

Participation by the United Kingdom in recent EU Framework Programmes

Insight on the participations of large UK companies in FP7 and Horizon 2020

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Executive Summary

The United Kingdom has performed strongly in recent EU research framework programmes. Particularly, UK universities overperform compared to other countries in the programmes. This observation has led us to the hypothesis that large UK businesses corporations do not perform as well, perhaps in at least part due to the relative success of UK universities, compared to large corporations of other European countries. Overall, in the last two framework programs, the UK placed second in overall funds received (by country total). In Horizon 2020 (H2020, the most recent programme), when just large corporations are considered, the UK placed 6th overall in total funding received and to the overall value of consortia. This would put the UK closely behind the Netherlands, Italy, Spain, France, and Germany. In contrast, the UK universities consistently placed first amongst all countries during FP7 and H2020. Even when you adjust for the presence of non-university research institutions, the UK comes in a close second to Germany. While we cannot say specifically what nonmonetary factors influence these decisions, there is ample evidence to suggest that UK large corporations do not perform as highly when compared to other European countries, particularly those of similar economy sizes (Germany, France, Italy). The UK overall has performed well as a whole and maintained a strong presence in the cooperation which can provide nontangible factors that cannot be strictly considered in monetary terms.

Introduction

The Seventh Framework Programme (FP7) and the Horizon 2020 Programme (H2020) were the mechanism for international research funding collaborations for the European Union from 2007-2020. These programs funded collaborative projects between various entities across all member states of the European Union, associated states, and third countries. The net EU contribution for these projects were €46 billion for FP7 and €67 billion for H2020 [1]. Since the United Kingdom's departure from the European Union, the government has remained committed to becoming an associated state to the next funding framework programme, Horizon Europe with a projected budget of €95 billion [2]. This has recently come into doubt as unrelated political issues seem to be interfering with the association of the UK to the programme. To that end, UK Science Minister, George Freeman, has proposed a £6 billion science fund to fill the gaps over the next three years. While this is still being negotiated behind closed doors, the proposed "Plan B" science fund may be worth exploring. To that end, we wanted to examine the role of large private-for-profit research companies in these previous EU research funding schemes. Based on previous impressions and experiences, we hypothesized that large UK businesses (non-SME PRC) do not perform as well as large business of other European countries with similar economic sizes.

Project Participations by the UK and the rest of the top 10 countries

Participants in framework projects are classified into 5 major categories: **HES** (Secondary and Higher Education), **PRC** (Private For-Profit Companies), **REC** (Research Organisations, excluding education), **PUB** (Public Bodies, excluding research and education), **OTH** (other organisations). In addition, organisations are classified as an SME (small or medium-sized enterprises) or not an SME. While definitions may slightly vary by region, for the purposes of the EU an SME is defined as an organisation with fewer than 250 employees that has a balance sheet total of less than €43 million (or a turnover of €50 million) [3]. Projects normally include various entity types from multiple different countries.

Table 1. Top 10 Countries in FP7 EU Contribution by Legal Entity Type (Shown as billions of Euros)

FP7						
Country	HES	OTH	PRC	PUB	REC	Total
Austria	€ 0.50	€ 0.03	€ 0.34	€ 0.03	€ 0.26	€ 1.16
Belgium	€ 0.73	€ 0.16	€ 0.41	€ 0.05	€ 0.53	€ 1.87
France	€ 0.74	€ 0.44	€ 1.61	€ 0.06	€ 2.51	€ 5.36
Germany	€ 2.71	€ 0.09	€ 1.84	€ 0.08	€ 2.36	€ 7.09
Italy	€ 1.23	€ 0.06	€ 1.13	€ 0.08	€ 1.04	€ 3.55
Netherlands	€ 1.82	€ 0.11	€ 0.67	€ 0.04	€ 0.69	€ 3.35
Spain	€ 0.78	€ 0.10	€ 0.97	€ 0.12	€ 1.27	€ 3.23
Sweden	€ 1.08	€ 0.04	€ 0.36	€ 0.08	€ 0.16	€ 1.72
Switzerland	€ 1.25	€ 0.05	€ 0.35	€ 0.05	€ 0.34	€ 2.03
United Kingdom	€ 4.95	€ 0.06	€ 1.30	€ 0.27	€ 0.39	€ 6.97

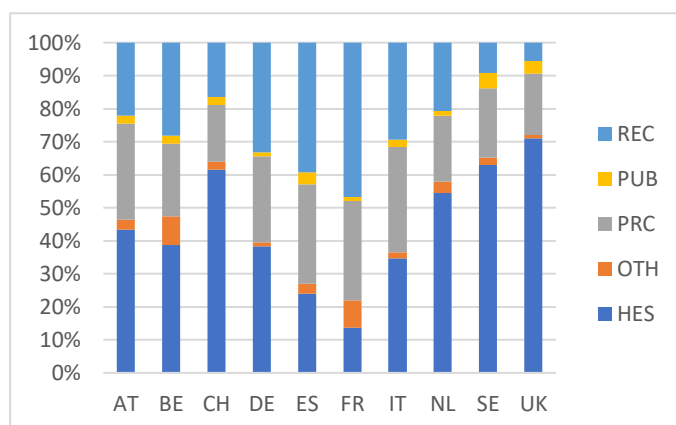
Since our primary interest is in the UK's participation relative to economic competitors among eligible countries, we have chosen to compare the top 10 countries by total EU contribution – a list which includes the UK. In FP7 (Table 1, Figure 1A) and Horizons 2020 (Table 2, Figure 1B), the top 10 countries (in alphabetical order) by their total EU contributions from these framework programmes

were: Austria, Belgium, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland, and the United Kingdom.

