

Background information

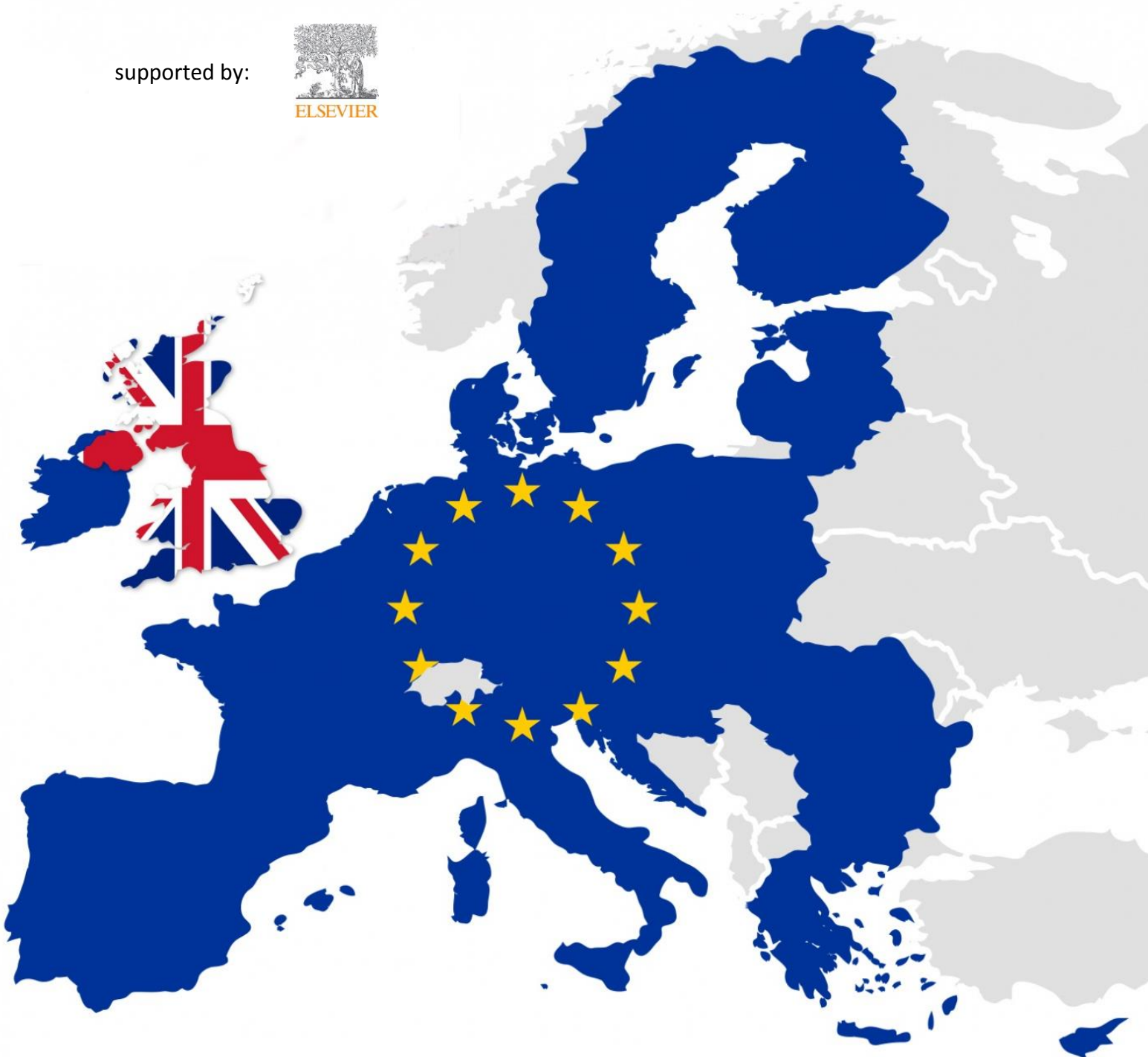
Brexit: The Facts behind Opportunities & Challenges for both the UK & European Science Establishments

Royal Institution, London | 8 May 2017



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EuroScience, the Royal Institution and Academia Europaea with support from Elsevier are organising an open discussion on “Brexit: the facts behind opportunities & challenges for both the UK & European Science Establishments”.

This booklet is intended to inform the debate. It provides factual data in three sections covering:

- 1) Association arrangements for the participation of non-EU countries in Horizon 2020 (*page 3*)
- 2) Flows of EU funding to the UK under Framework Programme 7 and Horizon 2020 (*page 6*)
- 3) Internationalisation of Higher Education and Research (*page 14*)

Data have been collected from various sources including a Royal Society publication; Eurostat; EC and ERC publications and statistics; the Higher Education Statistics Agency (HESA); individual institutions; and a report of HM Treasury.

Dr Luc van Dyck, Ed.

April 24, 2017

Section 1. Association arrangements for the participation of non-EU countries in Horizon 2020

Article 7 of the Regulation establishing Horizon 2020 opens the possibility to non-EU countries to be associated to the Framework Programme (FP) such that legal entities from Associated Countries can participate under the same conditions as legal entities from the EU Member States¹. Further, Associated Countries have the right to send observers to meetings of all the different configurations of the committee which is responsible for the implementation of Horizon 2020 and to the Board of Governors of the JRC, as well as the right to participate in all ERA related bodies as an observer.

Article 7 specifies the countries that are eligible to become associated to Horizon 2020:

- acceding countries, candidate countries and potential candidates;
- countries or territories covered by the *European Neighbourhood Policy*, the foreign relations instrument of the EU addressing those countries to the East and South of the European territory of the EU (e.g. Israel); and,
- members of the European Free Trade Association (EFTA), an intergovernmental organisation set up for the promotion of free trade and economic integration to the benefit of its four Member States: Iceland, Liechtenstein, Norway and Switzerland.

The legal bases for the association to Horizon 2020 are agreements signed between the third country and the 28 EU Member States which cover (notably) scientific cooperation and allow participation in EU programmes. The Horizon 2020 association agreement, including the financial contribution to the budget, is then negotiated between, and signed by the third country and the European Commission.

A standard rate for the financial contribution of associated countries to the framework Programmes does not exist. In principle, the Commission aims to use a simple proportionality factor, calculated every year, obtained by establishing the ratio between the gross domestic product (GDP) of the third country and the sum of GDP of all EU Member States. This is the case for Israel and Switzerland, for instance. Norway, thanks to the EEA Agreement (see below) and acceding countries benefit from a slightly more favourable rate including their own GDP to the sum of GDPs of all EU Member States, thereby reducing the proportionality factor.

¹ Official Journal of the European Union. REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC

Some countries benefit from an additional rebate because they are expected to perform poorly in the Framework Programme.

Amongst those associated to Horizon 2020², two countries could be considered as relevant examples for the United Kingdom post-Brexit because they too are highly-developed western European economies: Norway and Switzerland. However, both of them participate in the EU's Single Market whilst the pre-negotiation rhetoric of the UK Government seems to exclude it.

The legal base for Norway's participation in Horizon 2020 finds its roots in the *European Economic Area (EEA) Agreement*, which enables three of the four EFTA Member States (Iceland, Liechtenstein and Norway) to participate in the EU's Single Market. This agreement notably covers the so-called "four freedoms": free movement of goods, right of establishment and freedom to provide services, free movement of capital, and freedom of movement for workers.

