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Introduction

The role of EU funding varies across the UK research and innovation landscape, depending on the recent and current success in attracting EU funding, and the availability of alternative sources from within the UK or internationally. The case studies presented in this Annex describe how some institutions and sectors are likely to be more sensitive to the potential loss of access to EU funding than others, by showing the areas in which funding is secured, the ways in which the funding is utilised, and the additional benefits it brings. For example, a large proportion of external funding for research in the Arts and Humanities and the Social Sciences comes from EU sources. Specifically, approximately 38% of research funding for archaeology in the UK comes from EU sources. Also, there is substantial variation in the degree to which UK regions have benefitted from the European Regional Development Fund (ERDF) and the role of this type of funding in supporting the regional R&D strategy.

The case studies are stand-alone examples that serve to inform on the breadth and depth of EU funding in the UK research and innovation landscape and provide specific illustrative examples of the role of EU funding in different contexts. Together the case studies cover a wide range of topics and, consequently, build on a range of different information sources. Each of the cases includes the following: a brief introduction to the case, an overview of EU funding, an overview of the types of activities funded, and a scoping of the potential risks in the context of Brexit.

The first three case studies describe the potential impact of Brexit on three academic research disciplines: Clinical Medicine (case study one), Archaeology (case study two), and Social Sciences, via the European Social Survey (case study three). This is followed by a presentation of the role of EU funding for the ICT sector, which has shaped both academic research and steered R&D in the private sector (case study four). Two of the cases provide evidence on the potential risk in the context of Brexit in relation to joint initiatives, exploring in particular the Innovative Medicines Initiative (case study five) and the Clean Sky Joint Technology Initiative (case study six). Another case provides an overview of the importance of the European Metrology Programme for Innovation and Research (EMPIR) in relation to UK measurement technologies, and is used as an illustration of the European Commission's model for 'Public-Public Partnerships' (case study seven). The next case study shows the extent to which the EU provides direct support to UK-based SMEs for research and innovation activities (case study eight). Finally, the last three cases present the role of EU funding in the UK Devolved Administrations, covering Wales (case study nine), Northern Ireland (case study 10) and Scotland (case study 11).

1 The role of EU funding in the discipline of Clinical Medicine

1.1 Introduction to the case

Research in Clinical Medicine deals with the study of medicine based on examination of the patient, with the objective to better diagnose, treat, and prevent disease. The discipline includes the study of patients' vital signs, eyes, ears and nose, and cardiovascular, respiratory, neurological, musculoskeletal, and psychiatric wellbeing.

In comparison to other disciplines, Clinical Medicine has attracted the largest volume of funding from EU government bodies and this funding has helped to leverage additional research income. Access to EU funding has generated opportunities for EU-wide collaboration in research areas such as mental health, rare diseases and paediatrics and this has positively influenced the development of new and improved treatments.

1.2 Overview of EU funding

In 2014/15 UK HEIs received close to £120m of funding from EU government bodies¹ in relation to Clinical Medicine research. This is equal to 6% of the total research funding to UK HEIs. As illustrated in Figure 1, the discipline has seen a steady increase in funding from EU government bodies since 2006/07, when £34m was received, representing just over 3% of total research funding. The average annual growth in the proportion of EU government funding allocated was 17% for the years 2006/07-2014/15. Even though the overall proportion of EU government bodies income is relatively small, in absolute terms, Clinical Medicine has received more funding from EU government bodies than any other discipline in the UK,² and it would be a significant challenge to replace this from other sources.

Clinical Medicine also saw a substantial increase in the level of investment from UK government bodies³, which increased from £332m (33% of total research funding) in 2006/07 to £792m in 2014/15 (42% of total research funding). The average annual growth in the proportion of UK government funding is 12% for the years 2006/07-2014/15, which was lower than the growth rate for the proportion of EU government funding (17%).

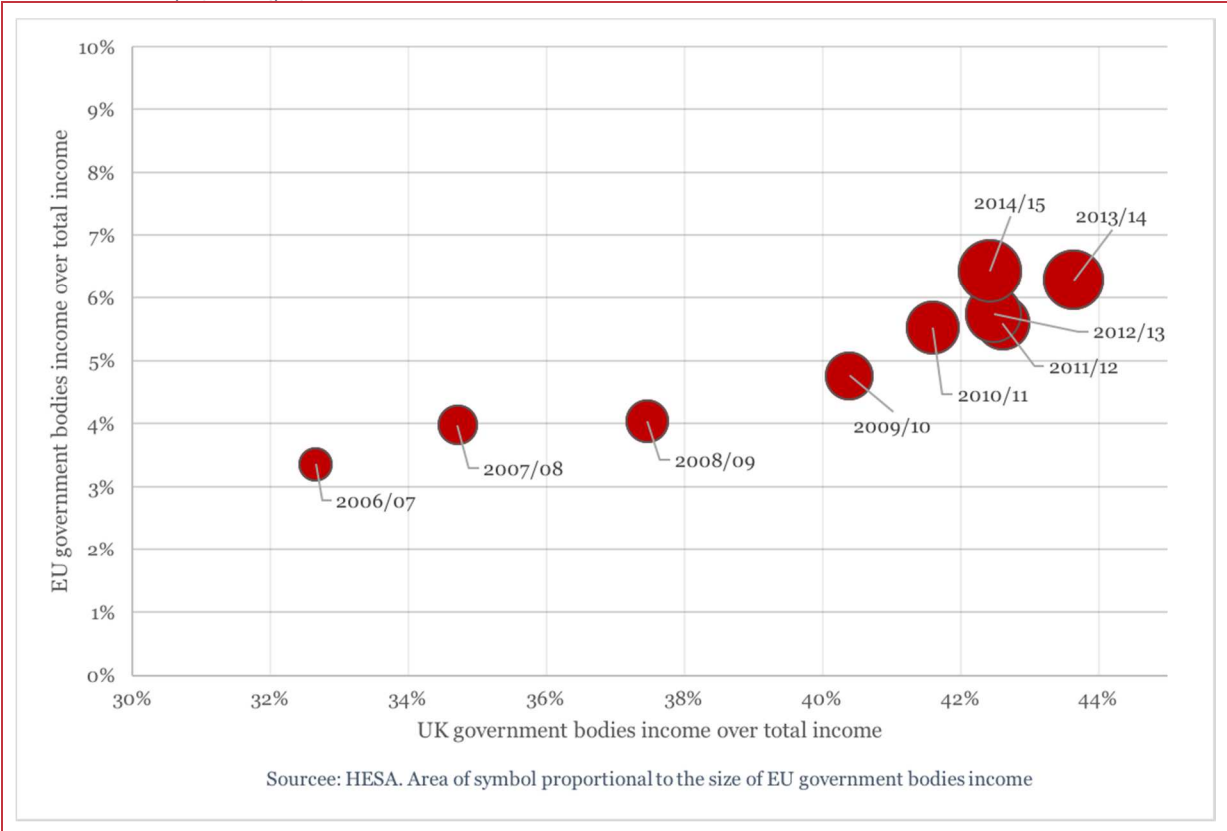
The charitable funding sector in the UK, which is dominated by medical research charities such as the Wellcome Trust and other members of the Association of Medical Research Charities, also contribute a substantial proportion of total research funding to Clinical Medicine research: £608m in 2014/15 (33% of total research funding), and this is unique to this discipline. However, as a proportion of total funding, UK based charity funding and UK industry funding has decreased from 2006/07 to 2014/15 (see Figure 2). Figure 2 represents the proportion of research funding from different sources that was received by UK HEIs in 2006/07 and 2014/15. The trends shown here do not necessarily reflect changes in absolute levels of funding over this time frame, nor the full extent of investment in clinical research which occurs outside of HEIs. For example, the absolute level of funding from UK-based charities actually rose from £440m in 2006/07 to £607m in 2014/15.

¹ As defined by HESA, income from EU government bodies includes all research grants and contracts income from all government bodies operating in the EU, which includes the European Commission, but excludes bodies in the UK

² Disciplines are defined by the HESA academic cost centres and the REF Unit of Assessments (UOAs).

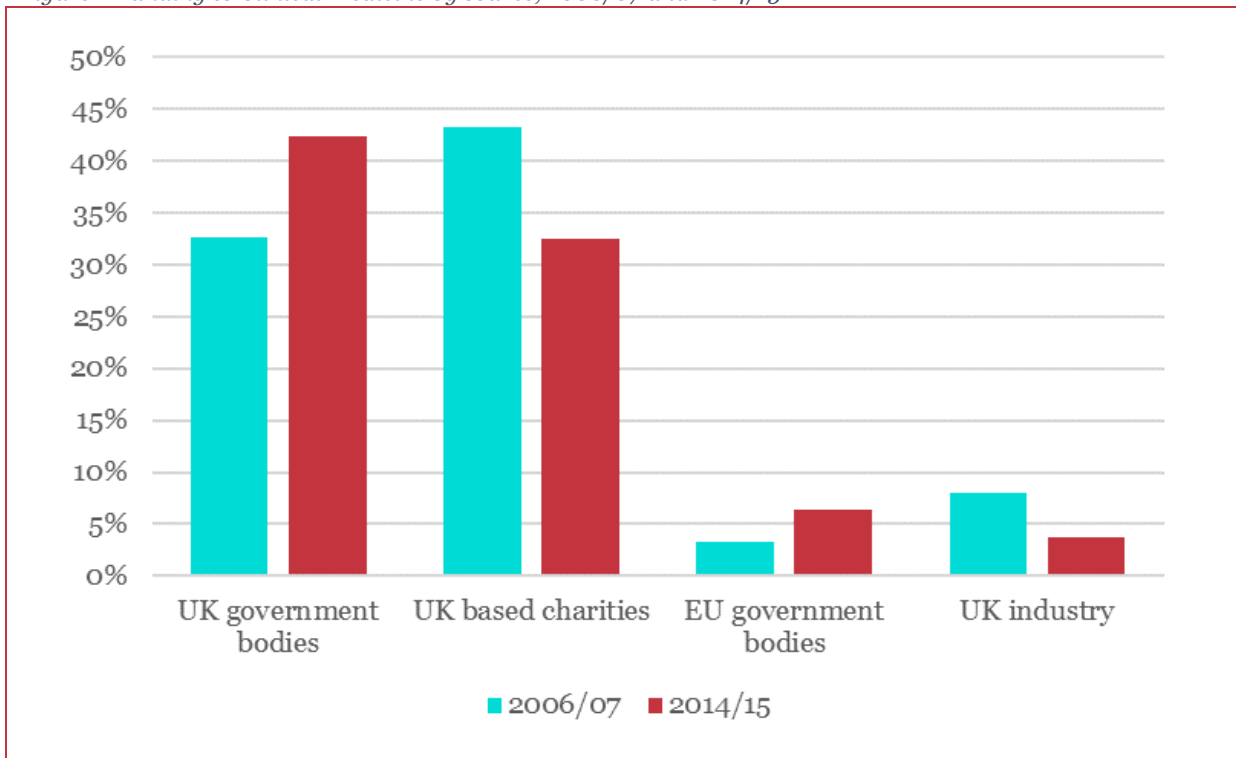
³ Income from UK government bodies includes income from the UK Research Councils, the Royal Society, British Academy and UK central government bodies, local authorities, health and hospital authorities

Figure 1 Distribution of EU government and UK government income as a proportion of total funding to Clinical Medicine, 2006/07-2014/15



Source: HESA data

Figure 2 Funding to Clinical Medicine by source, 2006/07 and 2014/15



Source: HESA data

37 UK HEIs received funding from EU government bodies in relation to research in Clinical Medicine in 2014/15, out of which 22 HEIs received more than £1m of EU government funding.⁴ University College London, The University of Oxford, King's College London, Imperial College London, and the London School of Hygiene and Tropical Medicine received most funding.

1.3 Types of activities funded

The impact case studies submitted under the Research Excellence Framework (REF) exercise in 2014 highlight some useful examples of impactful activities funded by EU research and innovation funding in the discipline of Clinical Medicine. For example, the REF impact case study on the '*Prevention of Cardiovascular Disease by Dietary Salt Reduction*' submitted by the University of Warwick, summarises that research that was part funded by the FP7 project HYPERGENES gave "impetus to national and global health policy developments" and a reduction in salt intake, which contributed to 131,000 Quality-Adjusted Life Years (QALY) gained and savings of at least £40M a year in the UK⁵.

Another, the REF impact case study '*Improving outcomes for children with leukaemia internationally: the results of scientifically designed clinical trials and translational research*', submitted by the University of Manchester sets out impactful research that likewise benefited from FP7 funding via the project IntReALL, which was coordinated by a German University⁶. According to the summary of impact, the research helped improve cure rates of children with Acute Lymphoblastic Leukaemia (ALL) in the UK.

1.4 Potential risks in the context of Brexit

Consultation of key stakeholders for the case study, and a complementary review of literature, identified the following potential risks in relation to the UK's departure from the EU:

- Volume and leverage of funding: EU funding is a crucial part of funding to Clinical Medicine and the loss of funding may hinder the development of new and improved treatments. EU Framework Programme funding – as well as charitable funding – creates a catalytic effect, leveraging more funding from alternative sources. This is because some EU Framework Programmes only partly fund projects, encouraging researchers to secure further funding from, for example, charities and the public sector.
- EU-wide collaboration: A key ingredient of EU joint projects is international collaboration. Table 1, below, lists various examples of EU funded projects where collaboration is of particular importance, such as in the fields of mental health, rare diseases and paediatrics. Outside of EU funding there is relatively little funding available in the UK for these types of collaborative efforts. Moreover, many relevant EU networks are backed by EU funding (e.g. the Stroke Alliance for Europe (SAFE), and the ERA-Net for Research Programmes on Rare Diseases) and/or coordination (e.g. the European Network of Paediatric Research at the European Medicines Agency (Enpr-EMA)). As suggested by our consultation partner, participation in networks funded by the EU can potentially have a positive knock-on effect access to new and improved medicine (e.g. reducing adverse drug reactions) and this may benefit the health of patients.
- EU regulatory framework:
 - Operating within the EU regulatory framework fosters opportunities for the UK to be part of clinical trials that involve subjects from across the EU, allowing for the coordination of sufficiently large cohorts to study rare diseases (e.g. the project 'RD-CONNECT', set out in

⁴ HESA data from 2014/15 by cost centre

⁵ <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2703>

⁶ <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=28036>

Table 1). It is estimated that around 28% of Cancer Research UK (CRUK) funded clinical trials involved at least one other EU country⁷.