Table 2. Top 10 Countries in H2020 EU Contribution by Legal Entity Type (Shown as billions of Euros)

Horizon 2020						
Country	HES	OTH	PRC	PUB	REC	Total
Austria	€ 0.75	€ 0.09	€ 0.62	€ 0.03	€ 0.44	€ 1.92
Belgium	€ 1.08	€ 0.69	€ 0.75	€ 0.07	€ 0.80	€ 3.39
France	€ 1.12	€ 0.25	€ 2.55	€ 0.20	€ 3.23	€ 7.34
Germany	€ 3.51	€ 0.24	€ 2.72	€ 0.14	€ 3.36	€ 9.97
Italy	€ 1.87	€ 0.14	€ 2.08	€ 0.17	€ 1.36	€ 5.62
Netherlands	€ 2.64	€ 0.18	€ 1.32	€ 0.11	€ 1.08	€ 5.33
Spain	€ 1.35	€ 0.18	€ 2.17	€ 0.30	€ 2.34	€ 6.34
Sweden	€ 1.31	€ 0.02	€ 0.59	€ 0.16	€ 0.20	€ 2.29
Switzerland	€ 1.46	€ 0.06	€ 0.44	€ 0.07	€ 0.36	€ 2.40
United Kingdom	€ 5.32	€ 0.19	€ 1.40	€ 0.18	€ 0.65	€ 7.75

A



B

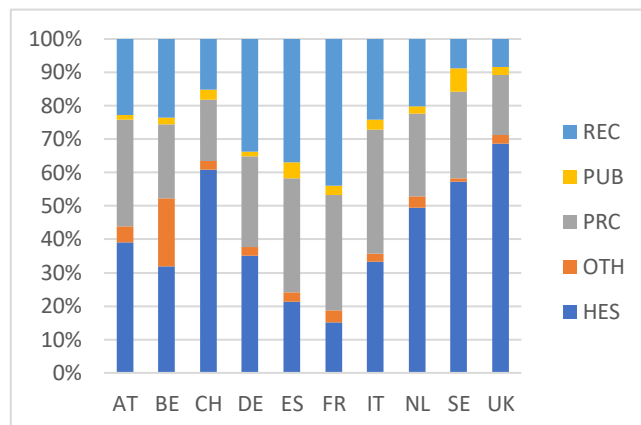


Figure 1. Stacked Bar Chart of the Top 10 Countries by EU Contribution partitioned by Legal Entity Type for FP7 (A) and H2020 (B). The total EU Contribution was made 100% for each country and the fraction of which each legal entity type received is shown as a percentage of that total. Countries are listed by their two-letter country code.

Looking at these distributions, countries tend to receive more funding in certain sectors (Table 3) than others. As an example, in the H2020 data (Figure 1B), for most countries HES organisations claim the highest proportion of funding. The exceptions to this are Spain, Italy, and France. In these countries, Italy's top performing category is PRC with about 37% (about four percentage points over HES). Spain and France's top performing category is REC making up about 37% of Spain's total (about two percentage points over PRC) and making up about 44% of France's total (about nine percentage points over PRC). Perhaps one of the most striking differences between the top 10 is the consistently high performing HES category for Switzerland and the United Kingdom (and to a somewhat lesser extent, Sweden). Switzerland's HES sector received around 61% of their total grant income from both programs. The United Kingdom's totals were around 70% for both programmes.

Table 3. Legal Entity Descriptions in EU Framework Programs

Legal Entity Type	Description
HES	Secondary and Higher Education
PRC	Private for-Profit Companies
REC	Research Organisations (excluding education)
PUB	Public Bodies (excluding research and education)
OTH	Other Organisations
HR	HES + REC

Since the UK and Switzerland seem to have such high proportions for their HES sector, the other groups that take away less funding are the REC and PRC categories. As a comparison in the most recent data for Horizon 2020, the UK's REC organisations only won about 8.5% of the UK's total funding whereas Germany and France's REC make up more than one third of their total. Similarly, we see that the UK's PRC won about 18% of the UK's total fund while France and Germany's PRC sector received around 30% of their total funding. The UK's PRC and REC percentages of the total contribution are lower than any of the top 10. This is not entirely unsurprising as it is reflective of the distribution of national funding, where research institutions are more substantially funded in Germany [4] and France than in the UK. Though France has been trying to increase their support of their universities in recent years [5].

From FP7 to H2020

Since Germany and France (in particular) have a much larger participation by the REC category over HES, we thought it may be more useful to compare countries combining these categories to make a 'higher education and research organisation' joint category. From this point forward, we will address this category as HR (HES + REC).

There was more than a 50% increase of the overall budget from FP7 to H2020. To notice any changes between funding programs, we examined the top 10 countries awarded contributions in total and in part from the FP7 programme to the H2020 programme (Figure 2). The UK, overall, increased total awards just over 10% from FP7 to H2020 seeing most of that gain in the HR organisations (about €600 million) over PRC (about €100 million). Spain saw the most dramatic growth of the top 10, nearly doubling their total EU contribution from FP7 to H2020. Spanish PRC organizations doubled their awards and HR organisations increased funding around 80%. Belgium also had a sizeable increase of around 80% with Austria with the third largest increase of 66%.

Germany, France, and Sweden had relatively moderate percentage increases (30-40%) with Switzerland and the UK at the bottom of the list (Figure 2D).