Switzerland decided not to ratify the EEA Agreement. The country therefore had to negotiate with the EU Member States a series of bilateral treaties allowing participation in the Internal Market. The *Bilateral I* agreements, which notably include the free movement of workers and science, are expressed to be mutually dependent. If any one of them is denounced or not renewed, they all cease to apply. Between 15 September 2014 and end of 2016, having failed to ratify the Protocol on the extension to Croatia of the Free Movement of Persons Agreement between the EU and Switzerland, the Horizon 2020 association agreement was downgraded to partial association allowing access to parts of Horizon 2020 only². Full association was restored as of 1 January 2017 after ratification of the protocol by the Swiss Federal Council.

Thus, UK participation in future Framework Programmes is subject to the negotiation of an agreement between the UK and the EU Member States covering scientific cooperation and allowing participation in EU programmes. Whether an agreement different from those in place with Norway or Switzerland, notably regarding the participation in the Single Market and the free movement of workers, can be reached remains to be seen. Furthermore, legal issues such as the control by the Court of Justice of the European Union, the power of audit by Commission agents and the European Court of Auditors over all grant beneficiaries, contractors and subcontractors who have received Union funds, and the power of investigation of the European Anti-Fraud Office (OLAF) may constitute additional hurdles for the participation of the UK in future Framework Programmes.

Given the size of its economy, the participation of the UK as FP Associated Country would be expensive. Under FP7 and Horizon 2020, the UK was a net beneficiary of EU R&D funding thanks primarily to the rebate of the UK on its contribution to the global EU budget. In 2015,

² European Commission. Associated Countries.

http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cp/h2020-hi-list-ac_en.pdf

the UK share of the EU budget revenue after subtraction of the UK rebate was 12.57 %³, which includes the GDP-based contribution, the VAT-based contribution, and the UK share of the EU 'Traditional Own Resources' (TOR) based on custom duties. The very same year the UK was the most successful participant country in Horizon 2020, receiving 15.9 % of the Horizon 2020 allocated funds⁴. In 2015, the EU-28 GDP amounted to approximately 14,714 billion euro whilst the UK GDP reached approximately 2,580 billion euro⁵. The simple proportionality factor mentioned above ($\text{UK GDP} / [\text{EU-28 GDP} - \text{UK GDP}]$) indicates that the UK contribution as 'Associated Country' would have been approximately 21.26 % of the Horizon 2020 budget in 2015. In other words, from net beneficiary as EU Member State the UK would have become net contributor to Horizon 2020. The non-monetary advantages of participating in the EU FP (attractiveness of the country as a R&D hub, increased opportunities for cooperation etc.) may however compensate, at least in part, the financial burden.

³ HM Treasury. European Union Finances 2015: statement on the 2015 EU Budget and measures to counter fraud and financial mismanagement.

⁴ European Commission. Horizon 2020 Monitoring Report 2015

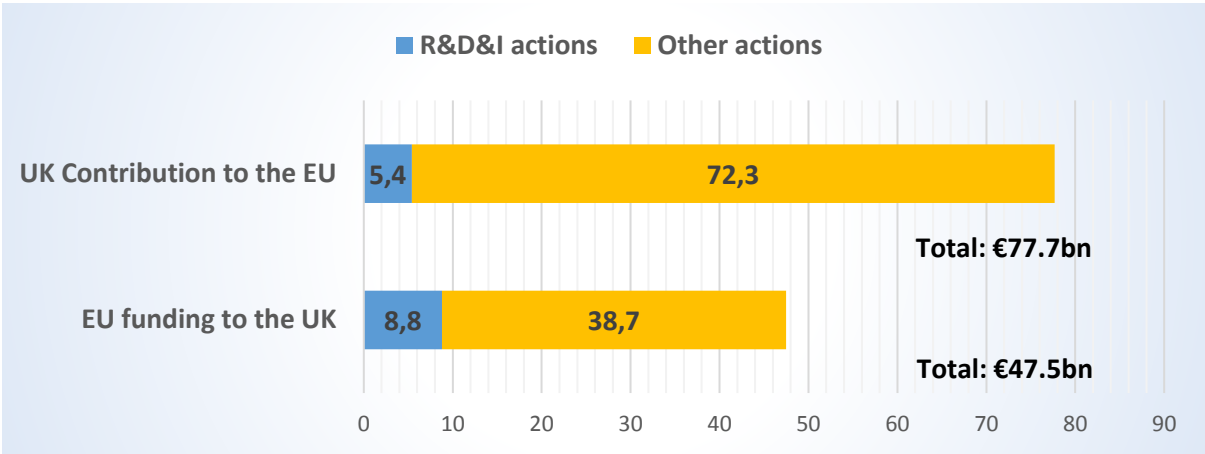
⁵ eurostat. Gross domestic product at market prices.

<http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tec00001>

Section 2. Flows of EU funding to the UK under FP7 and Horizon 2020

The UK is a net contributor to the EU budget. However, as depicted in Chart 1, it receives a greater amount of EU research funding (including both funding from the FP and Structural Funds for R&D activities) than it contributes. The Structural Funds for R&D activities represent 22 % of the total EU R&D funding received by the UK.

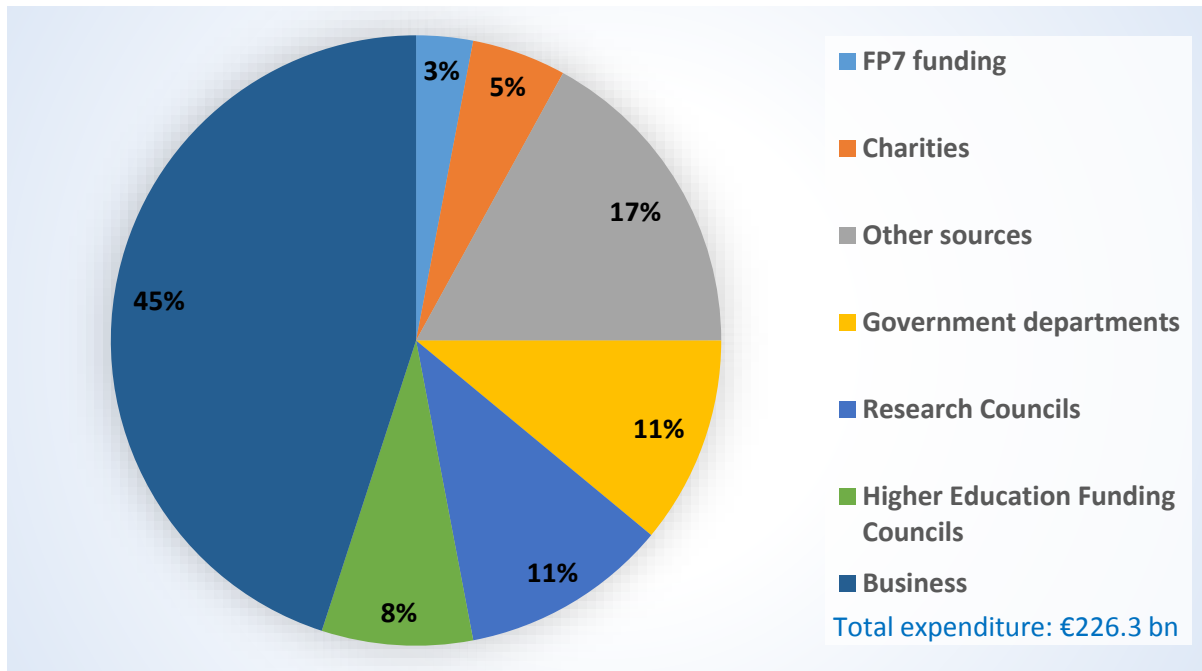
CHART 1: FLOW OF FUNDS BETWEEN THE UK AND EU 2007-2013 (€ BILLION)⁶



During the period 2007-2013, FP7 funding represented 3 % of the total (public and private) UK expenditure on R&D. The total EU funding would represent slightly more if Structural Funds for R&D activities were included in the figure.