- The EU also supports the harmonisation of systems of medicine regulation via the European Medicines Agency (EMA), a decentralised agency of the EU that is currently located in London. The EMA 'is responsible for the scientific evaluation, supervision and safety monitoring of medicines developed by pharmaceutical companies for use in the EU'.⁸

Table 1 Examples of networks in Clinical Medicine with UK partners/coordinators

Project name	Field	EU funding	Description
ROAMER: Road Map for Mental Health Research in Europe	Mental health	€1,999k of €2,266k (88% FP7 funded)	The largest ever exercise for setting out 'a comprehensive, coordinated mental health research agenda for Europe'. UK partners are Kings' College London, London School of Economics, University of Manchester, University of Cambridge
MATRICES: Multidisciplinary Approaches to Translational Research In Conduct Syndromes	Mental health/Paediatrics	€4,500k of €5,839k (77% FP7 funded)	A multidisciplinary consortium of academic partners and small and medium-sized enterprises (SMEs) that focuses on the subtyping of aggression both within 'Conduct Disorder' (CD) and of the broader cross-disorder trait of aggression. Several UK institutions and companies are MATRICES members.
TRANSEURO	Mental health	€11,994k of €16,143k (74% FP7 funded)	TRANSEURO is a European research consortium with the principal objective to develop an efficacious and safe treatment methodology for Parkinson's disease suffering patients using fetal cell based treatments. The consortium has gathered international experts including leading clinicians, scientists, industrial partners, ethicists and patients' representatives. UK partners are Cambridge University, Cardiff University, Imperial College London, University College London, Life Technologies Ltd, Cambridge Cognition, Imanova Ltd.
TACTICS: Translational Adolescent and Childhood Therapeutic Interventions in Compulsive Syndromes	Mental health	€6,000k of €7,872k (76% FP7 funded)	The aim of TACTICS is to identify, over a 5-year period, the neural, genetic and molecular factors involved in the pathogenesis of compulsivity. A multidisciplinary team of preclinical and clinical top researchers worked together to a better understanding and treatment of the syndromes. The project involved 11 partners from 7 different countries including Kings' College London and the University of Cambridge
RD-CONNECT: An integrated platform connecting registries, biobanks and clinical bioinformatics for rare disease research	Rare diseases	€11,997k of €17,678k (68% FP7 funded)	RD Connect is a global infrastructure linking up data from rare disease research projects in a central resource for researchers across the world; rare disease (RD) Research is still mainly fragmented by data and disease types and given the limited number of patients, experts, and resources, this coordination and pooling of knowledge is crucial. The project is coordinated by the University of Newcastle.
TAIN: Treatment of Adrenal Insufficiency in neonates- Development of a Hydrocortisone Preparation for the treatment of Adrenal Insufficiency in	Paediatrics	€4,197k of €5,517k (76% FP7 funded)	The aim of TAIN is to develop a neonatal formulation of hydrocortisone, a drug included in the EMA priority list that needs specific evaluation in the age range 0 – 2 years (neonates & infants). TAIN involves European leaders in neonatology, paediatric pharmacology, methodology and SMEs that will establish links with ethical bodies and regulatory authorities. TAIN is coordinated by the University of Sheffield

⁷ AMRC. How to secure the best for life sciences after Brexit: five key areas http://www.amrc.org.uk/sites/default/files/doc_lib/Brexit%20event%20briefing%20FINAL%20DESIGN.pdf

⁸ See: http://www.ema.europa.eu/ema/index.jsp?curl=pages/about_us/general/general_content_000112.jsp&mid=WC0b01aco580028a43

Project name	Field	EU funding	Description
neonates and infants			
NEMO: Treatment of NEonatal seizures with Medication Off-patent: evaluation of efficacy and safety of bumetanide	Paediatrics	€5,371k of €7,021k (76% FP7 funded)	NEMO is the largest multi-centred European study of neonatal seizures and their treatment. The project is coordinated by University College London
EPOC: European Paediatric Oncology Off-Patent Medicines Consortium	Paediatrics	€1,998k of €2,576k (78% FP7 funded)	'In order to recruit sufficient patient numbers for meaningful studies it is necessary to establish a wider group, bringing together the successful elements of established national organizations. The EPOC group combines leading pharmacologists, paediatric oncologists, regulatory organizations and a management structure which will successfully deliver data of appropriate quality on which to base future clinical use of this drug and to meet the demands of the EMEA priority list' This project is coordinated by the University of Newcastle
NEWMEDS Novel Methods leading to New Medications in Depression and Schizophrenia	Mental health	IMI budget with €1b contribution from FP7	Major initiative linking eight universities and ten pharm/biotech companies addressing schizophrenia and depression. King's College London operates as the Managing Entity for all participating academic institutions and SMEs.
AIMS: autism treatment	Mental health	IMI budget with contribution from FP7	The largest single grant for autism in the world, and the largest for the study of any mental health disorder in Europe. An international consortium of scientists, led by Roche and King's College London, has launched one of the largest ever research academic-industry collaboration projects to find new methods for the development of drugs for autism spectrum disorder (ASD).
ND4BB: New Drugs 4 Bad Bugs	Anti-microbial resistance	IMI budget: €700m	'Antibiotic-resistant bacteria kill 25 000 people in the EU every year, and cost the economy €1.5 billion. The Innovative Medicines Initiative (IMI) programme New Drugs 4 Bad Bugs (ND4BB) represents an unprecedented partnership between industry, academia and biotech organisations to combat antibiotic resistance in Europe by tackling the scientific, regulatory, and business challenges that are hampering the development of new antibiotics'. The programme encompasses 7 projects, including for example European Gram-negative Antibacterial Engine (ENABLE) which involves (amongst other) Aston University, the University of Oxford and Cardiff University.

Source: REF Impact case studies and CODA

2 The role of EU funding in the discipline of Archaeology

2.1 Introduction to the case

Archaeology is the study of historic or prehistoric people and culture via the analysis of, amongst other things, artefacts, inscriptions and architecture. The 2017 report 'Reflections on Archaeology' (British Academy), summarises archaeological research as "influenc[ing] contemporary society through discussions concerning heritage, identity, politics and gender".¹⁰ Research in Archaeology is widely disseminated, for example via media engagements, site tours, museum exhibits, popular publications, and school outreach programmes.

⁹ See: http://www.imi.europa.eu/sites/default/files/uploads/documents/Publications/IMIandAMRfactsheet_Nov2015.pdf

¹⁰ See: <http://www.britac.ac.uk/reflections-on-archaeology>

In comparison to other disciplines, Archaeology has the highest overall proportion of research income from EU government bodies. UK-based archaeologists have been successful in winning European Research Council (ERC) funding, which has allowed departments to grow and/or sustain their research activities since 2007.

2.2 Overview of EU funding

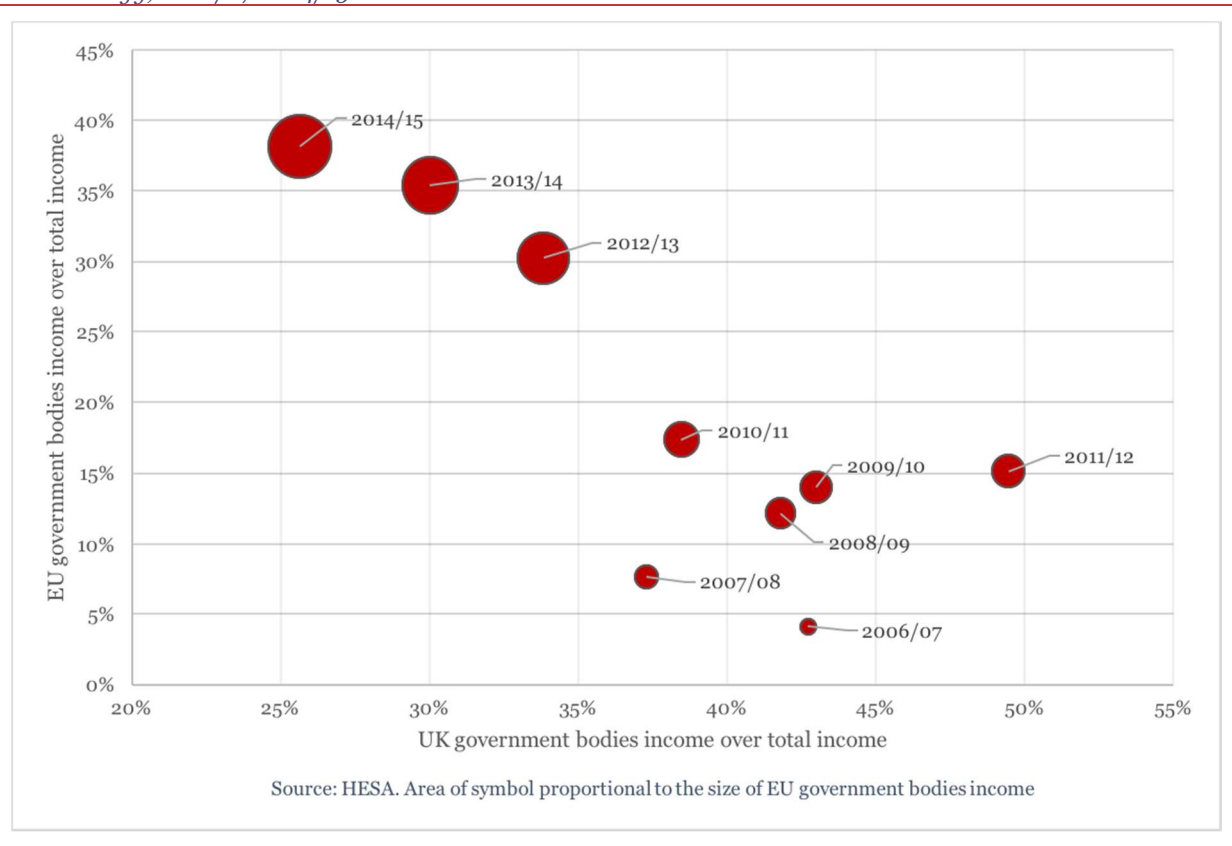
In 2014/15, UK HEIs received around £8.7m of funding from EU government bodies¹¹ for research in the field of Archaeology. Archaeology has the highest overall proportion of research income from EU government bodies of all disciplines, 38% of total research funding in 2014/15 (see Figure 3, below). This proportion of funding represents a more than tenfold increase in the volume of funding received since 2006/07, which was just £658k, 4% of total funding. The average annual growth in the proportion of EU government funding received is 45% for the years 2006/07-2014/15.

Moreover, since 2013/14, Archaeology research at UK HEIs has received more funding from the EU Framework Programmes than from UK government sources.¹² UK government funding to Archaeology has decreased substantially over recent years, from £6.8m (43% of total research funding) in 2006/07 to £5.9m (26% of total research funding) in 2014/15. In particular, UK central government bodies, local authorities, health and hospital authorities have awarded less funding to Archaeology over the past few years: a decrease from £3.4m (21% of total research funding) in 2006/07 to £1.3m (6% of total research funding) in 2014/15. Moreover, whereas UK industry provided close to £4.8m in 2006/07 (30% of total research funding), in 2014/15 industry provided close to £3.9m, which represents only 17% of total research funding. Together, these changes mean that Archaeology has become more dependent on EU government funding in recent years.

¹¹ As defined by HESA, income from EU government bodies includes all research grants and contracts income from all government bodies operating in the EU, which includes the European Commission, but excludes bodies in the UK

¹² Income from UK government bodies includes income from the UK Research Councils, the Royal Society, British Academy and UK central government bodies, local authorities, health and hospital authorities

Figure 3 Distribution of EU government and UK government income as a proportion of total funding to Archaeology, 2006/07-2014/15



Source: HESA data

The increasing dependency on income from EU government bodies can be in part explained by the availability of and success of UK-based archaeologists in winning competitive ERC funding, which was launched in 2007 under FP7. Currently, the ERC represents 17% of the overall Horizon 2020 budget.¹³ The ERC gives large grants – up to €1.5m for ERC Starter Grants (SIG), up to €2m for Consolidator Grants (CoG), and €2.5m for Advanced Grants (AIG) – for projects lasting up to five years. For Archaeology, there are few other sources of multiannual funding of this magnitude, and ERC funding has enabled researchers to address major research questions that would not have been possible otherwise. Some UK academics have become successful (repeat) applicants for EU funding at the same time as smaller pots of national funding available to researchers have declined.

19 UK HEIs received funding from EU government bodies in relation to the discipline of Archaeology as defined using HESA statistics in 2014/15. From this group of HEIs, 14 received more than £100k of EU government funding and three received more than £1m of EU government funding.¹⁴ The three largest recipients were the University of Oxford, the University of York, and the University of Cambridge.

To exemplify the extent of dependency on EU funds at top archaeology departments, more than 70% (£7.5m of nearly £10.5m) of externally-generated research money active at the McDonald Institute for Archaeological Research, a research institute within the University of Cambridge, is EU funding (from FP7 and H2020). The Institute has seen a significant increase in success in obtaining EU funding in

¹³ See: <https://erc.europa.eu/about-erc/facts-and-figures>

¹⁴ HESA data from 2014/15 by cost centre

recent years. It was involved in a number of FP7 projects: 13 Marie Skłodowska-Curie Intra-European Fellowships, eight ERC Grants, one Innovative Training Network (ITN – also part of the Marie Skłodowska-Curie Actions), and one collaborative project.¹⁵ In 2017, six new Marie Skłodowska-Curie Fellows will begin at the Institute and 6-7 ERC Grant applications are expected to be submitted to the 2017 Calls.

2.3 Types of activities funded

The impact case studies submitted under the REF exercise in 2014 highlight some useful examples of impactful activities funded by EU research and innovation funding in the discipline of Archaeology. For example, the University of Bradford submitted a REF impact case study on ‘*Old Scatness: the past providing a sustainable future*’.¹⁶ For this research project, the ERDF provided core funding. The Old Scatness is “an enormously complex, multi-period archaeological site focused on a broch surrounded by an Iron Age village, with both earlier and later settlement.” (idem). The project enabled field training on excavations and doctoral research, and the research that was conducted benefited from various international collaborations. As noted in the REF impact case study, the archaeological research at Old Scatness has positively influenced the cultural identity and tourist sector of the islands, inspiring the design and creation of a range of products. Artefacts found at the site are now on display at the £11.6 million Shetland Museum that opened in 2007.