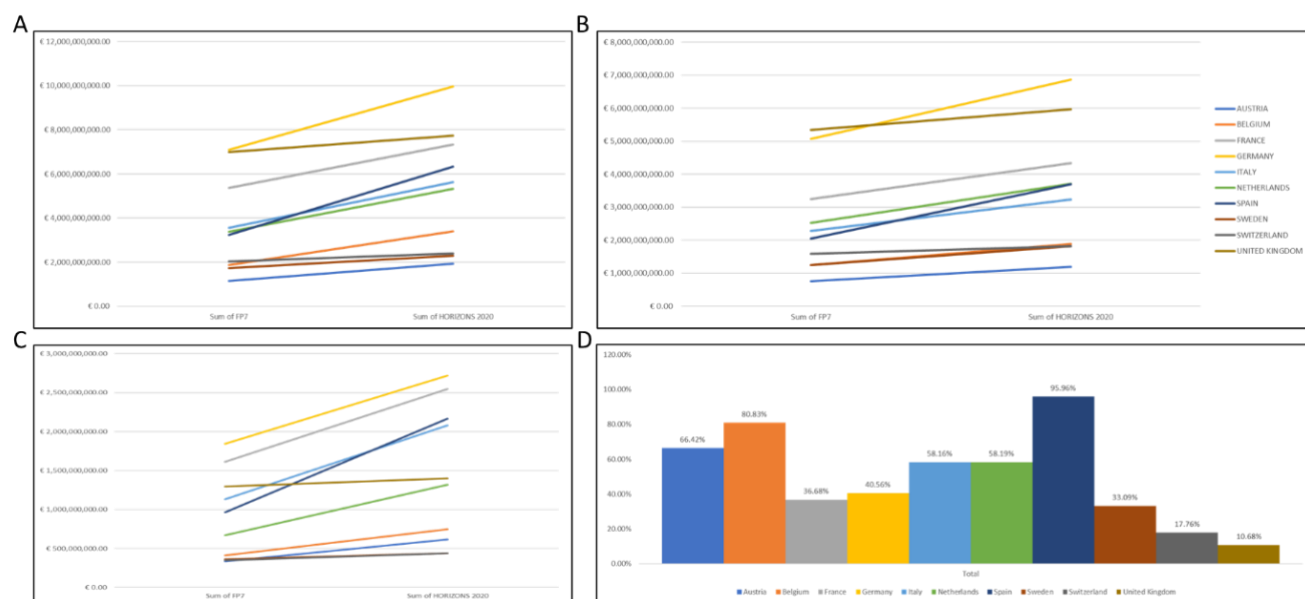


Figure 2. Trend of Contributions of Top 10 Countries from FP7 to H2020. (A) The trend line from FP7 to H2020 of total contributions of all entity types. (B) The trend line from FP7 to H2020 of total contributions of HR entities. (C) The trend line from FP7 to H2020 of total contributions of PRC entities. (D) The percentage change of total contributions of all entity types

Additionally, we wanted to look at these figures relative to the total budget. If you compare the ratio of the total EU contributions from FP7 to H2020 (Table 4, Figure 3), the top 10 split into two groups, those that lost overall award share and those that gained. France, Germany, Sweden, Switzerland, and the UK all lost overall share of the total budget from FP7 to H2020, while Austria, Belgium, Italy, Netherlands, and Spain gained. The biggest loss occurred from the UK, which dropped over four percentage points from FP7 to H2020. Sweden, Switzerland, Germany, and France lost around one percentage point or less, while Austria, Belgium, Italy, and Netherlands all gained one percentage point or less. The biggest improvement by far was Spain, which gained over two percentage points. Generally, the top 10 lost overall share of the total budget of the frameworks, from around 81% in FP7 to about 77.4% in H2020, with more funding going to non-top 10 EU member states, associated countries, and third countries.

Table 4. Percentage of the Total Available EU Contributions in FP7 and H2020 Budgets of Top 10 Countries

	Austria	Belgium	France	Germany	Italy	Netherlands	Spain	Sweden	Switzerland	United Kingdom
FP7 budget	2.57%	4.17%	11.96%	15.79%	7.91%	7.50%	7.20%	3.83%	4.53%	15.59%
H2020 budget	2.84%	5.01%	10.86%	14.74%	8.31%	7.88%	9.37%	3.39%	3.54%	11.46%

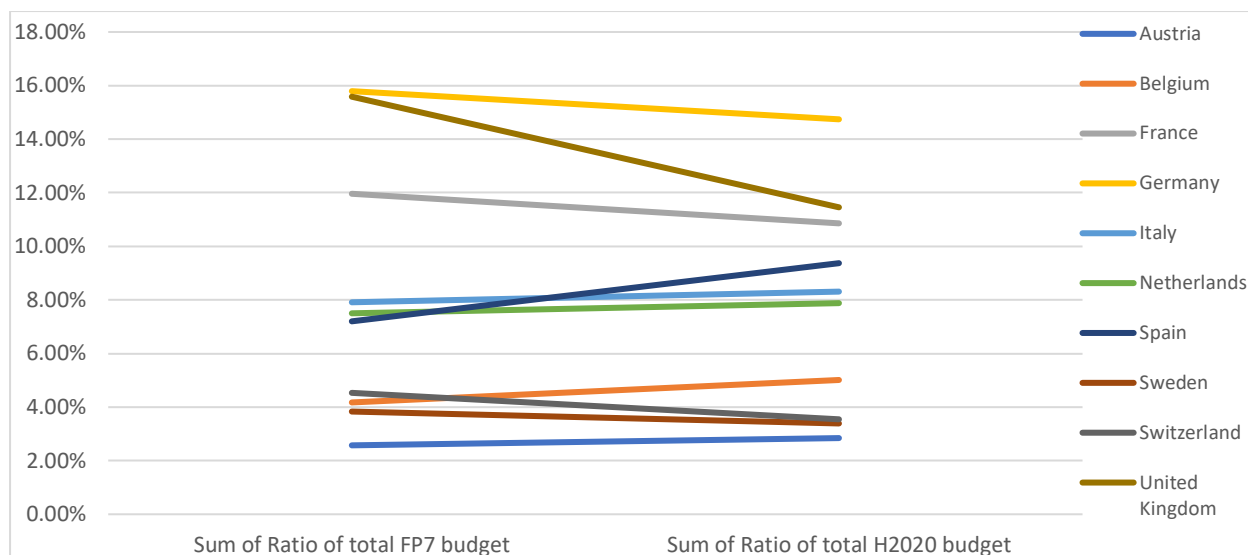


Figure 3. Trend of Contributions of Top 10 Countries from FP7 to H2020 as a proportion of the total funds available. The total EU Contribution for each country was determined as a proportion of the total awarded EU contribution to all participants. This was determined for both FP7 and H2020 and were plotted as a trend line from FP7 to H2020.

SME Participation

One of the priorities in both framework programmes was making sure funding for SMEs was appropriate and available. SMEs makeup 99% of all businesses in the EU [3]. Most SMEs typically are organized as PRC but there are SMEs found in all category types (Table 5). For our purposes, we are interested in how large UK businesses (non-SME PRCs) are performing, which would be organizations not classed as an SME. In the H2020 data, the UK has about 4708 total participations by PRC (not unique entities). Of that number, more than half are participations by SMEs. Of the top 10, Italy, Netherlands, Spain, and Switzerland have similar breakdowns. Belgium is nearly equal between the two groups. Austria, Sweden, and particularly France and Germany have more non-SME participations than SME participations. France and Germany had more than 1000 participations by large businesses than by SME businesses.