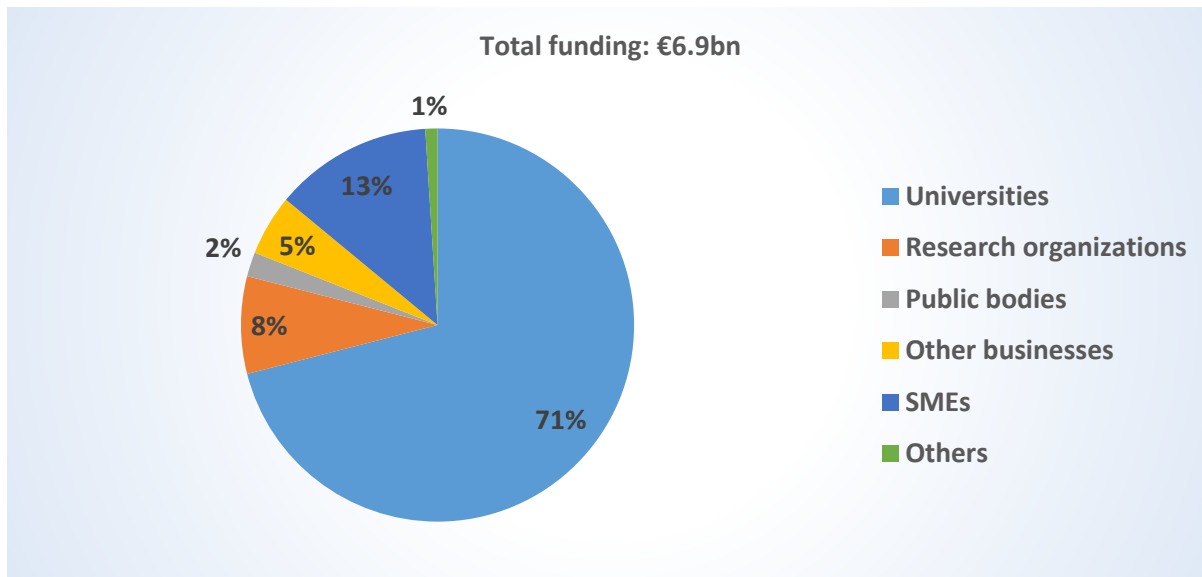
⁶ Royal Society. UK research and the European Union: The role of the EU in funding UK research. <https://royalsociety.org/~media/policy/projects/eu-uk-funding/uk-membership-of-eu.pdf>

CHART 2: UK EXPENDITURE ON R&D BY SOURCE OF FUNDING 2007-2013⁶



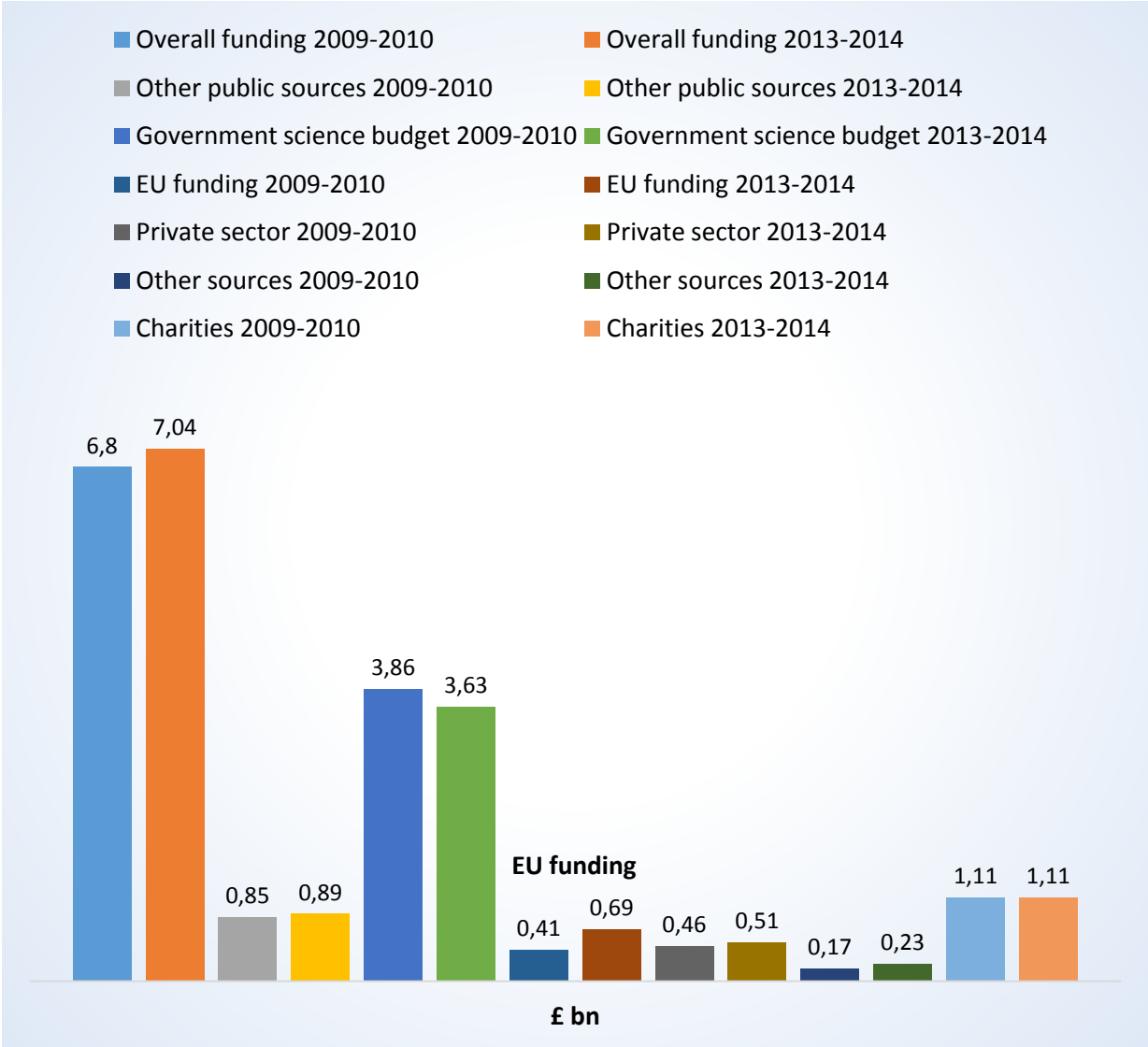
The main beneficiaries of EU funding for R&D in the UK are universities. Together with research organisations, they receive almost 80 % of the funds.