Archaeology and heritage related projects funded by the EU Framework Programmes also have cultural, media and educational interest. For example, Marie Skłodowska-Curie Fellows at Cambridge University work with the Faculty of Education on 3D production of artefacts and their use in school education. Another REF impact case study submitted by the University of York,¹⁷ ‘*ADS: Impact on preserving and presenting archaeological information*’, is relevant here. The interoperability of the Archaeology Data Service (ADS) has been extended across national borders, “influencing the EC’s INFRASTRUCTURE programme to facilitate cross-border access to databases of cultural heritage institutions” (idem). In 2013, 16 countries agreed to make archaeological data publicly accessible through common interfaces (the European ARIADNE project). A current ADS research initiative includes the project ArchAIDE (ARCHaeological Automatic Interpretation and Documentation of cERamics), which is funded by Horizon 2020 and aims to create a new system for the automatic recognition of archaeological pottery from excavations around the world.¹⁸

2.4 Potential risks in the context of Brexit

EU Framework Programme funding and in particular ERC grants have transformed the field of Archaeology in the UK in a positive way. As a result of the collaborative nature of EU projects, the UK is able to work with researchers across the EU. ERC grants are unique in the discipline because of the size of the grants (enabling sufficient funding for the salary of academics working at different career stages), the length of the grants, and the collaborative nature of the funding. ERC grants also enable teamwork that helps advance research. Archaeology is by nature a multidisciplinary field, where researchers work with a range of subjects, and ERC grants have helped to mobilise resources, enable significantly expanded research teams working in a single department, and create international collaboration. It is expected that at least some of the collaborations that have been established in recent years will cease to exist in the absence of this type of funding.

As an example of ERC-funded research, the Rome’s Mediterranean Ports (ROMP) project, led by the University of Southampton,¹⁹ was granted an Advanced Grant with a value of €2.5 million. The project

¹⁵ Project CRIC funded under FP7-SSH - Specific Programme "Cooperation": Socio-economic Sciences and Humanities

¹⁶ See: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=43613>

¹⁷ See: <http://impact.ref.ac.uk/casestudies2/refservice.svc/GetCaseStudyPDF/43451>

¹⁸ See: <http://archaeologydataservice.ac.uk/research>

¹⁹ See: www.portuslimen.eu

addresses specific questions relating to the capacities of and inter-connections between a range of 30 selected ports in ways that will allow a better understanding of their role in promoting the cohesion and integrity of the Roman Mediterranean during the imperial era. The ERC grant covers the costs of a central team of established researchers, post-docs and PhD students at the University of Southampton, a team of established researchers and a post-doc at the University La Lumière Lyon 2, the CNRS (*Maison de l'Orient et du Méditerranée*, Lyon) the costs of a researcher and fieldwork related costs at the British School at Rome, and fieldwork costs at the Universities of Cologne, Kiel and the German Archaeological Institute (Istanbul). The main benefit to the participants comes in the extensive exchange of different ideas, techniques and approaches to the study of ports that has taken place between the different institutions participating in the project, with annual project meetings having played a fundamental role.

Similarly, funding through the Marie Skłodowska-Curie Actions has helped advance the careers and research of grant recipients working in the discipline and the absence of this type of funding implies fewer resources available for early career researchers.

Limiting free movement of people is also a likely risk to the discipline. It is estimated that 22% of all UK academic staff in the field of 'humanities & language based studies & archaeology' are non-UK EU-nationals (this is above the average across disciplines, which is 17%)²⁰.

As archaeologists are heavily dependent on EU funding, a break away from EU funding sources puts the discipline in a vulnerable position. This is exacerbated by the fact that the UK is short of archaeologists and/or skilled workers active in the field of Archaeology because of the surge in large scale infrastructure projects (e.g. HS2, Crossrail, and the A14), which drives away many archaeologists from research positions.²¹ At the same time, funding is needed to train archaeologists and to conduct research on the commercial/development-led archaeology discoveries.²²

²⁰ HESA 2015/16 <https://www.hesa.ac.uk/data-and-analysis/staff/cost-centres>

²¹ <https://content.historicengland.org.uk/images-books/publications/national-infrastructure-development-and-capacity-2015-33-assessment/national-infrastructure-development-and-archaeological-capacity-shortages.pdf/>

²² <https://content.historicengland.org.uk/images-books/publications/building-the-future-transforming-our-past/building-future-transforming-past.pdf/>

3 The European Social Survey

3.1 Introduction to the case

The European Social Survey (ESS) is a biennial cross-national survey measuring attitudes, beliefs and behavioural patterns of diverse populations across Europe. The UK has been a key driver in the development of the survey and currently hosts the ESS Headquarter at City, University of London. The main aims of the survey are:²³

- to chart stability and change in social structure, conditions and attitudes in Europe, and to interpret how Europe's social, political and moral fabric is changing;
- to achieve and spread higher standards of rigour in cross-national research in the social sciences, including for example, questionnaire design and pre-testing, sampling, data collection, reduction of bias and the reliability of questions;
- to introduce soundly-based indicators of national progress, based on citizens' perceptions and judgements of key aspects of their societies;
- to undertake and facilitate the training of European social researchers in comparative quantitative measurement and analysis;
- to improve the visibility and outreach of data on social change among academics, policy makers and the wider public.

The ESS is academically driven and data is available free of charge for non-commercial use. The survey is widely considered to be the 'gold standard' for cross-national survey methodology and won the Descartes Research Prize in 2005 for "radical innovations in cross-national surveys".²⁴ In 2013, the ESS was awarded the status of a European Research Infrastructure Consortium (ERIC) by the European Commission and in 2016 was listed as a 'Landmark' Research Infrastructure in the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap.²⁵

3.2 Overview of EU funding

ESS activities are financed by a combination of EU grants and funding from national and other sources, including initial support from the European Science Foundation. Eleven grants from successive EU Framework Programmes have been awarded to the ESS with a total value of €26.5m. In the context of typical funding in the social sciences, this is a very significant amount.

The ESS's funding has changed over time. In the period 2001-2013, EU funding covered the central core functions of the ESS and this funding was critical in establishing the survey. Starting in 2006, the EU has provided additional funding for supporting the transformation of the ESS from a project into an infrastructure. Since the ESS's establishment as a European Research Infrastructure Consortium (ERIC) in 2013, participating countries have been required to collectively fund the central coordination function as well as the fieldwork in their own country, while EU grants have funded European added-value activities, methodological research and support for network development. The current 'ESS-SUSTAIN' grant aims to ensure the long-term commitment of current members and to expand the membership and coverage. In addition, the ESS ERIC coordinates the 'SERISS' project, a collaboration between European social science infrastructures which aims to strengthen the base of socio-economic evidence to support policy-making on grand challenges. Specifically, ESS ERIC leads the work on language translation and the development of 'probability-based web panels'.²⁶ The most

²³ <http://www.europeansocialsurvey.org/about/> (accessed 7 March 2017)

²⁴ <https://ec.europa.eu/research/press/2005/pro212en.cfm> (accessed 7 March 2017).

²⁵ ESFRI (2016), *Strategy Report on research infrastructures – Roadmap 2016*, European Strategy Forum on Research Infrastructures, p. 15.

²⁶ <http://www.europeansocialsurvey.org/about/news/new0037.html> (accessed 7 March 2017).

recent award is the RISCAPE project which aims to provide an analysis of European research infrastructures in the international landscape across all disciplines. The ESS ERIC is a beneficiary of that grant.

3.3 Types of activities funded

Since its establishment in 2001, the ESS has been conducted every two years using face-to-face interviews. The first round was fielded in 2002 and the most recent eighth round in 2016. So far, each round has had participation from between 22 and 31 countries, including EU Member States and other European countries.²⁷

The value of social surveys such as the ESS depends crucially on the ability to coordinate and collect data in different countries with different socio-economic and political characteristics. By paying the costs of the survey in their own country, ESS participants gain comparable data from more than 20 European countries. The strong central coordination and methodological rigour sets the ESS apart from other international surveys and allows a closer monitoring of the techniques employed across the participating countries. In the UK, the ESS has had a range of impacts on participants and stakeholders. For example:

- Financially, the UK benefits from hosting the headquarters and gets back substantially more than it pays in
- ESS data is widely used by UK academics: The UK has the third largest number of registered users and the number of ESS-based publications with a UK-based first author is higher than any other country²⁸
- The ESS has helped develop expertise and capacity among UK academics, especially young researchers who are able to gain experience with international project work at the highest level
- Methodologically, the ESS has helped to raise the standards for other social surveys in the UK and disseminate good practice. Examples where ESS has developed new approaches that have been adopted by the wider community include the methods for translating survey questions and the conceptualisation of ‘wellbeing’
- The ESS training resource, ‘ESS Edunet’,²⁹ is used in teaching at many of the top UK HEIs and by the Q-Step programme which promotes quantitative social science training in the UK³⁰
- Beyond academia, methodological expertise developed through the ESS is used by commercial marketing research organisations and results are used in the development of policy,³¹ for example in the field of procedural justice³²

For the rest of the EU, the involvement of the UK plays a key role. The UK is a leader in key elements of social science and a large number of leading scientists in the field are UK-based. The UK provides access to English language journals, and acts as a gateway to the English-speaking research community world-wide. As a member of the ESS General Assembly, the Economic and Social Research Council (ESRC) provides highly valued strategic input and the strong UK ‘impact agenda’ for research provides a model for the ESS and its other members.

²⁷ Non-EU participants include Israel, Kosovo, Norway, Russia, Switzerland, Turkey and Ukraine (see http://www.europeansocialsurvey.org/about/participating_countries.html, accessed 7 March 2017)

²⁸ Fitzgerald (2016), ‘The European Social Survey Infrastructure: Past Present and Future’, presentation at 3rd International ESS Conference Lausanne, 15 July 2016.

²⁹ <http://essedunet.nsd.uib.no/> (accessed 7 March 2017).

³⁰ <http://www.nuffieldfoundation.org/q-step> (Accessed 7 March 2017).

³¹ Drew, King and Richie (2013), *Impact Evaluation: Workplace Employment Relations Survey and European Social Survey*, European Social and Economic Research Council (ESRC), p. 33.

³² REF2014 impact case study: “Trust in justice: mapping public attitudes towards the police and other legal institutions and how these findings have changed EU and UK policy”, Birkbeck, University of London. (available at http://impact.ref.ac.uk/case_studies2/refservice.svc/GetCaseStudyPDF/17684, accessed 7 March 2017).

3.4 Potential risks in the context of Brexit

For the UK, hosting the ESS HQ brings a range of benefits that could be at risk when the UK leaves the EU. One aspect is the prestige and international recognition that comes with hosting a large international infrastructure. Financially, the UK benefits as a large proportion of ESS funding goes to the UK-based headquarters. This includes EU grants as well as contributions from other ERIC members to the central functions of the ESS. In addition, UK researchers have played leading roles in the development of methodologies and survey modules which provides both influence and learning opportunities for the UK. For example, out of 19 rotating survey modules so far (ESS rounds 1 to 9), 11 have been led by UK-based academics and 25 out of 102 team members were UK-based.³³ More broadly, ESS has helped reinforce the status of the UK as a leading centre for comparative social surveys able to attract top international researchers in the field.

Whereas the UK could likely continue to participate in the ESS, it is uncertain whether the UK could continue in the role as host and coordinator of the consortium after leaving the EU. The ESS headquarters depends on EU funding for its operation and development and as a European Research Infrastructure Consortium (ERIC), ESS ERIC operates under EU law. The EU legal framework facilitates the shared operation of the infrastructure and provides benefits such as exemption from VAT.³⁴ Thus, the ability of the ESS host country to access EU funding and to operate under EU law appear to be essential. All members of ERICs (not only the host) must accept the jurisdiction of the European Court of Justice (ECJ) in the case of disputes, and the UK has signalled its intention to leave the jurisdiction of the ECJ as it leaves the EU

³³ http://www.europeansocialsurvey.org/methodology/ess_methodology/source_questionnaire/ (accessed 7 March 2017).

³⁴ https://ec.europa.eu/research/infrastructures/index_en.cfm?pg=eric (accessed 7 March 2017).

4 The role of EU funding for the UK ICT Sector

4.1 Introduction to the case

This case study looks at the ICT sector in both the higher education and business sectors. ICT has been a key priority in the EU's science and technology policy since the European Strategic Program on Research in Information Technology (ESPRIT) was launched in 1983. ICT remains among the best funded areas in the EU framework programmes and is now connected to the wider EU priority to create a 'Digital Single Market' with fewer barriers, for example with common rules for data protection and online purchases.

In the UK, the digital sector is large and fast-growing. The sector's Gross Value Added (GVA) was £118.3bn in 2014 accounting for 7.3% of the UK economy. A 2016 statistical release from the Department for Culture, Media and Sport estimated that the sector had 1.4m jobs, equivalent to 4.4% jobs in the UK.³⁵ 'Computer programming and information service activities' and 'Telecommunications' accounted for 17% of all UK Business R&D spend (BERD) in 2014.³⁶ As part of the new UK Digital Strategy, published on 1st March 2017, the government has confirmed its commitment to supporting research and innovation in ICT through Innovate UK and the Engineering and Physical Sciences Research Council (EPSRC).³⁷

4.2 Overview of EU funding

ICT underpins activities in almost every part of the EU Framework Programmes, including e-infrastructures and Public-Private-Partnerships. UK HEIs and businesses have been very successful in attracting funding for ICT research. Since 2007, UK HEIs have received more than €700m from the specific ICT programmes under FP7 and Horizon 2020 (see Table 2 below), and UK companies have received more than €300m, and much more if other ICT-related activities are considered.