In terms of unique entities that participated in H2020 (Table 6), every country has fewer large businesses unique entities than SME PRC entities. Germany has by far the most unique non-SME PRC participants in H2020 (1717). They have 500 more unique participants compared to the second highest (France). The UK follows Spain and Italy to come in 5th overall for number of unique non-SME PRC, though the difference between the UK (5th) and France (2nd) is about 160 unique participants (about 15% more). In terms of SMEs, Spain leaps to the top of unique participants, but are followed relatively closely by Italy and Germany, with France and the UK rounding out the top 5.

Table 5. Horizon 2020 SME breakdown by legal entity type for top 10 countries

SME:	No	Yes	Grand Total
Austria			
HES	1466		1466
OTH	310	65	375
PRC	1031	857	1888
PUB	170	1	171
REC	957	186	1143
Belgium			
HES	1991		1991
OTH	1429	432	1861
PRC	1250	1247	2497
PUB	329		329
REC	1625	124	1749
France			
HES	3498	14	3512
OTH	795	193	988
PRC	3727	2561	6288
PUB	735	3	738
REC	5283	163	5446
Germany			
HES	6175	14	6189
OTH	577	232	809
PRC	4362	3275	7637
PUB	532	11	543
REC	5171	230	5401
Italy			
HES	5010	5	5015
OTH	664	155	819
PRC	3286	3545	6831
PUB	883	1	884
REC	3374	95	3469
Netherlands			
HES	4218	6	4224
OTH	494	116	610
PRC	1734	2139	3873
PUB	370	9	379
REC	1805	100	1905
Spain			
HES	3600	9	3609
OTH	724	200	924
PRC	3304	3989	7293
PUB	1280	7	1287
REC	5396	278	5674
Sweden			
HES	2383	3	2386
OTH	115	35	150
PRC	916	783	1699
PUB	431	1	432
REC	476	25	501
Switzerland			
HES	2325		2325
OTH	174	20	194
PRC	814	959	1773
PUB	195	1	196
REC	628	13	641
United Kingdom			
HES	10015	16	10031
OTH	408	227	635
PRC	2160	2548	4708
PUB	567	2	569
REC	1193	171	1364

Table 6. Horizon 2020 unique entity and SME breakdown for top 10 countries

SME:	No	Yes	Grand Total
Austria			
HES	45		45
OTH	92	22	114
PRC	367	428	788
PUB	49	1	49
REC	106	32	128
Belgium			
HES	25		25
OTH	443	78	512
PRC	493	522	999
PUB	88		88
REC	115	28	137
France			
HES	188	3	190
OTH	355	54	406
PRC	1186	1311	2464
PUB	220	2	222
REC	180	29	202
Germany			
HES	209	9	213
OTH	255	52	305
PRC	1717	1773	3442
PUB	167	5	171
REC	320	48	360
Italy			
HES	106	3	107
OTH	321	49	368
PRC	1120	1790	2879
PUB	279	1	280
REC	278	34	306
Netherlands			
HES	44	3	44
OTH	258	45	300
PRC	786	1130	1889
PUB	84	5	87
REC	102	22	122
Spain			
HES	78	3	80
OTH	308	81	384
PRC	1172	1954	3101
PUB	286	5	290
REC	329	47	370
Sweden			
HES	34	2	34
OTH	53	12	64
PRC	402	557	950
PUB	74	1	75
REC	49	8	55
Switzerland			
HES	24		24
OTH	83	12	95
PRC	301	493	790
PUB	41	1	42
REC	52	6	58
United Kingdom			
HES	135	6	137
OTH	215	102	316
PRC	1027	1457	2462
PUB	153	2	154
REC	135	44	173

Contribution breakdown by SME and Entity Types

We wanted to ascertain the individual breakdown of each category including this new category, HR, and to address the contribution breakdown for SMEs and non-SME businesses. From FP7 (Figure 4A) to H2020 (Figure 4B), it's clear that the HR grouping now overperforms PRC and in some cases by billions of euros.

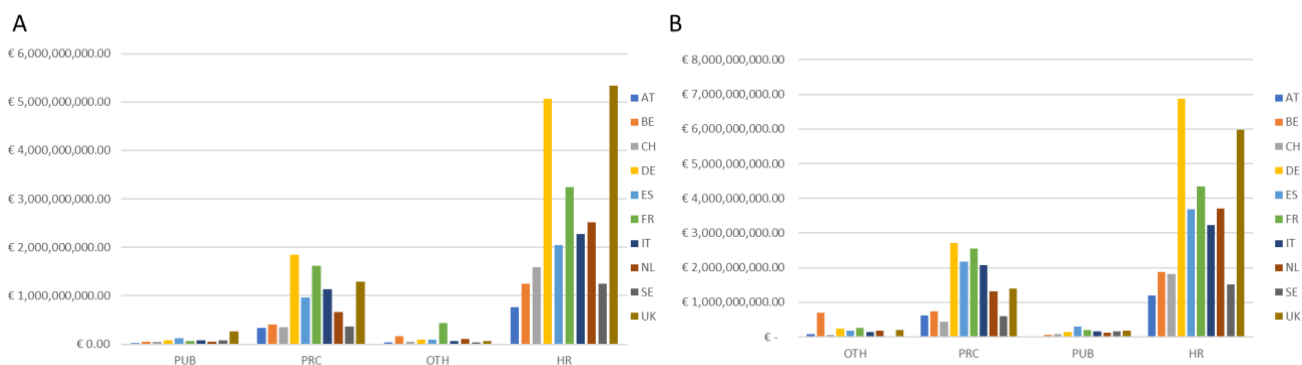


Figure 4. Top 10 countries by EU Contribution separated by legal entity type for FP7 (A) and H2020 (B).