CHART 3: SECTORS RECEIVING FP7 FUNDING IN THE UK 2007 – 2013⁶



In 2013/14 EU funding represented 9.8 % of the total research income of UK universities compared to 6 % in 2009/10. The global income of universities increased by 3.5 % over this period of time, an increase which can be entirely assigned to the EU funding as shown in Chart 4.

CHART 4: RESEARCH INCOME OF UK UNIVERSITIES IN 2009/10 AND 2013/14⁶



UK universities are, by far, the most successful amongst those participating in the FPs. In 2015 five of them were ranked amongst the top-10 universities in terms of EU funding (table 1). In contrast, UK research organisations perform rather poorly, notably compared to French and German organisations, illustrating the different structures of the research systems of these countries (table 2). The UK also ranked two companies amongst the top 10 private beneficiaries in 2015 (table 3). In contrast to the two other rankings the latter one, however, is more volatile and less meaningful given the low number of grants.

TABLE 1: TOP-10 HES ORGANISATIONS IN TERMS OF EU FUNDING UNDER HORIZON 2020 IN 2015⁶

Rank	Organisation	Country	Grants	EU financial contribution (€)
1	University of Cambridge	UK	114	73,543,045
2	University College London	UK	104	73,529,176
3	University of Oxford	UK	87	63,193,866
4	EPF Lausanne	CH	72	59,031,850
5	Technical University of Delft	NL	69	51,230,026
6	Imperial College	UK	72	51,221,257
7	University of Edinburgh	UK	47	42,413,753
8	University of Copenhagen	DK	73	40,850,818
9	ETH Zurich	CH	60	35,245,862
10	Catholic University of Leuven	BE	61	35,180,663

TABLE 2: TOP-10 AND TOP UK RESEARCH ORGANISATIONS IN TERMS OF EU FUNDING UNDER HORIZON 2020 IN 2015⁶

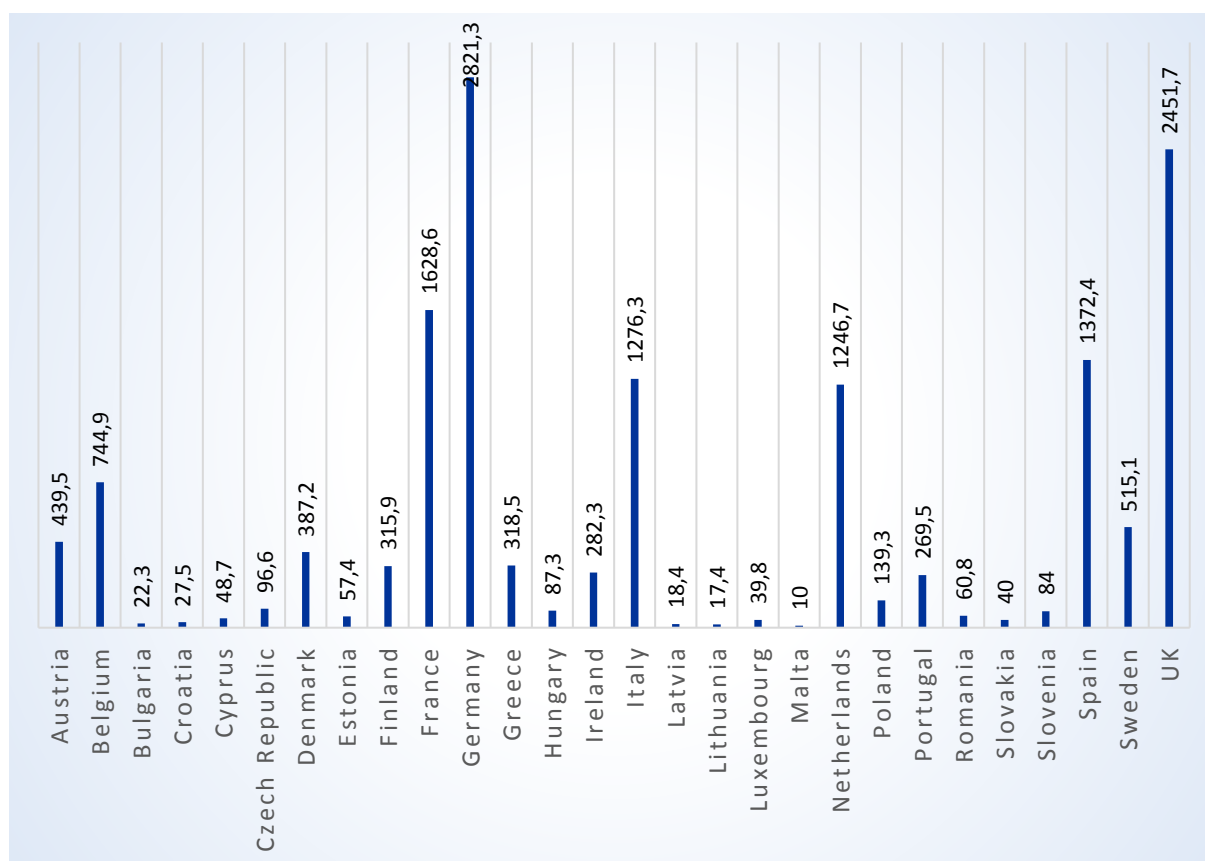
Rank	Organisation	Country	Grants	EU financial contribution (€)
1	CNRS	FR	162	113,283,521
2	Fraunhofer Gesellschaft	DE	144	81,075,752
3	CEA	FR	77	69,526,864
4	MPG	DE	78	62,003,850
5	CNR	IT	80	42,042,944
6	CISIC	SP	82	36,021,827
7	DLR	DE	57	32,636,040
8	INSERM	FR	43	32,583,903
9	IMEC	BE	19	27,961,208
10	Forschungszentrum Jülich	DE	24	22,750,739
...16	Natural Environment Research Council	UK	21	13,991,657
...33	Medical Research Council	UK	15	9,363,656
34	TWI Limited	UK	13	9,018,474
...43	John Innes Centre	UK	8	6,990,243

TABLE 3: TOP-10 RESEARCH ORGANISATIONS IN TERMS OF EU FUNDING UNDER HORIZON 2020 IN 2015⁶

Rank	Organisation	Country	Grants	EU financial contribution (€)
1	BORREGAARD AS	NO	3	26,664,439
2	Clariant Produkte GmbH	DE	1	22,451,450
3	SIEMENS AG	DE	10	17,832,259
4	GEANT LIMITED	UK	1	16,780,315
5	ENERGOCHEMICA TRADING AS	SL	1	13,441,418
6	SOLIDPOWER SPA	IT	2	10,254,375
7	ASML NETHERLANDS B.V.	NL	2	9,705,374
8	ITM POWER (TRADING) LIMITED	UK	4	9,459,880
9	ACCIONA INFRAESTRUCTURAS S.A.	SP	9	9,128,714
10	ATOS SPAIN SA	SP	22	8,991,774

For 2014 and 2015 the UK was the second recipient of EU FP funding after Germany (chart 5). In relation to the national GDP the UK was the most performant of the large EU countries but was outperformed by small countries such as The Netherlands, Belgium, Denmark, Sweden or Austria.