Table 2 Funding for UK participants from FP7 and H2020 ICT programmes

	FP7 ICT thematic programme	H2020 ICT (LEIT) programme ³⁸	FP7 + H2020 to date
Higher and secondary education institutes	€ 615.0m	€ 104.6m	€ 719.5m
Private for profit (excl. education)	€ 230.4m	€ 73.4m	€ 303.8m
Research organisations	€ 37.4m	€ 11.0m	€ 48.4m
Public body (excluding research and education)	€ 16.8m	€ 5.1m	€ 21.9m
Other	€ 12.3m	€ 4.4m	€ 16.7m

Source: CORDA

In 2014/15 UK HEIs received close to £46m of funding from EU government bodies³⁹ in relation to research in the field of IT, systems sciences & computer software engineering, which is equal to 30% of the total research funding received by UK HEIs.⁴⁰ This represents a steady increase in funding received since 2006/07, which was £22m (just over 23% of total funding - see Figure 4, below). The overall

³⁵ Department for Culture, Media & Sport (2016), *Digital Sector Economic Estimates*, Statistical Release, January 2016.

³⁶ ONS (2016), *UK Gross domestic expenditure on research and development: 2014*, Statistical bulletin, 18 March 2016

³⁷ <https://www.gov.uk/government/publications/uk-digital-strategy/uk-digital-strategy> (Accessed 15 March 2017)

³⁸ The CORDA dataset used for this analysis includes Horizon 2020 calls ICT-2014 and ICT-2015. The figure based on later extracts from the database are likely to be higher.

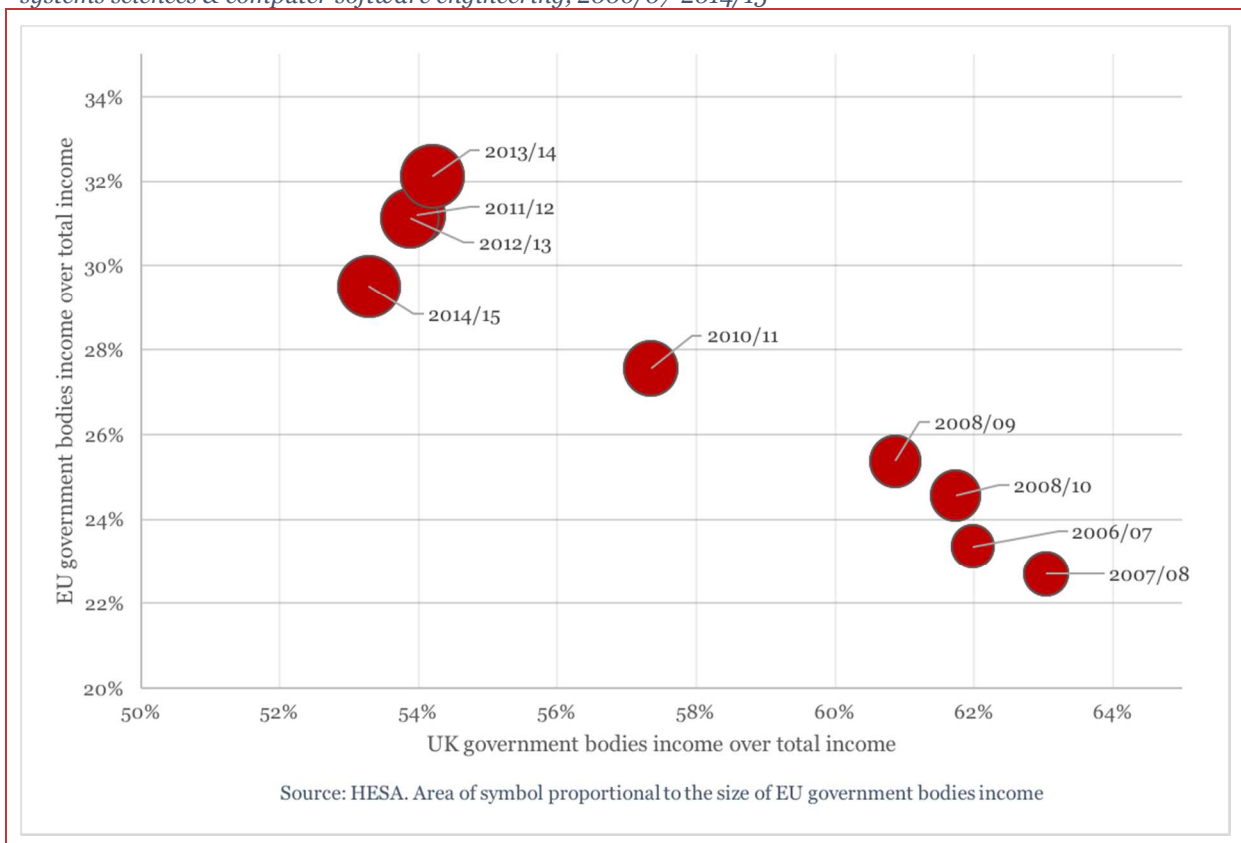
³⁹ As defined by HESA, income from EU government bodies includes all research grants and contracts income from all government bodies operating in the EU, which includes the European Commission, but excludes bodies in the UK

⁴⁰ HESA data from 2014/15 by cost centre

proportion of income from EU government bodies is high in the ICT sector compared to most other disciplines. Funding from UK government bodies⁴¹ to IT, systems sciences & computer software engineering has increased in absolute terms over recent years from close to £60m in 2006/07 to approximately £83m in 2014/15. In relative terms, UK government funding has decreased from 62% to 53%. Altogether, this suggests that the discipline has become more dependent on EU funding in recent years.

86 UK HEIs received funding from EU government bodies in relation to research in IT, systems sciences & computer software engineering in 2014/15, out of which 13 HEIs received more than £1m of EU government funding.⁴²

Figure 4 Distribution of EU government and UK government income as a proportion of total funding to IT, systems sciences & computer software engineering, 2006/07-2014/15



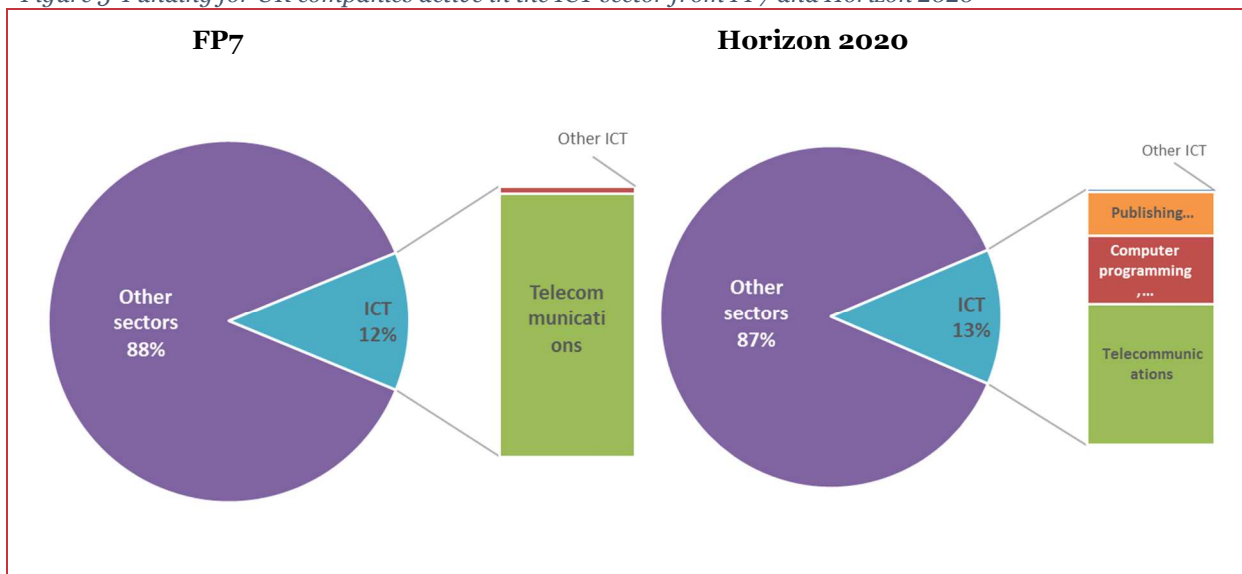
Source: HESA

UK business participation in ICT is dominated by telecommunications companies. As shown in Figure 5, 12%-13% of EU Framework Programme funding to UK business has been awarded to companies in the ICT sector during FP7 and Horizon 2020. In FP7, the great majority of funding was awarded to telecommunications companies, though in Horizon 2020, UK companies from other sub-sectors such as computer programming and publishing have attracted a more substantial amount of EU funding.

⁴¹ Income from UK government bodies includes income from the UK Research Councils, the Royal Society, British Academy and UK central government bodies, local authorities, health and hospital authorities

⁴² HESA data from 2014/15 by cost centre

Figure 5 Funding for UK companies active in the ICT sector from FP7 and Horizon 2020



Source: CORDA

Note: Using the statistical classification of economic activities in the European Community (NACE) (Rev 2).⁴³

4.3 Types of Activities funded

Whereas universities receive most of the direct EU research and innovation funding for ICT, the activities that flow from this feed into broader ‘eco-systems’ in cities like Edinburgh and London, among others. EU grants awarded to universities not only fund academic research but underpins a variety of innovation activities throughout the system. Stakeholders consulted for the study emphasised this aspect of EU funding.

Using REF impact case studies to illustrate activities supported by EU funding, the case study submitted to the exercise by the University of South Wales on *the ‘Mobile applications and technologies making economic impact’* was underpinned by £5.96m in 2010-2015 ERDF Convergence Funding for the establishment of the Centre of Excellence for Mobile Applications and Services (CEMAS).⁴⁴ CEMAS supports Welsh SMEs to develop, test and find a route to market for their mobile application product on a number of platforms including iOS, Android, Blackberry and Windows Phone. The REF case study outlines that “by July 2013, the Centre has provided assistance in forms of research and development services to 66 companies, developed 28 products.” (idem).

Moreover, participation in consortia funded by the EU have a positive effect on access to innovation and technology. The REF impact case study *‘Robotics Applications in Health, Education and Entertainment’*, submitted by Plymouth University benefited from €1.4m of FP7 funding via the project ALIZ-E, which was coordinated by the university.⁴⁵ The project was initiated following a request from an Italian hospital, and project partners included other HEIs and robotics companies abroad. As summarised in the case study, “economic impact is reflected by commercial investment, and world-wide sales of robotics technologies by spin-off companies” (idem), and technology developed as part of the ALIZ-E project became integrated into the commercial robot Nao, developed by Aldebaran Robotics. These robots were also used to teach autistic children and students in UK schools.

⁴³ NACE Revision 2 (Rev. 2) was agreed in December 2006 and implemented from 2007. See: [http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Statistical_classification_of_economic_activities_in_the_European_Community_\(NACE\)](http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Statistical_classification_of_economic_activities_in_the_European_Community_(NACE))

⁴⁴ <http://mobile.research.southwales.ac.uk/cemas/>

⁴⁵ <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=4592>

UK companies in the ICT sector benefit in a number of ways from EU funding. According to stakeholders consulted for this study, the following aspects of EU funding are important to the sector:

- It specifically allows very large scale projects
- It helps to build relationships with EU organisations and beyond.
- It enhances learning and knowledge
- For some small companies, participation helps establish business models
- It helps to build a wider client base
- It supports companies to understand markets and expand into new markets
- It helps to develop partnerships with other companies and potential customers.

4.4 Potential risks in the context of Brexit

UK HEIs have become increasingly dependent on EU funding for research in ICT. Since 2010/11, approximately 30% of all income from research grants and contracts for ICT research has come from EU government bodies.

Industry representatives see several risks for the ICT sector with respect to future participation in EU research and innovation collaboration:

- The work performed at universities is seen as the 'life blood' of the sector and a loss of EU funding could affect the wider ecosystem on which companies depend
- Many companies depend directly on EU Framework Programmes
- Access to large collaborations at the scale of the EU Joint Technology Initiatives (JTIs) could not be replicated by the UK alone
- UK funding allocations currently do not mirror EU funding with respect to the mode of collaboration between businesses and universities. EU Framework Programmes provide an opportunity for companies and HEIs to collaborate on equal terms, whereas UK funding streams tend to give prominence to either HEIs (Research Council funding) or business (Innovate UK)
- Access to strategic common initiatives, such as the current efforts to develop 5G telephony, is crucial for UK industry
- The UK has traditionally exerted a strong influence over the direction of EU ICT programmes. There is a risk that the UK's ability to ensure that future programmes suit UK interests will be diminished

5 The Innovative Medicines Initiative (IMI)

5.1 Introduction to the case

The Innovative Medicine Initiative (IMI) is a joint undertaking between the EU, represented by the European Commission (EC), and the European pharmaceutical industry, which is represented by the European Federation of Pharmaceutical Industries and Associations (EFPIA).⁴⁶ The initiative was founded with the aim of increasing the efficiency and efficacy of the drug development processes, supporting the development of more effective safe, and innovative medicines. The IMI operates through collaborative projects between large pharmaceutical research and manufacturing companies, public research institutions, SMEs, and patient representative groups.

The actions of the IMI projects support the development and implementation of pre-competitive research and innovation activities, deemed to be of strategic importance for EU competitiveness, industrial leadership or societal challenges regarding health and wellbeing. To foster collaboration, researcher teams from participating organisations must work within consortia that includes representatives from at least three different entities, located in at least three different Member States or Associated Countries.

5.2 Overview of EU funding

IMI1 ran from 2008-2013 with a total budget of €2bn, and IMI2 will run from 2014 to 2024, with a total budget of almost €3.3bn. Under IMI1 and IMI2, 50% of total funding is contributed by the EC, and this funding is used to support IMI project partners such as HEIs, regulators, patient groups, small biotech companies, etc. In 2014, 16% of total participants were SMEs, which also received 16% of the budget.⁴⁷

Under IMI1 the remaining 50% was contributed, in kind, by EFPIA and its member companies, and, under IMI2, EFPIA and its member companies will contribute 43.5% in in-kind contributions. Under IMI2, other large organisations can become associate partners in individual projects and together these organisations can contribute an additional €213m (6.5% of the total budget).⁴⁸

About a quarter of EFPIA companies are located in the UK, including Eli Lilly, Pfizer, GE Healthcare and GlaxoSmithKline, and these companies have benefitted from involvement in multiple IMI projects.