Even in the combined HR category, the UK maintained a slim margin over Germany in FP7 while Germany had a similar lead over France in the PRC category. This shifted during H2020, where Germany then comfortably led both categories. The UK still held second overall for the HR category in H2020 with more than €1.5 billion over third place (France; Table 7). The UK dropped to fifth in PRC awards which just narrowly beat Netherlands by about €80 million (Table 8). Interestingly, the UK was awarded a similar amount for PRCs in FP7 (€1.3 billion) as in H2020 (€1.4 billion), it just appears that not only did the margin widen for how much German and French PRCs were awarded but other countries PRCs, particularly Italian and Spanish, were awarded more overall.

Table 7. Top 10 Countries in FP7 EU Contribution by Legal Entity Type with HR (Shown as billions of Euros)

Country	HR	OTH	PRC	PUB
Austria	€ 0.76	€ 0.03	€ 0.33	€ 0.03
Belgium	€ 1.25	€ 0.16	€ 0.41	€ 0.05
France	€ 3.25	€ 0.44	€ 1.61	€ 0.06
Germany	€ 5.07	€ 0.09	€ 1.84	€ 0.08
Italy	€ 2.28	€ 0.06	€ 1.13	€ 0.08
Netherlands	€ 2.52	€ 0.11	€ 0.67	€ 0.04
Spain	€ 2.05	€ 0.10	€ 0.97	€ 0.12
Sweden	€ 1.24	€ 0.04	€ 0.36	€ 0.08
Switzerland	€ 1.59	€ 0.05	€ 0.35	€ 0.05
United Kingdom	€ 5.34	€ 0.06	€ 1.30	€ 0.27

Table 8. Top 10 Countries in H2020 EU Contribution by Legal Entity Type with HR (Shown as billions of Euros)

Country	HR	OTH	PRC	PUB
Austria	€ 1.19	€ 0.09	€ 0.62	€ 0.03
Belgium	€ 1.88	€ 0.69	€ 0.75	€ 0.07
France	€ 4.34	€ 0.25	€ 2.55	€ 0.20
Germany	€ 6.87	€ 0.24	€ 2.72	€ 0.14
Italy	€ 3.23	€ 0.14	€ 2.08	€ 0.17
Netherlands	€ 3.71	€ 0.18	€ 1.32	€ 0.11
Spain	€ 3.69	€ 0.18	€ 2.17	€ 0.30
Sweden	€ 1.51	€ 0.02	€ 0.59	€ 0.16
Switzerland	€ 1.82	€ 0.06	€ 0.44	€ 0.07
United Kingdom	€ 5.97	€ 0.19	€ 1.40	€ 0.18

To what extent the total EU contributions of PRC are divided between SMEs and non-SMEs was of particular interest. Whilst SMEs are most businesses within the EU [3], there are reasons they may be less effective at generating economic impact from products and processes developed through participation in EU research programmes than large businesses. For instance, some SME participants are service providers within consortia, that are responsible for undertaking tasks such as analytical, communication, or management services. Some SMEs are early-stage single-technology companies and we know that most of these businesses fail within the first five years [6]. On the other hand, larger companies (which receive a lower proportion of their full costs in grant income) are more likely to participate in EU programmes for the benefits that are closer to market application.

Perhaps surprisingly, the H2020 data shows SMEs in all legal entity categories, but since our focus was on for-profit businesses (PRC), we have chosen to take a closer look at H2020 data only for PRCs (Table 9). Based on our ability to manipulate the data, the H2020 data was more conveniently annotated for SME data than FP7 and given the time restraints, this is one reason why we focused on only H2020 for this part of the analysis. In addition, H2020 is obviously a better reflection of the most recent position. In this analysis (Figure 5), we see that of the top 10 countries, the UK has the second lowest share total for non-SME PRC (about 40%) versus the group average of about 49% of total funding received by PRCs. The highest non-SME PRC share by country went to France where the non-SME PRC received about 62% of the total share of PRC awards. Germany, Austria, and Italy are the three additional countries whose non-SME PRC total outpaces the SME portion. Belgium, Netherlands, Spain, Sweden, the UK, and Switzerland all have greater funding for SME organisations, with Switzerland being the highest proportion overall going to SMEs (67%).

Table 9. Top 10 Country PRC Breakdown with respect to SME status in H2020 (Shown as billions of Euros)

Country	Austria	Belgium	France	Germany	Italy	Netherlands	Spain	Sweden	Switzerland	United Kingdom
Total PRC Contribution	€ 0.62	€ 0.75	€ 2.55	€ 2.72	€ 2.08	€ 1.32	€ 2.17	€ 0.59	€ 0.44	€ 1.40
Not an SME	€ 0.35	€ 0.34	€ 1.58	€ 1.58	€ 1.17	€ 0.59	€ 1.00	€ 0.27	€ 0.14	€ 0.56
SME	€ 0.27	€ 0.40	€ 0.97	€ 1.13	€ 0.91	€ 0.73	€ 1.17	€ 0.32	€ 0.29	€ 0.84

