, to a certain extent, mean that we would not be able willy-nilly to subsidise or support businesses. As a general point of principle, the Government want to create a framework in which businesses can compete on level playing fields; they do not want necessarily to get into the world of persistent subsidies for individual companies or individual sectors. I am going to ask Gareth to take the point about VAT, if I may.

Gareth Davies: Sure. This has been raised with me a number of times, and I think there has been a range of different institutions—most recently, Crick would be one of them and, similarly, some of the major facilities we have been funding through the capital consultation process over the last five years. As ever with VAT and EU rules, complexity is the order of the day here. As you know, when you go over 5% that starts to trigger the flip from zero rating to 20% rating. These are all issues we will need to look at in the round. I come back to these choices and trade-offs we face, because there are specific issues facing science and more general issues facing the negotiation around the benefits of tailoring the rules and regulations for the comparative advantages we have as a country versus the benefits of market access and standardisation. As officials working through this process with colleagues in the Department for International Trade and the Department for Exiting the European Union, we will need to work through some of those issues, and we are spending our time now auditing the fact bases so that we can then make a clear assessment of the choices and trade-offs for Ministers.

Viscount Ridley: Can I press you a bit further on the "picking winner technologies" point? Are you a Willetts-ite in this respect?

Jo Johnson: I think it is not for Ministers to set down which technologies the community should best invest in and invest the science and research funding we make available to it. My broad approach is to make sure we get the best possible funding settlements for the sector, in answer to an earlier question on which I was probed, so make sure that, within the resources available to Government generally, science is getting properly supported, and

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then the general principle of letting people who know about the science decide where best to spend those resources. We allocate money to the research councils; that is a ministerial decision. Once those decisions have been made we want the research councils themselves to determine their research priorities.

Viscount Ridley: The Haldane principle is intact, in that sense?

Jo Johnson: It is entirely intact and we are using the opportunity of the Higher Education and Research Bill to entrench it further.

Lord Fox: A brief follow-up on that: how does that then superimpose into industrial strategy? By definition, are you saying all industry is in the purview of the strategy, or are you going to focus in on particular industrial sectors?

Jo Johnson: One of the principles we are taking for the industrial strategy is to say, "Let's not go against the grain of existing strengths". One of the first principles of strategy is to use your strengths, and we have many strengths as an economy. We have strengths in advanced manufacturing, in all manner of business and services and in creative industries, so let us use our strengths and support those areas, but we are not in a business of identifying particular winners within sectors.

Baroness Neville-Jones: Minister, do I understand you to be saying that the eight great technologies are now disappearing as a guiding principle of where the Government is going and where it is putting the emphasis?

Jo Johnson: No, I would not be as categorical as that. They were a useful tool when they were announced in 2012, but even at the time they were announced they were never intended to be an exhaustive, permanent 10 commandments. The world moves on and many interesting fields of scientific discovery have emerged since 2012. New focuses of energy are materialising all the time. Artificial intelligence, for example, I do not think was one of the eight greats. We would not want to set in stone for the next 30 years something set down in 2012 as the focus of our future science and innovation strategy.

Baroness Neville-Jones: Robotics was. I see.

Q54 Lord Mair: Minister, you mentioned the Higher Education and Research Bill. Does Brexit have implications for the role and shape of UKRI?

Jo Johnson: Yes, I think it makes it more relevant than ever. The science and innovation community would benefit from the kind of strong voice that it will represent. Observing John Kingman's work as its chairman in shadow form, he has been immensely effective on behalf of the community in making the community's voice heard strongly across Government. That role will become even more important as time goes by. As we seek to forge strong, new, international collaborations around the world, having a body such as UKRI representing a very significant chunk of government investment in research and development will be extremely helpful to science.

Lord Mair: If the UK was outside the single market and no longer under state aid rules, how might that change the way Innovate UK operates?

Jo Johnson: Viscount Ridley touched on this in his question about funding for innovation. That remains to be seen. We see Innovate UK as an integral part of UKRI. I have received a letter from the Committee, via Earl of Selborne, which I responded to a few weeks ago. We

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really see Innovate UK as having a key role to play in making sure we are getting the most from the investment in R&D and that the R&D community is aware of the needs of business. It is a bit early to say, at this stage, how its role in supporting business might change, but we see it as playing a vital role in that respect.

Lord Vallance of Tummel: You said that the industrial strategy will play to our strengths but presumably it will address our weaknesses as well. Perhaps you could say a little about what you think those weaknesses might be and what, if any, have been brought about by moving out of the European Union?

Jo Johnson: We have existing weaknesses which we need to address, irrespective of how our economy evolves in respect of Brexit. The skills base needs upgrading, and our productivity is a fifth of the G7 average. We have growth which is very variable across the country. We want to make sure that our industrial strategy addresses existing as well as future challenges. The skills base is foremost among them.

Lord Hunt of Chesterton: Going back to the industrial strategy, when we had our meeting a couple of weeks ago there was an interesting discussion about the German approach. They have this so-called 4.0 Industry/internet of things, and so on, which is a very strong programme which means that different companies, industry and the science community will operate in quite a different way. I have been to the German embassy and heard a presentation from your department, and there still seems to be no strong movement in that direction. Lord Willetts was explaining this. The second point I wanted to make was that when I asked colleagues at Rolls-Royce how is it that a significant amount of research is now going on in Berlin—I hear this all across Europe, including Rolls-Royce Germany—they say, "The German Government is giving us a lot more subsidy". I wondered if the question of Government support and this question of a new strategy of technology and industry working together will be part of your own strategy.

Gareth Davies: Shall I come in on that? That is critical. A lot of the role of the industrial strategy will, as you say, will need to build on where we see our strengths. You were asking previously around the scientific input into this. We have been working with the British Academy and the Arts and Humanities Research Council to ensure we have scientific input on the history of industrial policy in this country and internationally, which we think is critical.

On the specific points around Rolls-Royce and research, we operate in a global market now for research. UK companies will always look internationally before locating either new research facilities or new projects, and we are constantly in competition with Germany, parts of the US, Singapore—I have touched on before—and we need to be competitive. That will touch on a range of things. I will touch on a combination of the underlying science and research base, and we see that around Cambridge and the LMB and the way in which that attracts inward investment from the life sciences industry. The Minister has touched on talent and there is Government support for early-stage research and development.

On roles in particular, we have set up the APC, the Advanced Propulsion Centre, which is around taking new technologies in engine design and helping to commercialise them. This is a long-term commitment. One of the issues we hear often from business is not wanting year by year support but multiple years. This is over 10 years. It is those sorts of interventions that can help anchor research and development.

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Baroness Neville-Jones: At Bristol. Is that right?

Gareth Davies: Partly Bristol and up in the West Midlands—Derby—as well.

The Chairman: Finally, Lord Hennessy.

Q55 Lord Hennessy of Nympsfield: Does Brexit mean a new role for scientific advice within Her Majesty's Government? We are repatriating a great deal of regulation. I was a remainer, like you, but I can sense an element of liberation in some of this stuff coming home. Does it mean this is the time to review the role of the chief scientist and, also, the chief scientists across Whitehall? Not least because in all these wonderful trade deals we are going to get, the scientific element is pretty crucial. Are you looking at that in the round, afresh?

Jo Johnson: I think we have a very effective network of chief scientists across the various departments, led by Sir Mark Walport, and they are providing very helpful input into this process. The network is not under review, as I understand it.

Gareth Davies: No, but I know he is obviously working around what the new demands on the network will be and has been working with the permanent secretary in the Department for Exiting the European Union, both in the actual negotiation itself and, more generally, in any future environment, on to what regulations might be domestic rather than European in the future. Defra is an obvious example of a department that may need additional capacity.

Lord Hennessy of Nympsfield: May I add to that a personal question? I have been thinking about British politics and government and every generation puts science and technology and R&D at the heart of everything, and yet we never know where to put it in the machinery of government. You are peripatetic, almost a mendicant, and now you are split between two departments. Why is it that we cannot work out where science and technology should be? You are in a long line of these rather sad and weary Ministers who take their portfolio from one semi-welcoming Ministry to another.

Jo Johnson: I am not sad or weary. In fact, science has stayed where it is in the Department for Business, in one of the two growth departments of government. It is universities that have moved over to DfE. I have another office about 80 yards away in DfE where, with my universities hat on, I think about many of the same issues.

Lord Maxton: Is the problem that Lord Hennessy is advising that you think in a five-year timescale, because that is when the next election will be, whereas science and technology, obviously, thinks in a much longer timescale than that?

Jo Johnson: We are setting up this new body, UKRI, through the Higher Education and Research Bill, which is going to provide some capacity for the strategic, long-term thinking that we really need. Take, for example, capital allocations. As a department, BIS has often been criticised for the manner in which it has allocated capital. It is said to be too short-termist, insufficiently evidence based, without sufficient regard for value for money, and so on. We are putting in place now a structure with UKRI that will enable us to take a really rigorous approach to capital allocation for science for the first time, and I think that is a demonstration, through this Bill, of us putting in place a solution to some of the problems that you point to around where science sits in Whitehall for the first time. That is why I think the community should get behind it.

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The Chairman: An absolutely final word from Baroness Neville-Jones. This really is the final word.

Q56 Baroness Neville-Jones: Minister, I wanted to go back to what was being said about international trade deals in the future. Quite a lot of expectation is being reposed in the trade deals that the UK will be able to make. Do you accept the proposition that modern trade deals are going to be about technology and services—things other than classic tariff activity on manufactured goods—and that, therefore, our negotiating objectives should be ones that advance the modern economy and the scientific and research input into it? Will that be a priority and will there be advice going into the negotiating hand for that purpose?

Jo Johnson: Yes, I think, is the answer to that, but it is really for another department to comment in more detail.

Baroness Neville-Jones: That is exactly our worry: it does not happen because it is another department. These things are whole of Government.

Jo Johnson: Yes, of course, we want to be ambitious in the trade agreements we strike in the new world with what may be our new ability to do that, subject to whatever arrangements we arrive at. Being ambitious means having agreements that reflect the nature and the interests of our economy.

Baroness Neville-Jones: That is right. The Cabinet committee system is set up to be able to do that.

The Chairman: Minister and Mr Davies, thank you very much. It has been a most informative session. As you know, we are going to do a follow-up report to the pre-Brexit report, which we will produce in a month or so. I am fairly confident that our follow-up report will be positive, as you have been today, setting out how science might help inform and plan the industrial strategy, and indeed settle some of the concerns which are inevitable after the turmoil in this area since Brexit. Thank you for your very positive response today. You have given us a lot to think about. As always, there will be a record which you will have an opportunity to correct for inaccuracies. Thank you very much indeed.

James Hutton Institute – Written evidence (EUF0014)

Executive Summary

1. What the effect of the various models available for the UK's future relationship with the EU will be on UK science and research, in terms of:

- **Collaboration**
  - A new relationship with EU institutions and partners should expand on existing relationships with EU research infrastructure (e.g. European Commission Joint Research Centre), and the range of science advisory groups in which UK researchers play a significant role (e.g. EFSA, scientific review panels, High Level Group on Scientific Advice Mechanisms on which the UK is represented)

- **Free movement of researchers and students**
  - The position of the UK in bids for competitive funding from EU and international sources, has been strengthened by its unique opportunity to exploit global connections in science, trade and culture, and importance of the English language (e.g. EU project coordination). These have attracted high quality researchers and students from EU Members States to the UK, significantly simplified by free movement within the EU.
  - Negotiations of new arrangements provides an opportunity to promote UK science excellence and its contribution to industry and business as a central element of the reported wish of the UK Government to be a global leader in free trade.

- **Access to funding**
  - Access to funding from EU sources is important for improving scientific understanding and the financial support it provides to research organisations.
  - If future routing of funding was managed through a UK body (e.g. UKRC) then care is required to ensure continuity of eligibility for organisations which do not have automatic access to research council funding, such as the James Hutton Institute.

- **Access to EU-funded research facilities, both in the UK and abroad**
  - Enable effective ongoing relationships with the EU Joint Research Centre which facilitate internationally important collaborations (e.g. European Soil Data Centre), and provide mechanisms which increase the impact of research funded by Scottish and UK Governments and their agencies to inform international agreements.

- **Intellectual property and commercialisation of research**

    - Seek a relationship with the EU which does not disadvantage business opportunities with current and future clients in EU Member States, no changes in existing protection of intellectual property, and no increase in complexity or overhead for protecting new intellectual property.

2. What the science and research priorities for the UK Government should be in negotiating a new relationship with the EU.

- The UK should seek participation in discussions about the programme and structures of the successor to Horizon 2020, reflecting an intention to maintain a strong working relationship with partners in the EU and EEA.
- Scientific priorities should address internationally agreed challenges (e.g. climate change, biodiversity, UN Sustainable Development Goals; IPM/pesticide reduction targets) which are supported by international agreements (e.g. Aichi Biodiversity Targets of the Convention on Biological Diversity).
- The priorities should also have a focus on the growing the EU (bio) economy within which the UK would make a full contribution.
- Relations should be maintained with functional units of the EU research programmes, such as the European Research Council Marie-Sklodowska-Curie Actions which contribute to the delivery of the objectives the UK Government and the devolved administrations of international leadership, competitive industry, and social justice.

3. What science and technology-related legislation, regulations and projects will need to be reviewed in the run up to the UK leaving the EU.

- Many regulations relate to international protocols or agreements for which the UK or Scottish Government have set targets. These can be expected to remain irrespective of UK membership of the EU (e.g. Scottish Government targets for reducing GHGs and pesticide use).
- Social, natural and interdisciplinary science informs a broad range of regulations with environmental or rural considerations, such as the Common Agricultural Policy Pillar 2, implementation of the Water Framework Directive, food safety and pesticide legislation.

4. The status of researchers, scientists and students working and studying in the UK when the UK leaves the EU, and what protections should be put in place for them.

- Existing staff and students should not be disadvantaged by a change in status of UK membership of the EU.
- Stresses on staff created by uncertainty in status (e.g. employment rights post secession of the UK from the EU) are alleviated as rapidly as practical.
- No change is made to their eligibility for continuity of employment on the same conditions as at appointment to ensure the completion of research contracts, and

opportunities to designing new proposals under whatever new structures have been put in place.

The opportunities that the UK's exit presents for research collaboration and market access with non-EU countries, and how these might compare with existing EU arrangements.

- Negotiate agreements with non-European countries for bilateral research collaborations to engender increased cooperation between UK researchers and other parts of the world.

What other measures the Government should undertake to keep UK science and research on a sound footing, with sufficient funding, after an EU exit?

- Implement a comprehensive communication strategy emphasising that UK industry and science are 'open for business'.

Introduction

The James Hutton Institute's response to the Science and Technology Committee's Call for Evidence is based on its extensive experience in participation in contributing to the science base and infrastructure of the European Union, and participation in its research programmes over the last 30 years as beneficiaries and evaluators.

Our submission aims to inform the UK Government and devolved administrations in their negotiation of new arrangements between the EU and its Member States. We are seeking continuity of collaboration and securing of funding through the suite of mechanisms currently available, and identifying new opportunities into the future.

In recent years, the Institute has provided invited convenorships or membership on influential European advisory groups. Notable amongst these is the EU Joint Programme Initiative (JPI) on Water; European Food Safety Authority (3 of 10 Panels); EU European Innovation Partnerships of DG AGRI (4 of 20 Panels), for the EU agricultural research agenda to support CAP, Bioeconomy and Biodiversity Strategies, and EU 2030 Climate Framework; EU Joint Research Centre New Plant Breeding Technologies Group; European Soil Bureau; Board of European Plant Science Organisation (EPSO), contributing to development of agriculture, horticulture, forestry and biodiversity in Europe. Delivering high impact from research projects is informing strategic thinking and options, such as the roles and functions of advisory services in Europe as part of the process of innovation generation and problem solving set out in the 'Agricultural Knowledge And Innovation Systems Towards The Future', drawing on findings from the ProAKIS project.

Under the EU's Framework 7 Programme, the James Hutton Institute secured €8 million funding. It is eligible to apply to all relevant EU funding streams but not all equivalents from UK funding sources. As such, the EU Research and Innovation programmes are key sources of revenue, comprising almost 23% of newly obtained funding since formation of the Institute in 2011.

In the first two years of the Horizon 2020 funding programme the Institute secured over €8.3m, in topics across a spectrum of the bio-economy research agenda which is common to the European Union, Scottish and UK Governments. In 2015, Scottish research organisations

were partners in 8 of the winning bids of the 15 projects funded by the EU on aspects of food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the Bioeconomy, including three to the James Hutton Institute. Such a level of success illustrates the types of opportunities which are being taken by Scottish research organisations and in so doing promote Scotland as a centre of innovation and creativity.

The Institute's perspective is also informed by its scientific and technical support to Scottish Government on reforms and implementation of the new Common Agricultural Policy from 2015, field/business level, and sectoral and/or regional levels. This included options for changing to area-based CAP payments (2013), payment region implementation (2014), review of Greening (2015/16), and designation and differentiation of payments within Areas of Natural Constraint (2016). Therefore, the organization is in a unique position to understand the benefits of linking research with the needs of policy, practice and industry.

Response to Consultation Questions

1. What the effect of the various models available for the UK's future relationship with the EU will be on UK science and research, in terms of:

- **Collaboration**
  The well documented success of UK organisations in securing funding from EU research programmes (e.g. The Royal Society report on The role of the EU in funding UK research) reflects not only the science excellence but also the capability to collaborate with industry, policy and civic society to ensure the relevance, high impact and legacies of research. These are key requirements for achieving success in programmes of European funding such as Horizon 2020 and at which UK research teams have become highly proficient. Together, this four-way relationship has demonstrated understanding of the critical importance of collaboration across borders, disciplines and responsibilities to the advancement of science. The requirement of such collaboration in H2020 programmes is, in part, a reflection of the input of UK interests to their design.

  Collaboration is broader than through research projects. It includes contributions to joint initiatives in which the European Commission Joint Research Centres take a leading role, participating in panels which evaluate research programmes and individual proposals, joint supervision of post-graduate students irrespective of funding through EU mechanisms, and participation in science advisory panels. Negotiation of a new relationship with EU institutions and partners should present a case for expanding existing relationships with EU research infrastructure (e.g. European Commission Joint Research Centre), and the range of science advisory groups in which UK researchers play a significant role. Examples of such engagement are the European Innovation Partnerships of DG AGRI invited participation of Scottish research Institutes in 5 of 20 Focus Groups on priority topics, more than any other area of Europe, and the European Food Safety Authority (EFSA) on topics of significant societal interest such as environmental risk assessments of cultivation of genetically modified plants.

- **Free movement of researchers and students**
  Intrinsic to participation in research with European partners is the network of engagement which sees researchers move between collaborating organisation in science, industry and increasingly in policy and civic society. Such engagement often takes the form of exchange visits or placements in partner countries to enable researchers to take advantage of leading edge equipment or expertise, as well as the importance of developing interpersonal understanding and relationships through bilateral and multi-lateral meetings, workshops and conferences. It is key to building national and European capability in science and the ability to translate science to stakeholders and actors in industry, policy and civic society. Taken together, such engagement forms an integral part of the process of development of scientific ideas and the exchanges within European networks has been a core element in the development of a generation of researchers over the last 40 years.

  Such interactions are a *modis operandi* in much of the global scientific community, of which the UK is a core participant. UK research organisations have been able to exploit the country's rich heritage of connections across the world and the importance of the English language in international science and public affairs. European partners have become an increasingly important part, significantly simplified by the free movement of researchers and students from EU Member States. This in turn has strengthened the position of the UK in bids for competitive funding from EU and international sources, providing evidence of the depth and productivity of international collaborations.

  The differences between alternative existing models of scientific collaboration may be relatively limited. However, negotiating new arrangements with countries globally, as well as the EU and EEA, provides an opportunity to promote UK science excellence and its contribution to industry and business as a central element of the reported wish of the UK Government to be a global leader in free trade.

- **Access to funding**
  The development of mechanisms which enable access to such funding into the future is important both to improve scientific understanding to address societal challenges which respect no administrative boundaries such as climate change, and for the financial support it provides to research organisations. A number of models can be considered, informed by agreements in place for researchers in the existing fifteen Associated Countries.

  However, if the routing of funding were to change such that it was managed through a UK body (e.g. UKRC) then care is required to ensure continuity of eligibility. For example, the James Hutton Institute is eligible for funding through all EU programmes but is not eligible for most funding routed through UK Research Councils, unless by special arrangement (e.g. the Scottish Government contributing to a specific programme of research). So, follow-on funding arrangements should take full account of eligibility of organisations for funding.

- **Access to EU-funded research facilities, both in the UK and abroad**

The James Hutton Institute collaborates closely with the EU Joint Research Centre, principally the centres at Ispra (Italy) on issues relating to soil and land use (including as Chair of the European Soil Bureau Network located at JRC Ispra), and Seville (Spain) on issues relating to agriculture and food security. These links provide which facilitate internationally important collaborations to which UK organisations are recognized as leading contributors (e.g. European Soil Data Centre). They also provide valuable conduits for communicating findings from research funded by Scottish and UK Governments and their agencies which informs European and international dialogue on international agreements or protocols to which the EU, and UK and Scottish Governments are signatories or to which they have declared commitments (e.g. delivery of the UN Sustainable Development Goals, Paris Agreement within the United Nations Framework Convention on Climate Change).

- **Intellectual property and commercialisation of research**
  The corporate strategy for James Hutton Institute is to identify, filter and focus on the best ideas for commercialisation. Such ideas are developed for global relevance, markets and clients of which includes those in EU Member States, the UK and Scotland. We would seek a relationship with the EU which did not disadvantage business opportunities with current and future clients in EU Member States. It would be desirable if the negotiated outcome in relation to intellectual property was one of no change in existing protection, and no significant increase in complexity or overhead for arranging the protection of new intellectual property (e.g. European Patent protection).

2. What the science and research priorities for the UK Government should be in negotiating a new relationship with the EU?

The research priorities and mechanisms for the successor programme to Horizon 2020 will be being developed over the latter period of negotiations of the new relationship between the UK and EU. These will also be informed from the evaluation process of the working of the Horizon 2020. The UK should seek participation in such discussions reflecting an intention to maintain a strong working relationship with partners in the EU and EEA.

Scientific priorities should reflect shared investment in addressing global challenges (e.g. climate change, biodiversity, UN Sustainable Development Goals) supported by relevant international agreements (e.g. Aichi Biodiversity Targets of the Convention on Biological Diversity); and boosting economic growth through science and innovation (e.g. primary and secondary food production, and provision of safe, nutritious, high quality and affordable food across all stages of the food supply chain).

A relationship should be maintained with the functional units of the European and EU research programmes, notably:

- European Research Council in support of frontier research, cross-disciplinarity and pioneering ideas in new and emerging fields;

- Marie-Sklodowska-Curie Actions to encourage transnational, inter-sectoral and interdisciplinary mobility;
- COST Association for facilitating trans-national cooperation among researchers, engineers and scholars across Europe;
- European Research Area.

These contribute to the delivery of the objectives the UK Government and those of the devolved administrations of international leadership, competitive industry, and social justice.

3. What science and technology-related legislation, regulations and projects will need to be reviewed in the run up to the UK leaving the EU?

The science of the James Hutton Institute informs the design and implementation of a range of legislation and regulations for the European Union, UK and Scottish Governments. The science base informing the development of regulations or thresholds is funded by a broad portfolio of sources, one of which is the EU Horizon 2020 Programme and others are funded by individual EC Directorates General. Such regulations come under the remits or authority of public agencies or departments of government. In relation to the research and remit of the James Hutton Institute several such regulations or thresholds relate to international protocols or agreements for which the UK or Scottish Government have set targets. These can be expected to remain irrespective of UK membership of the EU (e.g. Scottish Government targets for reducing GHG emissions).

A broad range of regulations with environmental or rural considerations will require review and UK versions developed, such as the Common Agricultural Policy Pillar 2, implementation of the Water Framework Directive, food safety and legislation on pesticide control. In considering successor arrangements it should be noted that many of them are informed by combinations of social, natural and interdisciplinary sciences, and understanding of the social and ecological systems within which they operate and not in isolation.

At the level of individual European research projects in which James Hutton Institute is involved, it is not anticipated that the status of any will require to be reviewed, based on the recent commitment of the UK Government to honour funding of existing and new projects up to a set date.

4. The status of researchers, scientists and students working and studying in the UK when the UK leaves the EU, and what protections should be put in place for them.

The heritage of the James Hutton Institute as a world leading research organisation has been built upon attracting the brightest and best staff in their fields irrespective of nationality and background. The current compliment of staff and students is drawn from every continent of the world. Of importance in the development of future arrangements with the EU is that: (a) existing staff and students should not be

disadvantaged by a change in status of UK membership of the EU; (b) stresses on staff created by uncertainty in status (e.g. employment rights post secession of the UK from the EU) are alleviated as rapidly as practical; (c) no change is made to their eligibility for continuity of employment on the same conditions as at appointment to ensure their opportunity to complete research contracts for the benefit and fairness to all of the researcher, funder and employer, and to designing new proposals under whatever new structures have been put in place.

Changes in the status of researchers which then triggered significant number to leave the UK, even if only in the short term, would compromise the capabilities of UK research over the longer term due to the capability gap which would emerge and take time to fill.

5. The opportunities that the UK's exit presents for research collaboration and market access with non-EU countries, and how these might compare with existing EU arrangements.

Agreements should be considered with non-European countries for bilateral research collaborations to engender increased cooperation between UK researchers and those in other parts of the world. This would exploit the experience and acknowledged success of UK research teams in securing funding from the European Research Frameworks, increasing the attention towards addressing scientific and technical challenges outwith Europe. It could provide an effective element of the wider bilateral agreements and trading relationships expected to be developed with countries such as the USA, Canada, Australia, China and India, all of which are examples of world leading research. This would also support delivery of the UN SDGs, align with strategies for overseas development.

6. What other measures the Government should undertake to keep UK science and research on a sound footing, with sufficient funding, after an EU exit?

The UK Government and devolved administrations should design and implement a comprehensive communication strategy emphasising that UK industry and science are 'open for business', and actively engaged seeking new opportunities for collaborative working through existing EU funding mechanisms and more broadly. This should be done urgently to reduce risks associated with research organisations losing confidence in UK partners as members of consortia in the run-up to enacting Article 50. Funds may also be required to enable UK partners to 'buy in' to future research activities of the European Union.

9 September 2016

KiWi Power – Written evidence (EUF0010)

Background

KiWi Power is one of the UK's leading international, Demand Side Response (DSR) Technology Companies. KiWi is able to fund a great deal of its innovation from receipt of Horizon 2020 funds and it is important to recognise that these have been vital to drive innovation across the UK electricity sector. It is also important to note that as a business KiWi Power does not require government subsidies to operate, so the role of Horizon 2020 funding is to accelerate innovation rather than subsidise it.

KiWi Power builds its own software and hardware, with assembly lines in the UK, and has a business model designed around giving both away to the potential client without a charge. The software also provides a service that can give them full visibility of their whole company systems energy use.