CHART 5: EU FUNDING PER COUNTRY FOR GRANTS FROM HORIZON 2020 PROJECTS FOR 2014 & 2015 (€ MILLION)⁶



The comparison of the share of EU funding received by the UK in 2014 and 2015 for the various action lines of Horizon 2020 identifies the areas where the UK is most competitive (table 4). The best scores are obtained by ERC and MSCA grantees, highlighting the essential contribution of foreign researchers to the UK research system. Since the onset the ERC is an uninterrupted success story for the UK both in terms of grants and funding received (charts 6 and 7). The UK also performs very well in the future and emerging technologies (FET; chart 8), the health-related area and, to a lesser extent, the innovation in SMEs. Finally, the UK receives significant funding from Horizon 2020 under the research infrastructure headline (chart 9). The possible non-participation of the UK in future FPs would not impact on its participation in the large EIROforum research infrastructures (CERN, EMBL, ESA, ESO, ESRF, EUROfusion, European XFEL and ILL) which are intergovernmental organisations but may affect its participation in the newly created or planned infrastructures, notably the decentralised ones.

TABLE 4: FLOW OF EU FUNDING TO THE UK FOR THE THREE MAIN PILLARS OF HORIZON 2020 FOR 2014 & 2015⁶

Horizon 2020	Participations in grants	EU funding (€ million)	Share of EU funding
Total	4977	2451.7	15.4 %
Excellent Science			
ERC	484	707.5	21.5 %
FET	142	78	16.3 %
MSCA	1436	375.9	22.8 %
RI	186	86.3	14.1 %
Industrial Leadership			
Leadership in Enabling and Industrial Technologies	547	365	11.6 %
Innovation in SMEs	200	79.7	15.2 %
Societal Challenges			
Health, Demographic Change and Well-Being	391	231.5	18.3 %
Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research, and the Bio-economy	225	78.9	10.5 %
Secure, Clean and Efficient Energy	307	166.5	12.5 %
Smart, Green and Integrated Transport	284	109.6	10.6 %
Climate Action, Environment, Resource Efficiency and Raw Materials	221	90.6	12.5 %
Europe in a changing world – Inclusive, Innovative and Reflective Societies	123	38.6	15.0 %
Secure Societies – Protecting freedom and security of Europe and its citizens	146	55.4	14.1 %

CHART 6: ERC GRANTED PROJECTS PER COUNTRY OF HOST INSTITUTION⁷

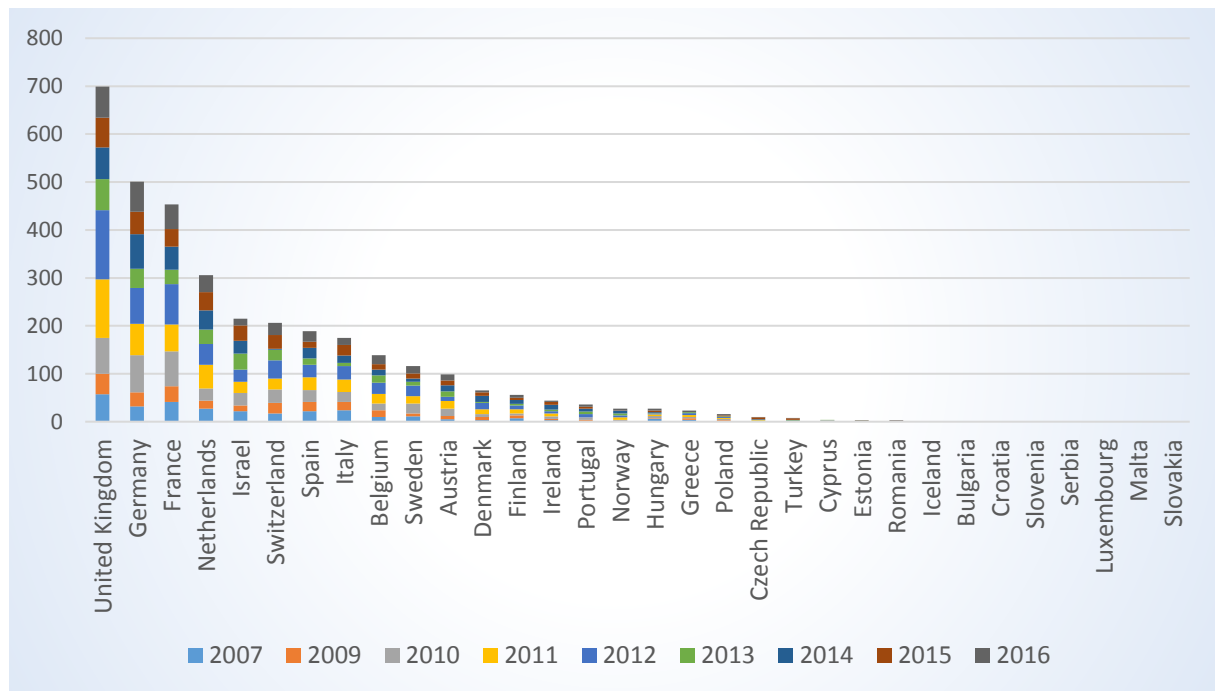
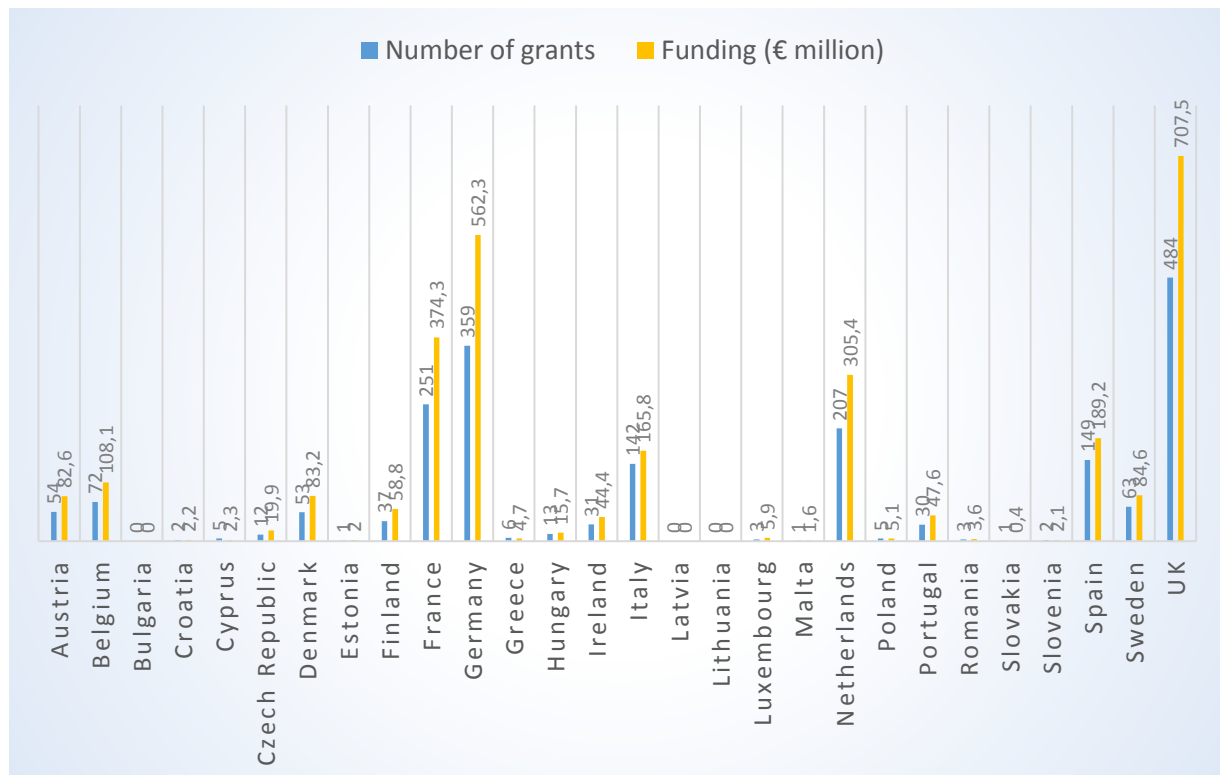