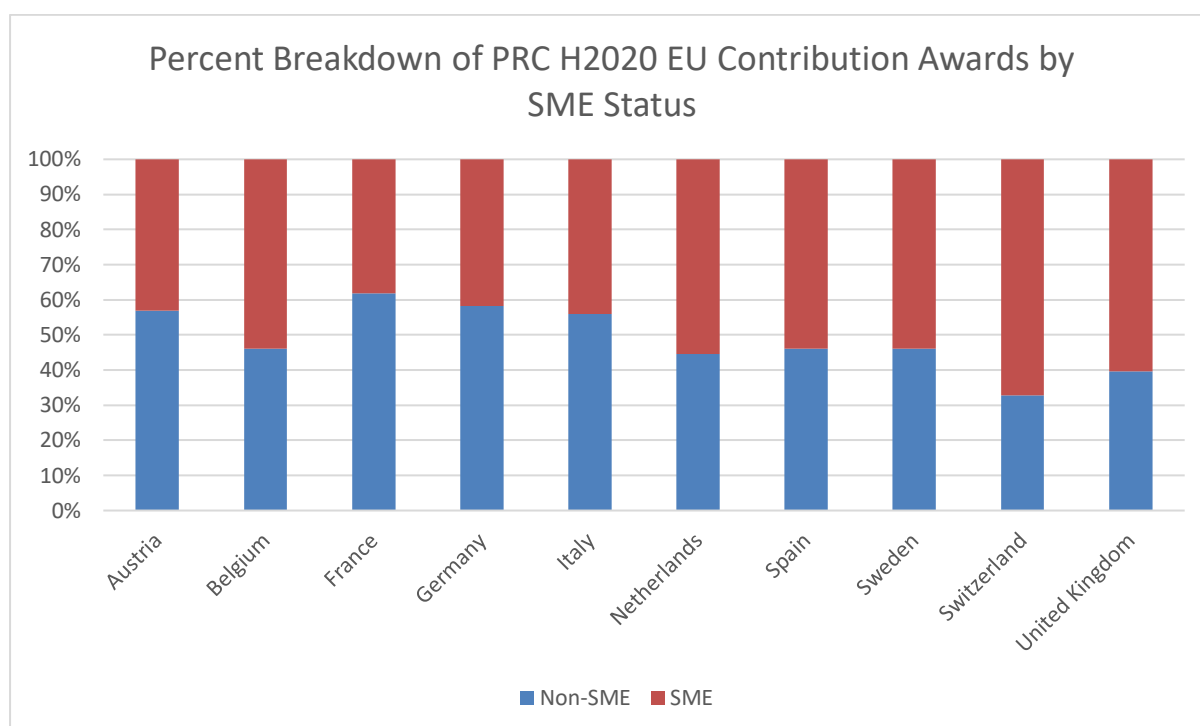


Figure 5. Percentage breakdown of SME Status of PRC EU contributions by Top 10 Countries in H2020. The total value of all individual participations was combined for all PRC project participations. The percentage total of either SME or non-SME PRC was calculated and plotted as a stacked bar chart.

Table 10. Top 10 Countries' top Five Large Businesses and Their Total Grant Income in H2020

Top non-SME PRC by EU Contribution by Country	Sum of EU Contribution (€)
Austria	
AVL LIST GMBH	€ 45,580,344.80
INFINEON TECHNOLOGIES AUSTRIA AG	€ 31,853,904.00
FORSCHUNGSINSTITUT FÜR MOLEKULARE PATHOLOGIE GESELLSCHAFT MBH	€ 25,982,573.13
CEMM - FORSCHUNGSZENTRUM FÜR MOLEKULARE MEDIZIN GMBH	€ 21,301,167.60
INSTITUT FÜR MOLEKULARE BIOTECHNOLOGIE GMBH	€ 15,248,722.83
Belgium	
GLAXOSMITHKLINE BIOLOGICALS SA	€ 14,124,135.00
EUROPEAN ROAD TRANSPORT TELEMATICS IMPLEMENTATION COORDINATION ORGANISATION - INTELLIGENT TRANSPORT SYSTEMS & SERVICES EUROPE	€ 12,359,579.55
TOYOTA MOTOR EUROPE NV	€ 12,125,376.68
C-SHIFT	€ 10,396,473.50
SIEMENS INDUSTRY SOFTWARE NV	€ 9,537,421.97
France	
AIRBUS OPERATIONS SAS	€ 90,774,612.69
THALES AVS FRANCE SAS	€ 60,486,714.17
SAFRAN AIRCRAFT ENGINES	€ 47,666,506.80
THALES LAS FRANCE SAS	€ 43,125,534.06
BULL SAS	€ 39,969,307.52
Germany	
ROBERT BOSCH GMBH	€ 62,622,775.20
INFINEON TECHNOLOGIES AG	€ 59,720,456.03
SIEMENS AKTIENGESELLSCHAFT	€ 52,179,831.61
AIRBUS OPERATIONS GMBH	€ 41,323,009.68
AIRBUS DEFENCE AND SPACE GMBH	€ 29,666,283.41
Italy	
LEONARDO - SOCIETÀ PER AZIONI	€ 113,823,558.02
ENGINEERING - INGEGNERIA INFORMATICA SPA	€ 61,202,308.49
STMICROELECTRONICS SRL	€ 52,453,318.55
GE AVIO SRL	€ 44,618,668.77
RINA CONSULTING SPA	€ 42,857,148.12
Netherlands	
ASML NETHERLANDS B.V.	€ 43,259,433.86
CLIMATE-KIC HOLDING BV	€ 38,466,600.38
PHILIPS ELECTRONICS NEDERLAND BV	€ 31,687,040.10
PHILIPS MEDICAL SYSTEMS NEDERLAND BV	€ 18,646,879.25
LANZATECH BV	€ 18,611,228.06
Spain	
INDRA SISTEMAS SA	€ 66,114,134.79
ATOS SPAIN SA	€ 65,242,900.86
AIRBUS DEFENCE AND SPACE SA	€ 36,399,429.14
TELEFONICA INVESTIGACION Y DESARROLLO SA	€ 22,925,906.71
ACCIONA CONSTRUCCION SA	€ 21,688,432.34
Sweden	
GKN AEROSPACE SWEDEN AB	€ 30,419,109.94
SAAB AKTIEBOLAG	€ 18,976,535.26
ERICSSON AB	€ 18,196,262.88
VOLVO PERSONVAGNAR AB	€ 12,420,953.13
BOMBARDIER TRANSPORTATION SWEDEN AB	€ 12,137,649.93
Switzerland	
IBM RESEARCH GMBH	€ 47,345,747.40
SKYGUIDE, SA SUISSE POUR LES SERVICES DE LA NAVIGATION AERIEUNE CIVILS ET MILITAIRES	€ 7,141,658.17
ID QUANTIQUE SA	€ 3,229,019.98
FPT MOTORENFORSCHUNG AG	€ 3,139,584.21
SKYSOFT-ATM SA	€ 3,094,375.25
United Kingdom	
ROLLS-ROYCE PLC	€ 58,601,723.81
JOHNSON MATTHEY PLC	€ 20,150,786.10
NATS (EN ROUTE) PUBLIC LIMITED COMPANY	€ 18,393,022.73
3F BIO LIMITED ¹	€ 13,486,157.38
LEONARDO UK LTD	€ 11,222,272.76
Grand Total	€ 1,681,996,576.60