The UK is disproportionately successful in gaining EC funding via IMI projects, receiving 26.9% of the total IMI funding from the EC under IMI1 and IMI2, a total of €345.9m. UK universities are the most successful at obtaining this funding, receiving an average of 27.9% of the money attributed to universities across the IMI and reflecting 21.3% of academic participation. Furthermore, UK SMEs have benefitted substantially from the IMI programme, reflecting 21.3% of all SME participants across IMI1 and IMI2, and receiving 24.3% of total funding allocated to SMEs.⁴⁹

5.3 Types of activities funded

The objective of IMI is to drive new product development, with a focus on generating collaboration between key stakeholders working on a range of disease areas (infectious disease, drug discovery,

⁴⁶ Members of the EFPIA include national pharmaceutical industry associations and companies undertaking research, development and manufacture of medicinal products in Europe

⁴⁷ http://www.imi.europa.eu/sites/default/files/uploads/documents/Publications/FactsAndFigures_Sept2015.pdf (page 5)

⁴⁸ <https://www.imi.europa.eu/content/mission>

⁴⁹ <http://www.abpi.org.uk/our-work/library/industry/Documents/UK-EU-Steering-Group-Report.pdf> (page 6) and IMI Cordis Data

brain disorders, etc.⁵⁰). Research and innovation-related outputs resulting from ongoing projects include the following⁵¹:

- Identification and validation of new drug targets and novel hit and lead discovery;
- Establishment of robust, validated tools for preclinical drug development;
- Development of biomarkers and tools predictive of clinical outcomes (efficacy and safety);
- Clinical trials -improved design and process;
- ‘Big data’ solutions to leverage knowledge;
- Implementation of data standards;
- Impact on regulatory framework;
- Implementation of project results inside industry;
- Education and training for a new generation of R&D scientists.

Participation in the IMI benefits UK research and pharmaceutical communities in a number of ways, not only through funding but also through the additionality offered by access to the largest public-private partnership in the life sciences, in the world.⁵² This mobilises research teams across sectors, countries and organisation types, which benefits the UK through⁵³:

- Access to skills and expertise of over 7,000 researchers across Europe and 55 public-private consortia
- Access to regulatory bodies, associations and patient organisations, extracting advice, support and information to assist in the drug development process
- Inflow of research excellence into UK institutions through collaborative projects
- Supporting the growth and development of SMEs and the wider life sciences eco-system in the UK through opportunities for larger project work, fostering collaboration and access to new technologies
- Developing expertise and capacity among UK academics, especially young researchers, through training and exposure to large, progressive projects and the Eu2P training programme⁵⁴
- Access to tools and databases developed within other IMI projects

In relation to these types of benefits, one interviewee suggested that the value of the IMI “is not only about the input and financial figures but also about the quality and calibre of the arrangements.” As the IMI is pre-competitive, it brings with it the potential for the generation of technologies, problem-solving tools and methods to support and foster SME growth and development. This is noted particularly in light of the high levels of participation in generic drug development projects, and the particularly significant participation of UK SMEs in projects of this topic.⁵⁵

⁵⁰ http://www.ema.europa.eu/docs/en_GB/document_library/Presentation/2016/12/WC500218415.pdf

⁵¹ Research and innovation-related outputs have been classified according to these nine categories based on the Council regulation setting up IMI1, see https://www.imi.europa.eu/sites/default/files/uploads/documents/Governance/IMI_AAR2015.pdf

⁵² <https://www.imi.europa.eu/content/mission>

⁵³ See http://www.abpi.org.uk/our-work/library/industry/Documents/UK_Participation_in_IMI.pdf and http://www.imi-protect.eu/documents/8.2_TheInnovativeMedicinesInitiativelessonslearnt.pdf

⁵⁴ <https://www.eu2p.org/>

⁵⁵ <http://www.abpi.org.uk/our-work/library/industry/Documents/UK-EU-Steering-Group-Report.pdf> (page 6, 20)

IMI projects generate international collaboration between different types of organisations and thereby contribute to the development of integrated innovation systems.⁵⁶ A bibliometric analysis of IMI1 project outputs suggests that close to 80% of project papers involved cross-institution collaboration, and more than half of all project papers involved international collaboration. Furthermore, about 60% of IMI1 projects involved collaboration between academia and industry.⁵⁷

5.4 Potential risks in the context of Brexit

The UK's future relationship with the EU will determine the extent to which the UK can be involved with the IMI in the future. The rules of the programme stipulate that in order for third country entities or organisations to be eligible for funding, they must prove either that their participation is essential for the activity, or that the funding is provided under a bilateral or technological agreement between the EU and the country within which the organisation is established.⁵⁸ Furthermore, in kind contributions are limited to 30% of the costs incurred by the members at the IMI2 programme level, thereby limiting the involvement of larger organisations.⁵⁹

As UK-based institutions and organisations have played leading or coordinating roles in many of the IMI projects, they have benefitted from a strategically well-placed role in the overall direction of the research.⁶⁰ The loss of these positions could negatively affect the ability of the UK research community to play a leading role in steering future research directions.

⁵⁶ http://www.imi.europa.eu/sites/default/files/uploads/documents/Publications/SocioeconomicImpactAssessment_FINALMay2016.pdf

⁵⁷ http://www.imi.europa.eu/webfm_send/1632 (page 36)

⁵⁸ http://www.imi.europa.eu/sites/default/files/uploads/documents/IMI2_CallDocs/IMI2_provisions_for_participating_in_IMI2_actions.pdf (page 3)

⁵⁹ *ibid.* (page 5)

⁶⁰ <http://www.abpi.org.uk/our-work/library/industry/Documents/UK-EU-Steering-Group-Report.pdf> (page 6) and IMI Cordis Data

6 The Clean Sky Joint Technology Initiative

6.1 Introduction to the case

The Clean Sky (CS) Joint Technology Initiative (JTI) supports research and innovation in the aerospace sector, aiming to reduce CO₂ and gas emissions and noise levels produced by aircraft through the development and breakthrough of clean technologies. As such, the project works to enable the European aviation sector to satisfy societal needs for sustainable, competitive mobility and addresses all sectors of the Air Transport System. Clean Sky 1 (CS1) was launched in 2008 under FP7, serving as a foundation for Clean Sky 2 (CS2), funded under H2020 and running from 2014 till 2020.

Given the long technological time scales and high cost of innovation in the aerospace sector, the technologies and aircraft being developed now are those that will be in the air in 2050. As such, there is a strong need to drive innovation and technology development to support long term sustainability and emissions targets. In light of this, CS provides the aerospace sector and participating firms with a consistent strategy and framework within which to work, and against which to develop long term planning and investment decisions. Furthermore, the funding received allows firms to be more ambitious with their long-term planning and facilitates the faster progression of technologies through Technology Readiness Levels (TRLs), particularly where they require larger, more costly testing.

6.2 Overview of EU funding

The total budget for CS1 2008-2013 was €1.6bn, with a maximum input from the European Commission of €800m complemented by a 50% in kind contribution from aeronautical industrial partners. Following the successful delivery of these projects, the funding for CS2 has increased and will involve a contribution of €1.8bn from the Horizon 2020 Programme budget, leveraging an estimated €4bn from other public and private sources.

A maximum 40% of the EU funding will be earmarked for the project lead partners. 30% will be attributed to core partners, who are selected through a process of open calls at the beginning of the programme and become full members of the JTI for the duration of the programme, making significant long-term commitments. The remaining 30% of EU funding is available for partners to be involved in specific topics and projects for limited time periods through open calls for proposals.⁶¹

Clean Sky also encourages high levels of involvement from SMEs, which represent almost 40% of all beneficiaries, and out of which about 40% apply independently as a partner.⁶² However, the involvement of SMEs is not limited to those receiving direct funding from the CS JTI, and extends to those firms subcontracted by the lead partners. While there is a reasonable amount of subcontracting activity within each work package, these impacts are not reported under the CS JTI. Due to the design and structure of the supply chain for lead partners such as Rolls-Royce, there is a tendency to work with local companies. As such, funding received under CS serves to bolster not only the recipient but contribute to local R&D ecosystem.

Under FP7, 73 UK organisations and universities were involved in a total of 102 different projects. EU funding for these projects involving one or more UK partners totalled €56.7m. Notably, while many partners and participants are only involved in one or two projects, others have been involved in many. The Universities of Bristol and Manchester have been involved in ten and eight projects respectively, and other organisations have also been heavily involved, such as TWI Ltd. (11 projects) and GKN Aerospace Services Ltd. (ten projects). The number of UK-based participating organisations and universities remains high for Horizon 2020, according to the map of CS 2 partners: the UK is home to

⁶¹ https://ec.europa.eu/research/press/jti/factsheet_cs2-web.pdf

⁶² The 'mono-beneficiary' opportunity means that any entity can apply alone and has the opportunity to join the scheme after the selection process <http://www.cleansky.eu/smes>

six project leaders, 19 core partners and 29 other partners, totalling 54 participants.⁶³ In particular, as a lead partner, Rolls-Royce are responsible for leading two Integrated Technology Demonstrators (ITDs) and will obtain €70m-€80m for its involvement in CS2.

6.3 Types of activities funded

The Clean Sky JTI uses three complementary instruments to achieve its goals:

- Monitoring and developing technologies, deemed to have promise for future impact, to higher Technology Readiness Levels (TRLs), through the Technology Evaluator
- Concept aircraft design studies into viable conceptual configurations, integrating progressive technologies for a range of future aircraft
- Integrated Technology Demonstrators (ITDs) to determine potential, demonstrate feasibility and facilitate maturation of technology up to TRL6

The Technology Evaluator, a complex computer modelling system capable of predicting technological efficacy, is of significant value for the participating organisations. This tool not only allows reflective evaluation of the technologies developed within the programme, but provide real time feedback for its members and partners. Furthermore it, and the programme as a whole, allows the aerospace sector to reflect on the technologies developed, and the direction of aerospace technologies more generally. As CS is an industry-led programme, the UK's participation in the programme gives participating companies access to information and direction setting processes, and enables them to be strategically involved in the future of the sector itself.

ITDs are large scale testing processes, involving the incorporation of new technologies into an aircraft for real-life operational test flight, and are focussed in the areas of Green Rotorcraft, Green Regional Aircraft, Eco Design, Sustainable and Green Engines, Smart Fixed Wing Aircraft and Systems for Green Operations.

The aerospace sector within Europe is one of global excellence, with the aeronautical industry contributing 4% of EU GDP in 2013 and over half a million jobs.⁶⁴ As such, access to this market may be partially facilitated through access to the CS projects, offering UK firms access to a wider range of potential collaborators that may not be as accessible without their involvement in the programme.

6.4 Potential risks in the context of Brexit

Participation in the CS JTI is subject to H2020 funding rules, whereby participants may receive funding only when an organisations participation in the project is deemed essential for the action, enacted within an existing bilateral arrangement between the EU and the third country, or clearly laid out within the work plan. Furthermore, only entities established in Member States or Associated Countries are eligible to apply as Core Partners, and as such this could significantly limit the influence and participation of larger organisations based in the UK such as Rolls-Royce.⁶⁵

Given the large size of national aerospace funding programmes, other funding opportunities for funding are still available to larger aerospace firms based in the UK through the Aerospace Technology Institute (ATI). The ATI provides strategic direction and public/private funding for UK aerospace R&D, with a programme that is significantly larger than other EU countries. However, our consultation partner suggested that CS and CS2 “facilitated consistency of planning that is important for research and products with such long lead times.”

⁶³ See: <http://www.cleansky.eu/clean-sky-2-map-o>

⁶⁴ See: <http://www.cleansky.eu/benefits>

⁶⁵ See: http://ec.europa.eu/research/participants/portal/doc/call/h2020/jti-cs2-cpw-lpa-01-02/1630102-cs2-cpw01-qanda_r6_en.pdf

Rolls-Royce functions as the lead partner on many ATI projects, thereby encouraging the engagement and development of the sector in the UK. Furthermore, Rolls-Royce additionally have access to the German federal aerospace research funding programme (Luftfahrtforschungsprogramm), through their German-based sites. Given the national focus of these programmes however, they do not easily allow for engagement of companies outside of their countries. As such, while funding is an important aspect of CS, its unique value lies within the capacity to enable cross border collaboration. In doing so, our consultation partner suggested that CS works to amplify the work of the national projects, connecting partners and programmes across Europe to facilitate the scaling up of individual technology projects to a ‘system level strata’.

Should UK firms not have access to these projects, they could have trouble forming such collaborative partnerships with European-based firms and accessing the wider R&D ecosystem.

In light of this however, larger firms participating in CS are also more likely to have pre-existing partnerships and connections, for example Rolls-Royce have a supply chain spanning the EU and beyond. Furthermore, with skills and expertise based in other European countries, there is scope for moving more research projects to mainland Europe. Given the role funding plays in supporting local R&D ecosystems, it follows that the loss of this resource may prove more detrimental for UK-based SMEs. While these companies are still able to access national funding, they will lose the opportunities to engage with the wider European community.

7 The European Metrology Programme for Innovation and Research (EMPIR)

7.1 Introduction to the case

Metrology is the science of measurement, that is, research into the development of the next generation of measurement techniques. As such, it plays a central role in the UK Quality Infrastructure, i.e. standardisation, testing and measurement, and certification and accreditation.⁶⁶ Within this domain, the laboratories funded by the BEIS National Measurement System programmes, and in particular the National Physical Laboratory (NPL), provide the foundation for measurement activities throughout academia, industry and wider society in the UK.

Many of the issues around measurement are common to many countries, e.g. climate change, energy and healthcare. Collaborative research on common challenges means that costs and workload can be shared and wasteful duplication reduced, and the benefits of shared results enable more to be achieved, and faster progress, amplifying the direct financial contribution. Cross border collaboration can also open access to specialist equipment or expertise.

The European Metrology Programme for Innovation and Research (EMPIR) is the culmination of more than 15 years of collaboration with EU support from a series of EU grants, including an ERA-NET preparatory grant (MERA), a full ERA-NET grant (iMERA), an ERA-NET Plus bridging grant (iMERA-Plus), leading the way for the large-scale research and innovation programmes, the European Metrology Research Programme (EMRP) under FP7 and the EMPIR under Horizon 2020. It is a key example of the European Commission's model for 'Public-Public partnerships' (P2P) which aim to support coordination and collaboration between national and regional research and innovation activities.⁶⁷

7.2 Overview of EU funding ⁶⁸

The European Metrology Research Programme (EMRP) was a €400m programme jointly funded by the European Commission (EC) and Member States. Much of the drive and thinking to develop the European Metrology Research programmes came from the NPL.