CHART 7: NUMBER OF ERC GRANTS AND EU FUNDING PER COUNTRY IN 2014 & 2015⁶



⁷ ERC Statistics. <https://erc.europa.eu/projects-and-results/statistics>

CHART 8: NUMBER OF FUTURE AND EMERGING TECHNOLOGIES (FET) GRANTS AND EU FUNDING PER COUNTRY IN 2014 & 2015⁶

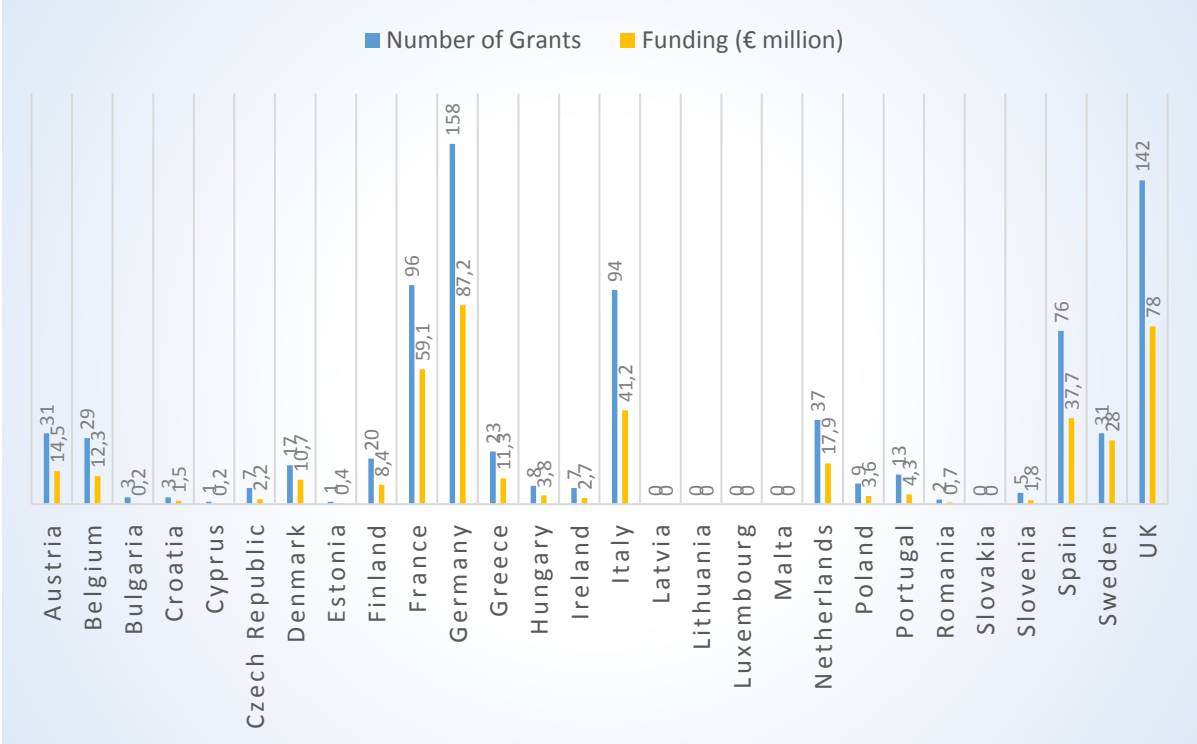
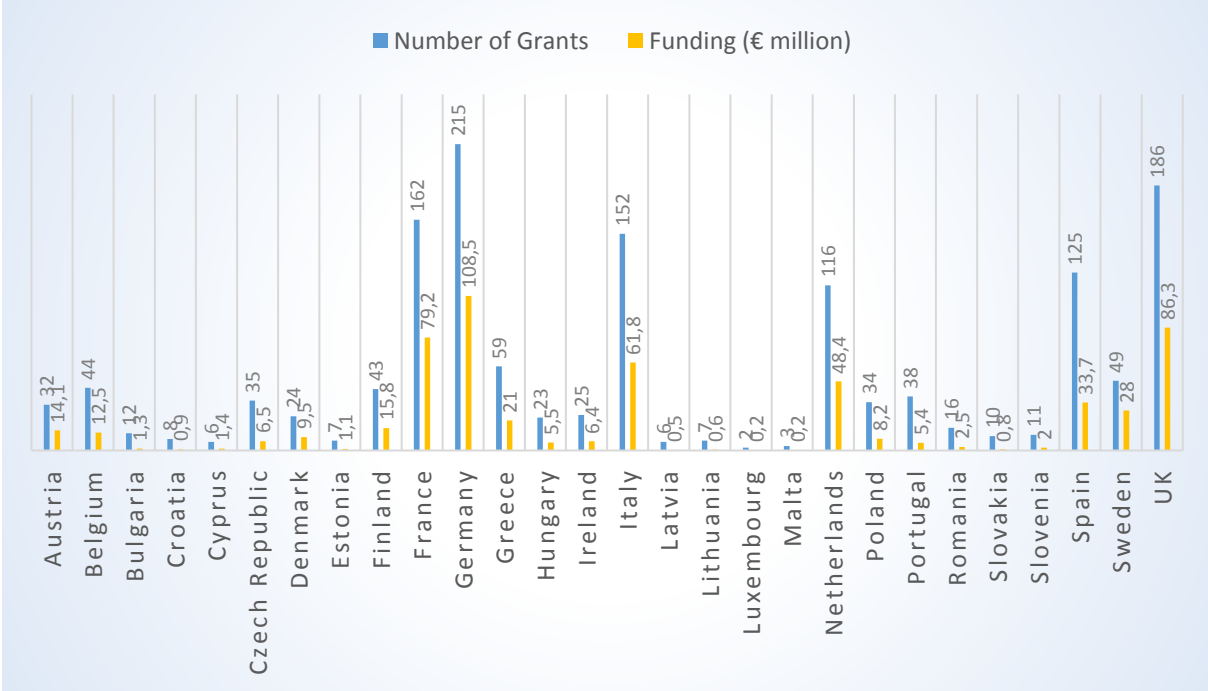


CHART 9: NUMBER OF RESEARCH INFRASTRUCTURE GRANTS AND EU FUNDING PER COUNTRY IN 2014 & 2015⁶



Section 3. Internationalisation of Higher Education and Research

Internationalisation of higher education has become a common feature around the globe. More than 42,000 UK tertiary-level students are studying abroad, amongst which more than 35 % in an EU country (table 5). UK higher education (HE) institutions welcome a large number of foreign under- and post-graduate students: in 2015/16 the total number of HE enrolments in the UK stood at 2,280,830, amongst which 6 % from the EU and 14 % from the rest of the world. With the notable exception of China which is showing a significant increase, recent statistics show a decline in foreign student enrolment numbers from almost everywhere, which is probably linked to the introduction of high tuition fees (charts 10 and 11). The trend may further amplify for EU students after Brexit. Indeed, EU students currently pay the same fees as UK students, which are usually significantly lower than for other foreign students. The UK also receive and send abroad for short stay a significant number of students thanks to the EU-funded ERASMUS+ programme (table 6).