KiWi is also described as an aggregator. That is a company which engages industrial/commercial sites with small amounts of power generation capability, or enterprises that have the capacity reduce power at peak times, and works with them to manage their power use. KiWi is able to collectively control the demand across aggregated client sites, creating flexible load, and then sell the flexibility back to the National Grid.

KiWi Power will innovate without Horizon 2020 funding. However the scale at which it does so and the capacity to share learning across the electricity industry will dramatically diminish. One current fear is that the £50M promised by the last government's budget in 2016 may become part of the funds used to maintain a scaled down Horizon 2020 programme. This would be a net £50M loss to direct innovation in DSR and smart technology.

KiWi Power's response to the specific questions posed is as follows:

What are the threats and opportunities posed by Brexit to science across the UK?
This question is best answered by viewing the figures below. They show clearly the level of funding that will currently be lost across our immediate industry sector. The most important point is that all these projects have to demonstrate innovation, and also contain an obligation on the part of the companies to part fund the projects as well. Hence the gap between the total project funding and the EU funding. This can be valued on a payment in kind basis as well.

The second table currently shows projects that were not successful. However, its inclusion demonstrates how much funding would be available to a start-up company like KiWi Power in the space of just one year providing that the projects are accepted.

Successful applications 2016

Project	Total project budget (€)	EU funding (€)	Number of partners
Flexiciency	19,115,936	13,946,741	18
MOEEBIUS	7,340,742	6,036,468	16
KDRP (SME I)	71,429	50,000	-

Total Value of Applications Made in 2015

Project	KiWi's grant (€)	Submission date
SHAR-LLM (GLA)	122,412.50	05/05/2015
Plug&Save	538,562.50	04/06/2015
iDREAM	502,600.00	04/06/2015
AMBER	188,750.00	04/06/2015
iRespond	529,812.50	04/06/2015
REDBoB	351,050.00	04/06/2015
EnerGEM	664,650.00	04/06/2015
Total	2,897,837.50	

What are the immediate issues, which should be addressed by the end of this year?

KiWi Power does not face immediate issues with regard to the year end in relation to the Horizon 2020. It currently understands that the Government has now announced that any projects awarded before the UK instigates Article 50 will honoured by the UK Treasury. George Osborne's last budget promised £50M for DSR/Smart technology funding, and it is important to note that this funding should be 'ring-fenced' and made available in its own right and not form part of a new Horizon 2020 scheme.

What are the medium term issues which will need to be addressed over the next 3 to 5 years?

KiWi Power represents a growth company in a globally growing industry, with savings to the consumer identified by the National Infrastructure Commission to be in the region of £8BN pounds a year by 2030. KiWi Power will continue to innovate, however without access to these partnerships and collaborations the ability to share learning across companies will be to the UK's overall detriment. It will also dramatically slow the pace of innovation. One further key point is that Horizon 2020 delivered intangible value reflected in the way that small companies or even start-up companies were able to work alongside very big established companies. It's difficult to value this benefit, but it will be one of the larger losses of not being able to take part in future Horizon 2020 work. Therefore government policy should look to replace this gap.

How will the health of UK science will be monitored and how quickly will any impacts be detected?

KiWi Power does not have a view on how this will be measured.

5 September 2016

James Lawford Davies, Hempsons – Written evidence (EUF0017)

I am a solicitor and partner at Hempsons in London. I am also a member of the Board of the Campaign for Science and Engineering, a Director of the London Regenerative Medicine Network, and an Honorary Lecturer in the Department of Biochemical Engineering at UCL. I specialise in the regulation of life sciences, particularly human tissue, reproductive and genetic technologies, and cell and gene therapies. I am writing to address certain specific regulatory challenges for the UK life science sector which arise as a result of the UK leaving the European Union. I hope these this will make a helpful contribution to the Committee's work on Brexit and science following the 23 June referendum.

The life sciences sector is notable not only for the breadth of regulation which applies to it, but also for the extent to which that regulation is harmonised within the EU. This is aimed at ensuring the safety and efficacy of products intended for human use, whilst also giving Members States a competitive edge in the global market.

Much EU life science legislation has already been incorporated into UK law. Directives, such as the EU Tissues and Cells Directive, have been implemented via statutory instruments and occasionally Acts of Parliament, and will therefore remain in place after Brexit.[62] By contrast, EU Regulations are directly applicable without the need for national legislation and so will no longer apply when the UK leaves the EU, unless specifically adopted.

The UK's withdrawal from the EU offers an opportunity to review existing regulation, and it may be determined that certain aspects of EU regulation are unnecessary post-Brexit, or that the UK should develop its own regulatory frameworks. In my view, however, there are numerous and significant risks for our life science sector if the UK diverges from EU standards and regulations. Many of these concerns have been elucidated elsewhere, and I would particularly endorse the joint submissions of the ABPI and BIA to the UK EU Life Sciences Steering Group in this regard.[63]

Both the UK and the EU benefit from a comprehensive and sophisticated regulatory framework which has evolved over the past 50 years, often with significant input and leadership from the UK. Divergence from this gives rise to a range of concerns, including (but not limited to) the following:

- The UK has a very well established and internationally respected regulator for medicines and medical devices in the MHRA. It is recognised as a leading regulator within the EU and is responsible for a significant proportion of the EMA's workload. Similarly, other regulators in this sector, such as the HTA and HFEA, act as UK competent authorities for the implementation of specific areas of life science regulation; they are also internationally respected, commonly setting the gold standard for regulation in their areas of expertise. There is a reciprocal benefit to the

[62] The EU Tissues and Cells Directive (2004/23/EC) and accompanying technical directives were implemented into UK law via the Human Tissue (Quality and Safety for Human Application) Regulations 2007.
[63] http://www.abpi.org.uk/our-work/library/industry/Documents/UK-EU-Steering-Group-Report.pdf

UK and EU of this regulatory expertise as a part of the wider European framework, and it would require a very considerable effort to redesign and construct a new model of regulation for the UK.

- The UK is often seen as an attractive environment for product development and a point of entry to the EU market due (in part) to the robustness and reputation of its regulation. If UK regulation ceases to be harmonised with wider EU regulation, the duplication of effort, increased costs and different standards are sure to make it a less attractive prospect for research, development and product launch, reducing the economic benefits derived from industry investment but also resulting in delayed or no access to new products for UK patients.

- If the UK is not part of EU-wide pharmacovigilance systems, there may be an increased risk of falsified medicines targeting the UK. More broadly, withdrawing the UK from participation in EU integrated vigilance processes will impact upon their ability to detect side effects, compromising patient safety.

- Regulatory harmonisation facilitates collaboration between researchers in different Member States, and the UK has led the highest number of IMI projects, facilitating the development of better and safer medicines for patients. If the UK is not eligible to participate in EU research projects, and/or the UK adopts a different model of regulation in this area, it will increase the complexity of collaboration and is likely to reduce the appeal of the UK as a location for collaborative research.

- Multinational research commonly requires data sharing. The new EU Data Protection Regulation creates a facilitative environment for scientific and biomedical research. If the UK's data protection regulations were to develop inconsistently with the EU Regulation post-Brexit, this may create an obstacle to any collaborative research which requires data sharing.

- The UK has been instrumental in ensuring that EU legislation creates an environment in which patients are protected, but also where scientific and medical innovation can flourish. The final form of the new Data Protection Regulation is an example of this, as was the EU Tissues and Cells Directive before it. The loss of UK influence and expertise in EU legislative and policy development may therefore result in a more notable divergence in the future.

For these and other reasons, it is essential that the UK agrees a form of regulatory cooperation with the EU for the life science sector post-Brexit, allowing us to remain aligned with the current and future regulatory framework. Further, and ancillary to that, it would be hugely beneficial for the UK to remain actively involved in EU regulatory processes and decisions, vigilance systems, and policy development.

There is a danger, in my view, that the simple adoption of existing EU legislation and guidance at the point of the UK's withdrawal from the EU will be seen as an adequate solution to address these concerns. In certain areas of industry this may be true: in life sciences, however, much of the regulatory landscape is constantly changing and evolving in light of new developments in science and medicine. Likewise, many of the Directives and Regulations governing the sector established processes and systems which require infrastructures and administrative capabilities of their own. The pharmacovigilance systems described above are an example of this, as are the processes governing the coding and traceability of tissues and cells in the EU, and the arrangements for the reciprocal recognition between Member States of material for the purposes of import and export.

Unless the UK agrees to maintain continuity and involvement with existing and forthcoming EU processes and systems, it will have to establish its own infrastructures to mirror those of the EU, creating a significant burden and expense with no additional benefit to the UK. An active and proactive form of regulatory cooperation between the UK and EU is therefore vital.

8 November 2106

Met Office, Science and Technology Facilities Council (STFC) and Cisco – Oral evidence (QQ 35-44)

Transcript to be found under Science and Technology Facilities Council (STFC)

Met Office – Supplementary written evidence (EUF0015)

Letter from Professor Dame Julia Slingo OBE, Chief Scientist, Met Office

Many thanks for your invitation to appear before your Committee on 13th September as part of your inquiry into EU membership and UK science. As the session was relatively brief you suggested I write with any further points which I did not have the chance to share with the Committee during the session.

Collaboration across organisations and across disciplines is widely recognised as essential to delivering the best scientific results. Funding from successive EU Framework Programmes has facilitated us working together with our EU partners around joint endeavours that have led to a much richer set of collaborations and deeper quality of outputs than would have been possible without that funding. Indeed other parts of the world look with envy on what we have been able to achieve through EU cooperation, funded through EU programmes. For example, the FP6 ENSEMBLES project, made possible by the EU, included over 70 partners and pioneered seamless ensemble climate prediction.

In my own area of research, I have no doubt that some scientific advances would not have been achieved without these EU collaborations and the funding to support them. A good example is the science of ensemble-based, multi-model prediction which has underpinned the development of seasonal to decadal climate prediction and climate change projection. It is the case, also, that UK leadership in these areas has enriched significantly the EU science base, something that could also be lost with the UK's exit from the EU.

Any loss of access to EU Framework Programmes will therefore have far greater consequences than just the loss of research funding. Our ability to collaborate effectively with our EU counterparts and for the UK to exert its science leadership will be weakened significantly in my view unless there are mechanisms, of which funding is an important part, to support it.

The importance of setting up the right mechanisms to drive the development of meaningful science partnerships is exemplified by the introduction of the Newton Fund. This has enabled us to enter into joint research programmes with countries such as China and India, something which I have sought for many years but been unable to achieve, because there was no funding mechanism in the UK through which to form these mutual partnerships. Through the Newton Fund, the Met Office now delivers successful research programmes in China with the China Meteorological Administration and the Institute for Atmospheric Physics of the Chinese Academy of Sciences, as well as in Brazil, South Africa and South East Asia. Through bi-lateral and multi-lateral programmes, Newton helps the UK build strong, sustainable relationships with the partner countries and supports the continued excellence of the UK research base and innovation ecosystem.

From our experience, we would suggest this proven model could hold valuable lessons for the development of future programmes that aim to develop high benefit international science collaborations after the UK has exited the EU, including with the EU.

Finally, I fully support the comments made by other panellists on the importance of ensuring an outcome which encourages and enables collaboration - on this point I have been very glad to see the statements given by Science Minister, Jo Johnson, emphasising that the greatest future benefits will come from being collaborative, outcome-focussed and global in our approach, as well as the recent commitments provided by the Chancellor on Horizon2020 funding.

5 October 2016

MillionPlus – Written evidence (EUF0002)

Briefing Note

MillionPlus briefing note on the implications and opportunities for science and research as a result of the United Kingdom leaving the European Union

Models for future relationships with the EU on UK science and research

While there is much analysis of the reasons why the UK electorate voted to leave the European Union (EU), concerns about immigration and the free movement of EU citizens were undoubtedly key issues. Decisions around the UK government's negotiating position on free movement will therefore be challenging but must be considered alongside access to key markets, including the potential to trade in European markets with no or minimal trade barriers.

The value to the UK economy of higher education exports is significant. The UK's science and research, and UK universities generally, are net contributors to the UK economy and must be considered as a key market which requires equal consideration in negotiations linked with trade.

It is clear from the cases of Switzerland and Norway that, for example, access to EU research funding is influenced by domestic decisions related to free movement. Currently there are five possible models post Brexit. Four of those models are based on the four different existing relationships between Norway, Switzerland, Turkey and South Korea and the EU. The fifth model is often referred to as the World Trade Organisation (WTO) model. There are also two national European trade organisations that stand outside the EU – the European Free Trade Association (EFTA) and the European Economic Area (EEA).

<u>Recommendation:</u>

- The UK government must prioritise UK higher education, science and research as key areas of future trade with the EU. Ministers should liaise with the university sector to explore the merits or otherwise of engaging with the different models that may be available. Future arrangements in relation to the status and mobility of higher education students, staff and researchers need to be considered as part of the UK government's negotiations.

Staff and students

Staff

The extent of the collaboration and interchange of university staff and the subject areas in which they were engaged in 2014/15 is outlined below:

Total academic staff	198,335
UK Staff	70.2%
Non-EU	11.8%
EU (non-UK)	16.0%

EU Academic Staff across Subject area (by cost centre)

Subject Area	% EU staff	Percentage point increase from 2009-10
Biological, mathematical & physical sciences	22.1%	4.5%
Humanities & language based studies & archaeology	21.0%	2.5%
Engineering & Technology	18.2%	5.6%
Agriculture, forestry & veterinary science	17.1%	5.6%
Social studies	17.1%	3.8%*
Administrative & business studies	15.4%	
Architecture & planning	14.3%	4.5%
Medicine, dentistry & health	14.1%	3.5%
Design, creative & performing arts	8.3%	2.2%
Education	6.8%	1.7%

*until 2012-13 data was given for combined Administrative & business studies and social studies.

Erasmus+ 2014

In 2013/14, 2,327 staff trained or taught in Europe through Erasmus+, with 3,597 staff coming to the UK. This is up from 1,580 UK staff going to Europe and 2,048 staff coming to the UK in 2007/08.

Recommendation:

- Ministers should ensure that the principle of reciprocity is applied to the status and mobility of UK and EU staff, students and researchers is agreed and applied as part of the UK government's negotiations.

The status of researchers, scientists and students working and studying in the UK

The relationship between all non-UK EU nationals as a proportion of all students in the UK in the 2014/15 admissions year is shown in the table below:

University Group	Undergraduate		Postgraduate	
	Full-time	Part-time	Full-time	Part-time
UK	5.3%	1.1%	11.6%	4.2%
England	4.9%	1.6%	11.3%	4.4%
Wales	4.1%	0.7%	7.4%	2.6%
Scotland	9.7%	0.9%	16.0%	3.8%
Northern Ireland	3.2%	0.5%	11.8%	5.3%
Modern	4.2%	2.5%	8.1%	3.5%
Pre-92	6.4%	0.6%	13.1%	4.8%
Russell Group	6.0%	2.4%	12.9%	6.0%

Erasmus Students

The number of Erasmus students has increased with Erasmus students studying in the UK far exceeding the number of UK students who study via these programmes in Europe. Between 2007/08 and 2013/14 Erasmus students in the UK increased by 44% and UK Erasmus students studying in other countries as part of Erasmus programme increased by 52%.

	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
In UK	19,088	20,850	22,650	24,474	25,760	27,147	**27,401**
From UK	10,278	10,826	11,723	12,833	13,662	14,572	**15,610**

Student mobility within the EU is linked with access to student fee and funding systems (within the UK devolved to governments and administrations of England, Scotland, Wales and Northern Ireland). Access to maintenance loans is a matter for Member States and is linked in England to residency which was extended for future EU students from 3 to 5 years prior to the referendum. In addition to the status and mobility of EU students wishing to study in the UK, the issue of access to funding is a key factor. The assurances by Ministers that EU students in England will be able to access student loan funding for the entirety of their course if they enter university in the 2016-17 admissions year is welcome, as is the Cabinet statement (11 July) on EU residency. However, assurances limited to 2016-17 do not go far enough.

<u>Recommendations:</u>

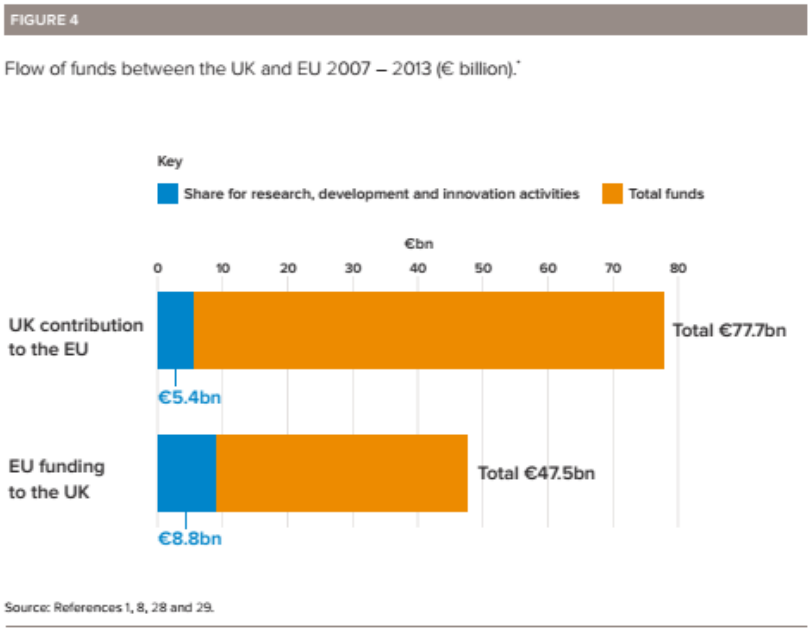
- Access to the student loan system should be extended to the 2017-18 admissions year (for which recruitment commences in autumn 2016) and the 2018-19 admissions year.

- As part of the UK's negotiations, Ministers should seek to secure student access to funding systems within the EU on the basis of reciprocity. Such arrangements would support future access to science and research funds and collaborations and the HE market more generally.

Research, Develpment and Innovation

Flow of Funds between the UK and EU

The UK contributes 5.4bn euros to EU research, development and innovation but receives back 8.8bn in funding.



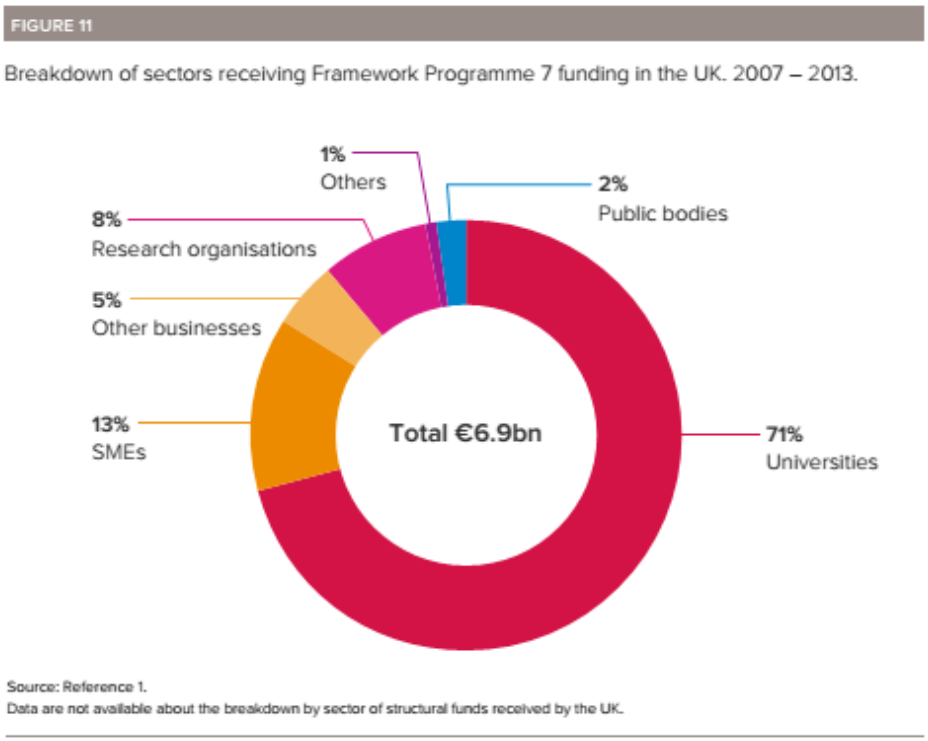
Source: Royal Society *UK research and the European Union: The role of the EU in funding UK research*

The relationship between EU research grants and contracts, the UK and its devolved nations and universities is illustrated in the following table:

Research Grants and Contracts Income from the EU

	EU total as proportion of all research income total		EU total as proportion of all research income total
UK	14.1%	Modern	22.2%
England	14.2%	Pre-92	13.6%
Wales	18.2%	Russell Group	13.0%
Scotland	12.2%		
Northern Ireland	15.4%		

The Royal Society estimates that 71% of EU research, development and innovation funding in the UK goes to universities.



Source: Royal Society *UK research and the European Union: The role of the EU in funding UK research*

However it is important to note that the proportion of research income from the EU is significantly higher in modern universities.

Recommendations:

- As an interim measure the UK government should seek to reach an agreement with the European Commission to facilitate the full engagement of UK universities and researchers in Horizon 2020.
- It is vital that the UK government seeks to negotiate a new relationship with the EU that continues to provide access to science and research funding programmes. This is likely to require a funding contribution from the UK to European programmes.

Measures to keep UK science and research on a sound footing with sufficient funding
Currently EU funding makes up 3% of research funding in the UK but, as outlined by the Royal Society, it is heavily concentrated in universities.

As the Science and Technology Committee has consistently pointed out, science and research is under-funded in the UK when compared with the UK's OECD competitors. The loss of EU funding and / or uncertainties about access to EU programmes will undermine and weaken the science and research base in the UK.

Recommendations:

- HMT must increase investment in research funding to meet shortfalls from the EU, particularly in the period of transition. This investment should be additional to any increase in investment to bring the UK in line with OECD competitors.

- The additional investment required to cover shortfalls in EU income in science and research should not be focused solely on the resource available to the research councils. It will be equally important to boost investment in quality-related research funding.

As the Committee has identified there are wider implications of the vote to leave the EU. These include the future of intellectual property generated by universities and facilities which are co-hosted by UK universities. These will require further consideration by the UK government in advance of any negotiations.

EU Structural and Investment Funds (2014-2020)
As illustrated below, UK universities have been heavily engaged in European projects linked with these funds.

Region	Population	Funding (£ 2014 prices)	Funding per head (2014)
England	54,786,300	£5.6 billion	£102.12
Wales	3,099,100	£1.9 billion	£617.82
Scotland	5,373,000	£721 million	£134.28
Northern Ireland	1,851,600	£414 million	£223.62

Recommendation:

- The UK government should seek to clarify as a matter of urgency the ongoing management of ESIF projects and the future of funding of projects that have been approved but have not yet been allocated. The future of these projects and the investment associated with them have significant implications for regional economies and the contribution that universities make to these economies.

Non-EU markets – opportunities
The UK's exit from the EU does present opportunities for research collaboration and market access with non-EU countries. However, this should not be limited to the promotion by the government or its stakeholder organisations of the science and research programmes related to a small number of universities or STEM-related subjects. Modern universities have research collaborations throughout the world and support internationally recognised research in the UK. These should be equally promoted particularly since they often offer different disciplines and programmes which are highly valued.

If the role of the Innovate UK is refocused, it is important that it does not simply become the commercialisation arm of the research councils.

Recommendation:

- Any new remit given to Innovate UK must include the promotion of the full offer of excellent research undertaken in universities across the sector.

International Staff and Student Mobility

Research collaborations are supported by the mobility of international staff, researchers and students. The current Home Office visa regime acts as a non-tariff barrier to mobility and the participation of UK universities in the international higher education market.

Any review of regulations and domestic policy undertaken by the UK government following the decision to leave the EU must include a review of policy and the visa regimes currently applied to international students and staff.

Recommendation:

- International students should be taken out of the migration targets.

- New visa regulations which support international staff and student mobility must be an integral part of efforts to expand the UK's universities and their science and research markets outside of the EU.

15 July 2016

MillionPlus, GlaxoSmithKline (GSK) and Russell Group – Oral evidence (QQ 20-34)

Transcript to be found under Russell Group

National Heritage Science Forum (NHSF) – Written evidence (EUF0001)

The National Heritage Science Forum (NHSF) welcomes the opportunity to submit written evidence to the House of Lords inquiry into the Relationship between EU membership and UK science in advance of the Committee's follow-up session.

1.1 NHSF was set up in response to a recommendation in the House of Lords Select Committee report on Science & Heritage (2006).

1.2 Since 2006 the heritage science community in the UK has responded. The Science and Heritage Programme (funded by the AHRC and EPSRC) ran from 2007-2013. It supported 39 projects (14% of the 282 projects that bid for funding) with £6,866,771 of investment (6.5% of the more than £105 million that was bid to the research councils).

1.3 Evidence on the priorities for heritage science in the UK was gathered and in 2010, the National Heritage Science Strategy was published. In 2013 the National Heritage Science Forum was launched to take forward the implementation of the strategy.

1.4 Having been at risk of losing its pre-eminence in the field of heritage science, the UK has regained its global standing as stated by Dr Robert J Koester, the Director and Chief Scientist of the Museum Conservation Institute of the Smithsonian at the launch of the EPSRC CDT Science and Engineering in Arts, Heritage and Archaeology in 2014. The NHSF is now urgently concerned that heritage science will be disproportionately affected by the withdrawal of the United Kingdom from the European Union and the potential impact of reduced access to European scientific research funding.

1.5 Cultural Heritage research, including Heritage Science research, has benefitted from European Community RTD funding in recent years through the FP5, FP6, FP7 and Horizon 2020 programmes.

1.6 Of the €57 million of funding for cultural heritage research under the FP7 Environment programme, UK institutions benefitted from €3,857,657 (source: CORDIS: Community Research & Development Information Service). This is 6.7% of total EU funds awarded to the programme. Whilst this level of funding is significant to the heritage science sector, of at least equal importance is the ability of the UK to work with European research partners. The UK participated in 16 out of the 25 projects in the FP7 environment programme.

1.7 Looking ahead, cultural heritage is eligible for significant EU funding from 2014-2020 including for conservation, digitization, infrastructure research and skills from a number of programmes including: European Structural & Investment Funds, Horizon 2020, Creative Europe, Erasmus + and Europe for Citizens (source: http://ec.europa.eu/culture/policy/culture-policies/cultural-heritage_en.htm).

1.8 For heritage science the most significant of these is Horizon 2020, the EU framework programme for Research & Innovation. The programme has €80 billion to invest over 2014-2020. Support for heritage-related research is available through at least 16 different funding strands.

1.9 Continued access to EU funding is of particular importance to heritage science research because any reduction in EU funding, coupled with HM Treasury/ Department for International Development's 'UK Aid: Tackling global challenges in the national interest' (November 2015) and BIS's 'The Allocation of Science and Research Funding 2016/17 to 2019/20' (March 2016), send 'take home' messages that the conventional research council pot is going to reduce and instead Grand Challenge projects and developing country projects will increase. Large projects tend to penalise small sectors such as heritage science due to scaling problems which is what happened with FP6. (Credit: Professor May Cassar, UCL Institute for Sustainable Heritage).