An annual call for research projects was issued between 2009 and 2013, with 119 projects selected for funding. Each project runs for three years with the final projects from the 2013 call expected to report in 2017. The European Metrology Programme for Innovation and Research (EMPIR) is €600m, similarly joint funded. The first annual call was issued in 2014 and these will continue until 2020 with work continuing until 2024.

The UK is the second largest participant in the programmes, close behind Germany. The UK's core commitment to EMPIR is €83m over the period 2014-2024, with a further €41.5m available as a reserve. NPL was awarded 22% of total EMRP available funding, and it could be expected to achieve wins of a similar order over the course of EMPIR.

7.3 Types of activities funded

The Metrology Research Programmes' calls fund collaborative metrology research and are largely responding to Grand Challenges.

⁶⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/554803/UKQI-UK-Quality-Infrastructure-brochure-UK-EN.pdf

⁶⁷ <https://www.era-learn.eu/public-to-public-partnerships>

⁶⁸ Funding provided by the EMRP and EMPIR programmes is not included in EU's CORDA dataset and available data does not allow for any detailed analysis of funding from these programmes.

- Themes for EMRP were: Energy, Industry, Environment, Health, New Technologies as well as Support for the International System of Units (SI) and Open Excellence.
- EMPIR calls will cover: Industry, Health, Environment, Energy, SI as well as calls for Fundamental science, for building research capability, supporting the production of Standards and maximising the impact from the earlier programme.

Most of the funding from the Metrology Research Programmes goes through the EU National Metrology Institutes and related Designated Institutes (such as NPL in the UK), but external partners, which include HEIs, research institutes and industry, can also receive funding. The proportion of funding for external partners has increased over time with the target now being about 30%. The UK National Measurement laboratories co-fund the EU work from their domestic programmes which ensures that the work is aligned with the UK Measurement Strategy and provides additional leverage to this.

7.4 Potential risks in the context of Brexit

In the context of Brexit, the UK is at risk from losing the benefits of collaboration in the Metrology Research Programmes and is at risk of losing income to, amongst others, the NPL. Over the last few years NPL has seen a rapid increase in revenue from the EU, such that in 2014 it equated to 17% of its turnover. Most of this revenue results from participation in the European Metrology Research programmes and from contracts won to manage the programme on behalf of EURAMET, the association of metrology institutes delegated to act for the EU Commission.

Because the UK is a core contributor, there may also be negative implications for the future of the programmes.

8 The role of EU funding for UK SMEs

8.1 Introduction to the case

Under the definition of the European Commission, small and medium-sized enterprises (SMEs) have fewer than 250 employees. This group of companies represents 99% of all businesses in the EU.⁶⁹

Support for innovative SMEs was a priority in FP7 and is in Horizon 2020, and UK SMEs have been among the most successful at winning grants from these programmes. Direct support to SMEs provides opportunities for SMEs to undertake research and innovation activities that are often difficult for them to finance.

SMEs are embedded into wider research and innovation ecosystems in which large companies perform the vast majority of research and innovation. Support for SMEs should therefore not be seen in isolation from the support to larger companies with which they collaborate.

8.2 Overview of EU funding and activities funded

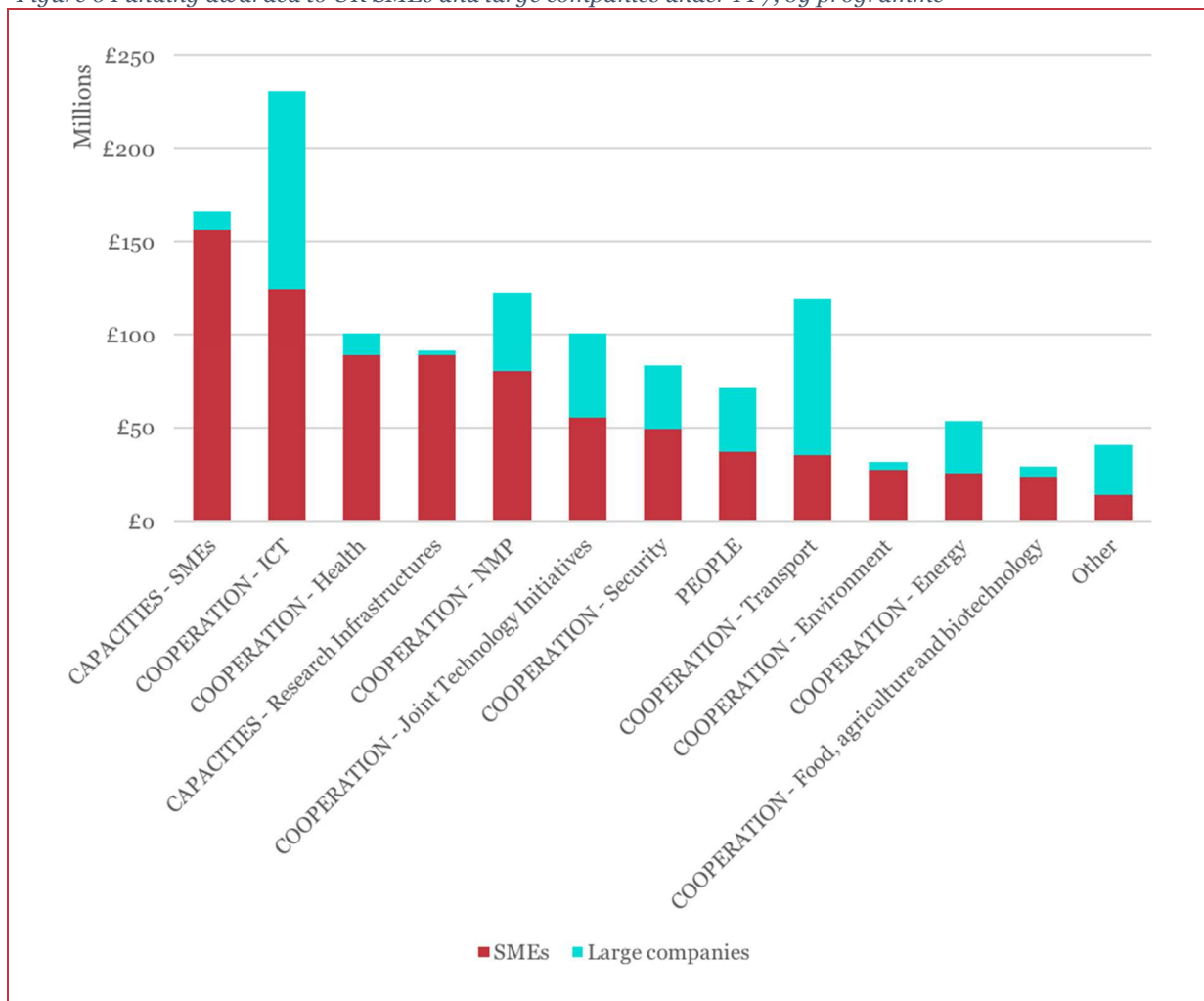
SMEs are among the most important beneficiaries of funding from the Framework programmes as well as from the European Regional Development Fund (ERDF).

8.2.1 FP7

Under FP7, targeted SME support was available under the ‘Capacities’ specific programme, from which UK SMEs received €156.2m (excluding non-for-profit) over the programming period. In addition, SMEs received significant amounts of funding under several thematic areas of the ‘Cooperation’ specific programme, including Health, ICT and materials (NMP). Overall, UK SMEs received 12.8% of all UK funding from FP7, and 65% of funding for UK companies (see Figure 6, below).

⁶⁹ http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en

Figure 6 Funding awarded to UK SMEs and large companies under FP7, by programme



Source: CORDA, SME and large company data only includes private-for-profit companies

8.2.2 Horizon 2020 ⁷⁰

In Horizon 2020, SMEs are particularly encouraged to seek support through the ‘Innovation in SMEs’ programme under the Industrial Leadership (pillar II) and under the seven Societal Challenges (pillar III). A new ‘SME Instrument’ has also been introduced to support for-profit SMEs with simpler rules and procedures and a budget of €3bn.

Up to 2014-2015, SMEs from all countries have received 23.7% (€2.1bn) of funding from the two programmes, surpassing the EU’s 20% target. Two UK SMEs, Geant Limited⁷¹ and ITM Power Limited, are first and third respectively on the list of SME beneficiaries from Horizon 2020. Total funding awarded through the dedicated SME Instrument amounted to €524.9m, of which 17.2% has been awarded to UK SMEs.⁷² Looking at the whole of Horizon 2020, UK SMEs are recorded as receiving more funding than those in any other country.

⁷⁰ At the time of writing, the available version of CORDA data for Horizon 2020 does not contain reliable data on company size. This problem may be addressed in an upcoming data release from the European Commission.

⁷¹ Geant is listed as a for-profit company (PRC) and SME in CORDA statistics but stakeholders consulted for this study believe this to be incorrect, that it is a non-profit organisation. The analysis here relies on EU CORDA data.

⁷² Horizon 2020 Monitoring Report 2015, European Commission, pp. 211, 248

ITM Power is an SME that specialises in the manufacture of integrated hydrogen energy systems. ITM has participated in several EU projects, including two Hydrogen Mobility Europe projects (H2ME and H2ME 2). The first of these projects (H2ME), is the most ambitious coordinated hydrogen deployment project attempted in Europe, involving the deployment of fuel cell vehicles, refuelling stations, four national hydrogen mobility strategies, and reflective technological and consumer analysis.⁷³ H2ME 2, an extension of H2ME, involves expanding the focus across to eight European countries and increasing the manufacturing capabilities and addressing innovative requirements for hydrogen mobility market ready. ITM Power received €2.34m for H2ME and €5.57m for H2ME 2.

8.2.3 European Regional Development Funds (ERDF)

ERDF funds have also been an important source of support for SMEs research and innovation activities. The EU has budgeted (in the context of the ERDF) €1.48bn for research and innovation in the UK for the period 2014-2020. Most, but not all, of this funding falls under Priority Axis 1 (Research and Innovation). Closer analysis shows that 58.6% (€865m) of this sum is targeted directly or indirectly at SMEs as shown in Table 3, below.

Table 3 Planned ERDF funding for research and innovation in UK SMEs (2014-2020), in € millions

ERDF intervention field	England	Wales	Scotland	Northern Ireland	UK total
001 Generic productive investment in small and medium –sized enterprises ('SMEs')	€ 0	€ 0	€ 16.5m	€ 0	€ 16.5m
056 – investment in infrastructure, capacities and equipment in SMEs directly linked to research and innovation activities	€ 102.8m	€ 17.8m	€ 0	€ 76.1m	€ 196.8m
062 – technology transfer and university-enterprise cooperation primarily benefiting SMEs	€ 100.8m	€ 55.2m	€ 47.0m	€ 0	€ 203.0m
063 – cluster support and business networks primarily benefiting SMEs	€ 100.8m	€ 27.6m	€ 0	€ 0	€ 128.4m
064 – Research and innovation processes in SMEs (including voucher schemes, process, design, service and social innovation)	€ 100.8m	€ 63.9m	€ 48.0m	€ 4.7m	€ 217.4m
067 – SME business development, support to entrepreneurship and incubation (including support to spin offs and spin outs)	€ 102.8m	€ 0	€ 0	€ 0	€ 102.8m
TOTAL ERDF support for research and innovation in SMEs.	€ 507.9m	€ 164.5m	€ 111.5m	€ 80.8m	€ 864.8m
SME support as share of all UK ERDF funding for research and innovation	62.2%	42.4%	70.7%	71.2%	58.6%

Source: Operational programmes for ERDF 2014-2020 (England, East Wales, West Wales and the Valleys, Northern Ireland, Scotland).

8.3 Potential risks in the context of Brexit

UK SMEs receive large amounts of funding from EU Framework Programmes and EU Structural and Investment Funds. Whereas the business sector as a whole is less reliant on EU funding, support for SMEs through FP7 alone corresponded to 16.9% of total SME spend on research and innovation over the programming period (2007-2013) This is show in Table 4, below. In addition, the value of ERDF support for UK SMEs is of a similar magnitude. There is anecdotal evidence of companies depending on EU funding for as much as 75% of their R&D expenditure in certain periods.

⁷³ http://cordis.europa.eu/project/rcn/198091_en.html

Table 4 FP7 funding (2007-2013) in proportion to total R&D expenditure by UK SMEs and large businesses, in millions of pounds

	FP7 funding (2007-2013)	Business Enterprise R&D expenditure	FP7 funding as proportion of R&D expenditure
UK SMEs	£658m	£3,885m	16.9%
UK large businesses	£354m	£112,660m	0.3%
All UK businesses	£1,012m	£116,545m	0.9%

Sources: CORDA and UK Office of National Statistics⁷⁴

^[1] Average exchange for the period 2007 to 2013: 1.225 EUR/GBP

During the period of the most recently completed EU financial framework (2007/08-2013/14), Innovate UK (then TSB) provided £697m worth of grants for micro, small and medium-sized companies – just under £100m per year – thus slightly more than FP7. Since then, annual Innovate UK funding for SMEs has more than doubled to approximately £250m in 2014/15 and 2015/16. Innovate UK is a well-regarded and flexible funder of commercially-oriented projects, however, EU funding provides specific benefits. Amongst those mentioned to us by stakeholders are:

- Access to a larger pool of collaborators, including ways to work with HEIs and other partners not typically included in Innovate UK-funded projects
- Sharing of knowledge and skills across the network of collaborators
- Higher funding rates (up to 100% for certain project types), making it viable to undertake certain types of more fundamental work regardless of short-term commercial return
- Pre-payments given as part of EU grants are particularly useful to SMEs, as they give financial stability
- Help for the development of business models and expansion into new markets.

The consequences of losing access to EU funding could be radical for some companies. Anecdotal evidence indicates that inquiries from European partners about new projects has gone down compared to previous years, and that concerns about access to funding as well as talent has led some SMEs to draw up plans to relocate R&D activities to EU27 ahead of the UK's formal departure from the EU. It is not possible, on the basis of available evidence, to quantify such developments at this time.