TABLE 5: TOP-10 DESTINATIONS AND NUMBER OF TERTIARY-LEVEL STUDENTS FROM THE UK STUDYING ABROAD (2014)⁸

Total number of students from the United Kingdom studying abroad: 42,384			
Rank	Destination	Number of students	Percent of total
1	USA	9,689	45.7 %
2	France	2,110	10.0 %
3	Ireland	2,106	9.9 %
4	Australia	1,618	7.6 %
5	Germany	1,499	7.1 %
6	Canada	1,337	6.3 %
7	Netherlands	888	4.2 %
8	Denmark	709	3.3 %
9	United Arab Emirates	630	3.0 %
10	Austria	606	2.9 %

⁸ Project Atlas| United Kingdom

<http://www.iie.org/Services/Project-Atlas/United-Kingdom/UK-Students-Overseas#.WMKs839M5P2>

CHART 10: TOP TEN EU COUNTRIES FOR HE STUDENT ENROLMENTS IN THE UK 2011/12 AND 2015/16⁹

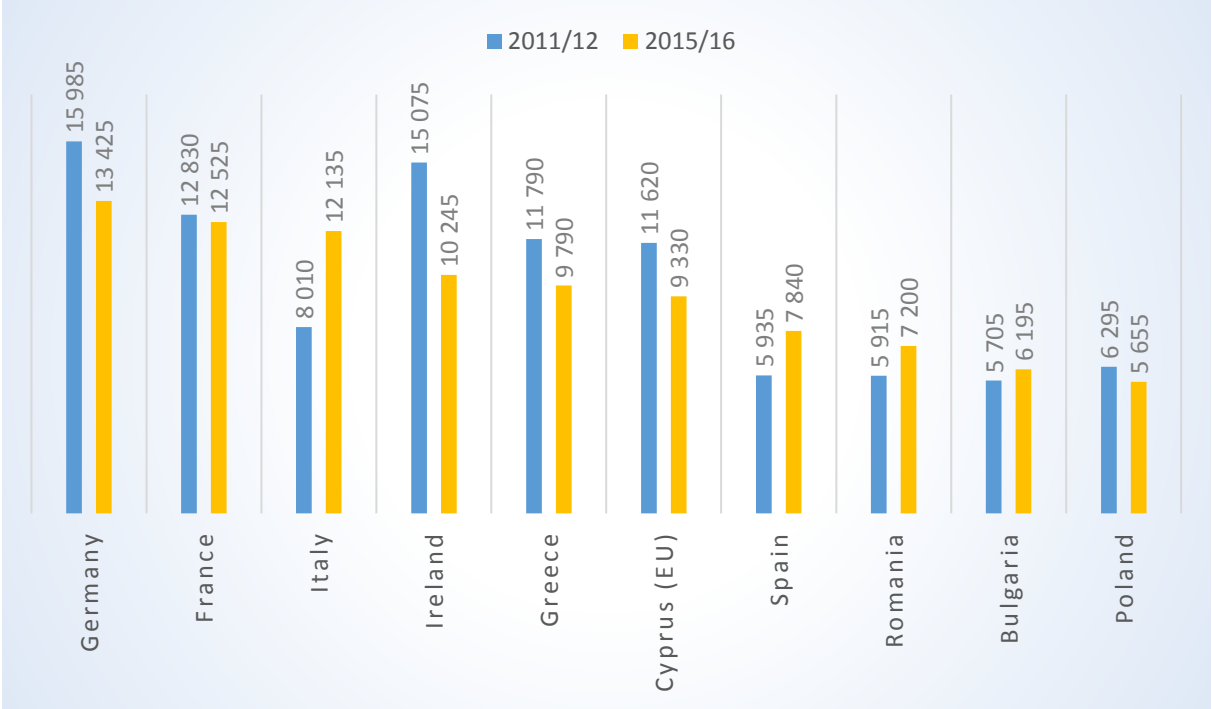
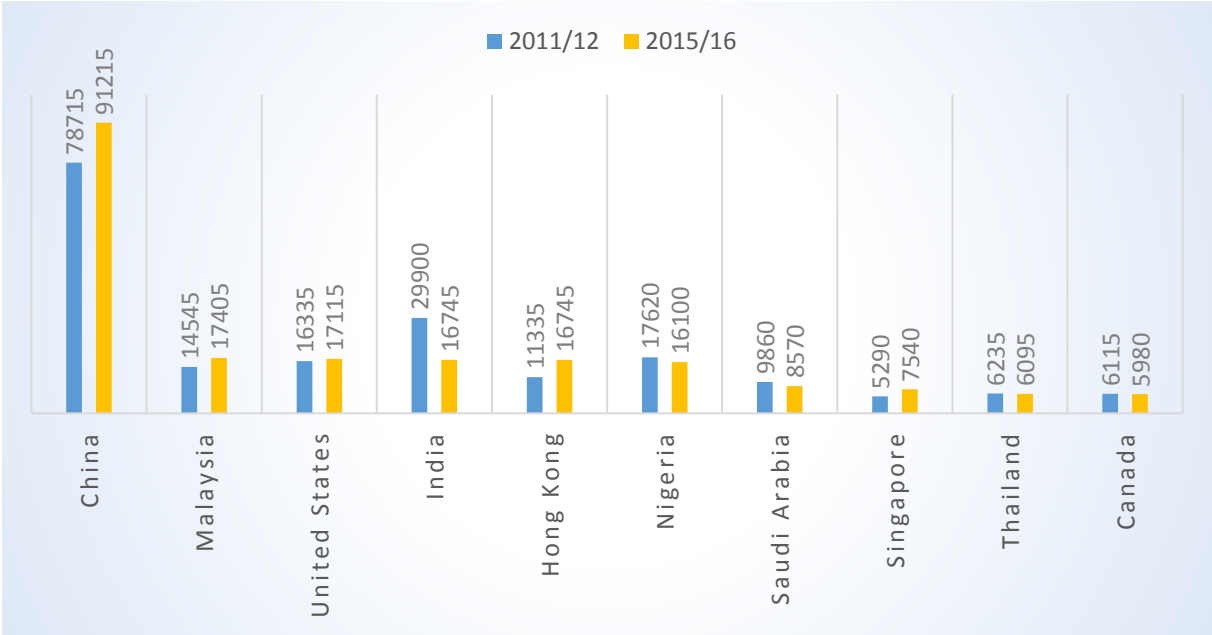


CHART 11: TOP TEN NON-EUROPEAN UNION COUNTRIES FOR HE STUDENT ENROLMENTS IN THE UK 2011/12 AND 2015/16⁹



⁹ HESA. <https://www.hesa.ac.uk/news/12-01-2017/sfr242-student-enrolments-and-qualifications>