1.10 The UK has contributed significantly to the policy initiatives associated with the development of the research programmes to support cultural heritage. In the 'Joint Programming Initiative in Cultural Heritage & Global Change' the UK has representation on the governing board, executive board and as one of 12 experts on the scientific committee. In the Horizon 2020 'Expert group on Cultural Heritage' the UK had two members out of a group of ten.

1.11 Heritage science is now on the European road map of the European Strategy Forum for Research Infrastructure (ESFRI) having received the support of AHRC and STFC. This has opened up the opportunity to develop an ERIC (European Research Infrastructure Consortium). An E-RIHS.EU (European Research Infrastructure for Heritage Science) has been developed in which the UK is a partner and a mirror organisation is being developed in the UK (E-RIHS.UK). An H2020 (CALL: DEVELOPMENT AND LONG-TERM SUSTAINABILITY OF NEW PAN-EUROPEAN RESEARCH INFRASTRUCTURES) INFRADEV proposal was submitted on 22nd June.

1.12 NHSF calls on Government to advocate strongly for access to funds and mobility of people in its future negotiations with the EU. This advocacy should not just be on the behalf of the UK's universities but also its major cultural organisations (many of which have IRO status) and the independent organisations and businesses that have much to contribute to the highly interdisciplinary field of heritage science research.

8 July 2016

Publishers Association – Written evidence (EUF0013)

1. Introduction

The Publishers Association welcomes the opportunity to submit written evidence to the Committee's inquiry into the implications and opportunities of leaving the EU for science and research.

The Publishers Association is the leading trade organisation serving book, journal, audio and electronic publishers in the UK. Our members represent over 80% of the UK publishing industry and include academic journal publishers such as Elsevier, Wiley, society publishers and University presses.

2. Academic Publishing

The UK punches above its weight in the production of world-class research. Despite making up less than 1% of the world's population and 4.1% of researchers, the UK accounts for 9.5% downloads 11.6% of citation and produces 15.9% of the world's most cited journal articles, more than any other country after the US.

The academic journal market is worth £1.1bn, making a significant contribution to the UK economy. Approximately 90-95% of this revenue comes from exports. The UK journal publishing industry is also a world-leader in itself, with UK publishers responsible for five thousand journal titles and a fifth of the articles published globally each year. In addition, academic publishing plays an important role in investing in innovation, helping academics build on and scrutinise the work of others and helping them share and refine their own work.

3. Main areas of concern

1. Loss of funding from EU grants

According to figures from the Royal Society, in total the UK received £8.8bn of funding for research from the EU between 2007 and 2013, making it the second largest recipient of EU funds. To put this into context, the UK spent £4.6 billion on research and science in 2012/13, meaning EU funds make up a substantial percentage of the overall funding on the sector.

Therefore access to funding, including that provided by the Horizon 2020 project, is one of the major concerns academic publishers have following the vote to leave the European Union. In a survey of our members 53% of academic publishers said that reduced funding for research and higher education institutions was the main challenge posed by Brexit.

Although publishers do not receive funding directly from the EU themselves, if such funding is lost without being replaced the damaging effect it would have on science and research in general would most likely trickle down to academic publishers, for example in the number of articles produced and journals published.

This means that as well as any impact on science and research, which is a significant concern in itself, a loss of funding could also have a knock on effect on the £1.1bn journal market, the export revenues it generates, and the ability for UK research to receive as wider audience as possible.
Increased pressure on funding will also inevitably reduce the time that researchers can devote to book-writing, which could lead to fewer academic books being published from UK-based authors.

A loss of funding could also impact the UK's good progress towards open access, as article processing charges are paid out of research budgets. If these budgets were shrunk, there may also be an impact on Gold open access, with more authors having to publish via the Green route.

2. Higher Education funding

Higher education institutions are at risk of losing the income they receive from international students following the Brexit vote. According to Universities UK, international students contribute around one-eighth of universities income and around £7 billion a year to the economy.

If the number of international students falls as a result of Brexit, either because of onerous visa requirements or a perceived lack of attractiveness of studying in the UK now it does not also provide easy access to Europe, this would reduce funding for higher education, which could again reduce how much money could be invested in research.

3. Freedom of movement

Ensuring free movement of staff and students between higher education institutions in the UK and EU is important. Restrictions would also make it difficult for universities to attract world class researchers and international students which would hamper the UK's position as a leader in this field.

This issue also concerns academic publishers who employ specialised non-UK EU nationals in their UK offices, as well as who employ UK staff in their EU offices. For example one large academic publisher said EU citizens make up 5% of its UK staff, while UK nationals made up about 15% of its staff in the EU.

4. Loss of UK influence

Brexit could also reduce the UK's influence across both the European Union and the rest of the world. If a drop in research funding leads to a reduction in the number of journal articles published this could reduce the impact of UK research. Meanwhile scientific books are vital in illuminating the studies of students and researchers around the world. If researchers have less time to devote to writing these books this influence risks being lost.

Additionally, there is a danger that the UK could lose its influence in important policy debates and developments, such as those being developed in many other Member States on open access. The UK currently has developed a strong open access system, encompassing both Gold and Green options. To date, being part of the EU has enabled the UK to be influential in assisting other member states in the development of their own policies and

systems, and given us the opportunity to demonstrate the benefits of our approach. There is a concern that this influence could be lost as other countries develop their policies.

4. What the government should do

We welcome the government's commitment to safeguard the EU's Horizon 2020 grant and would urge the government to develop new strategies for domestic investment and negotiate access to the successor funding package to Horizon 2020 in order to give UK research the funding and support it needs to remain a world leader.

We would also ask the government to give assurance over the status of EU nationals currently living in the UK, and seek to protect the status of UK-nationals living in the EU. Any immigration policy post-Brexit should also preserve the ability of EU nationals to freely work and study in UK higher education institutions and in academic publishing houses.

A lot of the concerns from academic publishers surrounds the uncertainty created by the Brexit vote, such as over the future UK trading relationship with the EU and the new government's priorities. The government should therefore outline a clear plan and timetable for negotiating a new relationship with the EU.

September 2016

Research Councils UK (RCUK), Elsevier and Academy of Social Sciences (AcSS) – Oral evidence (QQ 11-19)

Transcript to be found under Academy of Social Sciences (AcSS)

Royal College of Physicians (RCP) – Written evidence (EUF0006)

Introduction

1. The Royal College of Physicians (RCP) welcomes the opportunity to submit written evidence to this important inquiry. Our submission highlights the impact that leaving the EU will have on academic medicine and research from the perspective of physicians (primarily hospital based doctors).

Summary

- Patients should be the first priority. The UK's exit of the European Union must not affect patients' ability to participate in high quality research, clinical trials and access to innovative new technologies.
- Clinicians are a vital part of the research community. Workforce and mobility are key concerns for the UK's role as a global leader in research. Increasing pressure on the workforce including unfilled positions can decrease the time available to physicians for research purposes. Restrictions on the mobility of researchers and clinicians may add further pressures.
- The UK is a significant recipient of funding from the EU for research purposes. The decision to underwrite Horizon 2020 funding is welcome. However, it is unclear how the UK would maintain its position as a world leader in research if it was excluded from accessing Framework Programme 9 (FP9) funding, in addition to regional development funds, facilities and bursaries.
- Harmonised legislation across Europe is an important part of the UK research sector and it would be valuable to ensure this continues as much as possible. However, there is the risk that the UK will lose its ability to influence future legislation, which has been of considerable benefit in the past.

Evidence

<u>Impact on Patients</u>

2. It is important to highlight the risk that changes to medical research in the UK can adversely affect patients. Patients in research active institutions have better outcomes than those in other institutions and are more likely to benefit from earlier access to new treatments, technologies and approaches[64]. The UK has an outstanding history of contributing to medical research, from identifying the link between smoking and lung cancer to the 100,000 Genomes project which aims to revolutionise treatment in the NHS. It was identified in a recent report 'Research for All'[65] by the RCP that over 64% of physicians surveyed would like to be more involved in a range of research activity, from audits to clinical trials[66]. Doctors are uniquely

[64] RCP Research for All, 2016
[65] RCP Research for All, 2016
[66] RCP Research for All, 2016

well placed to contribute to research, as they are in a position to discern patterns and disseminate research findings through regular clinical contact with patients and have an understanding of what is realistically translatable into practice[67]. This is an incredible opportunity to drive forward the research capability within the NHS and improve care for patients; however this can only happen with a supportive culture of collaboration, funding, regulation and resources. Patients deserve to have access to the latest treatments and clinical trials. The EU plays a significant role in terms of researching rare diseases as it is not always possible to conduct research within one population and conducting research across multiple countries ensures that there is a large enough sample size in addition to providing the opportunity for patients across several countries to be involved. Retaining access to innovative treatments for patients should be an important element of negotiation, to ensure that they are not negatively affected.

Workforce and Mobility

3. The sustainability of the NHS workforce is a huge concern. The RCP is concerned that mobility will be restricted and seeks to ensure that this does not adversely affect the NHS workforce and medical research taking place in the UK. With 11%[68] of doctors working in the NHS from EU countries and 40% of advertised consultant posts remaining unfilled[69], there is significant risk of exacerbating this skills shortage to an already stretched workforce. Many physicians do not have research formally identified in their role, yet contribute in a variety of ways through patient recruitment, quality improvement and clinical trials. Freedom of movement in Europe is essential to collaborate, ensure a skilled and full workforce, in addition to sharing facilities and resources for the advancement of healthcare for patients.

4. Cultivating the research environment within trusts is important for patient care, from lab to bedside, so that patients can continue to benefit from access to innovative treatments, trials and having physicians who are at the cutting edge of science treating them. It is not a luxury but a necessity to ensure a robust system in the future. At the RCP, we can see the potential within the UK healthcare workforce in terms of research and innovation. However with many consultant posts remaining unfilled, the time physicians can devote to research is limited and frequently being sacrificed to fill the gap in front-line services.

Funding

5. Funding is a significant concern for medical research. Continued involvement and access to Horizon 2020 is essential as it in turn leverages funding, but it is unclear how the sector would continue to fund research if the UK is not included in FP9[70], in addition to other opportunities such as regional development funds, shared facilities

[67] RCP Research for All, 2016
[68] BMJ 2016;353:i3027
[69] RCP Census 2016
[70] The Research, Technological and Development Framework Programme (FP9) will take place 2021-2027

and fellowships[71]. In the short term the reassurance to those seeking to participate in Horizon 2020 through the commitment to underwrite the funding is welcome; however in the long term further reassurance is needed. The charities currently funding around a third of non-commercial research in the NHS, will be unable to fill the funding void.[72] The referendum vote does also bring opportunities to diversify research funding through commercial and international partnerships which could be pursued.

Regulation

6. There are concerns over the future of regulatory frameworks, many of which the UK has had the privilege to shape. This has enabled the UK to obtain faster access to new technologies, a cost effective approvals, distribution processes and is attractive for the pharmaceutical industry, which invests heavily in the UK. The UK currently benefits from the ability to influence the direction of scientific pursuit and shape priorities for funding and regulation but it may need to harmonise with future EU legislation to ensure that it is an attractive place to do research and invest. It remains unclear how the UK would be able to harmonise legislation and greater investigation is needed into the feasibility and impact this would have.

Conclusion

7. Now is the time to prioritise the strategic direction of research in the UK to ensure that it is a leader in healthcare, looking firstly at what is needed to achieve this, then the model from which this can happen. Uncertainty is detrimental to the research environment and the RCP welcomes the recent reassurance given. However in the long term, longer-term reassurance is needed to ensure that the UK continues on its path as a world leader in medical research.[73] The UK should take this as an opportunity to further identify itself as a place for global research and innovation in healthcare whilst considering the risks and impact on patients, researchers and the future of research in the UK.

About the RCP

8. The RCP plays a leading role in the delivery of high quality patient care by setting standards of medical practice and promoting clinical excellence. We provide physicians in the United Kingdom and overseas with education, training and support throughout their careers. As an independent body representing almost 32,000 fellows and members worldwide, we advise and work with government, the public, patients and other professions to improve health and healthcare. Our primary interest is in building a health system that delivers high quality care for patients.

26 August 2016

[71] AMRC response to the Science and Technology Committee inquiry on 'Leaving the EU'
[72] AMRC response to the Science and Technology Committee inquiry on 'Leaving the EU'
[73] Times Higher Education, 'Brexit: growing numbers of academics face EU funding worries' July 2016

Royal Society, British Academy and Royal Society of Edinburgh (RSE) – Oral evidence (QQ 1-10)

Evidence Session No. 1 *Heard in Public* *Questions 1 - 10*

TUESDAY 19 JULY 2016

Members present

Earl of Selborne (Chairman)
Lord Cameron of Dillington
Lord Hennessy of Nympsfield
Lord Hunt of Chesterton
Lord Mair
Lord Maxton
Baroness Morgan of Huyton
Baroness Neville-Jones
Viscount Ridley
Lord Vallance of Tummel
Baroness Young of Old Scone

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Examination of Witnesses

Professor Alex Halliday, Vice President, Physical Sciences Secretary, Royal Society; **Lord Stern of Brentford**, President, British Academy, IG Patel Professor of Economics and Government, London school of Economics; and **Professor Dame Jocelyn Bell Burnell**, President, the Royal Society of Edinburgh (RSE)

Q1 The Chairman: Could I welcome our three very distinguished witnesses to this evidence session? As you know, we thought it might be appropriate to revisit our report on EU membership and UK science in the light of the fast-moving events since the referendum vote. As always, we are being broadcast, and so I am going to ask if for the record you would introduce yourselves. If you would like to make an opening statement, please feel free so do so.

Professor Alex Halliday: I am Alex Halliday. I am the physical sciences secretary at the Royal Society, which means that I am concerned mainly with physical sciences, but I also do quite a lot on science policy, particularly UK science policy. I have just stepped down as head of science and engineering at Oxford University. Before moving to Oxford in 2004, I was in Switzerland for six years as a researcher, and before that I was in America, so I have seen different systems of science funding.

Professor Dame Jocelyn Bell Burnell: I am Jocelyn Bell Burnell. I am president of the Royal Society of Edinburgh. The Royal Society of Edinburgh bridges what the two gentlemen either side of me do. We encompass science, the arts and professions of all sorts. I do not want to say more than that at the moment. I will be making clear later that Scotland is sometimes different, but you probably already knew that.

The Chairman: That will be helpful.

Lord Stern of Brentford: I am Nick Stern. I am president of the British Academy for humanities and social sciences and professor of economics and government at the London School of Economics. I have spent most of my life working on economic development/economic policy around the world. I am a Cross-Bench Member of this House.

Q2 The Chairman: Thank you very much. Before I ask what will be a very general question to start proceedings, I have to remind myself and others that we have to declare interests as we are revisiting a report. I have to declare an interest as a fellow of the Royal Society, chairman of the Foundation for Science and Technology and fellow of the Royal Society of Biology.

In your view, what opportunities, and threats for that matter, does Brexit pose for UK science and research? What do we need to do now?

Professor Alex Halliday: There are both opportunities and threats. The immediate concern is the threats. Last year, the UK Government set out the bold plan of being the best place to do science. When I talk about science, I mean science in the broad sense, meaning all the subjects we are talking about today. Yet, in practice, successive flat-cash settlements have limited the amount that we have been able to grow science and academia in this country. We lag behind in science funding in this country relative to the OECD average. This underfunding has to some extent been made up by the European Union. Ninety-five per cent of the UK's citations come out of the university sector. If you are talking about the impact on science, you are talking mainly about what you do to the universities. In that respect it is important to realise that, despite what has happened in the UK, there has been a growth in research income in many universities, fuelled partly by new opportunities in Europe. For example, while I was head of science and engineering at Oxford we grew our research income every year, and the amount of money we were getting from the European Union ended up being 20% of what we were getting from the UK's research councils. It is massive and has been growing and making up for the flat cash that we have had in the UK. There will be a major problem if we cannot maintain that funding level.

The UK has also had a disproportionate influence on international science policy. That has given us a very competitive edge, particularly in Europe. We have to wonder how that is going to work in future. We have also had disproportionate access to facilities. Some of those are European facilities based in the UK, but there are also others across Europe that we need to worry about. We are also ranked now as one of the most entrepreneurial countries in the world. That was not the case 10 years ago. To some extent that is a result of the many people who have been coming into this country and is reflected in a lot of the entrepreneurial opportunities and spin-outs that have been created in universities over the last few years. We need to worry about that being affected by this too. That includes some funding streams from the European Union.

We have also been the place that seeks to bring the brightest and the best here. Across Europe, 24% of Marie Curie fellows choose to come to the UK. That is a staggering statement about the benefits to academia of the UK as it is perceived by the world. That will potentially no longer happen unless we negotiate very carefully in the future.

We urgently need a very strong, co-ordinated voice for the UK. Ultimately, I could see this as a potential benefit of Brexit. As you know, the UK has been looking at its higher education research landscape, particularly following the publication of Paul Nurse's review of the research councils. There is a need for stronger co-ordination of what we need as a country to deliver for the future. The implementation of UKRI, even though there are details that we need to sort out, is potentially a very important vehicle for delivering a future for UK science and engineering, medicine, humanities and social sciences. We need to get that going quite urgently to address the Brexit issues.

We also need to worry about other aspects that involve major restructuring of the universities, in particular the fact the universities will now be split between the Department for Education and BEIS as to where they go to get their advice, support and funding, as part of the White Paper. Having all this happen at the same time as we are trying to deal with Europe is a potential risk that we need to be concerned about.

Lastly, there are issues to do with the universities that particularly reflect their need for stronger infrastructure. Many of their facilities have been going downhill with the cuts in infrastructure spend by government over many years. As a result, universities have been taking out low-interest loans from the European Investment Bank, so a significant amount of money could be at risk. It is European money that has been supporting universities. It is £200 million in the case of Oxford University, which we took out as a loan fairly recently. These strike me as the main worries that we need to think about.

There are potential opportunities as we put together a bold strategy for where we need to go in the future. Hopefully we will talk about some of those opportunities in more detail today, because I think we can rephrase things and look at the UK landscape, as well as the global landscape, in a new way, and we should grab the opportunity to do that.

The Chairman: We will make sure we cover that. Dame Jocelyn.

Professor Dame Jocelyn Bell Burnell: Trying very hard to be positive and starting with the opportunities, I can see relatively few, I must admit, but one obvious thing is that Brexit will lead to a strengthening of collaborations with academics further afield. These perforce will be more expensive because they are further afield and will be more intermittent, so probably will not be as sustaining as the more local European collaborations.

If we wish to trade with Europe we are going to have to largely abide by the European regulatory system, but if some of that proved too onerous—and perhaps the GMO regulation in Europe is a bit ponderous—we could say, "Stuff that", and trade in GMOs with elsewhere in the world. We might be able to opt out of some of the regulatory stuff if we are more independent.

As has already been articulated, the threats are large. The UK has been successful in science and innovation because it attracts excellent talent from overseas. It is a huge amount of talent. In the leading Scottish universities, about one-fifth of the lecturing staff and one-third of the research staff, other than British passport holders, are EU. They are all very twitchy right now because they do not know what is going to happen. If good opportunities show

themselves elsewhere in Europe, they will be off. There is an urgency about reassuring EU passport holders about what the near future holds for them. I will pause there. Perhaps those are things that we can come back to.

Lord Stern of Brentford: Could I highlight the economic/economic growth aspects? I will start with the threats and go on to the opportunities. We have to begin by recognising the importance of productivity and growth and the importance of research and innovation in productivity. I can refer you, for example, to the LSE growth commission, of which I was part, which published at the beginning of 2013. Going up to the financial crisis—everything looks different after that—something like half of UK growth was associated with productivity, and we know that research and innovation is at the heart of that. For example, a couple of years ago, four UK societies published *Building a Stronger Future*, a document I am sure you will have looked at, outlining the importance of productivity and growth and the importance of research and innovation in productivity. In the UK, we invest in this area as a fraction of GDP about half that of our key competitors. It is about 0.5% of GDP on the public side of research and innovation. Our comparators, such as Scandinavia, Germany, South Korea and the US, are much closer to 1%. There is an interesting leverage. Normally the public side is about half of the private side, so 1% of public GDP in our comparators would go with 2% of private. We are similar, with about 0.5% of our investment as a fraction of GDP in public research and innovation and about 1% in private. We are below our comparators. Key to our strategy in the future, where growth is going to matter more than ever, is that we move that upwards, not downwards, and do so strongly because the gap is big. About 0.5% compares with two-thirds of a per cent for OECD countries—Mexico and many others—let alone our comparators. We have to shift up public research and innovation. That is fundamental to carry through all this discussion.

If you look at what we get from the EU, it is difficult to get the figures on an exactly comparable basis, but we are talking about £800 million or £900 million per annum, with 0.5% of GDP being about £9 billion per annum, so we are losing around 10%—I am deliberately keeping these numbers round—of a number that we should be increasing very rapidly if we are to catch up on our comparators. Our comparators are going up in their share.

That is very important background and there are resources at risk here. These are not marginal resources; £800 million or £900 million in a £9 billion total is a lot. Our research councils get about £3.1 billion per annum. If you compare the £800 million or £900 million with £3.1 billion—that is 800 or 900 compared with 3,100—you can see that we are talking about 25% to 30%. It is a major loss compared to the research council income and a major loss compared even to the overall public expenditure in this area. The resource side of it really matters at a time when we are too low and others are moving up sharply.

I started with resources, but I will say something about people. Around 15% of our university teachers are from non-UK EU countries. For the Russell Group that is about 20%, and for my own—please excuse a rather parochial example—the Department of Economics at the London School of Economics, which is rather important and rather good, in my view, and I am not entirely unbiased, more than half the number of its full professors are from the EU. There is some indication here and we have to investigate it more carefully. Not only is it clear that 15% is a high fraction of our university teachers coming from EU non-UK, but that fraction is higher the higher the quality of universities that you are looking for. If those

people are at risk, the quality of our university system would suffer. Of course, we will do our best to make that impact as small as possible and one way to limit it—as my friend and colleague Jocelyn Bell Burnell has already indicated as has the Royal Society in its statements—is to commit to the people who are already here at the moment. That would be extremely valuable. Entrepreneurial vice-chancellors in Europe and entrepreneurial presidents in the United States are already circling. They go after the best. Why would they go after anybody else?

It is early days. We are going to have to look at this very carefully. At the moment the evidence is largely anecdotal. One of the tasks is to look very carefully at that as time goes by. You do not wait until the whole story has played its way through before deciding that the evidence is that this risk is strong. You have to act early on that and guaranteeing the position of those already here is not only the right thing to do morally, from my point of view, because we have given promises in the past, but economically.

Finally on collaboration, I would give the ball-park figures again. It depends whether you measure collaboration by papers published in collaboration with those overseas or resources or research programmes. There are various different ways of doing these numbers. They come out as 60% to 70% of our international collaborations are with the non-UK EU. Whether you look at the resources, the people or the collaborations, these are serious risks. We will be very active, of course, and do our best to handle them, but government can be really helpful in showing that it understands these risks and making it a real priority in any negotiations. If we are interested in growth—I take it we all are—we are interested in research and innovation as arguably the most important driver of productivity. This is not a minor side thing to be fixed after we have washed out everything else. This is absolutely central to our growth story. That is a key message, which I hope you will take—I assume you are already taking it—to government. Do not put this in the second rank or third rank, put it in the first rank, if you are interested in growth, as I assume you are, but of course it is much wider than growth; it is about what kind of people we are, what kind of society we want, and how we want our students to be educated with others in a very strong way to understand the world much better. I have emphasised growth, but do not get me wrong; it is more than that.

On the opportunities, it is possible that we may be more open to others. I have spent much of my life working and teaching in other countries, particularly India and China. If we open up more to India and China in this context, that is good. I have also watched colleagues and students over the years grappling with embassies and consulates in foreign countries. It is really hard. Will we transform that?

Lord Hunt of Chesterton: No.

Lord Stern of Brentford: Maybe. It would be a triumph of hope over experience, but if we push in that direction—and I hope we do—that could be an opportunity. Whether we take it or not I leave to your judgment.

The reinvigoration of research under UKRI, to which Alex Halliday referred, could be very important. I have discussed that at length with Jo Johnson, who is a fine Minister in this area, and with John Kingman, who is going to chair UKRI and was one of my colleagues in the Treasury when I was there briefly for three years or so. They are very strong on UKRI becoming a clear, analytical, thoughtful, effective, powerful voice for research and

innovation in the UK. I believe very strongly that is what they intend. As the academies we will help with that. UKRI is an opportunity to be much more strategic and strong about the role of research and innovation. If we see the threats that we face—and they are real threats, which I have tried to give a quantitative indication of—as making the argument for that strategic approach still stronger, the threats could kick up an opportunity. At the moment, I think it is fairly clear that on balance the threats are rather more specific, large and immediate than the opportunities.

Q3 Lord Mair: I should start by declaring some interests. I am a fellow of the Royal Academy of Engineering and a fellow of the Royal Society. I am a professor of engineering at Cambridge University where I lead a large research team, many of whom are EU nationals.

My question is about UKRI, which you have raised. The Higher Education and Research Bill is getting its Second Reading in the House of Commons today. In the light of Brexit, do you feel that it is on the right course? Do you think it could be amended? Is there anything that should be addressed resulting from Brexit, or should the Bill with its proposals for UKRI continue as if Brexit had not happened?

Professor Alex Halliday: UKRI is an outgrowth of what a number of organisations thought was needed, which was for there to be greater co-ordination of research across the UK, between research councils and with other parts of the UK, such as HEFCE and the way it delivers research funding to the universities. The original Nurse review had already highlighted that it would be good if there was better communication with Innovate UK. There was less emphasis in the Nurse review that Innovate UK had to sit within UKRI. How this will develop depends to some extent on the detail. We need to be careful about that, because the original Nurse review provided a fairly open framework for considering what should happen next. As we are putting UKRI in place, it is important to consult and think hard about what the best way of implementing it might be.

A strategic view and voice of UK science has been needed for a long time. We see this across a range of different sectors. People talk about the need for the research councils to talk to each other more, but it is much bigger than that. It is also the interface with universities and what we learn from the research assessment exercise, which tells us about the health of disciplines in this country. That interface has not been well developed in the past, and it would be of massive benefit to the science community to put this in place. We do not want to hold that back. We want to push it forward, as long as there are safety clauses on the side of the packet that will allow us to flesh out the details more carefully.

The bigger concern is that we are seeing a split between research and teaching, so whereas you had one organisation that covered both research and teaching that looked after all the bits and pieces—the buildings, the people, the museums, the libraries and everything else that happens in universities—that is now being divided into two (research and teaching) organisations. There is not much detail on how that will work. It is fair to say that we are very happy that Greg Clark has taken over at the new department BEIS, because he has some experience of the university sector. We are also very pleased that Jo Johnson has been given this rather unusual broader portfolio to look after across the two departments BEIS and Education (DFE). How that will work will need to be looked at, but we see that as a good thing.