To determine if there was any pattern amongst individual non-SME PRCs, the top 5 awarded non-SME PRCs were determined for each of the top 10 countries (Table 10). There are few noticeable differences in the perceived pattern of funding. For instance, in Switzerland, where the non-SME PRC portion is quite small, the top performer IBM RESEARCH GMBH received 40 million more euros than the next PRC. In this case, IBM is about one third of the total non-SME PRC money that was awarded to Swiss organisations. Similarly in the UK, ROLLS-ROYCE PLC received nearly 40 million more euros than the next PRC, but the total of Rolls-Royce only accounts for about 11% of

¹ In the Horizon 2020 data export, it lists 3F Bio as receiving that amount but the information on CORDIS suggests that they only received about €3.5 million. According to their published accounts, it is possible they are also an SME, not a larger business. If this company were removed from the top 5, its replacement would be Samsung Electronics (UK) Limited.

the UK's non-SME PRC total. This is because the other non-SME PRCs have received considerably more funding than the remaining Swiss companies had done. The largest non-SME PRC winner in the top 10 (and indeed the entire H2020 programme) was an Italian company, LEONARDO - SOCIETA PER AZIONI, that was awarded over €110 million. This also highlights the dynamic component of international subsidiaries and how they participate in these framework programmes. In this instance, we have Leonardo's UK subsidiary in the top 5 UK large business recipients while GSK's Belgian subsidiary was their top recipient. This is a trend that can be seen for most countries' large non-SME PRC recipients, which complicates the analysis of where research money ultimately goes.

Total Consortia Value

One way to potentially encapsulate value to non-SME PRC is by assessing the total consortia value in which they participate. Presupposing that non-SME PRC participate in projects not solely for the grant income they receive individually (Table 9), but that that the value they recover from participation is based more on the total work of the consortium, we wanted to compare countries on the total value of the consortia that include larger businesses. It should be noted that these values will be considerably larger than the overall totals for the entire research programme because many of these consortia overlap between different country participants. These consortia values also account for all participants of all entity types and SME status in a consortium. This metric has the benefit of ignoring the country of the lead participant entity (coordinator) and thus accounts for businesses that participate with domestic and international lead partners. Table 11 shows the total consortia values for the top 10 countries for H2020. It also shows the number of unique non-SME PRCs.

In H2020, the UK non-SME PRC had about €6.7 billion in consortia value, which placed the UK sixth overall on this metric. Despite being the top earners in the PRC category, Germany and France fell behind Italy and Spain in total consortia value. Italy was the country with the largest consortia value for non-SME PRCs with Spain in the second position. Perhaps surprisingly, Netherlands passed the UK's total consortia value followed closely by Sweden and Belgium's totals which are both within €500m less than the UK's.

In addition to the total consortia value, we examined the average consortia value for a non-SME PRC. In this case, essentially the roles were reversed. Now Switzerland and Sweden were receiving the most value on average to their non-SME PRC participants while Germany and France were seeing the least value on average. The UK still fell behind Italy, Netherlands, and Spain in average value – ranking eighth out of the ten.

Table 11. Total Consortia EU Contribution Value involving non-SME PRC (shown in millions)

Country	Unique Non-SME PRC	H2020 EU Consortia Value (in millions €)	Average Consortia Value (in millions €/PRC)
Austria	367	€ 4,791.44	€ 13.06
Belgium	493	€ 6,227.61	€ 12.63
France	1186	€ 6,973.91	€ 5.88
Germany	1717	€ 7,518.79	€ 4.38
Italy	1120	€ 8,199.77	€ 7.32
Netherlands	786	€ 6,800.89	€ 8.65
Spain	1172	€ 7,667.71	€ 6.54
Sweden	402	€ 6,510.65	€ 16.20

Switzerland	301	€ 4,696.59	€ 15.60
United Kingdom	1027	€ 6,677.99	€ 6.50

Discussion

The United Kingdom has performed very well in the EU Framework Programmes when viewed in terms of total income – being a net recipient of funds when the UK was a member of the EU. The UK was second in overall award totals both during FP7 and H2020 (with Germany and France on either side). However, the question we seek to address is what role large UK business play in these awards and whether they are competitive with large businesses of other participant countries. While the UK is second in overall awards, the UK HES sector contributes to the majority of this and in fact is the leader of any country in this category by a margin of nearly €2 billion. However, in H2020 when accounting for both HES and REC as a larger academic grouping, then Germany pulls ahead by nearly €1 billion. This largely reflects the relative paucity of research Institutes in the UK compared to the UK's main competitors.

The UK comes in 6th overall for non-SME PRC grant income, falling behind Germany, France, Italy, Spain, and Netherlands in H2020 (the UK does just barely pass Netherlands when accounting for all PRCs). This is striking in that three of these countries have much smaller economies than the UK [7] and presumably fewer businesses, but we cannot at this time control for the total number of larger businesses in each country.

Our original hypothesis was that UK larger businesses fared poorly from these EU research programmes. UK universities clearly dominate UK income, but it remained possible that UK large businesses received counter-balancing benefit from collaborating outside the UK. The consortia value metric that we devised might provide evidence to refute our hypothesis. Essentially, we posit that the raw numbers of what a non-SME PRC takes away from the consortia (as discussed earlier) is not the only value that they receive from their projects. If we assume that the total value of a consortium is a better proxy of participant value than simple grant income to large businesses this would account for results and IP they might access from the whole consortium – bearing in mind of course that there may be large business competitors in the same consortia, reducing any competitive advantage from project outcomes. We therefore determined the total consortia values for all non-SME PRC for top 10 countries.

We found that the UK was sixth overall in H2020. Though France, Netherlands, Sweden, and Belgium are all within around €700 million (or less than 10% of the total) of the UK figure. France being ahead of the UK by about €300 million and Germany ahead of the UK by about €800 million would not be totally unexpected as we know that Germany and France have more PRC involvement than the UK and the UK generally makes up the difference on France in the HES category, but we see Netherlands, Sweden, and Belgium participating in total consortia value rivalling that of the UK and France, which make up two of the three top economies in Europe. Spain and Italy had the highest consortia value, which puts them ahead of all countries including the largest competitor, Germany.