TABLE 6: ERASMUS+: HIGHER EDUCATION MOBILITY – STUDENTS BY SENDING AND RECEIVING COUNTRY UNDER CALL 2014¹⁰

Countries sending students to the UK		Countries receiving UK students	
AT	543	AT	342
BE	740	BE	336
BG	105	BG	27
CY	55	CY	104
CZ	602	CZ	176
DE	5,269	DE	2,129
DK	792	DK	308
EE	43	EE	21
EL	298	EL	89
ES	4,381	ES	3,299
FI	637	FI	249
FR	7,663	FR	4,190
HR	51	HR	19
HU	267	HU	91
IE	372	IE	265
IS	54	IS	21
IT	2,704	IT	1,079
LI	2	LI	4
LT	189	LT	16
LU	9	LU	21
LV	32	LV	16
MK	–	MK	–
MT	98	MT	152
NL	2,021	NL	875
NO	265	NO	163
PL	869	PL	85
PT	396	PT	150
RO	147	RO	33
SE	855	SE	420
SI	103	SI	27
SK	86	SK	12
TR	535	TR	82
Total	30,183	Total	14,801

Globalisation has also become a reality in research. Table 7 shows that almost 17% of the academic staff at UK HE institutions are EU-27 citizens. If data on foreign academic staff are not readily available for other EU countries, they can be obtained for some institutions. The ETH Zürich employs 507 professors and 7,255 scientific staff among which, respectively, 163 and 2,631 only are Swiss citizens. Similarly, the EPF Lausanne employs 40 % Swiss citizens, 39

¹⁰ Annex 1. Erasmus+ Programme Annual Report 2015.
https://ec.europa.eu/programmes/erasmus-plus/about/statistics_ga

% European citizens and 21 % non-European citizens. In 2015 31% of the personnel employed by the TU Delft was foreigner. A third of the Directors and 80% of the post-docs employed by the Max-Planck Society hold a non-German passport. Switzerland and the Netherlands are probably exceptions among EU countries. Statistics would certainly prove to be much lower in Central and Eastern European countries and in many Southern European countries. Factors such as the structure and competitiveness of the host research system, salaries and social benefits and the possibility to teach in English may impact on mobility. The enlargement of the EU to Central and Eastern European countries in 2004 and 2007, for instance, has led to a massive brain drain of scientists for the benefit of Western European countries.

TABLE 7: ACADEMIC STAFF AT UK HE INSTITUTIONS BY NATIONALITY 2015/16¹¹

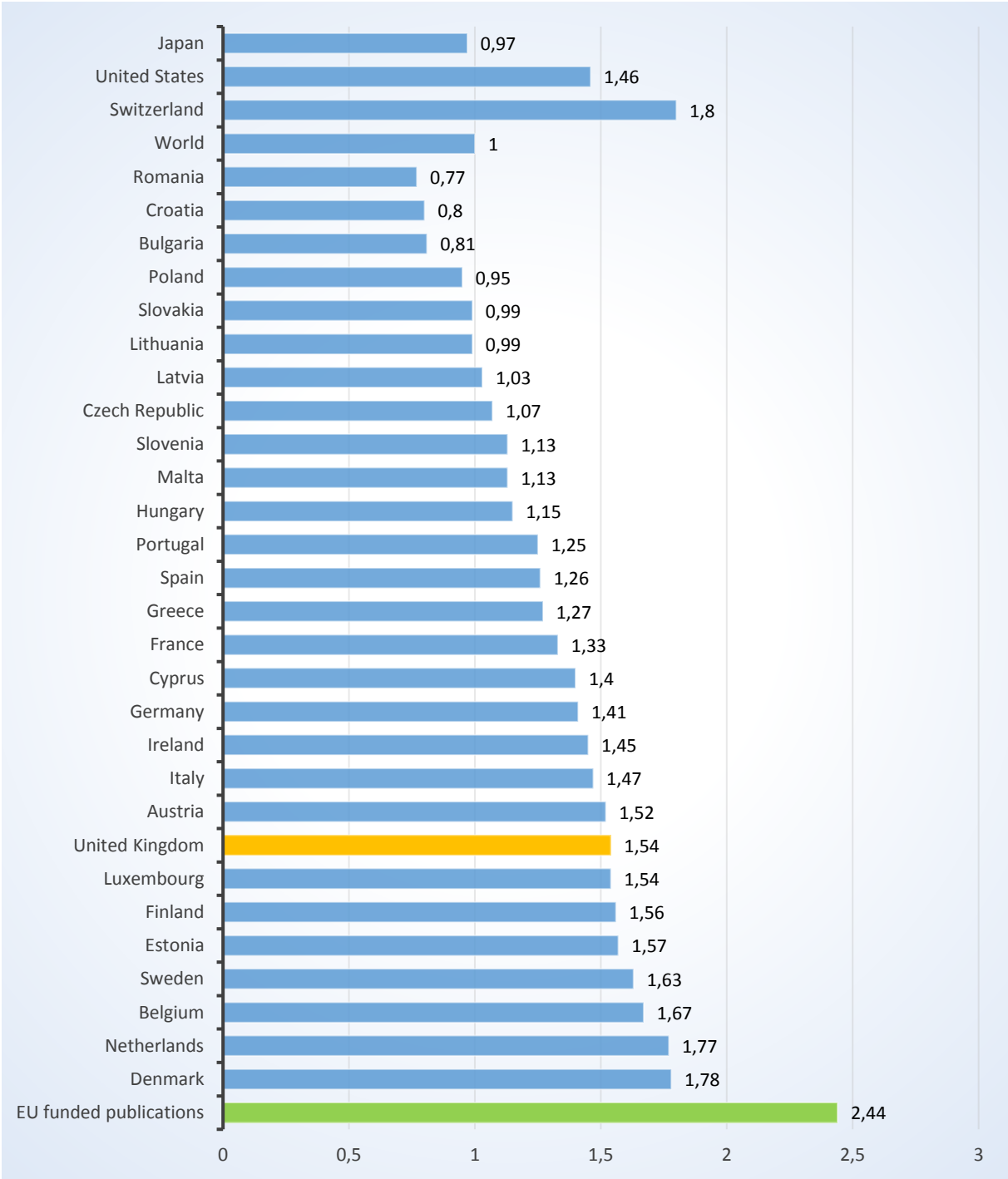
Nationality	Managers, directors and senior officials	Professional occupations	Associate professional and technical occupations	Clerical and manual occupations	Total academic staff
UK	610	138,160	1235	5	139,910
Other EU	25	33,595	116	0	33,735
Non-EU	25	24,445	65	0	24,535
Not known	5	3,180	10	0	3,195

Globalization of science is also being witnessed by the steady increase in the number of international collaborations. A recent study comparing the decade before and after 2004 shows that Western Europe and North America experienced a 36 to 42% increase in the rate of cross-border collaboration measured in terms of publications¹². In this paper, the authors warn that “national borders are still a formidable hindrance to cross-border activity”. On the other hand, an analysis of the citation impact shows that publications funded in the EU FPs are more often cited than Member States publications (chart 12). Brexit and the non-participation in the EU Framework Programme may thus impact on the attractiveness and performance of the UK research system.

¹¹ HESA. <https://www.hesa.ac.uk/news/19-01-2017/sfr243-staff>

¹² O.A. Doria Arrieta, F. Pammolli, and A. M. Petersen. Quantifying the negative impact of brain drain on the integration of European science. *Sci. Adv.* 2017; 3:e1602232

CHART 12: FIELD-WEIGHTED CITATION IMPACT, AVERAGE (2007-2016)⁴



The Field-Weighted Citation Impact divides the number of citations received by a publication by the average number of citations received by publications in the same field, of the same type, and published in the same year, thus adjusting it for field and year.



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