People have worried about Innovate UK in the context of UKRI and it was under quite serious threat from Government regarding its funding. Bringing it under UKRI has partly been about trying to protect it and to make sure that it is stronger in the future, rather than grabbing money from it and using it for something else. That has not been the intent at all.

Professor Dame Jocelyn Bell Burnell: I should have said earlier that I am based at the University of Oxford as well as being president of the Royal Society of Edinburgh, so I have a foot either side of the border, and in this response I am going to use both feet.

There is some anxiety about having research and innovation under the one heading, with perhaps a pooling of resources, because if innovation work moves towards having loans and there is a default on the loans, that money will probably come from the research side. That is not good. There needs to be some Chinese wall at least between the funding for innovation and that for research.

Turning now to being the stroppy Scot, it is different in Scotland. We have a totally different philosophy of higher education. The Bill to which you refer does not really work in Scotland because of the different philosophy. For example, we do not have audits; we have enhancements, which sounds a much better idea. However, it means that we do not have something to measure by in the way the universities in the rest of Britain have. That Bill causes considerable issues in Scotland and gives rise to the question of the extent to which you can regard the devolved Administrations as little perturbations on the Westminster norm that can be sorted out afterwards. We are getting to a stage—and Brexit will make this more acute—where we have to recognise the particular differences of Scotland. When powers are repatriated from Brussels, those that are not reserved will go to Edinburgh. It is different for Wales. Wales has been told, "You can do this, this and this and everything else is Westminster", but in the Scottish situation it is said, "Westminster does this. You do the rest, Scotland". That was set up never assuming that we would leave the European Union. Thus Scotland could become more different still, which is going to be a right headache for everybody.

Lord Stern of Brentford: I want to echo what Alex Halliday said about Greg Clark and Jo Johnson being a very strong team. We worked with Greg Clark when he was in the position now held by Jo Johnson and it was a very productive collaboration, and Jo Johnson has been a very strong, thoughtful, listening Minister to work with. I wanted to underline what Alex Halliday had said about that. I would draw your attention to the fact that Greg Clark has a PhD from the London School of Economics. I should have said at the beginning that I am also a fellow of the Royal Society, although, obviously, Alex speaks for the Royal Society, not I. Also I am chairing a review of the research excellence framework. It will report in a couple of weeks and Alex is a very valuable member of that group. I will not anticipate what we are going to say, but obviously we are concerned about relationships between REF and TEF. They should mutually support each other, and it is entirely appropriate to assess both research and teaching, indeed it is necessary, but it is very important to do it in a supportive, complementary way. That is going to be important as we see the division between Education and Business, Energy and Industrial Strategy.

I want to underline the importance of UKRI in the context of uncertainty and therefore the difficulty with growth. Uncertainty is bad for investment and innovation and the extra uncertainty we now have underlines still further the importance of a strategic, strong and

well-resourced approach to research and innovation. In that context UKRI is still more important.

I would note one thing. Both Alex and I have emphasised the importance of the strategic approach and how valuable that is in giving a big voice and why that is a good idea. At the same time, of course, academics get nervous about people bossing them around, for good reason. The Haldane principle is of great importance. Governments can and should allocate resources in broad strategic directions, but it is the academics who should look at the detail of assessment. The more you pull things together for good strategic reasons, the more academics get worried about micromanagement. That is a very important issue. We will try to do our bit, but the more you can do to mitigate against any tendency to micromanage would be of real value. That is not an accusation of what is happening; it is an argument for watchfulness.

Q4 Lord Hunt of Chesterton: I am a fellow of the Royal Society and involved in the various other organisations on my list. Do you think that a combination of the research Bill and Brexit will push universities to do new things? Arguably, the American style of university where you have a broad first year is very educational, and it is extraordinary that has not caught on in Europe, except at UCL, in which I declare an interest as an emeritus professor there. One feature of this of course is in the Bill—and perhaps we only began to understand it yesterday after a briefing from the National Union of Students—the Government are encouraging a new type of university. Arguably, we do not have universities providing a significant breadth of operation. The American universities have significant campuses in Europe. Do you think one of the consequences of this Bill and Brexit is that British universities might start having campuses in Europe? That might be very helpful for employment and other things. At the moment we are subject to very considerable change and the universities are saying, "Help, help, help. We want to carry on as we are", and I am not hearing from the universities that this is an opportunity to do things very differently, perhaps by looking across the Atlantic.

Professor Alex Halliday: I welcome the question. First, when you think about America you have to bear in mind that the financial model for universities is totally different, with much bigger endowments and a longer tradition of significant tuition fees for which people save and get loans for. It means that universities are quite flexible because there is considerable funding coming in that is used to cross-subsidise in a flexible way. To some extent that is an opportunity for the UK with its tuition fees, but, because the UK is in a slightly different place in the development of tuition fees, politically that is quite a difficult thing to do. It is quite difficult to say, "We are going to cross-subsidise something from UK tuition fees". We have to worry a bit about trying to draw too close an analogy.

However, there are opportunities that we need to think about that Brexit has brought to light. The first thing to say is that Brexit has shown us that there is a fairly deep problem in UK society that we need to be thinking about hard as universities. I am not quite sure how much we have done on this. It has been a bit of a bolt from the blue. It is quite clear that America has problems like this as well. What are we doing about the sectors of society that are becoming severely alienated, and how do we make them part of the solution for their own country? Universities, education and science have lots of opportunities for engagement. Getting the universities to work in that space and come up with new kinds of educational and research opportunities would be a really fantastic thing to do. That should be a top

priority for all universities. The need for widening access is very much behind the move of the teaching side of universities into the office of students. UKRI can be part of getting an agenda that links to the needs of the UK regarding its people and social mobility and inequality, and that is an important thing for us to be thinking about. I totally agree with you.

Secondly, we should be thinking much more about the strategic development of our science base. The universities should be considering this in line with the research councils and UKRI more generally. At the moment we are somewhat non-strategic in the way we do things. We grab opportunities to get money to develop science. We hire people with the expectation they will get funding. However, we have been pretty bad at thinking about which areas we really need for the future as a country and which areas we have lost within the UK relative to some other countries.

Thirdly, there is an opportunity from Brexit to think about our international influence and what we can do differently. This brings us back to what you were saying about universities being set up abroad. One of the notes you put down here was about the financial sector and the potential for building links between Singapore, Hong Kong and Switzerland. If you asked me where the most innovative, exciting universities are right now, I would say they are probably in those three countries. In Switzerland, EPFL has been phenomenal. In Hong Kong, HKUST is amazing. In Singapore, there are two universities, NUS and the Nanyang Technology University, as well as the CREATE campus, which are all fantastically innovative. They see the importance of the knowledge-based economy. They realise that to be strong and prosperous as a country in the future they have to invest in education and research, and they are going at it like gangbusters with very exciting, creative new programmes that are somewhat different from the way we have traditionally run our British universities. Thinking outside the box and building links with them is good. They are very open to partnerships, of course. A number of universities in the UK as well as America have built campuses abroad. Since this has started, people on the blogosphere have been talking about building joint networks with France and setting up joint campuses. There are lots of opportunities to think about in this space and how the university sector can be more international, connected and innovative.

Q5 Baroness Morgan of Huyton: You may well have largely covered my question, but I will ask it any way in case you have anything else to add. I should declare an interest as a member of the Council of King's College, where 24% of our academics are from the EU. Certainly there we have already had people turn down opportunities for senior academic appointments. We have all had anecdotes from wherever we are involved. We wanted to nail down whether, beyond the anecdotes, there is any assessment at the moment about the immediate impacts of the Brexit decision. Are there any specific aspects that we should be aware of in relation to Scotland? Are the humanities and social sciences affected in any particular way, or is it the same across the piece?

Professor Dame Jocelyn Bell Burnell: The Institute of Physics is preparing a dossier of examples of EU organisations or individuals refusing to include Brits because we are leaving. That dossier is going to be a confidential submission to your sister Committee, the House of Commons Science and Technology Select Committee. I do not know whether you can share documentation or whether you would like me to see if I can get the Institute of Physics to submit it to you too as a confidential document. Let me know. Universities UK and Scientists

for EU are also compiling a dossier of information. I have that information second hand. I have the information from the Institute of Physics first hand.

The Chairman: If you would like to send a copy to our clerk, that would be helpful.

Professor Dame Jocelyn Bell Burnell: I will ask them to send a copy. The issues for Scotland are writ a bit larger because the Scottish universities play a bigger part in Scottish society than British universities do in the UK. The issue is more acute. I do not know that it is particularly different, except to the extent that every so often the Scots get stroppy because people do not realise that things are different there, but you will be familiar with that.

Lord Stern of Brentford: Thank you for the question. Yes, in the social sciences and the humanities it is more difficult. There are one or two indicators of that. Of all the European Research Council grants awarded, the UK has won about a fifth of the total. For social sciences and humanities it is more like a third, so it cuts a good deal harder for them. You can appreciate that we are having to chase down these numbers quickly, but the picture is pretty clear that the loss of grant income for the social sciences and humanities is potentially much worse. According to the Digital Science report, for education 43% of competitive grant research income is from the EU and for law and legal studies it is 39%. I think that is a strong indication, although again you have to back it up, but it is pretty clear already that resources are a good deal more difficult for social sciences and humanities than the average, difficult though it is potentially for the average.

Q6 Viscount Ridley: Can I follow up on Baroness Morgan's question, because I think you have answered the one I was going to ask? Before I do that, I declare my interests as a fellow of the Academy of Medical Sciences, vice-president of the Conservatives for Britain, honorary president of the International Centre for Life in Newcastle and ownership of a farming business in receipt of EU funding.

I was surprised by how many academics I talked to during and after the campaign who were under the impression that EU funding programmes were available only to members of the EU, even though we made it clear in our report that associate country status was available, et cetera. To what extent have these problems that are emerging and the rumours that we have heard about, and that you have all mentioned, been worsened by the fact that Universities UK, other organisations and leading academics have left an impression with academics that by leaving the EU we will automatically have to leave Horizon 2020, Erasmus and many other projects?

Professor Alex Halliday: The harsh reality is that the Brexit vote was in part connected to the issue of mobility and migration.

Viscount Ridley: That is a slightly different point from the one I am making.

Professor Alex Halliday: It is intertwined regarding these other countries having access to that funding. The alternative models such as the Swiss model, which is hovering there at the moment as to whether they go ahead or not, and the Norwegian model, et cetera, are dependent to some extent on migration.

Viscount Ridley: But that is not true of Israel, Tunisia, Armenia, Georgia, which are all in Horizon 2020.

Professor Alex Halliday: It is true that there are other versions of the model. Getting down to the detail over the next couple of years of a proposal that is going to be acceptable to the UK public as well as what will work for science in delivering that funding is going to be quite a difficult and complicated issue. Most people assume that the UK will not be treated in quite the same way because it is a very, very big fish and that there will be political agendas to try to stop the UK from being seen as though it has benefited from this. There are worries about that. I take your point, Matt, but at the same time there are lots of worries about trying to assume that because it has been done this way in these other countries that will necessarily map on to how it will work out for the UK, particularly when so much concern was being raised about migration in particular.

Viscount Ridley: What I am getting at is that it is not just the Government's responsibility to reassure academics; it is also academics' responsibility to reassure each other on this.

Professor Alex Halliday: Universities have been doing that in spades. Having said that, people are deciding not to come to the UK right now, and they are saying that they are not going to become a professor at such-and-such university—and we have growing evidence for this—because of what has just happened.

Lord Stern of Brentford: It is an important and fair question. There is a distinction between "not impossible" and "getting more difficult". There is a clear perception—and it may well be well founded; we will find out—that it is going to be a lot more difficult. There are consortia that were in the process of being put together in which it has been suggested that while the UK group could be associated with it, it could not hold the principal investigator position, which is an attractive one from the point of view of funding.

Viscount Ridley: I pointed out in debates with Dame Jocelyn and others that some countries outside the EU provide more project co-ordinators in Horizon 2020.

Lord Stern of Brentford: There is a difference between things being possible, and examples of where they happen, and life becoming more difficult. I am sure as academics that we will make a big effort to keep associated, but you have to recognise how the behaviour of other people in the EU might be towards us as they think about the probabilities of grants being successful. Putting in research grants is a lot of work. Thinking of the consortium I have put together in France, with others, for an application to the EU, which contains the UK, I think that some of them may be a bit more cautious about who to include. It is that kind of example of it being not impossible but probably more difficult. It is very important to distinguish those two perspectives on this. The examples prove that it is possible, not that it will not become more difficult. That is a real worry.

Secondly, you spoke about rumour, and it is early days for the data, but there are lots of anecdotes that we have to try to build up and understand the collection of better. It is not rumour. These are real stories about real people.

Viscount Ridley: Who said that the plural of "anecdotes" is not "data"?

Lord Stern of Brentford: I understand that, but it is not rumour either. I think you have to be careful with that language.

Q7 Lord Hunt of Chesterton: The other question is whether higher education and research communities and government can take practical steps to address all these issues. All one hears at the moment is slightly tenuous statements by Ministers, particularly Mr Davis,

which clearly cause upset. I helped to set up networks in my areas, which continue, and they were from Europe, not just the EU. Surely one of the ways in which the UK scientific community must demonstrate its strength and commitment to collaboration is to push forward and strengthen these networks. Some of the comments are that, even with the existing situation, the research councils do not necessarily regard putting money into these networks as being a particularly good way of spending money. Last night I met scientists who commented there was funding into these networks from the research councils of the EU countries, but it was always very difficult to get it from our research councils. I merely comment. Is there some kind of programme of practical developments that will reassure and keep involving people, because you can do that without waiting for the grants?

Professor Dame Jocelyn Bell Burnell: Can I start a response to that? In Britain over the last five or six years there has been a significant cut in funding from the British Government for science research. Miraculously, British scientists have made that up through gaining prestigious European Research Council grants and the like. We have showed great innovation in that respect and now that source looks as if it is going to be pulled from under our feet or reduced. Our track record shows that we can be very innovative and have been to a remarkable extent. In my community of astrophysics we were expecting a serious dip in research following the cuts five or six years ago, and it did not happen because we pulled in European Research Council fellowships and professorships right, left and centre.

Lord Hunt of Chesterton: That is money for a few people. In the 1990s the Royal Society had an amazing meeting of European clockmakers, lettuce growers and national physicists to see what these networks were. These networks do not cost a lot of money, but it is those little bits of money that are jolly difficult to get out of the research councils. That is not the money given for superstars; it is money given for a lot of communication. Do you feel that is a practical area?

Professor Alex Halliday: The first thing to say is that science is absolutely international and global. It is no longer so much the lone scientist and, even when it is, the lone scientist needs to talk to people around the world. Europe has achieved so much relative to America over the last 20 years as a result of working together and establishing some major research initiatives that have put it on the map. Of course we all think of CERN but there is also the European Centre for Medium-Range Weather Forecasts, which is based here in the UK and is the best weather forecasting system in the world. It predicted the right egress of the storm that hit New York a couple of years ago and the American forecasting did not. We have this phenomenal capability that has been developed through very clever people working together, networking, and putting together facilities, where necessary, that are world leading. As a country we have done exceptionally well from having our foot in the door and providing leadership for Europe. For example, our leadership of fusion through JET and ITER and UK leadership of the Square Kilometre Array project for studying the universe with radio waves—these and others are spectacular projects. We must make sure that we do not lose access to these and also not lose leadership and influence. I do not know how one does that, because they are only partly related to the European Union, and the question of exit and the degree to which you can use money to solve the problem is not necessarily clear. However, where people had been talking about forming networks in Europe and engaging with or sometimes under the leadership of Britain, they are now thinking about using other partners. We have anecdotal evidence of that. When they are putting forward a proposal for

a new network, they are wondering if it will receive more harsh criticism in review from people across the European Union who, frankly, do not see the UK as such a wise partner to involve at this particular stage or perhaps just feel somewhat fed up with the way things are going in the UK.

Q8 Baroness Young of Old Scone: I declare my interest as chancellor of Cranfield University and an honorary fellow at Sidney Sussex College, Cambridge, and in various capacities with conservation bodies that commission research. Can I ask about a parallel funding process that may have the same issues? Lord Stern told us about the split between publically-funded research and business-funded research. There are a number of collaborations across Europe and beyond that are funded by industry equally with the public purse or even funded totally by industry with universities. What effect will Brexit have on those collaborations, some of which can be very major and very long-term?

Lord Stern of Brentford: I am sure that Alex and Jocelyn will come in. There is a perception that the UK economy in relation to Europe has become a secondary market for investors rather than a gateway. If that is what investors are thinking, there is a danger that that would also apply in some part to research and innovation. It is another example of things becoming potentially more difficult; not disappearing, not going away, just being less of something that really matters. If you think of research to innovation to investment as being an important pathway in a healthy, strong economy, if you make the investment end of the pathway more difficult—and, as I say, it becomes a secondary market rather than a gateway as far as Europe is concerned—it could well have kick-in effects on the earlier stages of research and innovation as well. We do not know. They will not disappear, but there is a risk they will be damaged.

Q9 Lord Cameron of Dillington: I have to declare interests. I am a farmer. I am a trustee of Rothamsted, chair of the Advisory Committee at CEH, and chairman of the Strategy Advisory Board of the Government's Global Food Security programme.

I am interested in what positive steps you thought the UK Government could take over the next four years to sustain the health of UK science. In talking about the ensuring of continued access to EU funding that Lord Ridley was talking about, the hosting of EU institutions and research facilities and driving opportunities, perhaps Lord Stern could put some flesh on the bones of his problems with China and India, and say what the Government could do to drive an agenda with other countries, not only BRIC countries but the developing world, the opportunities in Africa and so on.

Lord Stern of Brentford: Relations with China and India, being the two most populous countries in the world and the two fastest growing among the major economies, are extremely important. We should be investing in those relationships anyway. I do not see the relationship with Europe being a conspiracy against relationships with India and China and that a reduced relationship with Europe would mean an increased relationship with India and China. That is not a logic that I would follow. All three are very big potential sources of markets and ideas. China is moving very rapidly as part of its 13th five-year plan to increase its investment in research and innovation. It is very important that we invest in those relationships. As an academy we do exactly that. We have close relationships with the Chinese Academy of Social Sciences. Those inter-academy relationships are going to be very important around some of the difficulties created by Brexit, inter-academy relationships

both in Europe and outside. It seems to me that China, India, Africa, Latin America and Asia more generally are of enormous importance to our student body and our academic researchers. That has been clear for a very long time. Many of us have been working very strongly in those parts of the world. It continues to be true. I am not sure how far Brexit makes that any truer. It should have been obvious to us all anyway. We work very carefully and closely on that. Personally, I spend a lot of time particularly in India and China and will continue to do so. Let us not see those things as being alternatives where the relationship with Europe going down automatically means we go up in the others. We should be going up strongly in those relationships anyway.

Professor Dame Jocelyn Bell Burnell: One of the things I have done in the last week or so is to write to 25 or 30[74] academies around the world as president of Scotland's national academy, stressing that we want to continue to work with them and that, as far as we are concerned, it is business as usual. I am happy to say that I have had a lot of positive responses. Academies can do things like that. There is a soft power network around the world of academics and academic institutions, regardless of the political ones, and it is surprisingly strong. At one level I am optimistic. I am a bit concerned about the funding, however.

Professor Alex Halliday: Briefly, we need stability in what the UK—both the Government and universities—does, and right now everything is shifting. Stability is needed, because when you hire an academic you are doing it for 20 or 30 years, maybe longer, and you are planning research around a particular individual. We are doing this with multiple individuals across multiple universities. If the framework for doing all this stuff suddenly changes, or we do not know what it is going to look like, people will have second thoughts about whether to come to the UK, and universities will have second thoughts about whether they can afford to develop this exciting new programme that would have been world leading because there will not be the funding for it. Things are finely balanced. There is a myth that universities are awash with cash. Some may be making some money at the moment, but many universities, in particular the major research-intensive universities, are borrowing money because they are so short of it. There is a lot of money coming in, but it is money in/money out and the bottom line is barely sustainable. When you are faced with uncertainty like this, it sends a shock wave through the system, which I think we need to deal with as quickly as possible and produce some stability, both from what the Government says to the world and what we as universities do to try to influence that effectively.

Viscount Ridley: Dame Jocelyn mentioned GMOs as an example of where we could escape restrictive regulation. Are the academies drawing up lists of other examples like that? The General Data Protection Regulation, which comes in in 2018, is scaring a lot of the digital industries in Europe. Is it worth putting together a list of regulations and directives coming out of Europe so that, once we are not in, we can be more nimble and innovative as a result of not applying those.

Professor Dame Jocelyn Bell Burnell: As far as I am aware, GMO is the only one with a question mark against it. Speaking with a Scottish hat on, even that is slightly ambivalent, because the Scottish Government does not want GMOs but the UK as a whole is now turning towards them.

[74] A subsequent count showed the number to be almost 90.

Professor Alex Halliday: Data regulation is clearly an issue that Europe has been looking at. In some areas, such as a data-mining, the UK has been much more like America. There are aspects of Brexit that will allow us potentially to look at this differently. Having said that, we still have to work within Europe. We are not suddenly going to become a separate island. We are going to have to work with these other countries and would like to try to influence how regulation is done in those countries. To some extent it makes it harder for us rather than easier.

Lord Stern of Brentford: We have to recognise that the UK on the whole, by most measures, is a rather less regulated place than elsewhere. It may be doing well, to the extent that it does, in part because of that. I do not think that regulation is a great problem overall in the UK, but it is important to be watchful and careful.

Let us not lose sight of the very big issue. We are badly underinvesting as a country compared to our competitors in research and innovation. I gave the numbers at the beginning. The Brexit story makes that still more pressing and important. We work very hard to keep the quality up. For example, Alex and I are working on the review of the research excellence framework. Our quality is very high. You do not have to be a professor of economics at the LSE to work out that if you have a sector that is very productive in its use of resources and is very important to future growth—now even more so—that is where we should be investing more. That is the biggest message that I hope this Committee can give to the Government in this context.

Q10 Baroness Young of Old Scone: Measuring all this and monitoring the impact is going to be really important. I know that the Royal Society did some analysis of some of the key parameters pre-Brexit. Are there some very important lead indicators that we should be monitoring? Is the Royal Society planning to do that on an ongoing basis?

Professor Alex Halliday: A team at the Royal Society under Dr Julie Maxton the Executive Director has been meeting every day to talk about what we do next and how we deal with the situation. We produced three reports prior to the vote: one on the impact on funding, one on the impact on mobility and a third on regulation. That database is still there. Monitoring what is happening now, apart from some anecdotal work, as the data and information build up, will be quite important for an organisation such as the Royal Society—but it could also be BEIS, and BEIS has offered to engage with us—to monitor quite closely and systematically across the UK what is happening with the success of research funding and people turning down contracts and thinking about leaving, et cetera. However, we should not wait to see the data unfold. We should plan the "what if" scenarios quite aggressively now. I am particularly worried about facilities and making sure that we have a clear understanding of our position on some of the world-leading facilities that are based here, or we have access to, or are connected to in Europe, so that we do not lose our competitive advantage in those areas.

Lord Stern of Brentford: We must act on the risks as we see them now before all the data comes in, as well as doing our best to collect that data. Perhaps the most important of those risks that we can act on is to give clear reassurance now to those people who are already here that their position is secure.

Professor Dame Jocelyn Bell Burnell: A number of the indicators will have a lag on them, such as publications, patents and spin-outs. The more immediate indicators will be to do

with research income and the number of overseas academics and researchers in Britain. That will give us a more immediate signal.

The Chairman: You have given us some very helpful and clear advice. We take away some very clear messages. This country has a history of underinvestment in science but nevertheless has maintained high quality by our innovation and the quality of our science. Brexit clearly puts a lot of the sources of funding at risk. You have also given us a very clear message that UKRI could be an important source of clear, analytic, strategic advice in the approach to co-ordinate our science. I am certain that this Committee will wish to talk to Jo Johnson and John Kingman in the future, and we will certainly return to that as we look at the longer-term approach to the strategic issues that you have set out so clearly. I am sorry that we ran out of time. We could have extended this much longer to our great advantage. Very many thanks to the three of you for helping us this morning.

Royal Society of Edinburgh (RSE), Royal Society and British Academy – Oral evidence (QQ 1-10)

Transcript to be found under Royal Society

Russell Group, MillionPlus and GlaxoSmithKline (GSK) – Oral evidence (QQ 20-34)

Evidence Session No. 3 *Heard in Public* *Questions 20 - 34*

TUESDAY 13 SEPTEMBER 2016

Members present

Earl of Selborne (Chairman)
Lord Borwick
Lord Cameron of Dillington
Lord Hennessy of Nympsfield
Lord Mair
Lord Maxton
Baroness Morgan of Huyton
Baroness Neville-Jones
Lord Oxburgh
Lord Vallance of Tummel
Baroness Young of Old Scone

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Examination of Witnesses

Professor Sir David Greenaway, Chair, the Russell group, and Vice-Chancellor, University of Nottingham; **Professor David Phoenix OBE**, Chair, MillionPlus, and Vice-Chancellor, London South Bank University; and **Dr Patrick Vallance**, President, Pharmaceuticals R&D, GlaxoSmithKline (GSK)

Q20 The Chairman: Good morning, gentlemen. Thank you for joining us today. We are most grateful. As you know, we are conducting a short inquiry as a follow-up to our earlier report on EU membership and UK science, in the light of the Brexit decision. I should warn you that we are being televised. Would you like to introduce yourselves for the record?

Professor David Phoenix: I am Dave Phoenix. I am vice-chancellor at London South Bank University and chair of MillionPlus.

The Chairman: If you would like to make any opening statement as you introduce yourself, please feel free to do so.

Professor David Phoenix: I think any comments I make will come out during the questioning.

Dr Patrick Vallance: I am Patrick Vallance. I head research and development for GlaxoSmithKline and, in a previous life, was an academic at UCL.

Professor Sir David Greenaway: Good morning, your Lordships. I am David Greenaway. I am here as chair of the Russell group universities and my day job is as vice-chancellor of the University of Nottingham.

Q21 The Chairman: Unless you would like to make any further opening statement, we will go straight into some of the questions. I am absolutely certain that we will have difficulty in asking all the questions we want to in the allotted time of one hour. Let me start with a very general question. In the light of the decision to leave the European Union, how would you see the opportunities and threats for UK science and research? To what extent have your views of what Brexit means for UK science and research changed since the referendum?

Professor David Phoenix: From my perspective—and, from discussion with colleagues, their perspective—after the initial decision about Brexit, my main change is looking at the more global opportunities that could exist, so focusing on what we need to do to manage Brexit and also to look at the other opportunities that sit alongside a Brexit decision. For me, as we go through the questions, it falls under three headings: how that decision affects productivity and the roles that universities play in support of UK-based productivity at a regional level, not just a macro level; how we support the stability of universities through that transition into the future; and, as part of that, how we encourage the exchange of ideas and maintain our global position in the new world.