⁷⁴ Office of National Statistics (2016), *Business enterprise research and development, UK: 2015*, Statistical Bulletin, November 2016, table 26.

9 The role of EU funding for research and innovation in Wales

9.1 Introduction to the case

The 2012 Welsh Government strategy for science sets out a strong commitment to building the capacity of Welsh research centres and groups in order to achieve a step change in performance.⁷⁵ The 2014 Welsh national strategy for innovation sets a focus on greater commercialisation of science and research, including increased knowledge transfer, collaboration, and innovation activity among Welsh businesses.⁷⁶ Wales is highly dependent on European funding. Examining the role of EU funding at the level of the Devolved Administration allows us to see how different funding streams interact, and in which strategic areas European funding contributes – in particular, research and innovation infrastructures, and the development of capacities and capabilities in the research base.

9.2 Overview of EU funding

The allocation of European Structural and Investment Funds to the Devolved Administrations is set out by the UK Government.⁷⁷ The Welsh European Funding Office (WEFO) within the Welsh Government is the Managing Authority and is responsible for delivery of European Structural and Investment Funds in Wales⁷⁸, as well as programmes for territorial co-operation (e.g. ERDF INTERREG), and the EU Framework Programmes for Research and Innovation. The two 2014 to 2020 Structural and Investment Funds Operational Programmes in Wales (that is, how the funds would be implemented over the programming period) were developed through a partnership between the UK Government, the European Commission and Welsh partners.⁷⁹

Wales is a significant beneficiary of EU funding for research and innovation. Prior to any changes following the UK's decision to withdraw from the EU, Wales had been allocated €388m (26%) of the UK's €1.4bn European Regional Development Fund (ERDF) for research and innovation under the 2014-2020 programming period, the highest of any of the UK Devolved Administrations. From the two most recent EU Framework Programmes, Wales has received almost €200m (€145m in FP7 and €55m to date in Horizon 2020), 2% of the total awarded to the UK. Wales has also been a significant beneficiary of funding from the European Investment Bank (EIB). Between 2012 and 2016, Wales received €211m in EIB financing for key projects in Higher Education, 8% of the total awarded to the UK Higher Education sector over this period.

9.3 Types of activities funded

Wales's ERDF budget for research and innovation is set out against 12 intervention categories, with high concentrations in four areas⁸⁰: There is a strategic focus in the areas of research and innovation infrastructure (categories 058 (public) and 059 (private) together is 24% - higher than the overall UK allocation), research and innovation infrastructure, processes, technology transfer and cooperation in enterprises focusing on the low carbon economy and on resilience to climate change (category 065, 22%), research and innovation processes in SMEs (category 064, 16%), and technology transfer and university-enterprise cooperation primarily benefiting SMEs (category 062, 14%). Information

⁷⁵ Welsh Government (2012) Science for Wales: A strategic agenda for science and innovation in Wales. <http://gov.wales/docs/det/publications/120306scienceen.pdf>

⁷⁶ Welsh Government (2014) Innovation Wales. <http://gov.wales/docs/det/publications/140313innovationstrategyen.pdf>

⁷⁷ See: <https://www.gov.uk/government/news/allocation-of-eu-structural-funding-across-the-uk>

⁷⁸ See: http://ec.europa.eu/regional_policy/en/atlas/managing-authorities/?search=1&keywords=&periodId=3&countryCode=UK&typeId=ALL

⁷⁹ See: <https://www.gov.uk/government/publications/european-structural-and-investment-funds/european-funds-european-structural-and-investment-funds#government-role>

⁸⁰ West Wales and the Valleys ERDF Operational Programme: <http://gov.wales/docs/wefo/publications/141206westwalesandvalleysopen.pdf> and East Wales ERDF Operational Programme: <http://gov.wales/docs/wefo/publications/141210erdfeastwalesen.pdf>

provided to the study team illustrates how ERDF funding is being used in Wales to fund projects such as £20m funding for the £36m Aberystwyth Innovation & Enterprise Campus (approved in 2014)⁸¹, and £15m funding for the £26m investment in Swansea University’s Sustainable Product Engineering Centre for Innovation in Functional Coatings (SPECIFIC, approved in 2015 and in partnership with Cardiff University and industry).^{82, 83}

Welsh participants in the last two EU Framework Programmes have drawn down a significant proportion of funding for talent development through Marie Skłodowska-Curie Actions (around one fifth of funding awarded to Welsh participants in FP7 and one third of funding awarded to Welsh participants in Horizon 2020). The largest participation funded in Horizon 2020 is a €9.6m grant awarded to the Welsh Assembly for ‘Strengthening Research Capacity in Wales’. This grant part-funds the second phase of the Sêr Cymru (‘Stars Wales’) programme, which aims to strengthen the capacity of Wales’s leading research groups via talent attraction and training,⁸⁴ particularly in Wales’s three Grand Challenge science activities (advanced materials and manufacturing, life sciences, and energy and environment).⁸⁵ The second phase of the programme is also supported through ERDF and Welsh national and institutional funding. As of 2016, the four Sêr Cymru Research Chairs attracted to Wales, and the three National Research Networks had secured €36.4m⁸⁶ of competitive research funding for Wales, and had also been successful at securing competitive Welsh research funding.⁸⁷

Table 5 Sêr Cymru (‘Stars Wales’) programme phases

Phase	Support for	Budget and funding source	Duration
I	Establishment of three National Research Networks, with dedicated directors Appointment of Four Sêr Cymru Research Chairs	€58.6m 70% from Welsh Government 30% from the Higher Education Funding Council for Wales	5 years
II	90x 3-year COFUND Research Fellows 30x 3-year Research Fellows 12x 3-year ‘Recapturing Research Talent’ Fellowships 26x 5-year ‘Rising Star’ fellowships Strategic Awards for Capital Equipment Staff to support rising stars Delivery team	€67.3m 11% from Marie-Skłodowska-Curie Co-Funds 41% from ERDF 12% Welsh Government 6% Higher Education Funding Council for Wales 30% HEI match contribution	5 years

Source: Welsh Government Enterprise & Business Committee Scrutiny Session – Science, Research and Horizon 2020 <http://www.senedd.assembly.wales/documents/s46282/EBC4-28-15%20p.1%20Evidence%20from%20the%20Chief%20Scientific%20Adviser%20for%20Wales.html?CT=2> and HEFCW: https://www.hefcw.ac.uk/documents/council_and_committees/council_papers_and_minutes/2016/16%2009%20Ser%20Cymru.pdf Note: Amounts converted from GBP at current rates via InforEuro: http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/index_en.cfm

Welsh researchers have also secured a significant amount of European Research Council (ERC) grants, indicating an ability to attract funding for scientific excellence in a relatively broad set of domains. Our consultation partners suggested that the broader suite of European funding had been key to developing the capabilities and capacities to secure such high-profile funding in Wales, in part due to

⁸¹ See: <http://aiec.wales/>

⁸² See: <http://www.specific.eu.com/about>

⁸³ A full list of approved projects is available at <http://gov.wales/funding/eu-funds/2014-2020/approved-projects/?lang=en>

⁸⁴ Welsh Government (2015) New Frontiers: Cutting-edge Science in Wales. <http://gov.wales/docs/det/publications/150807-new-frontiers-en.pdf>

⁸⁵ The three areas are: advanced materials and manufacturing, life sciences, and energy and environment, as per <http://gov.wales/topics/science-and-technology/science/growing-research-in-wales/national-research-networks/?lang=en>

⁸⁶ Converted from GBP at current rates via InforEuro: http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/index_en.cfm

⁸⁷ See: <http://gov.wales/docs/det/report/160331-science-for-wales-report-2016-en.pdf>

the development of scientific excellence, as well as in building experience and capability in the research base itself.

Wales has received large-scale investments in university facilities from the European Investment Bank (EIB). Between 2012 and 2016, the EIB invested over €211m in campus developments and upgrades to facilities and infrastructure. These flagship developments also leverage other significant investment. For example, the Swansea University Bay Campus was also supported by €49.4m of ERDF investment^{88 89}, plus other regional, institutional and industry funding, including Rolls Royce, Tata and BP. Early regional impacts have been estimated, and include a 119% increase in the number of research awards for the university, and an up-skilling of 165 local people during construction.⁹⁰

Table 6 Selected EIB university investments in Wales, 2012-2016

University	Year	Investment	Description
Swansea University	2012	€ 31.7m	Establishment of an innovation platform with the aim of giving new impetus to the economy of the Wales region through R&D activities in cooperation with companies
Swansea University	2012	€ 43.7m	
Swansea University Campus Optimisation	2016	€ 71.3m	Enhance the Singleton Park Campus and expand research facilities at the new Bay Campus.
Bangor University	2014	€ 54.5m	Expansion and modernisation of campus, upgrade to teaching and research facilities
Bangor University	2016	€ 10.2m	
Total		€ 211.4m	

Source: EIB funded projects data: <http://www.eib.org/projects/loan/list/index.htm>

9.4 Potential risks in the context of Brexit

Our consultation partners suggested that EU funding has played an important developmental role in Wales in two main areas: investment in research and innovation-focused facilities, and the development of capabilities in the Welsh research base. This developmental support was described as being complementary to UK funding, which primarily supports areas of existing excellence.

Significant investment has been stimulated in Wales by EU programmes, and there was uncertainty among our interviewees around what would replace European funding, as well as a sense that research and innovation is not seen as a devolved matter.

The White Paper “Securing Wales’ Future: Transition from the European Union to a new relationship with Europe”⁹¹ published in 2017, raises specific concerns in areas of strategic importance. In relation to the higher education system, the paper outlines risks to the attraction and retention of talent, which has been supported by both EU funding and free movement. There is concern that significant resource could leave the Welsh system. “The Single Market of the Mind”,⁹² also published in 2017, suggests that Wales’ higher education sector will be disproportionately affected as EU funding represents nearly two thirds of competitive funding to the sector from the UK Research Councils and Innovate UK, in

⁸⁸ See: <http://www.swansea.ac.uk/media-centre/latest-news/swansea-singleton-park-campus-to-be-transformed-with-60-million-new-european-investment-bank-backing.php> and <http://www.eib.org/infocentre/press/releases/all/2012/2012-122-GBP-60-million-European-funding-boost-for-Swansea-University.htm>

⁸⁹ See: <http://www.swansea.ac.uk/media-centre/news-archive/2015/first-minister-opens-university-bay-campus-engineering-quarter.php>

⁹⁰ See: <http://www.swansea.ac.uk/campus-development/economic-impact/>

⁹¹ Welsh Government (2017) Securing Wales’ Future: Transition from the European Union to a new relationship with Europe: https://beta.gov.wales/sites/default/files/2017-01/30683%20Securing%20Wales%2%B9%20Future_ENGLISH_WEB.pdf

⁹² Talfan Davies, G. (2017) The Single Market of the Mind: Education and Culture in Wales after the Europe referendum

contrast to one third in the rest of the UK. The report also argues that potential risks stretch beyond funding to access to expertise and participation in formal European academic networks.

10 The role of EU funding for research and innovation in Northern Ireland

10.1 Introduction to the case

Northern Ireland has a relatively small pool of R&D-active firms, and it has been a strategic priority to embed R&D deeper into the core of the country's business activity,⁹³ particularly to complement areas of research excellence. EU funding is an important source of funding for programmes and interventions that seek to address these national strategic priorities, such as targeted business support programmes and the establishment of key infrastructure that supports development of the research base and leverages further funding or collaboration.

10.2 Overview of EU funding

The allocation of European Structural and Investment Funds to the Devolved Administrations is set out by the UK Government.⁹⁴ There are several organisations that take the role of Managing Authority in Northern Ireland: the Department for the Economy of the Northern Ireland Executive, and the cross-border Special EU Programmes Body, which takes responsibility for territorial co-operation funds.⁹⁵ The 2014 to 2020 Operational Programme for Northern Ireland was developed collaboratively between the UK Government, Northern Ireland Managing Authorities and the European Commission.⁹⁶

Northern Ireland has been allocated 8% of the €1.4bn UK European Regional Development Fund (ERDF) budget for research and innovation⁹⁷, amounting to €113.4m. Over the two most recent EU Framework Programmes, Northern Ireland has drawn down more than €145m in European Commission contributions (€102.4m in FP7 and €43.0m to February 2017 in Horizon 2020). Northern Ireland has also been a beneficiary of cross-border funding via the PEACE and INTERREG programmes. The current PEACE IV programme focuses on cross-community and cross-border societal actions in Northern Ireland and the Border Region, Midlands and West of Ireland, across four areas: shared education, children and young people, shared spaces and services, and building positive relations.⁹⁸ The current INTERREG VA programme United Kingdom-Ireland (Ireland-Northern Ireland-Scotland) supports cross-border cooperation in three areas of importance for job creation and growth: Research and Innovation, Environment, Sustainable Transport, and Health. To April 2017, Irish and Northern Irish projects have secured €50.1m through PEACE IV and €152.1m through INTERREG VA.⁹⁹ Finally, the European Investment Bank (EIB) has invested almost €183m in campus development at the University of Ulster, with a loan agreed in 2014.

10.3 Types of activities funded

Northern Ireland's ERDF budget allocation for research and innovation is set out against three categories of intervention, and is highly concentrated in areas of business benefit: investment in infrastructure, capacities and equipment in companies directly linked to research and innovation

⁹³ Invest Northern Ireland Strategic Plan to 2015: <https://secure.investni.com/static/library/invest-ni/documents/corporate-plan-2011-2015.pdf>

⁹⁴ See: <https://www.gov.uk/government/news/allocation-of-eu-structural-funding-across-the-uk>

⁹⁵ See: http://ec.europa.eu/regional_policy/en/atlas/managing-authorities/?search=1&keywords=&periodId=3&countryCode=UK&typeId=ALL

⁹⁶ See: <https://www.gov.uk/government/publications/european-structural-and-investment-funds/european-funds-european-structural-and-investment-funds#government-role>

⁹⁷ See InvestNI: <http://www.investni.com/news/eu-support-helps-northern-ireland-smes-to-succeed.html> and IGJNI: <http://www.jobsandgrowthni.gov.uk/the-programme/programme-priorities/research-and-innovation/>

⁹⁸ See: http://ec.europa.eu/regional_policy/en/atlas/programmes/2014-2020/united-kingdom/2014tc16rfpcoo1

⁹⁹ See: <http://www.seupb.eu/Home.aspx>

activities (96% overall, 67% to SMEs and 29% to large companies).¹⁰⁰ ERDF part-funds (60%) a €200m EU Investment for Growth and Jobs Programme run by Invest Northern Ireland,¹⁰¹ which assists Northern Irish businesses via R&D support, a design service and access to financial instruments. The programme is scheduled to run to December 2020.