From another angle, if you look at the average consortia value for non-SME PRC; countries with smaller economies have far greater average value for their non-SME PRCs while the UK takes a step ahead of France and Germany, it still lags all other countries in the top 10. This consortia value is an interesting metric because it includes all participations of these organisations without respect

to the country of origin of the project coordinator. This allows us to look at the total value of all collaborations both domestic and international for these organisations. Perhaps the biggest downside for this metric and really all PRC metrics is that there is no mechanism to account for subsidiaries of large multinational corporations. For instance, Airbus has affiliates in nearly every top 10 countries' top 10 (not shown). And there is ultimately no simple answer for this, as obviously profits off of any venture will be ultimately that of the parent company. These companies do employ and provide services in their country of operation. Ultimately in this analysis, we treated the subsidiaries as independent non-SME PRCs for their country of operation, but more could be done to tease apart this issue in the future. A further limitation of this metric is that smaller countries need only participate as one small non-SME PRC to be included in the total consortia value, even though other countries' participants may reflect a larger commitment. Though we think this metric still applies well as even still in that hypothetical, the company could still bring back large value through the consortium's output.

If we take a step back to look at the larger picture, the top three countries from FP7 to H2020 did take the largest loss of the overall ratio of the total budget. The UK fared the worst in this metric and generally had the lowest growth (in absolute terms) among the top 10 from FP7 to H2020. Again, we see most of the growth in the top five due to Italy and Spain, particularly they saw the largest growth in their PRC but also had quite significant increases in their HR sectors.

The outstanding question as to whether we found evidence to support our hypothesis is complicated. Looking at the total consortia value of non-SME PRCs in H2020, the UK is certainly lagging where you would expect it to be compared to some smaller countries. However, we cannot overlook the fact that France, which has a similar sized economy to the UK, is not that much farther ahead. Germany is slightly farther ahead but this is consistent with the larger German economy.

Looking at the total value of participant countries' awards total, France and Germany have a similar value of contributions going to non-SME PRCs while the UK has a little bit more than one third of their total amount. Spain, Italy, and Netherlands also have larger amounts than the UK, with Netherlands the closest with nearly double what UK non-SME PRCs receive. Considering both metrics, it is hard to conclude that the UK received the level of non-SME PRC support (grant income or wider consortium value) that would be expected in relation to the size of its economy. Based on our analysis here, it seems fair to accept our initial contention that British non-SME PRCs do not perform as robustly as similarly sized competitor nations, but that analysis is complicated by international subsidiaries and the ultimate value of intellectual property. Ultimately, further analysis is required to flesh out this question in more detail and take a more pointed look at how these components effect decision making and the desire of large UK businesses to participate in schemes going forward.

Even though we see this phenomenon with UK large businesses, it raises the question of what the UK's role in the EU framework is programmes. Certainly, it should not be lost that the UK did well in these programs overall, but in a way that is dominated by the UK University sector. This is clearly good for the UK contribution to European science, and it supports highly paid employment within universities. However, it does not address where the economic benefits from programme outputs and outcomes accrue. All participant organisations, including both universities and businesses, benefit from intangible factors present in these programs that would be absent or harder to establish if the UK were not part of it. The question remains as to what a UK "Plan B" could provide in those intangible categories and whether more large businesses benefits would be generated than participation in the Horizons Europe programme.

Methods

The data used in this report comes exclusively from the Directorate-General of Research and Innovation of the European Commission. Specifically, the FP7 and the H2020 Dashboards (<https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard>) [1] and the total available data from the Community Research and Development Information Service (CORDIS; <https://cordis.europa.eu/projects/en>) [7] [8]. Since funds were released as recently as last year, the H2020 database is updated regularly. At the time of this report, the data was last updated on 16 December 2021 and published on 25 January 2022. For the H2020 data, there were 176,512 individual participations logged with 35,381 unique projects. For FP7, there were 139,933 individual participations logged with 25,785 unique projects. Given the large nature of the data set, the data was presumed to be entered correctly

The most complete data sets were downloaded and manipulated in Microsoft Excel. All tables and graphs were generated via Excel. In general, most of the tables and graphs were generated with the pivot table feature and summarized therein. To combine the HES and REC categories, all HES and REC were relabelled in Excel to the new HR category.

For Figure 6, the totals for countries total EU contribution received were calculated by excel in a pivot table individually in total and in part (by legal entity type) for FP7 and H2020. The information was extracted and plotted in a line from FP7 to H2020. The percentage change in these two totals was calculated for each country. For Figure 3, to calculate the ratio of the countries' portions, the values obtained for Figure 6 were extracted and divided by the total contributions for each framework programme and replotted. The percentage change was calculated from these values as well.

To calculate the total consortia value for each countries non-SME PRCs, the project numbers for each countries' non-SME PRCs were extracted individually. Those project numbers were then used to pull all data for every participant from each project, regardless of country or entity status. Each country's total cumulative EU contribution total was then calculated for Table 11. In addition, the number of unique entities for non-SME PRC was determined by country. This was then used to determine the average consortia value associated with non-SME PRC.

Summary

- The UK received the second highest total funding in both FP7 and H2020, with most of that funding going toward UK Universities which received approximately 70% of total funding in both programs
- UK organisations had the smallest relative increase in funding from FP7 to H2020 compared to the Top 10 highest contribution receiving countries and most of that funding was to UK Universities.
- Of all the H2020 businesses, the UK has a higher proportion of SMEs to Non-SME PRCs compared to the average amongst the top 10.
- Germany has by far the most unique non-SME PRCs participants in H2020 (1717) while the UK has only the fifth highest number overall (1027).
- Large businesses (non-SME PRCs) in the UK received the 6th highest funding in H2020 (behind Germany, France, Italy, Spain, and Netherlands).
- Among participant countries, large UK businesses ranked 6th and 8th in total and average consortium value, respectively.

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