Dr Patrick Vallance: We were clear before that Brexit would not have a material impact on the overall performance of the company, but we were concerned about the uncertainty that would come with it. The uncertainty remains a concern, but we absolutely see some opportunities, which I will come to. The issues for us from a science base are very much around talent. It is critically important that we can attract and retain talent into our business. We are a global science business with a very large UK base, so the attraction of talent remains a priority for us. The science environment in which we operate in the UK is critical, so a company such as ours with a big R&D organisation needs to be sure that the science base continues to get funded—not just the applied science base but the fundamental science base across disciplines from chemistry, biology, physics, engineering and mathematics, and the integration of those.

I believe there is an opportunity there in relation to what UKRI might do in allowing a focus on interdisciplinary research and ensuring that we keep that research base vibrant in the UK. From a regulatory point of view, simple harmonised regulation is important for us, so having to make multiple different regulatory submissions adds a burden and adds complexity, so in general we look for harmonisation and, therefore, a retreat from that, if that is what happens with the EU, would be undesirable.

On the other side, we recognise there are some opportunities to make bespoke pathways and make fast the linkages between what can happen between the science base and clinical trials and so on in the UK. It is obviously important that we exist in an environment where innovation is funded adequately regarding the incentives for risk-taking and we see some opportunities there, particularly in the creation of science clusters. Uncertainty remains and those are the areas we are particularly focused on.

The Chairman: That is helpful. Sir David.

Professor Sir David Greenaway: Chairman, I would pick out three threats which are relatively high-risk, a couple which are lower-risk and then two opportunities. The threats

which are relatively high-risk are, first, talent development, which is partly about the students we attract. If you look across the 24 Russell group universities, there are 57,000 students from other EU member states at the moment, and they add a great deal to our university communities and to our communities more broadly, so some part of that would be at risk. There is also talent in the faculty that we attract—20% of the faculty at Russell group universities are from other EU member states—and they are skewed towards STEM and early-career researchers; that is, people who are in one of the most productive periods of their careers with great energy, who are multilingual and super-networkers, and we rely very heavily on other EU member states to supply that pipeline, which is so important to the science base.

The second risk is around collaboration in general; not so much with other universities because I think we will find ways of making that happen, but the big partnerships also involve businesses, which are funded under things such as the JTI, the Clean Sky Initiative, the rail initiative et cetera, which are quite high-risk.

The other one which is relatively high-risk is access to funding. At the moment, about £600 million a year comes to Russell group universities through Horizon 2020/the European Research Council. Depending on what our Government negotiate for the terms of exit, some part of that will surely be at risk.

There are two other smaller risks I am not so worried about. The first is access to capital where there is some nervousness around EIB, but in fact the capital markets are pretty deep and, if universities need to raise finance, there is a lot of support in the bond markets with the banks. I am less worried about mobility. We have 8,000 students out on Erasmus+ programmes, which is great and we will find ways of continuing to support mobility.

I would pick out two opportunities. There is a real opportunity to rethink, redefine and rearticulate many of our relationships with other European partners because—Brexit or not—we will still culturally and geographically be part of that broader European space and we will find ways of developing maybe more strategic partnerships than transactional partnerships. The other big opportunity for university science in general is to be at the very heart of maybe the biggest challenge that our new Government faces, which is the productivity challenge. If we cannot find ways of accelerating productivity growth, we will not find ways of accelerating economic growth or creating the resources we need to meet other challenges—funding healthcare, schooling, care of the elderly et cetera. Right at the heart of that challenge is science and innovation, not just what happens in universities but what happens in companies such as GSK and Rolls-Royce. There is a big challenge before Government to look at how we, as a nation, can find ways of investing more in research and innovation. We are somewhat below the OECD average. I know that your counterparts in the Commons have set a target of 3% of GDP, which is a bit of a stretch given that the OECD average is 2.4%, but at 1.7% we have a way to go. It is a real opportunity for universities working with partners such as GSK to explain how we are part of the solution as we develop new trade and investment relationships and as we rearticulate our place in the post-Brexit world.

The Chairman: Could I come back to Dr Vallance? We very much take on board your point about the need to make sure that regulations are harmonised, particularly for companies such as yours dealing around the world. In our earlier inquiry, much of the evidence was very much in favour then of remaining in Europe, but nevertheless there was a concern that the

balance of regulation had tipped far too much in favour of precaution rather than there being a balance of precaution and proportion. It has been put to us in some of the written evidence since that maybe now we have an opportunity in the United Kingdom to become a regulatory sandbox, a place for trying new approaches that will prevent this bias which has been seen in some ways to be unhelpful. Would you like to comment on that?

Dr Patrick Vallance: There definitely are bits which are too precautionary and are not prepared to make the appropriate level of adjustment for the regulation versus the risk it is facing, but it is very helpful for a global company to have standardised regulation, so the trade-off there is quite important. For example, in the case of antibiotics where there is an urgent need to get more medicines out, we are pushing very hard for a single global approach to that so that you do not end up with fragmentation, which is going to make clinical trials and development easier, so in general harmonisation is better. A good point is that, if we are not absolutely part of the EU regulatory system going forward, we need to be more radical in asking what we could do to make the UK somewhere that is really pro-innovation in thinking not only about the regulatory aspect but the link through into the NHS and the ability to get new treatments out. The first point, though, is that harmonisation definitely makes life much better and it has been much easier since we have had an EU-wide regulatory process without having to go to 50 countries separately to get approvals for medicines.

The Chairman: Thank you. Lord Mair.

Q22 Lord Mair: Chairman, I should start by declaring an interest. I lead a large research team at Cambridge in the Engineering Department and I am a fellow of the Royal Academy of Engineering and fellow of the Royal Society. Many of my research staff are EU nationals. Sir David, I want to follow up your very important point about talent. Clearly, researcher mobility between the UK and EU members is key to our future excellence. On collaboration, something like 60% of the UK's internationally co-authored research papers are with EU partners, so it is vital that that continues. Are the Government saying enough and doing enough, or what do you think is required?

Professor Sir David Greenaway: That is a good question. I understand the position the Government are in: we have to pause and think very carefully about when to trigger Article 50 and exactly what we want for our country after that. There have been some helpful moves thus far. One is the early statement with regard to the position of students from other EU member states entering in 2016. I hope the Government can follow up quickly on that with running it into 2017 and, in particular, with regard to their funding because that recruitment season has already begun. The Government have been very helpful through the Chancellor in making a commitment to underpin any Structural Fund applications through ESIF and Horizon 2020 up to the Autumn Statement. I hope that they review the position after the Autumn Statement and consider whether that underpinning can hold for any longer ahead of any resolution of what our role and position will be in that European research area. With research staff, the Government could very helpfully clarify the position now of those staff and their families going forward so that they have a degree of certainty with regard to their medium-term and maybe even long-term future. That is one of the things I hear from my own staff most of all and we are trying to provide them with support regarding indefinite leave to remain, or maybe dual nationality if they want it et cetera, but

an early statement from the Government that their resident and employment rights will be maintained would be really helpful to the existing workforce.

Lord Mair: At Nottingham and, Professor Phoenix, at your university, have you experienced already a reluctance of EU nationals to join your research groups or to come to your universities?

Professor Sir David Greenaway: There is only one case, my Lord, which was of a particular individual we were trying to recruit from Max Planck in Germany for a chair in metabolic engineering, which did not work out, despite the pretty attractive package that we had on the table, and one of the factors cited was the uncertainty at the moment around the UK's position in the European research area going forward, but that is an exception and I do not have any more to cite.

Professor David Phoenix: Similarly, I know of one case at LSBU, but there is a danger in the discussion around both applications for European grants and the exchange of staff where we talk ourselves into a position or let the media push us into a position without having a strong evidence base, because there are one or two examples around the sector, but not enough to be clear on.

From my perspective, I would make two points which are similar to David's, but from the modern university sector. The universities have seen significant growth over recent years, as I am sure you are aware, in the research activity that is undertaken, especially at an international level. In the UK, the challenge around funding is such that there is a degree of hyperconcentration, which means that, if you look at the money that is drawn from the EU, although about 14% of the money coming to the UK is from Europe for research, when you look at the modern sector, nearer to 20% to 25% of the income that they generate in proportion is from the EU. For us, in maintaining that research growth, productivity and engagement, both internationally and locally, the EU sources of funding are extremely important to enable us to have a platform where we can compete and continue to expand. Certainty around how we can support that research activity, not just while we are in the EU but looking at the amount of GDP that is being made available to research is absolutely essential because we cannot squeeze further those institutions which are already very strong on research, and we have to make sure that those universities developing that research base continue to do so. Moving to the 3% investment level is important as well as looking at the expansion of HEIF and the way we can underpin the conversion of that research into application, and providing a fund for innovation which is not just targeted at the EU, but also at other overseas countries where we are supporting bilateral and multilateral arrangements, would be really important. Although, as you rightly say, about 50% of our papers in the UK are internationally co-authored, about half of that number are from the EU and the other half are from elsewhere, with big growth in China, America, Canada and elsewhere.

Q23 Baroness Neville-Jones: I declare an interest as a member of the Engineering and Physical Sciences Research Council, the Foundation for Science and Technology and the Quantum Technology Strategic Advisory Board. I want to follow up on something Sir David Greenaway said. You mentioned developing more strategic relationships and, the inference is, with other European institutions. Is that right?

Professor Sir David Greenaway: Yes.

Baroness Neville-Jones: Could you expand a bit on that thought; how your thinking is developing and how it might differ from now?

Professor Sir David Greenaway: Many of the relationships all of us have with other European partners tend to be built around some of the collaborating agreements and some of those may endure beyond a particular initiative on a particular programme. At the moment we are looking at building longer-term, deeper relationships with a smaller number of partners in other EU member states so that we can build, first and foremost for our own university, mobility programmes and joint research programmes where we can partner for proposals to EPSRC or other research councils and to other European windows of funding and provide opportunities for exchange of postdoctoral research, fellows et cetera. The point is that it is forcing us to think, if the world is going to change, how we change with it. Universities are pretty adaptable organisations; they would not have been around so long were that not the case. It is just an example of thinking now, even before we know the rules of the new game, how we can lay down foundations to ensure that we can succeed, whatever the rules are.

Baroness Neville-Jones: Do you think that might help compensate for some of the potential disadvantages of Brexit?

Professor Sir David Greenaway: I think it will and there is an appetite through our European partners. We should not forget that we have many universities which are attractive to our partners in other parts of Europe and that will not change post-Brexit because the excellence of Cambridge will not change fundamentally post-Brexit and there will still be a demand to work with the researchers at that and other universities. Certainly it was very noticeable to me in the initial weeks after the referendum the number of leaders of other universities in other parts of Europe and other university leaders who were writing to me to say, "We value the relationships that we have. We will continue to work with you to ensure these relationships endure for the mutual benefit, whatever the outcome once Article 50 is triggered".

Baroness Neville-Jones: Thank you.

Q24 Lord Hennessy of Nympsfield: I have listened to your answers so far and I sympathise with you. You sound like sculptors seeing a shape in a piece of marble, but you cannot be precise with the multiple uncertainties. We all have a certain idea of Brexit and we all have this problem, but I wonder if you could sharpen it up a bit. If I could ask you to think of three tests that the post-Brexit settlement for science, R&D and technology in this country should meet in 10 years' time if we are to be where we are, what would those three tests be?

Professor Sir David Greenaway: One would be whether we have been able to manage in one way or another the likely gap in funding, because it is a big number. That is not me saying that I just expect Mr Johnson to turn round and say, "Okay, we'll write a cheque for the remainder of that". We have to make the case for why investment in science continues to be a priority to build relationships with business, with other European partners and indeed more globally, so the first is the funding position.

The second is whether we are still attracting undergraduate and postgraduate students from other EU member states at scale. As I said earlier, Lord Hennessy, we have 57,000 students at the moment in Russell group universities and they are great people to have. Will we still

have 20% of our academic staff? That is my second test. The third test would be whether we have used the opportunity to persuade not just the Government but the wider public of the crucial role that universities have in driving economic well-being through the productivity agenda, because I am not sure we have done the best job we could on that front yet.

The Chairman: Professor Phoenix, did you want to add anything?

Professor David Phoenix: Rather than repeating what Sir David said, the points I made at the start around productivity and stability and the staff and student mobility are key. The only added dimension is that, when we are talking about productivity, looking at the impact of Brexit at a regional level as well as a national level is absolutely essential because, if you look at the distribution, for example, of EU student numbers that we currently get, they provide a major source of income not just to universities but to local economies in jobs created and indirect spend across the country, especially in the northern regions and regions where there are a range of challenges. Similarly, with productivity, the Horizon 2020 funding and the funding that comes into those regions is really important to enable both the moderns and the research-intensives to engage with the research agenda, which also provides an infrastructure that allows especially moderns to really engage with SMEs. When you are talking about productivity and Brexit, one of the tests is looking at the regional impact and being aware that the Brexit decision impacts on other activities around innovation and engagement with other bodies because of the capacity that is being built through things such as Horizon 2020.

The Chairman: Dr Vallance, did you want to add anything?

Dr Patrick Vallance: I completely support the idea that we need to look at science funding as a key measure here. Are we still attracting funding not just from what comes in the UK but our ability to attract it from overseas as well, which has always been, and will remain, a source? There is also a need to look at the ability to attract inward investment for growth of translational activities, biotech start-up, tech start-up and so on, and that will be a critical measure because, if we get the regulatory bit right, the talent right and the science base right, we should see continued upward investment there. If we get it wrong, it will be an early indicator that we have lost an attractiveness, so we absolutely need to find ways of measuring that carefully and looking at it as an early barometer of things not being as attractive as they were. We will be more attractive if we can get it right.

Q25 Baroness Morgan of Huyton: Can we move on to the implications on the people issue, both students and faculty? I would like to ask you particularly about visas. We have obviously had a good look at this at various points as a Committee, including a detailed report in 2014. Can you spell out for us a bit how the current tier 2 and tier 4 system works for you and what would be the implications if the current system for non-EU students were extended to current EU students and faculty? What are the implications for research-intensive industries, and not just for universities but for you as well, Dr Vallance?

Professor David Phoenix: I would be concerned if we applied the same visa regulatory regime to EU students. The current regime has led to a drop of 2% in international student recruitment at our universities in recent years at a time when some of our major competitors are expanding their activity. We are not seen as an attractive place. On the Hobsons survey recently, 80% of the students who were interviewed indicated that the Brexit decision may well make the UK a less attractive, rather than more attractive, place.

Baroness Morgan of Huyton: Is that undergraduate and postgraduate?

Professor David Phoenix: Across the two. Both are extremely important because, from a university perspective, especially in some of the areas of STEM, that combination of UK and international students is what allows us to maintain a strong, viable population across a range of courses. I would be worried, in short terms, one, about the added level of bureaucracy and, two, about the barriers and disincentives that we put into the sector, and that would be at a micro level and would not be evenly distributed, so you would really start to see regional impacts and impacts across individual institutions where the EU numbers are the only numbers that are currently growing for us in maintaining growth. Finally, the visa system struggles with current numbers. If you bring in the volume of EU numbers, which is knocking on 300,000 if you include both undergraduates and postgraduates, I really think it would struggle to manage that.

The Chairman: Sir David, did you want to add anything from your perspective?

Professor Sir David Greenaway: A couple of points, if I may. Again, I understand the issue that the Government are grappling with on migration, but I do not think that students are really the issue, given what they bring to our universities and our local economies. An easy solution, which I am sure the Committee has discussed before, is to take them out of the net migration target, but I am not sure that will happen any time soon, so I would like to see us move to a more risk-based compliance both for international students and, if they were brought into this frame, EU students. I am bound to say that, if students from other EU member states were subject to the same arrangements as current international students more generally, we would see some fall-off in numbers. That will be amplified by the fact that those students presumably would no longer be able to access loans from the Student Loan Company, so any fees that they were liable for would be up-front fees as opposed to deferred payments, and that is a very different calculation for a potential student to make. On the employment side, tier 2 is already oversubscribed. About 20-25% of those whom many of us would hire under tier 2 as postdoctoral researchers would not make the £30,000 salary cut-off at the moment.

Baroness Morgan of Huyton: So we are already losing?

Professor Sir David Greenaway: I think so.

Dr Patrick Vallance: About 10% to 15% of our UK-based workforce are EU nationals. It is less of an issue for us and we certainly have not had any concerns expressed about what happens afterwards, so I have not picked that up inside industry in quite the same way that I have in funding for academic areas.

Baroness Morgan of Huyton: Is that because your salary levels are higher?

Dr Patrick Vallance: It is probably that.

Baroness Morgan of Huyton: So they get the visa through?

Dr Patrick Vallance: Yes. From a student perspective, obviously our numbers are very much fewer but we recruit quite heavily and have joint student schemes from Europe, so we have a very big connection with France on chemistry and, frankly, we have outstanding students coming across, which has created a very vibrant culture within our organisation. Little barriers can go quite a long way to destroying that, so I do not know what impact it would have, but it is certainly an area I would want to make sure we preserve.

Baroness Morgan of Huyton: Thank you.

Lord Cameron of Dillington: Are we supposed to declare our interests?

Baroness Morgan of Huyton: Sorry, I should have declared an interest.

The Chairman: I think most of us declared our interests on an earlier occasion.

Q26 Lord Cameron of Dillington: Thank you. My question is very much a follow-on from the last one because the Government seem to insist on including students as immigrants and they are committed, seemingly, to reducing immigration and, at the same time, they are committed to increasing overseas students. I was wondering how they are going to match those two policies vis-à-vis STEM students at UK universities?

Professor Sir David Greenaway: With some difficulty.

Lord Cameron of Dillington: What are the answers?

Professor Sir David Greenaway: The overarching objective of increasing the number of international students has to be the right thing, I think, for our universities and for the economy more generally. The numbers that we look at in the Russell group suggest that those 24 universities bring in directly and indirectly about £4 billion in exports per annum on the current platform and that is a significant contribution to export earnings, quite aside from the echo effect you get thereafter. These are people who overwhelmingly go back to their own countries and get into positions of power, influence, business and government and think very highly of the United Kingdom, which helps in building trade and investment relationships in the future. As I said earlier, the really easy way of dealing with this is to take international students out of the net migration target. I understand that is politically sensitive and, that being the case, we need to do two things: one is to signal very loudly that the UK genuinely is a place that wants to welcome international students. I travel widely and there are some parts of the world where that is not the message they get, which is very much the case, for instance, in India. The second is to see if we can find ways of making compliance a bit less bureaucratic and a bit more straightforward than at present.

Professor David Phoenix: That soft power argument is very strong, but there is a discussion that has had limited airing which is around the fact that UK students, if they go to a university, expect nowadays it to be a multicultural experience; they expect to engage with people from different backgrounds, and the way that helps people to think differently and broadens their horizons is absolutely essential to the experience. The obvious answer is to take students out of the target. Given that is unlikely to happen, there needs to be some review as a halfway house, if we cannot go that far, to try to look at whether or not there could be key countries where different approaches could be articulated. That is not just on current engagement, so we know that, as I said with Canada, Australia and America, there are a lot of countries we have very strong links with where we could ease relationships, but also future partners, such as China. India has seen over a 50% fall in students coming to the UK in recent years and, as somebody who has done a lot of work in India, I find that really disappointing with the potential talent and entrepreneurial spirit they have in India around biomedicine, enterprise and STEM.

Lord Maxton: Where are they going?

Professor Sir David Greenaway: To the USA.

Professor David Phoenix: To a lot of our competitors. As Sir David said, international students attract around £9 billion to the UK economy, and European students about £3 billion. The return is far greater from EU students and international students to the UK than the return on the research, which is different, in the local economy, yet students are now applying for 2017-18 with no certainty about what the fees are, no certainty about the funding that will be available. If you honestly think we will be able to maintain numbers, unless we can at least tell them what they will be paying over the next three years, I am afraid it does not make sense.

Lord Cameron of Dillington: There seems to be a slight muddle in the figures. You were talking about £9 billion per annum and Sir David was talking about £24 billion from your Russell group—

Professor Sir David Greenaway: No, £4 billion.

Professor David Phoenix: I am using the UK base.

Q27 Baroness Neville-Jones: Do you think there will be an effect from the possibility that the Government will lift the £9,000 cap on undergraduates and what effect do you think it will have on attitudes? Is it again a problem of uncertainty or is it a problem of the absolute amounts that the fees might rise to?

Professor Sir David Greenaway: Do you mean more students from other EU member states?

Baroness Neville-Jones: Yes.

Professor Sir David Greenaway: First, for students from other EU member states, I would be more concerned about access to funding than to what might happen to the fee itself because, whether it goes from £9,000 to £10,000 £11,000 or whatever. If they become up-front fees, as opposed to a student from another EU member state being able to access funding through the Student Loan Company and repaying after he or she graduates once they are earning beyond a certain point, that is a very different proposition from having the entire resources up-front. I am less concerned about the fact that we might see more fee differentiation than I am about access to funding for those students.

Lord Maxton: In Scotland, of course, the universities do not charge fees at all and, as far as I know, they do not charge fees for European students at the present time.

Baroness Neville-Jones: No, they do not.

Lord Maxton: They do for English students but they do not for students from other European countries. Will that make a difference to the Scottish universities?

Professor Sir David Greenaway: It is a really good question. At the moment, there is a notional fee of £500 a year, so £2,000 for a four-year programme, which goes into a government endowment, so to speak. I think there is some threat to longer-term sustainability associated with that. At some point, whatever the shape of any post-Brexit resolution for the United Kingdom as a whole and Scotland in particular, very politically sensitive in Scotland is the issue that a bigger contribution from students will have to come on to the agenda, in my view.

Dr Patrick Vallance: One other thing to add to the issue of the undergraduate numbers is the knock-on consequences for postgraduates as well, which is important, and high-quality

postgraduate training is clearly essential for industry. There is a risk that, as fees get to the stage where people find it difficult, the postgraduate population begins to suffer as well or people go elsewhere, so that is something to watch.

Baroness Neville-Jones: Are you saying there is a danger that the UK will price itself out of the international market?

Dr Patrick Vallance: Yes, for postgraduates; that you have a consequence where people say, "I can't take the hit of the initial cost and then do my postgraduate as well, so I don't do postgraduate training, I do something else instead". That is the risk.

Professor David Phoenix: It is worth being aware of the number of EU countries that are increasing the number of courses taught in English to attract an increased number of students both from the EU and overseas at much-reduced fees. It would be very difficult, as has been said, to compete with such subsidies if we do not have some flexibility in maintaining the fee level and support. It is not just about the support we are giving; many of the European countries that allow students to travel to the UK also provide support in mobility or support allowances.

Professor Sir David Greenaway: Chairman, could I add a small point to Dr Vallance's point? Around 25% of the current postgraduate research students in the UK in mathematics are from other EU countries and about 20% of those in computer science are from other EU member states. That makes the point that, especially in the STEM area, there is a risk here to the postgraduate pipeline.

Q28 Lord Vallance of Tummel: My question is about the relationship between the Government and business. We do not know what kind of Brexit we are going to have, but let us assume for the moment that we leave the single market and we do not join the European Economic Area. If that were the case, a lot of the constraints involved in membership of the EU would fall away, such as constraints on state aid and the regulations you were talking about earlier. If that were the case, would there be an opportunity for changing the relationship between government and business in some way, perhaps through the industrial strategy? If that were the case, too, what would be the ingredients of such a change in relationship that you think would be important?

Dr Patrick Vallance: The answer is yes, there must be opportunities there, and I know the Life Sciences Transition group is looking at this, so there is already a close join-up. There are opportunities in a number of areas. One of them would certainly be around how we fund innovation and give incentives for innovation, so building on some of the mechanisms that are already in place, such as the Patent Box and so on. There are opportunities to think about whether you can enhance cluster development with some sort of incentive there to allow the industry-academic-biotech-tech clusters to really start to have some sort of aid and strategy behind them, and there is an opportunity, despite what I said about regulatory harmonisation, to think about whether there are regulations that could be eased to give a path through. The NHS can also be part of this. We have two things to think about there: one is that we have a lot of data in this country from long-term collections of genetics, from patient populations and from other areas, which, if we can join that up properly across the NHS, academia and repositories of data, is a huge resource which becomes a magnet. Focusing on some areas such as that becomes incredibly important for what comes next in

terms of an innovation culture in the UK, so there definitely are opportunities to go after there with a strategy.

Lord Vallance of Tummel: Are the constraints on that now a feature of being part of the European Union?

Dr Patrick Vallance: Not all, no. There are some in the regulations. There is also an opportunity to ask whether, in whatever funding opportunities emerge, we want to be more directed towards growing that sort of national resource in some of the funding rather than the EU putting a big brake on it.

Q29 Baroness Young of Old Scone: The rumours are that one of the ways of getting out of the uncertainty on regulatory frameworks in the immediate future is just to agree that everything currently in place will continue until it does not. Have you any worries about what happens to the subsequent negotiating process when we could see a war of ideologies between the deregulation lobby and the harmonisation lobby?

Dr Patrick Vallance: Yes, regulation seldom gets less. There is a danger that this leads, in all sorts of dimensions, to an increase in regulation. If you look at the current regulatory system, and I do not know how this will be dealt with, in the EU system for medicines the MHRA, our national regulator, takes a high proportion of so-called rapporteur positions when judging the medicines. That will go, and that leads to potentially a very different system emerging in Europe, where we have much less influence. Conversely, we may end up with a different system in the UK leading potentially to a faster system in the UK, but that is of limited global value if it is not linked to the ability to get the same approvals elsewhere. There is risk in this negotiation on how we settle the regulatory framework and I do not think those discussions have started in earnest yet. The simplest answer is: you adopt all the European regulations and accept you have no influence on it. I do not think that is a great outcome.

Q30 Lord Oxburgh: One of the important planks in the European research policy has been collaboration. How do you see that changing and what should we be doing to minimise the consequences, provided we think it is a good idea?

Professor Sir David Greenaway: I think collaboration is a great idea. I think all our universities are very well connected globally, not just in the European arena. There is a risk that some of those collaborations will be compromised by the fact that the funding may not be there to support research and mobility, or to support some of the big infrastructure facilities, which is why at this stage we are all spending less time trying to second-guess what the outcome of the settlement might be in three years' time and finding ways to ensure the foundations are there to sustain collaborations, not just with other partners in the European Union but more globally. My own university is making use of the two campuses we have in China and Malaysia, to build out from there to other universities in south-east Asia and in China. Other universities are reviewing their position because ideas are no respecters of borders or territories, and collaborative instincts are very much in the DNA of most academics. Funding makes it easier— there is no question about that—but the instincts will still be there and the willingness will still be there. We have to make sure we find ways of funding ourselves or persuading governments it is worth funding.