Our consultation suggests that ERDF has been an important catalyst for research and innovation in Northern Ireland, especially in terms of investing in buildings and capital equipment that has subsequently attracted researchers, leveraged further investment, and sparked innovation activities. One powerful example of the impact of such investments is the Nanotechnology and Integrated BioEngineering Centre (NIBEC) at the University of Ulster. The NIBEC building was supported through ERDF grants totalling £6m, and economic appraisals estimate the centre has attracted over 90 researchers, and leveraged approximately £50m in research funding from the EU Framework Programmes, INTERREG, the US-Ireland Research Partnership, Invest Northern Ireland, the UK Research Councils and industry. The Centre has generated 35 patents, and high value spinout companies valued collectively at £100m¹⁰².

Over the last two Framework Programmes, Northern Irish participants have drawn down a significant proportion of their European Commission contribution via Marie Skłodowska-Curie Actions (almost one fifth in FP7 and over one quarter in Horizon 2020). In other areas, there is an evident concentration in energy and health/life sciences. Queens University Belfast leads a flagship Innovative Medicines Initiative project, the five-year iABC project, funded in 2015.¹⁰³ The total EC contribution to the University is €23.5m. It was suggested that while Northern Ireland is successful in obtaining this kind of funding, as well as UK Research Council grants and innovation funding from central government (e.g. Innovate UK), it is rarely able to compete with the Golden Triangle in obtaining research funding.

The University of Ulster was recently awarded €23m of funding through INTERREG VA,¹⁰⁴ which supports three projects in personalised medicine, renewable energy and connected health technology.¹⁰⁵ Our consultation partner singled out the €8.1m Eastern Corridor Medical Engineering Centre project (ECME) as being a unique opportunity to work cross-border on common issues and data collection that would not be afforded domestically. The University of Ulster expects ECME to demonstrate an output of over €29m in the UK, with approximately €19m of this being in Northern Ireland.¹⁰⁶ Participants' access to knowledge networks and the building of international reputation were also discussed as broader benefits of accessing EU funding.

The University of Ulster has also received large-scale investment in facilities from the European Investment Bank (EIB), totalling €183m, to relocate most of its Jordanstown campus to Belfast City Centre by 2018, as well as upgrades at the Magee, Coleraine and Jordanstown campuses.

¹⁰⁰ Northern Ireland Operational Programme:
[http://www.jobsandgrowthni.gov.uk/downloads/Investment for Growth and Jobs Operational Programme.pdf](http://www.jobsandgrowthni.gov.uk/downloads/Investment%20for%20Growth%20and%20Jobs%20Operational%20Programme.pdf) (p.58)

¹⁰¹ Converted from stated £170m at current rates, via InforEuro:
http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/index_en.cfm

¹⁰² Case study: University of Ulster – A successful Research Centre and Spinning out medical technology because of EU Funding.

¹⁰³ See: <https://www.imi.europa.eu/content/iabc>

¹⁰⁴ Interreg V-A - United Kingdom-Ireland (Ireland-Northern Ireland-Scotland). Thematic Objective 1 – Strengthening research, technological development and innovation will receive an EC funding of €61m (25% of the total). Investment priority 1.1: Enhancing research and innovation €45m (19%); Investment priority 1.2: Promoting business investment in Research and Innovation: €16m (6%). See: [http://www.seupb.eu/Libraries/INTERREG VA Programme Guidance/IVA AdoptionByEC 28-01-2015.sflb.ashx](http://www.seupb.eu/Libraries/INTERREG_VA_Programme_Guidance/IVA_AdoptionByEC_28-01-2015.sflb.ashx) (page 24)

¹⁰⁵ See: <https://www.ulster.ac.uk/news/2017/january/ulster-university-wins-landmark-23-million-of-eu-cross-border-funding-for-research-and-innovation>

¹⁰⁶ See: <https://www.ulster.ac.uk/news/2017/january/ulster-university-wins-landmark-23-million-of-eu-cross-border-funding-for-research-and-innovation>

In addition to the scale of investment possible through EU funding sources, our consultation partner suggested that the mixture of funding and funding models has been significant for Northern Ireland. The strategic focus on boosting and embedding R&D activity in the business base has led to an increase in innovation funding. Funding a mix of Technology Readiness Levels (TRLs) is seen as important to underpin this. Invest Northern Ireland aims to fund TRLs 5-8, as part of the effort to enable Northern Ireland's businesses to innovate, and to complement UK Research Council funding.

10.4 Potential risks in the context of Brexit

While there is a broad acknowledgement of the flux of funding cycles over time, stakeholders in Northern Ireland see a risk attached to losing the opportunity to fund a mixture of TRLs. In this sense, the 'EU model' of research and innovation funding is seen to meet this mix, and would need to be replicated by any UK-based approach. It was suggested that if the funding for the full range of TRLs were to cease without replacement, there would be a negative impact on the country's ability to support innovation.

European funding also supports significant development opportunities for academics and businesses in their access to knowledge networks, which is particularly important to peripheral regions. In addition, it supports more formal training for PhD students, which has been an issue of importance in Northern Ireland. There is a sense that if this were to be removed from the country, there would be a negative impact on the labour market, and thus on the growth of companies and the broader Northern Irish economy.

In addition to concerns about funding and access to networks, there is a risk posed to the continued movement of people, samples and equipment across Northern Ireland's land border between the UK and EU as Northern Ireland's academic community straddles the land border.¹⁰⁷ Also potentially at risk is the current tri-jurisdictional support for the US-Ireland Research Partnership (the UK, Ireland and the US). These are issues that are unique to Northern Ireland and there is a strong belief that special consideration should be taken to sustain both arrangements.

¹⁰⁷ Royal Irish Academy Submission to the UK House of Commons Select Committee on Science & Technology Inquiry: Leaving the EU: Implications and Opportunities for Science and Research. 22nd August 2016.

11 The role of EU funding for research and innovation in Scotland

11.1 Introduction to the case

Under the innovation priority of the Scottish Government's economic strategy, there is a strong focus on increasing business innovation and entrepreneurship, as well as commercialisation of R&D.¹⁰⁸ This is further reflected in the business plans of the two regional development agencies, Scottish Enterprise¹⁰⁹ and Highlands and Islands Enterprise¹¹⁰, where programmes to encourage and enable businesses to innovate are set out, and activities to help boost knowledge transfer and commercialisation. EU funding plays a significant role in resourcing these strategic aims.

11.2 Overview of EU funding

The allocation of European Structural and Investment Funds to the Devolved Administrations is set out by the UK Government.¹¹¹ In Scotland, the Scottish Government is the Managing Authority for the delivery of European Structural and Investment Funds¹¹², taking responsibility to ensure that the funds deliver on the European Commission themes of creating smart, sustainable and inclusive growth, as well as contributing to Scotland's national outcomes.

Scotland has been allocated 11% of the UK's €1.4bn for research and innovation under the European Regional Development Fund (ERDF), amounting to €157.6m. This funding has in turn been allocated to four categories of intervention, each of which relates to support for SMEs.¹¹³ Across the two most recent EU Framework Programmes, Scottish participants have drawn down just over €1.0bn of European Commission contributions (€729.0m in FP7 and €295.7m in Horizon 2020 to February 2017). This is highest among all UK Devolved Administrations. In higher education, Scottish HEIs received approximately €513m of investment from the European Investment Bank (EIB) over four large-scale campus development projects between 2011 and 2016. Finally, Scotland has also been a beneficiary of funding under successive territorial cooperation programmes, including the INTERREG Northern Periphery and Arctic programmes, which specifically supports collaborative international projects within the Euro-Arctic zone (Finland, Ireland, Sweden and the UK - Scotland and Northern Ireland – in cooperation with the Faroe Islands, Iceland, Greenland and Norway).¹¹⁴ The Programme has four priorities: 'using innovation to maintain and develop robust and competitive communities', 'promoting entrepreneurship to realise the potential of the programme area's competitive advantage', 'fostering energy-secure communities through promotion of renewable energy and energy efficiency', and 'protecting, promoting and developing cultural and natural heritage'.

11.3 Types of activities funded

ERDF is used extensively by the two regional development agencies to support businesses to innovate. Scottish Enterprise and partners aim to engage over 5,000 additional SMEs over the three-year period 2015-2018 to raise awareness of innovation and its benefits within the business base, and to build

¹⁰⁸ Scottish Government (2015) Scotland's Economic Strategy. <https://beta.gov.scot/publications/scotlands-economic-strategy/documents/00472389.pdf?inline=true>

¹⁰⁹ Scottish Enterprise Business Plan 2015-2018. <https://www.scottish-enterprise.com/about-us/what-we-do/business-plan-2015-2018>

¹¹⁰ Highlands and Islands Enterprise Operating Plan 2016-2019. <http://www.hie.co.uk/about-hie/policies-and-publications/operating-plan.html>

¹¹¹ See: <https://www.gov.uk/government/news/allocation-of-eu-structural-funding-across-the-uk>

¹¹² See: <https://beta.gov.scot/policies/european-structural-funds/>

¹¹³ See: Scotland ERDF Operational Programme: <http://www.gov.scot/Resource/0046/00467309.pdf>

¹¹⁴ A list of current funded innovation projects under INTERREG-NPA 2014-2020 with Scottish involvement can be found here <http://www.interreg-npa.eu/projects/funded-projects/>

companies' capacity to realise new opportunities for growth.¹¹⁵ Similarly, the Highlands and Islands Enterprise 'Innovate Your Business' programme is part-funded by ERDF¹¹⁶. The programme is a one-to-one support service, and offers four areas of assistance: help to identify areas for growth; development of new products, processes or business models; design and implementation of collaborative projects; identification and securing of finance for innovation activities. There is also a small innovation grant scheme (up to £15,000).¹¹⁷

Scotland has also received £30m in ERDF to enable companies to capture new opportunities presented by the circular economy. This represents 43% of the £70m dedicated in Scotland to manufacturing and the circular economy, as set out in the Scottish Manufacturing Action Plan¹¹⁸, highlighting the significance of EU funding to resourcing these strategic aims.

Finally, the University of the Highlands and Islands was established and sustained with funding support from ERDF and the European Social Fund (ESF), and has subsequently achieved success in securing funding for excellent research through the European Research Council (ERC) grants under the EU Framework Programmes. In sum, these investments have resulted in new employment and economic development opportunities that would not have been available otherwise.¹¹⁹

Examining the Scottish participations funded through the two most recent EU Framework Programmes shows that participants have drawn down a significant proportion of their funding via ERC grants (over one third of total drawdown in FP7 and again in Horizon 2020 to February 2017). Thematically, significant funding has been secured for transport and renewable energy. There is also an indication of increased industry engagement so far under Horizon 2020 as compared to FP7. Our consultation partners stressed that the access to knowledge networks facilitated via the EU Framework Programmes has been a key benefit of European research and innovation funding to Scotland, where it has facilitated collaboration for otherwise isolated areas, and the ability to capitalise on and develop areas of strength more broadly.

Table 7 Selected EIB university investments in Scotland, 2011-2016

University	Year	Investment	Description
University of Strathclyde	2011	€ 100.9m	Restructuring of the two main locations of the Strathclyde University in Glasgow (Scotland)
University of Edinburgh	2012	€ 59.9m	Reconstruction and modernization of buildings on the campus of the University of Edinburgh
City of Glasgow College PPP	2013	€ 95.3m	Construction and maintenance of a new campus at two locations for the City of Glasgow College
University of Edinburgh Capex Programme	2016	€ 257.0m	Increase the relevance and quality of teaching, learning and academic research capacity at the university by increasing and improving the overall quality of the existing academic space.
Total		€ 513.0m	

Source: EIB funded projects data: <http://www.eib.org/projects/loan/list/index.htm>

EIB funding has been secured for four large university projects, primarily focused on modernising, restructuring and improving facilities. The largest of these Scottish awards is €257m awarded to the University of Edinburgh capital expenditure programme to improve teaching and research facilities.

¹¹⁵ Scottish Enterprise Business Plan 2015-2018. <https://www.scottish-enterprise.com/about-us/what-we-do/business-plan-2015-2018>

¹¹⁶ See: <http://news.hie.co.uk/all-news/business-innovation-supported-in-highlands-and-islands/>

¹¹⁷ See: <http://www.hie.co.uk/business-support/innovation-r-d/iyb.html>

¹¹⁸ See: <http://news.gov.scot/news/manufacturing-plan-to-boost-industry>

¹¹⁹ See: http://www.parliament.scot/General%20Documents/University_of_The_Highlands_and_Islands.pdf

11.4 Potential risks in the context of Brexit

EU funding has played an important role in Scotland, and the structure of successive Operational Programmes (which set out how Member States will spend European Structural and Investment Funds in a given period) has helped to address key geographical and socio-economic aspects through close alignment with the enterprise agencies.¹²⁰ ERDF and EU Framework Programme funding has supported key growth sectors such as renewable energy, through investment in both facilities and infrastructure, and funding for excellent research.

EU funding has been of particular importance to the offshore and renewable energy sector in Scotland, and there is a sense that Scotland has become more aligned with European priorities in this area over recent years. There is some concern that the decision of the UK to leave the EU could have a disproportionate effect on this sector, due to a perceived lower level of priority for investment in the sector at the national level than at the European level.

Most recently, EU funding has been increasingly important for supporting businesses to innovate, and, as this strategic priority has in effect been met by EU funds, our consultation partners raised a concern that financing for this purpose would have to be found from elsewhere.

Broader concerns were also reflected in consultation, including reduced engagement with the wider European business and research communities – particularly for organisations in more peripheral areas.

¹²⁰ ADE (2011) Study on the relevance and the effectiveness of ERDF and Cohesion Fund support to Regions with Specific Geographical Features – Islands, Mountainous and Sparsely Populated areas