Dr Patrick Vallance: I agree with that. Collaboration is not going to go away; scientists absolutely look for it to answer questions, so that is going to stay. The question is whether the barrier gets higher, and there is no doubt in my mind that the EU grant system fostered collaboration that otherwise would not have happened, and often pulled it quite hard, because people—and having been an academic I can say this—chase the money and the money did make a difference. From our perspective, we would continue to fund EU schemes and we could do so, as indeed do US companies. The worry I have is if UK investigators cannot really lead those, because so much of the great science is here.

Professor David Phoenix: The research funding will carry on; there will still be opportunity for exchange collaboration. The area where I have concern, and this is perhaps different from David's comments at the start, is on some of the student exchange programmes. Certainly at London South Bank, we put funds aside to support international travel because we believe it is absolutely vital for broadening students' experience. With the number of pressures on universities now in terms of additional support—we are having to take on supporting students with disabilities; we are taking on student costs on mobility; we have had to bed in additional cost savings—there is a danger as you start prioritising you end up with a system where people's background, economic and social situation affects their ability to engage on exchange programmes and universities are not able to take on that funding. Why is that important? It is not just about mobility for those individuals but for the future generation of researchers and the future leaders of our industry—those who have been overseas gain so much. It is the same with our students. If you bring a student from China, they have travelled to a different country, they have learned a different language and they are often leading the way on volunteering. Those students, when finished and having tried all those things, when applying for jobs, are the global graduates that our graduates have to compete with, not just UK-based ones. I worry that without the Erasmus schemes for those staff and student exchanges for early career undergraduates and postgraduates, it will have a medium-term impact on our status and productivity.

Lord Oxburgh: Do you think we need to be proactive now in planning for schemes which will meet these problems?

Professor David Phoenix: Yes, maybe on a reciprocal basis with bilateral schemes with different countries that look at exchanges two ways, because we are seeing a growth in UK students going overseas. It is still less than the number of students who visit the UK but it is growing rapidly, as UK students see the benefits of those overseas placements. I speak as somebody whose son is abroad for a year at the moment.

Dr Patrick Vallance: We can look beyond Europe in that, as was said earlier.

Professor Sir David Greenaway: I would be fairly optimistic, Lord Oxburgh. One of the things that ought to be easier to secure in any negotiations is continued participation in Erasmus because of the attractiveness of the UK as a destination and because other non-EU member states participate in Erasmus anyway.

Q31 Lord Hennessy of Nympsfield: Can you put a figure, at current prices, on the gap the Government would have to fill if EU collaborative money disappeared? It is a lot of money, is it not?

Professor Sir David Greenaway: About £900 million.

Lord Hennessy of Nympsfield: A year?

Professor Sir David Greenaway: Yes.

Lord Cameron of Dillington: When trying to replace that, some 65% of current funding for R&D in the UK comes from the private sector. What can the Government do to try to crowd in more private sector funding to help replace some of that missing funding?

Professor Sir David Greenaway: The Government have done quite a lot in that regard in the last five to 10 years when you look at structural funding for things such as the Research Partnership Infrastructure Fund. Indeed Patrick's boss, Sir Andrew Witty, is presently in Nottingham opening a building which benefited from that scheme. The Higher Education Funding Council for England put some funding in but on a 1:2 basis matched through private sector and other funding. It is also the case that the research councils, whether for doctoral training centre programmes or big collaborative grants, put universities on notice that they have to be seen to bring in matched funding from the private sector. We are part of a new initiative called the energy research accelerator, which has been funded by Innovate UK and six universities in the Midlands. Innovate UK is investing £60 million in that and we have had to draw down £120 million of private sector match. So there is quite a bit of activity and this is a good thing rather than a bad thing because it is promoting closer collaboration between universities and business, and I think we will see more of that. However, I think the Government will still have to look at the priority it gives to science relative to other investments going forward.

Dr Patrick Vallance: Whatever happens with the evolution of UKRI, the key thing to focus on is whether you can make that link such that you can really enhance the inward investment from the private sector as well as enhancing the public funding of science.

Professor David Phoenix: When people ask that question there is a danger that they focus on big industry. Of that £9 billion, about 70% goes to universities, and it is a large—disproportionate—percentage of the moderns' income. A lot of work supported through that activity by SMEs and regions. It is one thing arguing about how you get larger contributions from big business but a lot of our economic growth and interaction is being driven by SMEs, some of the creative industries and multidisciplinary interfaces. That is a much more difficult scenario to plan.

Q32 Baroness Young of Old Scone: Earlier somebody said we needed a barometer on what is happening so we could track trends quickly. There is a lot of either anecdotal evidence or example, depending how you look at it, of the impact of Brexit and there will be even more in the future. How can we do that and what should the Government be doing to track how these impacts run through?

Professor Sir David Greenaway: The Government have been proactive and receptive from the start. Mr Johnson, when he came for a meeting with Russell group vice-chancellors, asked for evidence that the Government could build on to take to Brussels, and all of us through the different mission groups and through Universities UK, have been gathering any evidence we have on appointments not taken up or instances where individuals have been asked to reconsider their position in leading a specific consortium. I must say there is not a lot of it, to be honest, as yet.

Baroness Young of Old Scone: Is that call for evidence sufficient or are there other, more systematic and scientific ways we can track it?

Professor David Phoenix: It would help to break it into two phases. A lot of the challenges we have in the university sector are on transitional arrangements and there is almost a concern that, "We cannot say that because it could affect the negotiating position" or "That might not be true further on". On European student numbers there is no reason why we could not agree a transitional arrangement, so that for students applying for 2017-18 and 2018-19 we would retain the regulations to enable them to continue to the end of their course. You are not then committing to that in the negotiation as the end point but you have given some stability to the sector. Because we have such a seismic change, coupled with the change in the regulatory environment for the sector, one of the key measures is the stability of the sector as a whole and how we are able not only to adapt but to grow, further flourish and prepare ourselves for a new environment.

Q33 Lord Hennessy of Nympsfield: Might it be difficult to measure developments that have occurred because of the stimulus of Brexit? For example, if I was a vice-chancellor—a position to which I have never aspired—I might be interested in furthering this last spasm of British colonialism, which is what you are doing in China, and I think my own college of Queen Mary is doing as well. It is a remarkable phenomenon which nobody has written up; it is the last throbbing of the British Empire. I might be tempted to do more of that to raise revenue because you do not do it out of altruism, do you?

Professor Sir David Greenaway: I have never thought of it in those terms, I can assure you, nor is it a vehicle for generating short-term margin. If I wanted a rapid route to short-term margin, I would build another hotel in the university park. It is there for long-term value. There are 7,000 students at that campus; it provides great opportunities for student mobility within their own university; it provides great opportunities for diversification of research, for building business-to-business relationships in companies we work with in western Europe that have an interest in Asia, as well as companies in Asia which have an interest in western Europe. There is enormous potential for long-term value in this; it is not about short-term margin.

Q34 Baroness Neville-Jones: What is the evidence, if any, of European universities not being able to participate in, or being rejected by partners for, bidding for future funding for projects which might end before Brexit but quite likely will not end before Brexit takes place? Is there evidence there and how will you try to gather that information? Do you think it a serious threat?

Professor Sir David Greenaway: It is a potential threat, but I do not see a lot of evidence that it has been a real threat in Russell universities.

Baroness Neville-Jones: I have heard of one.

Professor Sir David Greenaway: We hear of the odd instance here and there of an individual being asked, "Do you think you should still lead this?" as opposed to being a partner. We have seen some evidence of that because the consortium is concerned that if it is led by a UK institution, its chances of success may be compromised. Certainly the Commissioner has been very helpfully vocal on that front, but I personally do not have a lot of evidence to report on that.

Dr Patrick Vallance: I hear exactly the same. It is more whether they want a UK academic leading the whole thing in an area of uncertainty and even that has not—

Baroness Neville-Jones: How much of a loss is that?

Dr Patrick Vallance: It is a loss but I am not sure it has even happened; there have just been discussions where people have raised the question. Examples where it has really led to some change are very few and far between and certainly only anecdotal.

The Chairman: I suspect that this is an area where we will need some very hard evidence. Inevitably, after Brexit there was a lot of speculation and we are still waiting for the dust to settle on all this. We are most grateful to you for joining us today. We will be, by the end of October, following up on our report on EU membership and UK science and your contribution today will help us enormously, so very many thanks to Professor Phoenix, Dr Vallance and Sir David Greenaway. Thank you.

Science Council – Written evidence (EUF0004)

1. The Science Council's principal area of work is to advance the professional practice of science across the breadth of the science workforce, including technical roles in science. A key aspect of this is professional registration through the Chartered Scientist (CSci) designation which is the professional registration scheme relevant to all scientists working in the UK.

2. Since 2007, CSci has been accepted for the purposes of the European Union's Professional Qualifications Directive (PQD) (Directive 2005/36/EC) as a regulated profession, with the Science Council designated as the Competent Authority.[75] Approximately 13% of Chartered Scientists are overseas professionals.

3. The Science Council is a membership organisation representing 41 learned societies and professional bodies[76] drawn from across science and its applications. Our mission is to support the professional development of scientists through setting common high standards and code of conduct across the disciplines and sectors of science and at all levels in the science workforce.

Recognising professional scientists across Europe

4. Making sure UK science has access to the widest possible pool of talent and making sure UK-based scientists have the opportunities they need to develop their skills and talents by working across Europe is vital for ensuring science in the UK remains a key driver of innovation and our economy. The EU-wide recognition of professional qualifications has made vast improvements to the mobility of professionals, and has provided a better climate for businesses to operate.[77]

5. Facilitating easier movement between institutions within Europe has enabled UK scientists to work abroad more easily, and return to the UK with greater knowledge and expertise in their discipline, which can be greatly beneficial to wider society. The PQD has also enabled highly-skilled scientist from across the EU to be able to work in the UK and positively contribute to the economy, rather than seeking employment in other countries in Europe, the USA or China.

6. **The Science Council believes the government must seek to ensure that the European-wide recognition of UK-based professional scientists continues. We are concerned that the UK's ability to attract high-calibre scientists and researchers from across the EU and**

[75] http://ec.europa.eu/growth/tools-databases/regprof/index.cfm?action=regprof&id_regprof=7588&tab=general
[76] http://www.sciencecouncil.org/our-members
[77] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32276/11-794-uk-government-response-mutual-recognition-professional-qualifications.pdf

beyond will be negatively affected should UK professional qualifications stop being formally recognised across Europe. European-wide recognition of UK-based professional scientists is a key part of ensuring the UK remains an attractive place to invest.

7. The PQD and ready access to a highly-skilled scientific workforce will help the UK continue to be an attractive place for investment from both domestic and overseas businesses. Hindering UK-based businesses from appointing talented individuals from EU and non-EU states to fill vacancies will be detrimental to the UKs economic and social prosperity. This will be felt particularly strongly in sectors with an ageing workforce and those occupations with high skills shortages.

8. While it is essential that the UK attracts, educates and trains more home-grown citizens in scientific careers in order to fill long-term shortage gaps, it is unlikely that supply will meet demand in the short term. It takes many years for an individual to gain the knowledge and experience that businesses require.

22 August 2016

Member Organisations of the Science Council

August 2016
Association for Clinical Biochemistry and Laboratory Medicine
Association of Neurophysiological Scientists
Association for Science Education
Biochemical Society
British Academy of Audiology
British Association of Sport and Exercise Science
British Computer Society
British Psychological Society
British Society of Soil Scientists
Chartered Institution of Water and Environmental Management
College of Podiatry
Energy Institute
Geological Society of London
Institute of Animal Technology
Institute of Biomedical Science
Institute of Brewing and Distilling
Institute of Corrosion
Institute of Food Science and Technology
Institute of Marine Engineering, Science and Technology
Institute of Materials, Minerals and Mining
Institute of Mathematics and its Applications
Institute of Physics and Engineering in Medicine
Institute of Physics
Institute of Science and Technology

Institute of Water
Institution of Chemical Engineers
Institution of Environmental Sciences
London Mathematical Society
Mineralogical Society
Nuclear Institute
Oil and Colour Chemists' Association
Operational Research Society
Physiological Society
Royal Astronomical Society
Royal Meteorological Society
Royal Society of Chemistry
Royal Statistical Society
Society for Cardiological Science and Technology
Society of Biology
Society of Dyers & Colourists
The Organisation for Professionals in Regulatory Affairs

Science and Technology Facilities Council (STFC), Cisco and Met Office – Oral evidence (QQ 35-44)

Evidence Session No. 4 *Heard in Public* *Questions 35 - 44*

TUESDAY 13 SEPTEMBER 2016

Members present

Earl of Selborne (Chairman)
Lord Borwick
Lord Cameron of Dillington
Lord Hennessy of Nympsfield
Lord Mair
Lord Maxton
Baroness Morgan of Huyton
Baroness Neville-Jones
Lord Oxburgh
Lord Vallance of Tummel
Baroness Young of Old Scone

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Examination of Witnesses

Professor John Womersley, Chief Executive, Science and Technology Facilities Council (STFC) and Chair, European Strategy Forum on Research Infrastructures (ESFRI), **Phil Smith**, Chairman of UK & Ireland, Cisco, **Professor Dame Julia Slingo OBE**, Chief Scientist, Met Office

Q35 The Chairman: May I extend a welcome to Professor Womersley, Phil Smith and Professor Dame Julia Slingo—welcome back in your case. You probably heard some, if not all, of the last session and you know we are revisiting the report we did before the referendum. We are being televised. For the record, starting with Phil Smith, please introduce yourselves and if you would like to make an introductory statement please feel free to do so.

Phil Smith: Good morning. I am Phil Smith, chair of Cisco in the UK and Ireland. I am also a chair of Innovate UK and have been for the last four or so years. Additionally, I chair a skills-based organisation, the Tech Partnership, focused on STEM skills in the industry. I will not make any introductory remarks because it seems a number of them are covered.

Professor Dame Julia Slingo: I am the Met Office chief scientist. I also serve on the High Level Group of the European Commission's Scientific Advice Mechanism. I am a member of

NERC's council and a fellow of the Royal Society, where I work on the science policy advisory group and on a new group that has been constituted to look at the effects of Brexit.

Professor John Womersley: I am John Womersley, I am chief executive of the Science and Technology Facilities Council, which is the UK research council responsible for large research infrastructure. I will be stepping down from that position at the end of October to become director-general of the European Spallation Source, which is a European intergovernmental laboratory for material science being established in Sweden, so I can address questions with that hat on as well if you wish. Until recently I was chair of the European Strategy Forum on Research Infrastructures which is a Europe-wide priority-setting and strategy forum for large research projects.

Q36 The Chairman: Thank you very much. Perhaps I may start with a general question, which is really directed to Phil Smith as he might be said to be representing businesses based in the United Kingdom. What impact will Brexit have on science and technology businesses based in the United Kingdom? Is the UK still a good place to do research-intensive business, and are there any specific steps you would like to see the Government take to make sure it stays an attractive place to do research?

Phil Smith: Clearly, there is some way to go in this particular discussion. Obviously much of what has been discussed already today has been discussed over previous months, about the position where the UK ends up, but I think the fundamentals are still important. We have a strong university sector, we have good collaboration right across the ecosystem not only of science in the universities but of the innovation system in businesses; they are well tied together in the UK. There is more to be done and that has some potential challenges as we go forward; we have to make sure we sustain that whole ecosystem and not just particular parts of it. That is important. It is still a fundamentally good place to do business. If I look at a business such as Cisco, clearly we have choices. It was a Californian company originally which invests widely around the world, and we have to be concerned not only at the absolute things we do but about some of the subtleties in the messaging that start to appear in this sort of environment, where a company can make choices about where it invests. I do not think the fundamentals are any different and we have strongly said we will continue to invest in and support the UK, but there is the danger that some of those smaller messages will be uncertain for a period and can have challenges in the short term. They may manifest themselves later as well, but in the short term until certainty is established it means people who are one step away may not have a complete picture of what is happening in the UK.

Innovate UK and the support it has from the Government to translate science into innovation and technology is a powerful vehicle and we have to continue to support it. Of course the world is changing around us here, because not only are we in a post-Brexit world but we have the formation of UKRI and the change in some of the funding vehicles that Innovate UK uses itself away from purely a grant-based environment. So there are a number of changes and we have to keep some simplicity and clarity on these and some of the areas the Government have to focus on are exactly that.

I have been at four or more sessions where industry has been asked to give feedback on what the key issues are in this post-Brexit world and they broadly come out as three things. There is talent, which has been discussed already today, particularly talent not just in terms of people coming into the UK but our ability to export products and services and people and

flexibility of movement of people, which is extremely important to industry in general and certainly to the digital industry. We have seen issues around regulation, and again that plays particularly in the digital industry, for example in the generalised data protection regulation which comes into force. We will talk about privacy and so on. Is that going to be just what we do in the UK or do we have to do more? People are uncertain about that already and we are hearing a number of examples where customers have been advised not to build facilities in the UK because lawyers are saying they do not know what the ultimate position will be on data privacy. Then the final part, which is coming out consistently, is funding and support for ongoing funding, particularly for collaboration because that is one of the things that was rightly said in the last session that academics naturally do. The EU programmes—Horizon 2020 and the various programmes that Innovate UK runs—are predominantly vehicles for providing collaboration. Of course they provide funding but they are about getting people together to do things. We have to keep the faith on that and be clearer about that as quickly as we can.

The Chairman: Following that up, could I ask Professor Womersley, with the creation of the new UKRI and the need clearly to determine new strategic priorities for UK research, to what extent UKRI is fit for that objective?

Professor John Womersley: It remains to be seen because many details of UKRI still need be fleshed out. The Bill has yet to reach this House and is making its way through Committee in the House of Commons. I know members of the science community are hoping that the new CEO and chair of UKRI will be strong advocates for science and research, in particular explaining what science and research needs the Government to negotiate in the context of Brexit. That will require that UKRI is given sufficient independence to challenge government, if necessary, on these priorities; to make the points Mr Smith was making about talent, for example, which feeds in to any future immigration restrictions and so forth. In principle, the creation of a single body to speak for all the science research and innovation system is a good way to get these points across, as long as it is in place in time to influence things on the timescale that is needed.

The Chairman: Does Dame Julia want to add anything?

Professor Dame Julia Slingo: Just to emphasise that the timing of the formation of UKRI is in some ways quite fortuitous because it allows us to take a new look at the whole research landscape in the UK and our relationships not just in the UK but internationally, and to bring together Innovate UK with the research base. Indeed, yesterday I met John Kingman to discuss how we and other players in the research landscape beyond the research councils—thinking specifically of the public sector research establishments such as ourselves and the National Physical Laboratory, and indeed third-party research organisations—can use the creation of UKRI to understand the richness of the UK's research landscape and see how we can best use that in the future to maintain our position in the world of research. So the creation of UKRI is a real opportunity at this moment when we are thinking about where we are going on Brexit.

I would also make a very general comment, and it is really quite obvious, I suppose. The formation of the department in which you bring together business, energy and industrial strategy alongside the research base is also a very good signal of our intent on where we as a country want to go, which some of the previous people who spoke to you this morning

touched on. There are some real opportunities here which we have not had in the past that are very timely.

Q37 Lord Mair: I want to ask Professor Womersley more about research infrastructure—some of these very large facilities that exist both in the UK and in Europe. What do you think will be the effect of Brexit on those as far as the UK is concerned?

Professor John Womersley: This is a question that is best answered in stages. The European Union itself invests a certain amount in research infrastructures through its own Joint Research Centres, but only a few per cent of what Europe spends globally on large research collaborations is spent by the EU. The UK's membership of international treaty organisations—CERN, the European Space Agency, European Southern Observatory, the European Centre for Medium-Range Weather Forecasts and synchrotron radiation facilities—including the new projects that we have recently joined, is based on intergovernmental agreements that will continue to be in place and are not in any way affected by Brexit. That is clear and there is no negotiation needed and no doubt about that.

There are a few EU-funded research infrastructures whose future we do need to understand. Most obviously for the UK that is Culham and the fusion research project there, which receives about £60 million per year from Euratom and EUROfusion. Continued UK participation in some way in the European-wide fusion programme would be necessary if we are to continue to receive that funding. That is one thing we should put on the "to do" list of questions that need to be addressed and prioritised by the Government. Our colleagues in Culham have taken a big role in ITER, the next generation fusion project which is hosted in France. We would wish to continue to be part of that. We have won several hundred million pounds of industrial contracts through that project and are looking to bid for more, and our continued participation is necessary to support the lab at Culham and that project.

There are some details of the European legal structures that have been used for some of these intergovernmental projects, which have been set up as European Research Infrastructure Consortiums, or ERICs. That is a legal structure like an international company which is embodied in UK law through the European treaties. It is perfectly possible for third countries to be part of such ERICs, but I believe, to get the VAT exemptions we would desire, we would need to pass an Act through the UK Parliament recognising that status. That is what has happened in Switzerland and Norway. This is important because we host at least one ERIC, the European Social Survey, at City University in London. We need to do something to put that recognition in place.

So in general, our involvement in European infrastructure projects will not be hugely impacted by Brexit because they are not usually receiving EU funding.

The major concern for those we host, for projects such as the Square Kilometre Array—which we are trying to set up as a treaty organisation so it will have all the intergovernmental aspects which are recognised—is about the free movement of talent, as Phil Smith was saying. If we wish to host large research projects, just as our university colleagues wish to attract the best scientists from around the world, we would wish to attract the best scientists from around the world, not just from Europe but from everywhere. Therefore, it is much more a question of what new work permit regime, what new immigration regime, may be put in place than a particular consequence of withdrawal from the EU.

Lord Mair: Thank you.

Q38 Baroness Neville-Jones: One of our witnesses a moment ago mentioned the industrial strategy. Do you think this will be helpful in the context of post-Brexit and what particular priorities should the industrial strategy have, given the fall-out from Brexit?

Professor John Womersley: I think all of us will probably have an opinion on that but perhaps I could start. The inclusion of industrial strategy in government and the use of that language is important because it allows us to explain the role of science and innovation in underpinning future productivity growth in a knowledge-based economy. It allows us to talk about the skills, about basic technology and how to feed them through into economic activity, not just in a linear system but to feed back challenges. It enables us to make this connection between the work of the research councils, the work of universities, the work of Innovate and others and other PSREs as well, in a way which obviously relates to government priorities and which might influence negotiation strategy around Brexit and even future funding.

Baroness Neville-Jones: Who is the "us" in that? You said it allows "us".

Professor John Womersley: Earlier we were talking about the role of UKRI in making this case. It allows a Minister, a Secretary of State, to argue that an industry strategy is necessary. It is after all a Minister whose department hosts the £6 billion funding that goes into Innovate and into the research councils. So it is partly having that argument internally with the Treasury; it is partly the science community, people like the vice-chancellors you were just talking to and all of us here, being able to make that point. It is partly a public policy debate about what the priorities around Brexit need to be. We will be hearing and have been hearing a lot about the need to get crisper statements about the right of foreign residents to live and work in the UK, and about access to the single market couched in terms of tariff barriers and location of factories, but we also want to talk about the UK's knowledge economy—the movement of knowledge workers and our ability to attract small start-ups and the large research activities of multinationals like Cisco. So it is a way to have that conversation that avoids the sense that the science community, if there is such a thing, is merely arguing for science funding and trying to replace what appears to have been lost from Brussels. You will notice I have not even mentioned that funding up to now because I think that is a second-order effect compared with all these other factors.

Baroness Neville-Jones: It seems to me you are saying that we need to create some context within which people understand the—

Professor John Womersley: Exactly, and it is the same "we" you are using there: those of us who are advocates of appropriate investment in science and innovation to drive future growth in a knowledge-based world. We need to connect the science and innovation at the start of that ecosystem with the jobs and growth we seek to produce. For me, an industry strategy is a way to do that.

Q39 Lord Hennessy of Nympsfield: First, I would like to ask what you think the new industrial strategy is in a couple of sentences. I have always needed help with that. As a historian I am re-reading Labour's national plan from September 1965. We have been here before, but I do not want to sound cynical. I am very taken with the optimism you have been expressing in the sense it is a chance to look in a fresh way at all this, and Dame Julia put it

very eloquently a moment ago. However, is there not also an opportunity cost? There is only a finite amount of nervous energy and time that we all have to do these things and Brexit is imposing a huge load on the little grey cells of the nation that could perhaps be better deployed if we had voted to remain. Discuss.

Professor John Womersley: Well, you asked about three questions there. If I were in charge of the industrial strategy, I would start from the title of the previous version that was produced under George Osborne and Greg Clark and David Willetts. It said basically that science and innovation is our plan for growth. That gets you clearly away from the "propping-up major employers" approach that you are perhaps referring to in the "white heat of technology" era.

Lord Hennessy of Nympsfield: I did not put it quite like that.

Professor John Womersley: Industrial strategy was correctly derided for many years as support for failing industries rather than stimulation for growing industries—

Baroness Neville-Jones: Picking winners.

Professor John Womersley: Science and innovation is all about spotting the future rather than protecting the past. In terms of nervous energy, the science community certainly has been through many of the stages of a classic grieving process about Brexit, and was initially, and is still, very concerned about it, but now has got to the point where we can have a rational discussion about the ways to mitigate any potential damage, influence the outcome in such a way that it potentially has some benefits—we talked about the regulatory environment as one of those—and to input into the debate in a sensible way. However, the work of government, of Parliament and the Civil Service, will be dominated by this. We read yesterday, "One of the most complex negotiation exercises ever to be undertaken", so in the new Department for BEIS we need to make sure a sufficient—which probably means large—amount of effort is devoted to understanding some of the legal issues around the future position of science and innovation in a post-Brexit world, and making sure those are fed into the Departments for Exiting the EU, for International Trade and so forth, wherever negotiations are led. We understand those things may not be public positions that can be taken at this point, but privately behind the scenes I would very much hope a significant amount of work is getting started, because it will need to be done.

Phil Smith: It is exactly that nervous energy which needs to be shaped in some way and corralled over this period. In business when things hit you, whatever they might be—competitive or economic issues—you tend to then consolidate and think about how you will do things more efficiently. There is no doubt that having a department genuinely focused on championing the best of what we have in the UK is a very powerful thing to have.

There was a significant rallying of industry in the Greg Clark-Vince Cable-David Willetts environment when we had an industrial strategy before; industries were starting to rally strongly around it and there was a real sense of people feeling that the Government were trying to support the things we were good at. Having it back in this environment, when we have an awful lot to think about, is extremely powerful. There is no doubt that, as we look at how that is delivered, it allows us to start to think about investment. Some of the things that were talked about before potentially, in a slightly different regulatory environment than we were before, mean we can potentially heavily invest in areas that the UK is strong in. From an international business perspective, I think a clear signal that the UK is absolutely out to

excel in certain areas is a very strong message externally—saying we should be investing in the UK because it will excel in certain areas. You only need to look at what has been done with Germany and its much-talked about Industry 4.0. There is clearly substance to it but there is a lot of messaging to it as well which says, "This is what we are going to do" and people are rallying around it. It is very important that we find a way of doing clear and simple messaging on industrial strategy for the UK. What it exactly is at this point is not clear, but it is a welcome return to something that will work on those strengths. In industry generally it is widely accepted that it will be a good thing and now is the chance for industry to try and improve it.

A final point I would make, which has been made a couple of times, is that we have no choice but to improve our productivity. As you all know, we are significantly—17%—behind the G7 average. There were huge opportunities to improve productivity prior to Brexit. It is absolutely essential we do it now and we need to be working on industries that give us productivity advantages, and there are many of those that can be handled in a very different way going forward.

Q40 The Chairman: May I follow that up by asking you specifically about support for UK start-ups? About a third of the support has come from the European Investment Fund—£2.3 billion, I am told, over the four-year period to 2015. It seems dubious that we will qualify for that unless we negotiate successfully on Brexit. Are we expecting the British Business Bank, created in 2014, to fill the gap? What are the chances of their being able to get up and running in the two or three years we have, or are we facing a problem here?

Phil Smith: We are potentially facing a problem; I think it will be a struggle to fill that gap. However, there is significant industry and broader support for start-up businesses per se. Many people are starting to focus now on how can we take those start-ups to the next phase and allow them to scale and double their employment and so on where we will generate real productivity gains. That will be difficult in some of those larger bodies that have been funding significant start-up activity. There will still be opportunities to bid for it; there are people who are looking to invest in start-ups, and most big companies based in the UK have some sort of start-up support environment. As we were discussing previously, we need to focus on where the real growth is. For example, in the productivity activity in which I am involved with Sir Charlie Mayfield and a number of others, we identified that 70% of employees in the UK work for companies that are below the mean of productive companies for their own sector and size, so they are working in unproductive industries. If we could move them up by 10 percentile points, the UK could gain £163 billion per year. In other words, there are things that can be done to move people up the productivity environment, whether they are start-ups, collaborating better or better funding through industry and others. We have to target as much as we can now because we are in an environment with lots of noise and nervous energy where we need to do the best for the UK.

Q41 Lord Cameron of Dillington: Post-Brexit, will the UK be able to remain a member of the ESFRI and/or the Scientific Advice Mechanism? It was quite interesting in the last session hearing Dr Vallance say that he thought the biggest risk for industry was the fact that the UK would no longer be leaders in the EU regulatory environment. Presumably, there is an equal risk of our not being leaders in the decisions on informing EU science policy or, for that matter, research infrastructures. Is that true?

Professor Dame Julia Slingo: In my role as a member of the high-level group, of course, that is unaffected by Brexit because I am there in my personal capacity as an international scientist. Indeed, when the group was brought together, it was open to anybody from any country, not just EU countries, and it so happens we are all from EU countries, so that is not affected. There is a point here about the UK's leadership in EU science and research programmes which sometimes does not get mentioned enough. We often talk about the loss of funding, but I know that, on the EU side and when I talk to the Commissioner, one of things that concerns them is the loss of UK leadership in science—in Horizon 2020, for example. As an example, at the moment in the Met Office, we now co-ordinate five major programmes in the field of climate action. We have a major programme being developed on climate projections for Europe, which is a multimodel, multinational effort, and the feedback we have is, "Please, Met Office, continue to lead that". We need to understand not just from our perspective but from the EU's perspective that they will also lose if they cannot retain some of the expertise and leadership in science that the UK definitely brings to the table. We need to think about how those mechanisms to allow us to interact with the EU can continue.

Professor John Womersley: As far as the research infrastructures and other committees are concerned, ESFRI was set up by the Council of Ministers and the membership is formally EU members, so we will not be a member. However, Associated Countries which have associated to Horizon 2020 and which are part of the European Research Area do participate. There is more than one way to be associated to the Horizon 2020 programme or to FP9, or whatever it is called, that will follow. Countries such as Switzerland have paid into the scheme and can therefore receive grant funding out of it, but the Commission is clear that, to be an associate at that level, one has to accept free movement of people, and that may or may not be an acceptable position for the UK Government; we shall see. There are other ways to be associated to Horizon 2020. Even countries such as Turkey, which manifestly do not have freedom of movement, are associated with Horizon 2020 without the same privileges, such as being eligible for grant funding. At the very least, we should aspire to a status that lets us be part of these networks, part of proposals and part of collaboration, even if we cannot receive funding from the collaboration because often the funding is not the major driver. STFC is part of projects where we have received £20,000 or something from an EU network. That is great—you can hire a student with that—but the real value is being part of this international collaboration which is defining the next-generation technology in a certain area. One of my personal red lines is that there must continue to be some association with the framework programmes and future framework programmes that lets us be part of those international collaborations, even if we are not able to adopt the free movement that would let us be a financial beneficiary.

Phil Smith: Importantly, if you look at some of the things that leverage the rest of the money, saying we are going to lose EU money, whatever that may be, and replacing it with UK money is one thing, but at the moment we have a big multiplier on that money if we are influencing it. If we are shaping the agenda, then the sorts of industries and sciences we want to be in are put in as opposed to the ones that some other country might have. We have seen, for example, that the SME programme in the EU at the moment is based on Innovate UK's SME programme. In other words, we have influenced how it has done it, hence making it easier for our SMEs and start-ups to have access because they are familiar either through the work that Innovate UK does with them or having applied for Innovate UK funding. That influence is important; it is not simply matching, it is potentially a multiplier on

top which we have to be conscious of, so we should be looking for vehicles to be part of that, if we can.

Q42 Baroness Morgan of Huyton: Can I move us quickly on to research outside the EU? We have talked this morning about EU research, but we know that most high-quality research takes place outside the EU, whether it is in the States, Asia-Pacific, China or India, and we know that all of those, particularly the newer research nations, are rapidly increasing their high-quality research. Is there a ray of optimism here? When we looked at this before Brexit, we received evidence that that was all true, but it would not necessarily make a lot of difference. Has your perception changed at all since Brexit? Do you think there are real opportunities for more research collaborations outside the EU that will be enhanced by Brexit in any way?

Professor John Womersley: Let me answer that carefully because membership of the EU never stopped us from being part of broad international collaboration.

Baroness Morgan of Huyton: As we certainly were told before now.

Professor John Womersley: We have continued to collaborate broadly and internationally. I am not sure, therefore, that "opportunity" is the right word, but perhaps "imperative" is. It is extremely necessary for the UK to show that we are still open and enthusiastic to collaboration with European countries on a Government-to-Government basis and much more so with the United States, India, China and emerging science nations because we will have to create our own scientific identity as a partner of choice. We have already been trying to do that with projects, such as the Square Kilometre Array, which involves China and India for precisely that purpose. I am pleased to say that the Science Minister is indeed well aware of this and is interested in ways in which, within existing budgets, he can promote international collaboration with other partners. STFC has been talking about a particle physics project with the United States called DUNE, which might be a way to emphasise UK collaboration in a transatlantic way with a lot of excellent science. It happens to be a UK scientist who is co-leading the project, so it is natural for that. It is more important than ever for us to show that we are open to the world scientifically. We do not have any extra money or freedom to do this with, but we have an extra impetus to do it.

Baroness Morgan of Huyton: Thank you. I am not sure that is grounds for optimism, but it is clear.

Professor John Womersley: I am always optimistic when Ministers say they are interested.

The Chairman: We will have an opportunity to talk to Mr Johnson about this in October.

Q43 Lord Oxburgh: If EU funding for collaborative research were lost, what steps should the Government be thinking of to mitigate the consequences? What would you assess the consequences for the public purse to be in the UK?

Professor John Womersley: Our vice-chancellor friends gave an estimate of the Horizon 2020 funding. Mine was a little lower, about £800 million per year of EU support, predominantly into the university system, I think, so that is where one would need to look. It is a significant amount of money. We will have to see what mode of collaboration we would have with future EU framework projects, and whether that money is flowing into the

framework project in order to flow back to the UK, as the Swiss do, or whether it is UK matching funding to enable us to be part of projects for which we cannot receive funding from Brussels. If you do not replace that money, there will be shrinkage in the volume of research done in UK universities. I do not think that was anybody's intention and, therefore, some plan needs to be put in place to mitigate it.

Phil Smith: The number I have is around £2.2 billion so far from Horizon 2020, of which about £460 million is for industry, £290 million for the RTOs and 1.4 billion for the universities. Those numbers are obviously significant and not easily replaced, but I understand that the balance of how much we invest in this is roughly about the amount we get back, but it is not taking into account the multiplier I spoke of before because much of this is about collaboration. Simply giving UK businesses, RTOs or universities the money is fine, but they need vehicles to collaborate because, as we all know, if you are looking at things such as large-scale demonstrators—things which genuinely prove a change—science and innovation need to be done in a collaborative way. I am sure naturally both industry and science would want to be collaborative, but we do not want barriers put in place that make that more difficult. The funding is significant and potentially manageable over time, but the other factors are extremely important.

Professor John Womersley: While we are on the subject of money, a point I forgot to make earlier on research infrastructure is that we have already seen an unfortunate significant impact this year because of the fall in the exchange rate of the pound against the Swiss franc and the euro. Where we are part of treaty organisations, such as CERN and the European Space Agency, the UK taxpayer is committed to paying a certain amount in euros or Swiss francs, and we have had to find that amount in euros and Swiss francs, which has cost more pounds to do. Because of the timing of the comprehensive spending review followed by the referendum, it was not possible to buy that currency ahead, which would have retired the risk. Certainly STFC has now bought all the foreign currency we need, which limits the risk. It also means we will not benefit from any improvement in the exchange rate, but so be it. In the fullness of time, this will even itself out because our GDP will be recalculated in the currency the organisations work in and, after three years, we will be back to paying what we had budgeted to pay. In the meantime, the taxpayer, through the Treasury, has to dip into our collective pocket to make up this shortfall. For STFC, that is about £20 million a year and it is a similar amount for the Space Agency.

Q44 Baroness Young of Old Scone: Could I go back to a more general question? Someone mentioned our needing to continue to be a partner of choice. Could we widen that slightly? Clearly, there are challenges in partnerships and collaborations between research organisations, as we have heard today, but there will also be important questions on how business feels about all of this—not only the ability of UK science to continue to be a partner of choice but whether they are having a tough time dealing with the transition, the future access to skills and the conditions for them conducting their businesses. What are your thoughts on that? Are we likely to see a flight of businesses from the UK that would compound the collaboration difficulties we might otherwise experience?

Phil Smith: My view is that it is unlikely in the short term. I do not think businesses would panic necessarily in that way. I genuinely feel, however, that there are subtleties in the investments made. In the previous discussion on talent, it was said that it is largely anecdotal

at the moment, but there is no doubt, in the experiences I have had, that there are people already making decisions not to come to the UK because they are not sure about their families or whatever. If it is one researcher or student, that may not be significant, but, if it is an executive in a company who says, "I'm going to base myself in Switzerland or wherever for a period", the natural tendency in the company is, "I'll recruit a few people around me" and maybe the next headquarters will happen to be there. There are corrosive things potentially happening under the covers, hence the Government need to provide clarity sooner rather than later. Some of the things they have done around research to say, "We'll fund things which are already funded by Horizon 2020" are good. The talent position needs to be clarified. There is no doubt that it was the most vocal issue for industry in every forum I have been involved in. We understand the Government are trying to negotiate the best, but it is totally unacceptable to have people being used as pawns at the moment; it does not work. I ran a conference call for the 4,000 or 5,000 people based in the UK at 24 hours' notice on Brexit issues. Nearly 2,000 people joined it and the biggest issue that came out was people saying, "What's going to happen? Are the company going to support me?", so there is definitely uncertainty there. Although businesses will not make rash decisions because there are lots of things tied up in assets and so on, we have to be very conscious of those subtleties, which means clarity, simplicity and a strong vocal position, as the Prime Minister is taking, saying this is going to be a strong place to trade in. They may seem high-level, but they are very important. If I am talking to an executive in California who does not know what is going on here on a day-to-day basis, he hears things in a different way from how we are necessarily saying them, so simplicity is important. Businesses over time will make the right decisions for their businesses, and we need to make sure that this short-term uncertainty does not force people to start thinking about other things. At the moment we need clarity and simplicity.

The Chairman: What would you suggest to the Minister needs to be done in the short term to address this problem of uncertainty?

Phil Smith: In the short term, if I look at some of the key emerging areas, and I am sure different industries have different perspectives, the position around talent has to be clear: we are going to support people based here who are EU nationals with some vehicle for giving them certainty for themselves and their families. I do not think that is certain at the moment. It is implied it will be fine, but that is not very good when either you are here already or you are planning to come here, so something needs to be done sooner rather than later. There are maybe other key pieces of legislation or standards. For example, we are going to have to implement the General Data Protection Regulation in the UK, which is about privacy and so on, because it is within the scope of us still being in the EU, but what happens after that? Does that mean industry will have to pay a load more for other regulation put on top? Each industry has been consulting with the Government, so take the top three key issues—not everything as we know they cannot solve everything—and start to address them simply and systematically. That is going to give a lot of comfort potentially within the scope of the industrial strategy, but it needs to be done quickly.

The Chairman: That concludes our evidence session with you. We are most grateful for your help. You have given us a number of pointers. When we return in October to complete this revisit to UK science and Brexit, we will draw on some of the pointers you have given us to draw up a list of issues we think need to be addressed, not so much in the short term but in the medium and longer term. We are particularly grateful for the help you have given us.

Science and Technology Facilities Council (STFC), Cisco and Met Office – Oral evidence (QQ 35-44)

Professor John Womersley, Phil Smith and Professor Dame Julia Slingo, many thanks for your help. There will be a record, as you know, in the normal way, so please make any alterations if we have the record wrong.

Scientists for EU Campaign – Written evidence (EUF0011)

Lead authors are Dr Mike Galsworthy (Programme Director) and Dr Rob Davidson (CTO)

Executive Summary

In this brief document, Scientists for EU presents the results of our "Brexit impact monitoring" database of responses from scientists immediately after the referendum vote. This is then augmented by other lines of information concerning the immediate fallout. There are also new risks previously not brought to light during the referendum campaign or newly emerging.

We then seek to set a set of immediate actions that need to be undertaken in order to mitigate the damage and put UK science on the front foot.

In summary of the damage, the immediate impact concerns two key aspects: Firstly a seemingly sharp reduction in the UK's attractiveness to talent, causing retention and attraction problems from Day 1 after the vote. Secondly, uncertainty around the UK's long-term position within the EU science programme and legal structures (regulations, rights of EU researchers in the UK, Intellectual Property) which are seen to make the UK a risky partner on collaborative projects, particularly in a coordinator role.

We anticipate that these two streams of damage will continue up until the actual point of Brexit when the terms are known – or any earlier point whereby clear terms or new guarantees can counteract the risk.

Mid-term risks concern 1) changes to the multiple interrelated funding/investment streams to public and private research & innovation (R&I) in the UK, 2) the flow of talent into and out of the UK R&I ecosystem and the rights of individuals, 3) the complex regulatory environment for cross-border R&I – including research standards, new medical devices and drugs, intellectual property, data transfer, customs, access to EU security-related contracts, etc.

We conclude that, in all of the above, the mid-term aim should be to ensure the maximum continuity possible. This needs to be complemented by a funding increase to UK science to counteract the fallout and put the UK in a stronger, more flexible, negotiating position. The UK science community is strongly pro-European, so the science strategy going forward must seek to support the EU and European research landscape in order to allay fears and home and on the continent. The many European Research Infrastructures that do not require EU membership present a good target for strengthening UK footing. Once this is secured, the UK is then in a better position to contemplate reforms to research regulation and move to develop stronger non-EU bi/multi-lateral research relationships.

About Scientists for EU

- Scientists for EU launched as a social media campaign on May 8th 2015. It soon acquired a voluntary research team[78] and an Advisory Board[79] featuring leading UK scientists and political cross-party representation. During the UK's referendum campaign, SfEU was registered as a group campaigning for a "Remain" vote.

- Scientists for EU also spun out a secondary campaign during the referendum period, called "Healthier In the EU"[80] which focused on issues of health research, NHS, medial innovation and public health. It also had an Advisory Board[81] and strong social media presence.[82]

- Throughout the campaign, we sought to communicate to the public that the overwhelming majority of the UK's research, innovation and health professional communities believed that this sector was stronger with the UK as a full member of the EU. The primary reason for this was the demonstrable added value that team-play at the EU level brought.

- Since the referendum we have set up a monitoring database to gather and communicate broadly information about the immediate impact of the vote on the science community.

- Our current aim is to promote the public understanding of the value of science to the UK economy and the benefits of working as closely as possible with the EU on matters of research, innovation, technology and quality of health and environment.

Scientists for EU monitoring of Brexit vote impact

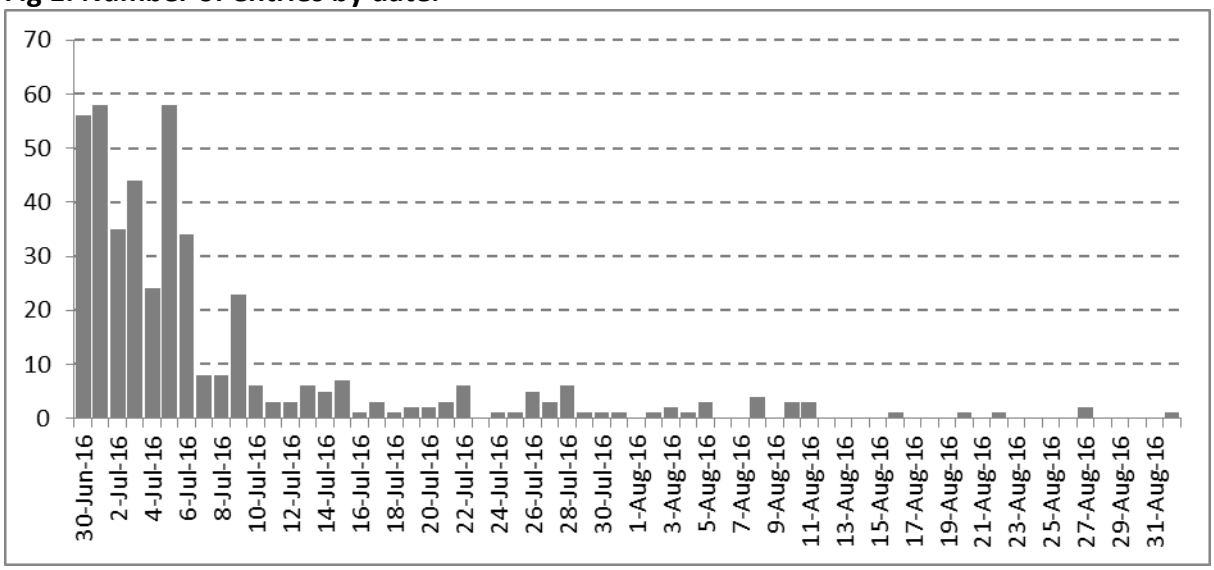
On June 30th 2016, Scientists for EU established a form entitled "Monitoring Brexit vote impact on UK science" on our website. See: http://scientistsforeu.uk/monitoring-brexit-impact/

This form encourages researchers to input their names, institutions and information about concerns or real impacts felt following the vote to leave the EU. The entries could be confidential or the respondent could indicate that they were willing to talk to media. Submitting the form sent it to a database where we can both collect the stories and code them according to areas of concern or impact.

[78] http://scientistsforeu.uk/about/who-we-are
[79] http://scientistsforeu.uk/about/advisory-board
[80] http://healthierin.eu/
[81] http://healthierin.eu/about/advisory-board/
[82] https://www.facebook.com/healthierin

We circulated and promoted the form widely on our social media and via willing institutions. After about two weeks, we had around 400 entries, so stopped promoting the form vigorously and began turning attention to the coding and analysis. We communicated our results and individual case stories widely in the media to raise public awareness about the issues faced by the community.

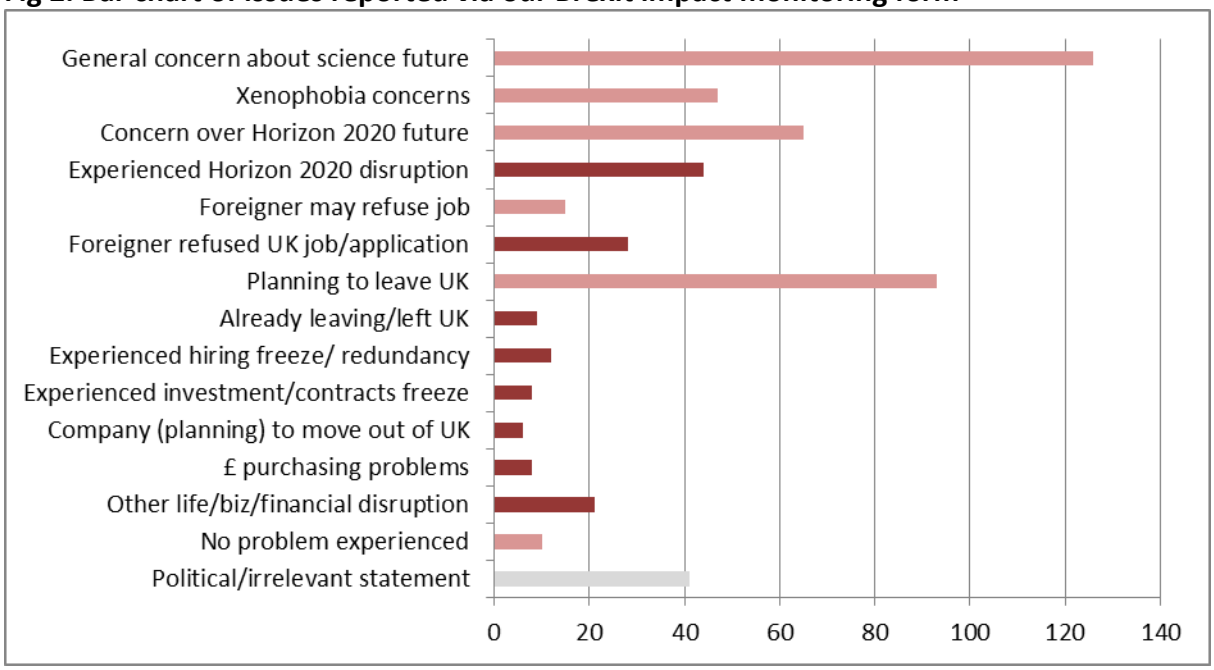
Fig 1. Number of entries by date.



Although the survey is self-selecting and qualitative in nature, not quantitative; nevertheless, it is a robust starting point to assess the nature and relative proportions of the most immediate impacts from the vote to leave the EU.

To date, we have 438 entries. Here follow the results of coding those entries. Note that there were up to two codes per entry as some respondents mentioned more than one issue that was affecting them or about which they had concerns (so total “issues” = 533):

Fig 2. Bar chart of issues reported via our Brexit impact monitoring form



**Note: We distinguish between cases of impact realised (dark red) and concerns/opinions expressed (light red).*

Here follows a list of those numbers with some more explanation.

Cases of impact:

28 A foreign national refused a UK job/ pulled an application or an advertised job received a surprisingly low number of EU applicants.

9 Someone in UK science actually leaving/left already (where Brexit was a factor in that decision. Note that these people usually had an offer on the table at the time of the vote)

40 Horizon 2020 disruption (usually UK partner stepped off project application or down from coordinator role, often at request of EU partners. Some of these cases resolved amicably)

55 Life/business/financial disruptions—including £ purchasing problems, businesses moving, investors holding back money, hiring freezes, redundancies, planned work frozen due to work becoming questionable in light of Brexit (eg EU regulation-based), personal financial disruptions (e.g. cancel house purchase)

Statements of concern/intention:

47 Citing xenophobia as an issue/concern (including several personal experiences of abuse)

93 Planning to leave (either respondent or people they know)

15 Foreigner may refuse job (concern - not happened yet/ in discussion)

65 Concern over UK future relationship with Horizon 2020

126 Other concerns about UK science's future or their own career future (eg. status of EU migrants, UK funding levels/plans, regulatory frameworks, other EU funding streams, reports on lowered mood of lab, concerns over anti-expert rhetoric...)

Miscellaneous

10 Statements saying there is no problem/ their European partners are supportive

41 Political/irrelevant statement (so ignore. Total N of relevant responses then is 438-41=397)

Discussion of key challenges

Reassurances

We note that the sample above was from very early days – and since then Science Minister Jo Johnson, Commissioner Carlos Moedas and Philip Hammond have all sought to provide assurances about the continuity of Horizon 2020 involvement in particular.

These will go some way to reassuring EU researchers about projects with UK partners in the short term. However, the UK's less certain long-term future with EU science means that those establishing very long-term EU-based projects may well consider partners other than UK-based individuals and teams to be the more natural choice for leadership.

We stress that this is not just due to concerns of a possible impasse over freedom of movement and full access to the EU science programme, but also due to issues of shared regulations, intellectual property, commercialisation of research, and EU citizen rights to work and settle. All of these are issues when considering partners & coordinators on a long-term endeavour.

Specifically, we noted in our press release[83] with regard to the Chancellor's statement of Aug 12th 2016, that the guarantee to underwrite UK involvement on EU research projects was a bare minimum. It is merely a statement that contracts signed will be financially honoured. To do otherwise would be irresponsible in the extreme. What was not promised, worryingly, was that any shortfall in the future left by lowered access to EU funding would be replaced at the national level.

Guarantees for EU citizens in the UK R&I workforce remain outstanding; we note this covers a complex set of issues from their long-term residency, pension and insurance rights to those of their families and partners.

Coordinator roles

When we gave oral evidence before the Lords' inquiry into EU Membership and UK Science, we specifically noted the threat of Brexit to UK coordinator roles.[84] This was evidenced this with the situation in Switzerland, where the disruption to Swiss access to Horizon 2020 brought a 40% drop in their participation rates relative to Swiss performance on FP7, but an even more dramatic drop in coordinator roles for Swiss teams from 3.9% under FP7 to 0.3% in Horizon 2020. We suggest that the same dynamics will likely operate with the UK

[83] Scientists for EU Press Release on the Chancellor's statement: http://scientistsforeu.uk/2016/08/press-release-philip-hammond-guarantees-eu-funding/

[84] http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/relationship-between-eu-membership-and-the-effectiveness-of-uk-science/oral/30032.pdf (page 10)

coordinator roles – with the longer-term uncertainty impacting heavily on the choice of leadership roles on multinational projects with long-term visions.

Talent, brain drain and poaching

The UK benefits hugely from attracting talent into the country. Early indicators show that this inward flow, our "brain gain" has been strongly diminished overnight by the vote for Brexit.

Aberystwyth University reported that over 100 European students cancelled places following the referendum result, with 50 of those the day after the vote.[85]

Our database contains 28 entries concerning UK jobs/positions being turned down by foreigners with 15 more entries discussing this as a current risk (ie. foreigners in two minds over taking a UK position). A survey of students (comprising 85% non-EU students) found that a third of them said they are less likely to come to study in the UK because of Brexit.[86] The risk specifically hits high-value individuals. More than half of UK PhD students are from overseas.[87] EU students are 50% more likely to earn a first-class degree and twice as likely to go on to postgraduate study.[88] EU researchers also win a high proportion of ERC grants in the UK. We would like to note a particular threat to the EU schemes by which the UK has to date been deriving substantial "brain gain": Marie Curie, Erasmus+ and ERC grants. Even though these continue now and we may be able to secure them on Brexit, the issue is not just about the gate being held open, but whether the researchers want to come in.

Our database has over 100 entries recording the intention of the respondent to leave the UK or someone they know declaring the same, directly or predominantly due to the Brexit vote. Several of these have already taken up positions abroad or accepted places. The three main driving factors behind these intentions, according to the entries appears to be: 1- cultural, with much focus on xenophobia, racism and the anti-expert rhetoric that featured during the referendum campaign; 2- funding landscape, with concerns voiced predominantly about the UK's future relationship with EU funds, but also the UK's own poor national investment into science; 3- EU citizen rights to stay in the UK.

We note that our own database cites several examples of racial/xenophobic abuse to UK-based scientists since the referendum. We also note a recent poll of 118 GPs around the UK where 63% said they had experienced racial abuse and 47% said they had noticed more racism after the Brexit vote.[89]

Juergen Maier, CEO of Siemens UK, reported similarly in his blog[90] that "I was horrified to speak to Scientists at ESOF [EuroScience Open Forum, which took place in Manchester 23-

[85] http://www.bbc.co.uk/news/uk-wales-36799951
[86] http://www.independent.co.uk/student/news/brexit-international-students-in-the-uk-after-eu-referendum-hobsons-survey-a7161661.html
[87] http://www.sciencemag.org/news/2016/07/uncertainty-reigns-aftermath-britains-brexit-vote
[88] http://home.bt.com/news/uk-news/brexit-britain-will-lose-best-and-brightest-graduates-11364063465437
[89] https://inews.co.uk/essentials/news/health/gps-brexit-eu-rise-racism/
[90] http://juergenmaier.co.uk/

27th July 2016] who have been targets of this type of verbal xenophobic abuse, that the Brexit campaign sadly amplified, and we all now have a responsibility to eradicate it."

Poaching is also an issue, albeit not major as yet. Cornelia Yzer, the Berlin Senator for Economics, Technology and Research has written to several hundred UK businesses[91] saying that Brexit will be damaging for UK businesses and she will help provide resources for them to relocate to Berlin. She visited London Fintech week in July 2016 to speak and openly advertise Berlin. At that point she claimed that more than 100 British start-ups have contacted her office asking about relocation.[92]

In Canada, a think-tank has advised universities to "make a coordinated effort" to advertise themselves to UK academics "as they seek alternatives to the instability facing them at home after the Brexit decision".[93] In Ireland, on August 4th 2016, the front page of the Irish Independent headlined "Our Brexit bid to poach UK's brightest talent".[94]

Funding streams into UK R&I ecosystem

There is probably not, at this stage, enough appreciation of the myriad EU-based mechanisms that bring funds into innovative players in both the public and private sector at the moment. These must be mapped urgently. Horizon 2020 and the "EU Structural Funds" (Regional Development Fund and the European Social Fund– jointly €10.8billion allocated to the UK from 2014-2020) are not the only investments.

For example, the European Fund for Strategic Investment (EFSI), also known as the "Juncker Plan" is a recent initiative (launched jointly by the European Investment Bank, European Investment Fund and European Commission) aimed at using public funds strategically to dramatically leverage private investment into innovation. "The EFSI aims to overcome current market failures by addressing market gaps and mobilising private investment. It will support strategic investments in key areas such as infrastructure, education, research and innovation, as well as risk finance for small businesses."[95]

The UK is the leading beneficiary of EFSI so far,[96] which seems to have been remarkably successful in releasing substantially more capital than the public investments made. According to the Commission, ESFI has to date funded 8 large infrastructure projects in the UK amounting to EUR 2.4 billion in financing. This is expected to trigger EUR 9.5 billion in investments and create more than 26,700 UK jobs. EFSI has also approved 12 agreements with intermediary banks (eg Barclays UK and Santander) or funds amounting to EUR 549 million. It is expected to trigger EUR 4.9 billion in investments and benefit 2,963 SMEs.[97]

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[91] http://uk.businessinsider.com/brexit-germany-politician-cornelia-yzer-writing-london-startups-relocate-berlin-tech-soampli-2016-8

[92] http://www.ibtimes.co.uk/over-hundred-london-startups-have-asked-relocate-berlin-since-brexit-1571243

[93] https://www.timeshighereducation.com/news/canadian-universities-told-to-offer-incentives-to-woo-uk-scholars

[94] Picture available via Scientists for EU Facebook page, with link to online article: https://www.facebook.com/scientistsforeu/photos/a.644219952346684.1073741828.642444842524195/826941070741237/?type=3&theater

[95] http://ec.europa.eu/priorities/jobs-growth-and-investment/investment-plan_en

[96] http://ec.europa.eu/priorities/sites/beta-political/files/uk-ip-state-of-play-july-2016_en.pdf

[97] http://ec.europa.eu/priorities/sites/beta-political/files/uk-ip-state-of-play-july-2016_en.pdf

The more long-standing support of the European Investment Fund (EIF) itself on UK start-ups has received scant attention to date. The Financial Times reported on August 9th 2016 that "Between 2011 and 2015 the EIF invested €2.3bn in 144 UK-based venture capital funds and similar entities — accounting for over a third of all such investment — according to industry data."[98]

The EIF's current rules state that its lending is limited to EU nations, members of the European Free Trade Association and potential candidates to join the EU. This makes its relationship with the UK post-Brexit uncertain. The EIF's closest equivalent in the UK is the British Business Bank created in 2014. It is questionable to what capacity the BBB could fill the shoes of the longstanding EIF with only two years' notice.

Regulations and intellectual property

There is much concern around planning future research and business where there could be rifts in regulations between the UK and EU. Lack of clarity from the UK government about what will change and what will not threatens to slow activity through uncertainty.

These fears were expressed by the Japanese Government on Sept 4th in a document which clearly stated that rifts in regulation between the UK and EU could encourage Japanese companies to relocate from the UK to the EU.[99]

Intellectual property and new patents represent a complicated landscape moving forward. The Government states simply on its website: "The referendum result has no impact on UK businesses' ability to apply to the European Patent Office for patent protection. It will remain possible to obtain patents from the EPO which apply in the UK. Existing European patents covering the UK are also unaffected. British exit from the EU will not affect the current European patent system as governed by the European Patent Convention (EPC). The UK remains a Contracting Member State of the Unified Patent Court at present. We will continue to attend and participate in UPC meetings in that capacity. There will be no immediate changes."[100]

The difficulty comes, however, because the Unitary Patent (UP) and the Unified Patent Court (UPC) – both in development – currently pertain to EU members only. Therefore, on leaving the EU, a UP will not extend to the UK and the UPC's jurisdiction will not extend to the UK.[101]

The system can only come into effect when ratified by 13 countries which must include the three EU Member states in which the most European patents have effect in the year preceding year in which the agreement was signed. These three countries are currently the UK, Germany and France. If the UK were to leave, the three EU member states required to ratify would become Germany, France and Italy. As over 10 countries have ratified with Italy

[98] https://www.ft.com/content/5a85be66-5d42-11e6-bb77-a121aa8abd95
[99] http://www.mofa.go.jp/files/000185466.pdf
[100] https://www.gov.uk/government/news/ip-and-brexit-the-facts
[101] http://www.hgf.com/updates/blog/2016/05/would-brexit-mean-the-end-of-the-unitary-patent-and-the-unified-patent-court/

close to that point, Brexit is no longer a threat to the UP & UPC's completion – although the loss of the UK would sharply diminish the value of the system.[102]

A problematic twist is that Article 7(2) of the UPC agreement specifies the three locations for the Central Division as Paris, Munich and London. This specificity means that London would keep the UPC seat even if the UK were outside the EU and the jurisdiction of the UPC. The remaining countries could either keep London for this seat of the Central Division or, at some point, amend the UPC agreement to specify another location.

Others believe that there are opportunities for the UK to continue in the Unified Patent Court and Unitary Patent. "If the UK ratifies the UPC Agreement, they can continue to be a participant even if they leave the EU. This only requires a small change of the Agreement by the Administrative Committee to open up accession for former EU Member States, being the UK."[103]

Negotiation dynamics for access to the EU's science programme

The science relationship that the UK enjoys as a full member of the EU is widely regarded as being optimal for the UK. However, any notions that it is in the interests of the remaining EU member states to give the UK full access, on terms similar to Israel or Tunisia, plus a policy voice, should be dispelled. Quite simply, we must turn the chessboard around and view the asymmetric situation from the perspective of remaining members.

With the UK no longer as an EU member, it will no longer have the automatic right to pay in 12% to the science programme and take over 20% of the ERC grants and 25% of the Marie Curie grants. That means more talent attraction opportunities ("brain gain") for the remaining members. British talk of the importance of our own "excellence" may not be well received by members who wish to harness EU mechanisms to drive up their own levels of excellence. Any sense of British entitlement may serve to aggravate.

Similarly, as a member of the EU, the UK pays a net contribution – part of which goes to less developed member states to help build up their research and innovation capacity. Those states would not be keen to grant full Associated Country status to a large entity that wished to spend nothing on helping develop them and rather wished to out-compete them and brain-drain them to lower levels yet. The other western European countries paying net contribution now would not be keen on increasing their quota to help eastern European countries so that the UK can pursue purely its own interests from the outside.

The negotiating politicians of the EU must prioritize the competitive development of their own institutions and scientists. If the UK attempts to negotiate from a selfish, predatory or adversarial standpoint, that would only encourage the bloc to cherry-pick the most competitive elements (ERC, Marie Curie, multinational project co-ordinations, SME

[102] http://www.hgf.com/updates/blog/2016/05/would-brexit-mean-the-end-of-the-unitary-patent-and-the-unified-patent-court/

[103] http://kluwerpatentblog.com/2016/06/26/brexit-new-scenario-discussed-to-save-the-unitary-patent-system/

Instrument) fully or partially away from the UK so as to maximise partnership with the UK whilst maximising strategic advantage to themselves.

Hitting an impasse over freedom of movement is both a valid concern for the remaining EU members (who do not want to see the EU's foundations undermined) and a useful excuse to offer the UK whatever level of access is economically and politically advantageous for the bloc.

Conclusions

In conclusion from reading through all the entries, we suggest that the UK has overnight become less attractive as a place to do science.

The two key reasons for this shift being firstly cultural and secondly funding-related. The surge in xenophobia nationally has made many foreigners in the UK science base feel less welcome. Also, many scientists are upset with the nation's vote per se and feel unsettled by the country's direction. The uncertainty of the funding landscape ahead is also a strong factor in the UK's decreased attractiveness to researchers here and prospective migrants. These concerns comprise potential economic recession, low national funding for science, re-shuffle of UK science structure and policy, plus the unknown future relationship with the EU science programme and with it the ability to draw talent, a full range of research options and leadership opportunities.

Our data indicates that the UK is not in as strong position a position as often imagined. Issues such as low wages, job insecurity, high visa fees (for family members), austerity and a history of low R&D funding re-emerge easily when the advantage of EU membership is removed. The scientists we wish to attract are also highly mobile, globally. If this is indeed the case, it will not only decrease our regular job applications and student applications, but also the substantial talent we bring in via Erasmus+, ERC grants and Marie-Curie grants.

Our qualitative snapshot must be followed by systematic quantitative research on the submission and acceptance rates of grants, money flows to businesses and hiring flows into universities and businesses.

With regard to the roles in Horizon 2020 consortia, we note that this survey includes very early entries, so before reassurances from the Science Minister, European Commissioner for Science and HM Treasury were given. Nevertheless, the UK's less certain long-term future with the EU science programme means that those establishing very long-term EU-based projects may well consider partners other than UK-based individuals and teams to be the more natural choice for leadership.

The most effective way to approach negotiations is first to plan what a UK outside the EU can do to strengthen both EU and Europe-wide science. British and European scientists alike hugely value what the EU has done to boost European science through considerable support to CERN, ESA, the development of the European Research Area (ERA), pan-European Research Infrastructures (RIs) and the Single Market. The UK position should be based on

what it can bring to the table that will positively develop the pan-European research and innovation ecosystem (and its global impact) rather than what the UK can do to compete with the EU or serve itself from it.

The UK could volunteer, for example, to take upon itself a special role to assess and lead development of current and new Research Infrastructures (RI) and to extend those more globally. That way the UK could follow opportunities to reach more globally, but with the inclusion of EU partners, rather than to the exclusion of EU partners.

This added value then becomes a valuable negotiating tool, both materially and in the spirit of the deliberations, helping to remove the threat that a Brexit Britain is hostile to the EU's development.

It would be appropriate that at some point the UK, Switzerland and Norway (and even other Associated Countries) have more of a policy voice on shared science investments and direction. However, this may have to be treated more sensitively and willingness to be patient must be shown. The EU's sovereignty over its own science programme and confidence with it at this stage is of strategic advantage to all. Calls for an "Associated Country Plus" model (where the "Plus" represents policy voice) may be too much at an early stage. This would represent special treatment for the UK over all the other Associated Countries. Alternatively addressing complexities of diluting power over 17 or more non-EU members may just be disruptive and unproductive at this unsettled stage.

5 September 2016

techUK – Written evidence (EUF0009)

About techUK

techUK welcomes the opportunity to provide written evidence to the House of Lords Science & Technology Select Committee on the topic of EU membership and UK science. techUK is the trade association for the UK technology sector, representing over 900 businesses. Our members range from leading FTSE 100 companies to new innovative start-ups. Collectively they employ more than 800,000 people, about half of all tech sector jobs in the UK. The majority of our members are small and medium sized businesses.

techUK's members are both beneficiaries of, and investors in, UK science. techUK would therefore like to share its views on the importance of UK science to the sector along with some background information, developed since the referendum result, that may be helpful to the Committee.

EU membership and UK science: importance for UK tech

1.1 Science and innovation provides the bedrock of the digital revolution and the digital economy. The UK's world-leading universities are essential anchor institutions for the digital economy in terms of the fundamental research that they undertake; the commercialisation of that research into new products and businesses; and their ability to attract world leading talent and inward investment to the UK. Their contribution, particularly in relation to the commercialisation of research, still needs to be strengthened.

1.2 The science and innovation budget is an engine for growth, and the Science and Technology Select Committee has previously raised concerns on the implications of cutting the budget for the wider economy[104]. The UK currently performs strongly on fundamental science[105] and this position must be maintained as global excellence in science is the cornerstone of a successful strategy for digital leadership. However, the UK performs less well compared with other countries on certain measurements of innovation and strengthening the innovation base must be a key objective for the UK, as we prepare to leave the EU.

1.3 UK science benefits greatly from EU funding programmes, such as Horizon 2020. These funding sources are now uncertain and, despite the Government's commitment to match funding to 2020, it is unclear whether the UK will be able to retain levels of funding

[104] Science and Technology Select Committee (November 2015) UK must increase science funding to keep up with competitors. Retrieved from http://www.parliament.uk/business/committees/committees-a-z/commons-select/science-and-technology-committee/news-parliament-2015/the-science-budget-report-published-15-16/

[105] Department for Business, Innovation and Skills (January 2014). Insights from international benchmarking of the UK science and innovation system. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/277090/bis-14-544-insights-from-international-benchmarking-of-the-UK-science-and-innovation-system-bis-analysis-paper-03.pdf

received through EU sources. It follows that the UK tech sector may suffer as a result of any drop in funding.

1.4 This should be of concern to the UK Government as the UK digital sector is one of the most important drivers of the economy. It accounted for £31.8bn of exports in 2014, 14.5% of UK total (and 57% of it to the EU); 7.1% of UK GVA in 2015 and it also saw significant growth in number of new enterprises created, increasing by 5.7 per cent between 2013 and 2014.[106]

1.1 If funding sources are diminished by Brexit, the Government should prioritise those areas which have the greatest impact on the UK economy. Research in technological innovation has been a significant growth engine for advanced economies and techUK believes this must be a priority area for Government science investment.

Technology sector sentiment pre-and post-referendum

2.1 techUK conducted a poll in March 2016, which found 75% of members in favour of Remaining in the European Union (EU) and 15% in favour of leaving. 93% of members were positive about the UK tech sector's potential for growth over the next two years.

2.1 Following the referendum, techUK conducted a new member poll and the change in results are stark:

- Seven in ten (70%) of respondents are overall positive about the UK tech sector's potential for growth over the next two years, a fall of 23 percentage points since March. One in five (20%) is very positive, down from 52% in March 2016.
- Nearly half of respondents said that the outcome of the EU referendum would have a negative impact on foreign direct investment (49%), capital investment (48%), and R&D spend in the UK (48%) over the next two years.
- Over three quarters (77%) of tech companies surveyed with a European HQ have those headquarters based in the UK.
- Just one in five companies (22%) are positive about the impact of the vote to leave the European Union on non-EU exporting over the next two years.

Priorities for Government

3.1 Immediately following the referendum result, techUK consulted extensively with its members, resulting in the following Five Point Plan for Government:

1 Access to the Single Market must be the primary objective of any UK negotiation

Access to the single market allows tech firms to compete for business on equal terms across Europe, generating jobs and growth and is a key factor in the UK's

[106] DCMS Sectors Economic Estimates Employment Update August 2016. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/546262/DCMS_Sectors_Economic_Estimates_-_Employment.pdf

ability to attract foreign investment. Maintaining access to the single market must be the number one objective of any new relationship with Europe.

2 **Retaining and attracting talent is vital to the success and growth of UK tech**
The UK tech sector has thrived on its ability to attract the best skills and entrepreneurial talent from across Europe. These people have been integral to UK tech's success. If the UK can no longer benefit from free movement then a new 'smart immigration' policy needs to be put in place that prioritises the needs to the UK's fast growing and high value tech sector. This isn't just about getting the bureaucracy right. These people must also feel that they are welcome and valued in the UK.

3 **Work should start now on securing international data flows and data protection**
Tech businesses are data driven and depend upon the ability to move data across national borders. Any changes in the UK's relationship with Europe must not impede the ability of data to flow freely to and from the EU. New European data protection laws are likely to enter into force before the UK leaves the EU. Urgent consideration should be given to the relative merits of maintaining, adapting or completely re-legislating the UK's data protection laws. Work needs to start now in full partnership with industry to develop solutions that position the UK as a global data leader. This issue will also be of vital importance to UK science.

4 **Government must take every opportunity to do business as usual and listen hard to tech on issues**
To address immediate concerns about the impact of the referendum, Government must demonstrate that uncertainty does not have to mean paralysis. There are many policy and funding decisions that should not be delayed by the EU Referendum outcome. For example, reforms to planning rules and wayleaves that would dramatically reduce costs and delays in rural communications infrastructure deployments should now be fast tracked. Meanwhile Government must listen again and be willing to compromise on big initiatives such as the Apprenticeship Levy. Strong and legitimate business concerns must be addressed if the Levy is to succeed. Now is not the time to make the business environment any more difficult for tech businesses.

5 **Work with business now on a new Digital Strategy for this new world**
A new Digital Strategy was expected to be published shortly and now needs to be re-written. Government should do this in collaboration with tech businesses. The Government should publish the existing strategy now as a draft and seek inputs from business about how it can be made fit for purpose for the challenges and opportunities ahead. The UK has one chance to get this right. The approach must be strategic and comprehensive, looking at the whole of the UK's tech ecosystem. It will fail if it is a collection of headline grabbing gimmicks.

3.2 techUK is currently finalising a series of papers on Government priorities for access to international talent, international data flows and access to the single market. They will

be published over the autumn and we would be very happy to share these with the Committee.

5 September 2106

University of Warwick – Written evidence (EUF0018)

The evidence is submitted by Professor Simon Swain (Pro-Vice-Chancellor for External Engagement) on behalf of the University of Warwick.

1. Summary

1.1 The University of Warwick is a globally-facing, internationalist higher education institution which has a wide range of relationships with partners in the European Union (EU) and the rest of the world. Warwick is one of the UK's leading research institutions and over 20% of its researchers are non-UK EU nationals. Warwick receives nearly 20% of its research income from EU funding programmes and it has used Structural Funds to support programmes designed to transfer research knowledge to innovative Small- and Medium-Sized Enterprises (SMEs) in the West Midlands.

1.2 The decision to leave the EU places at risk some of the most important elements that have contributed to Warwick's success, and the success of the UK Higher Education sector more widely. At risk is the scale and quality of the UK research base which exists in a globally competitive sector in which the big research questions transcend national boundaries and in which the very best researchers are highly mobile, and in demand.

1.3 Warwick submits that the research base in the UK is important for a number of reasons. First, it contributes to the economic health of the country by producing the world-class research from which innovative UK industries benefit. The quality of its research is also a magnet for the very best students who generate significant income for the sector and the country. Lastly, the excellence of the research done in the UK contributes to the UK's image abroad and its reputation as an outward-looking country.

1.4 Warwick is concerned that any restriction on the mobility of researchers may result in the exclusion of UK universities and research institutes from EU and international funding regimes and lead to a decline in the quality and capacity of the UK research base and its ability to contribute to the UK's national economic and social wellbeing.

2. The University of Warwick

2.1 The University of Warwick was ranked 7th in the Government's 2014 Research Excellence Framework and is a top 100 university globally. Warwick has also developed a global presence; it has an office in Brussels, a strategic partnership agreement with Monash University in Australia, is currently developing a new university campus in California, and is the only European partner in the New York-based Center for Urban Science and Progress.

2.2 The EU is a significant funder of Warwick's world-leading research. In 2015/16, research funding from Horizon 2020 and other European sources amounted to £18.6m out of total research awards of £103.3m (18%).

2.3 Warwick researchers also benefit from the support given by the EU to collaborative research aimed at addressing the societal challenges which affect all countries. While most of the collaboration is between researchers from within the EU, Horizon 2020 also supports joint working with researchers from developing countries and allows the participation of scientists from developed nations, such as the USA, Australia and China.

2.4 Warwick has also used European Regional Development Funds (ERDF) to support the development of mechanisms to transfer our research to Small- and Medium-Sized businesses in the West Midlands. The International Institute of Product and Service Innovations was set up with £6m of ERDF funding – and matching funding from Warwick – assisting over 200 businesses, creating and sustaining nearly 240 jobs, and creating 5 new businesses. The team established by this funding is now being expanded with a further £1.6m of ERDF funding to assist West Midlands businesses to develop new products and services.

2.5 Warwick employs over 750 staff from other EU countries, over two-thirds of whom are researchers. In common with other UK universities, Warwick's research benefits enormously from being able to recruit the best researchers in the EU and globally.

3. Risks and Opportunities

3.1 The Select Committee has already identified a number of risks to the UK science base of the decision to leave the EU and has taken evidence from a number of organisations representing the Higher Education sector as well as submissions from individual universities and colleges. Warwick supports the evidence submitted by the Russell Group (November 2015) in terms of the importance of the EU to UK Science and agrees with the potential risks to UK science from the decision to leave the EU which have been identified by the Select Committee.

3.2 In this evidence, Warwick will highlight the risks to the UK science base should EU support be lost and will identify the steps that it thinks would be necessary to protect UK science.

3.3 Warwick's main concern is that the manifold benefits of UK participation in the EU's research Framework Programmes will be lost if the UK Government pursues a strategy which prioritises greater control of migration into the UK over access to Horizon 2020 and its successor programmes. We are aware of the Swiss experience of losing access to Horizon 2020 when Switzerland restricted freedom of movement.

3.4 Warwick, along with other UK universities and research organisations, has benefitted from its participation in the EU's funded research programmes principally through the ability to recruit the best researchers from a pool of 500 million people, and the trans-national opportunities such programmes give for collaboration in Europe and across the globe. These are benefits which have not been features of the UK research funding landscape and their loss would be a major risk to the UK science base.

3.5 Warwick has a global, internationalist outlook and Europe is an important part of its strategy. As a university, we have positively sought to build relationships and partnerships in and outside of Europe as we have mentioned in paragraph 2.1. These aspects of our strategy will continue and we see our engagement in the EU's research programmes as an integral part of this approach. For example, EU support allows Warwick to:

a) carry out more research than would otherwise be possible using UK funds alone
b) develop excellent research teams working in world-class facilities to address shared challenges
c) develop the careers of both UK and non-UK EU researchers in an environment in which trans-national collaboration is normal.

4. **The Impact of Leaving the EU and Mitigation Measures**

4.1 Over the course of the UK's membership of the EU, the nature and organisation of research and science has changed. From being organised on a national, if not individual organisation, basis research has become truly global. The main challenges being addressed by researchers are common to most countries whether they be climate change, the impact of ageing populations or sustainable development. At the same time, researchers have become more mobile – at Warwick 23% of our researchers come from other EU countries and others are from countries outside the EU.

4.2 The main risk for the UK science base is that it will not be able to compete in the global research market; for example, the USA, Canada and Australia each have higher proportions of non-native researchers than any individual European country or the EU. It is not just that the UK science base might lose research income from the EU, which is about 15% of the total UK research income, but that it will lose its capacity to recruit the best scientists and students, that it will not be able to maintain its now established relationships, networks and collaborations with researchers in the other EU countries, and as a consequence it will lose its status as the leading nation for research in Europe and its position as second only to the USA globally.

4.3 Any decline in the science base in the UK will have consequences for the UK's capacity to develop a meaningful industrial strategy. Warwick is the base for one of the High Value Manufacturing Catapult centres – it specialises in lightweighting, advanced propulsion systems, intelligent vehicles, and energy storage and management. Warwick is also the site of the National Automotive Innovation Centre, which is due to open in 2017. These government- and industry-funded centres were located at Warwick so that they could benefit from our world-class research and researchers.

4.4 Any loss of position and reputation as a research base may have further consequences in terms of the ability of universities to recruit the best students, who will go to where the best research is done. This will be true at both postgraduate and undergraduate level and may impact on the UK economy as many of these high-quality students go on to live and work in the UK.

4.5 Given the degree to which the UK's science base is interwoven with that of the wider EU, the UK Government will need to be prepared to replace the EU funding lost, to support the development of collaborative research with European and third country partners, and to continue to allow the recruitment of the very best scientists from other EU countries if we are to avoid a steady decline in the quality of research done in the UK and the impacts of this on economic and social productivity.

5. Conclusion

5.1 Science and research, and the higher education system more generally, are not just one of the major industries of the UK has but are held in the greatest esteem throughout the world. We now face the risk of seeing the sector decline if it is cut off from a very significant source of funding and expertise which has brought enormous, demonstrable value to our country from a globally-facing, internationalist higher education sector.

5.2 The EU already allows non-EU states to negotiate bespoke agreements which allow them to access EU research funding programmes and to accept or reject freedom of movement in principle, or for researchers only. Known as Associated States, these non-EU countries contribute to the budget of the EU research programmes and participate on the same basis as full EU Member States. The opportunity, therefore, exists for the UK

Government to negotiate an agreement which will allow the UK science base to continue to prosper to the benefit of the UK economy and the world we all live in.

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