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Overview of the potential implications of Brexit for EU27 Horizon Europe Program

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Outline

Trends in the Global Research Environment: A multipolar global research world

- The US as a frontier pole
- China as a new very fast rising star pole
- EU/ERA as the largest pole quantitatively, catching up with US at the frontier, but less dynamic than China and losing power without the UK

A multipolar global science world: implications for science

- Shifting flows of scientific talent
  - Open poles at the frontier attract top talent, which helps keep them at the frontier
- Shifting partners for scientific collaboration
  - Poles at the frontier are strong partners for international scientific collaboration which helps keep them at the frontier

A multipolar global science world: impact beyond science

- New technologies, innovations, firms created where science hotspots are
- Firms (multinationals) locating R&D labs close to where hotspots are

Multiple poles in an open global science world with mobility of talent and international cooperation: a win-win for science and innovation?

Implications for Horizon Europe post Brexit

Mapping the new geography of research: the EU pole with/without the UK
scientific top publications

Country's Share in World Top 10% most cited publications

	Global share, 2005	Global share, 2016	
EU27	25,49	26,25	European Union without UK
EU28	33,22	32,25	European Union
USA	38,19	25,53	United States
CHN	3,86	14,01	China
GBR	7,73	6	United Kingdom
DEU	6,15	5,81	Germany
ITA	3,25	3,88	Italy
FRA	4,05	3,46	France
JPN	5,26	3,32	Japan
ESP	2,14	2,48	Spain
NLD	2,49	2,08	Netherlands
CHE	1,59	1,47	Switzerland

Source: Bruegel calculations based on OECD, STI 2017; OECD calculations based on Scopus Custom Data, Elsevier, Version 4.2017, July 2017.

For more evidence: see background slides

Mobility of Talent : *a gateway to higher excellence*

International mobility of scientific authors, 2016
As a percentage of authors, by last main recorded affiliation in 2016

	New inflows	Net flow
SUI	11,14	0,83
UK	7,28	0,15
GER	4,57	-0,54
FRA	3,78	-0,98
USA	3,85	-0,02
ESP	2,11	-1,56
ITA	1,37	-1,23

Expected citation impact of scientific authors, by mobility profile in 2016
Average 2015 Scimago Journal Rank (SJR) scores

	New inflows	Returnees	Stayers	Outflows
China	1,60	1,39	1,00	1,92
USA	2,35	2,10	2,09	1,86
Japan	1,79	1,69	1,18	1,83
SUI	2,38	2,30	2,11	2,27
UK	2,25	1,92	1,98	1,96
GER	2,26	2,07	1,70	2,11
FRA	1,80	1,88	1,65	1,93
ESP	1,85	1,68	1,36	1,98
ITA	1,60	1,55	1,33	1,95

Source: OECD calculations based on Scopus Custom Data, Elsevier, Version 4.2017; and 2015 Scimago Journal Rank, July 2017.

Partners for scientific collaboration:
a gateway to higher excellence

Co-authorship links and citation impact in biomedical research

	Share of pubs with international co-authorship
FRA	47,28
GER	44,69
ITA	40,87
SUI	61,76
UK	44,05
USA	28,96

Quality of INAT copubs relative to DOM pubs, World	1,26
Quality of INAT copubs relative to DOM pubs, UK	1,39

Germany 4.13	7.20	**UK 4.47**
6.96		6.47
	France 4.09	

EU's framework programs: a gateway to excellence?
Collaborative ties through FP7

For all collaborative projects in the FP7 period a total of about 1.5 million pairings were supported (European Commission, 2014).

- Only 0.4 percent involved a US partner
- Only 0.2 percent involved a Chinese partner

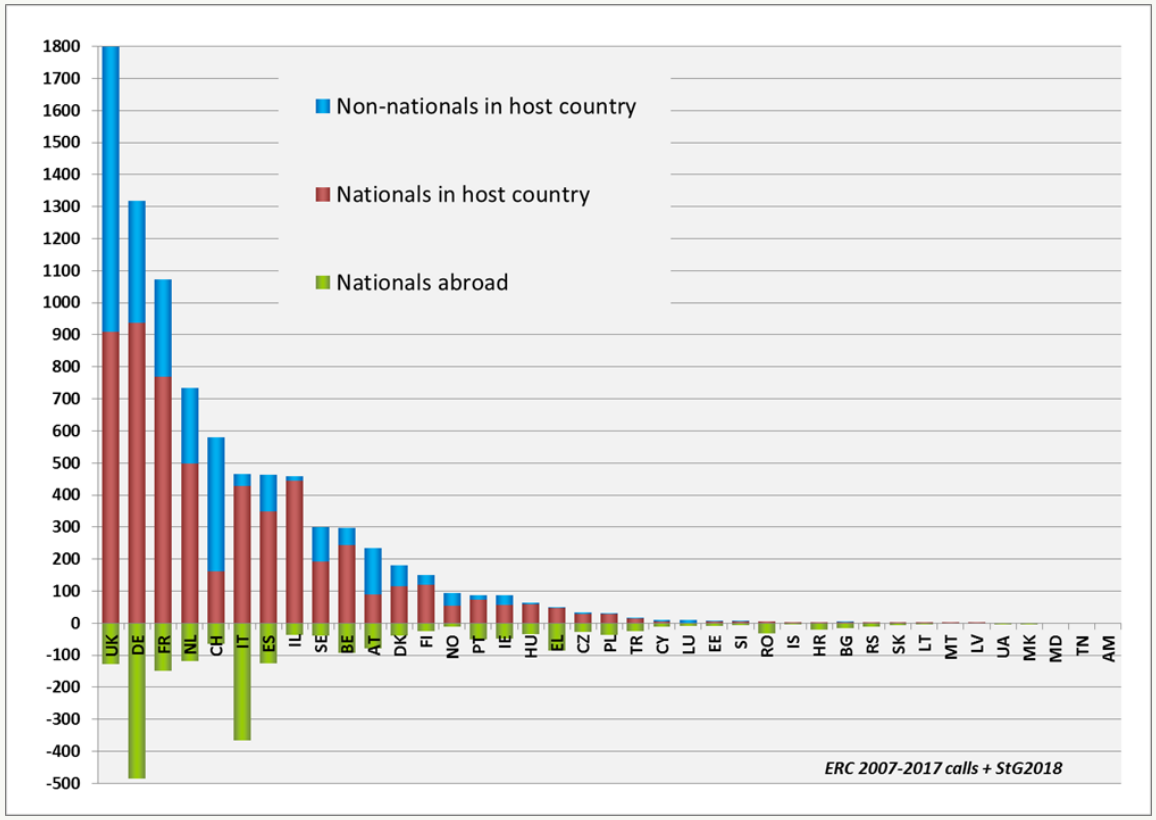
Source: E-CORDA

Collaborative projects in FP7 with UK

	Above par UK partners	At par UK partners	Below par UK partners
	for FP collaboration (in descending order)		
	DK, IE, NO, NL, DE, CH, SE ,FR, BE	ES, IT, IL, PL, EL, CY	BG, FI, EE, PT, LT, AT, CZ, HU, SK, HR, SI, LU, RO, MT, LV

Source: Bruegel calculations on basis of E-Corda; Positions above/below/at par are calculated by the ratio of the share of the country in UK's FP nodes relative to the share of the country in world international pubs

Attracting talent through ERC



Nat of PI	Country of HI	Share of All UK Nat PI	Success Rate
UK	UK	87,8%	13,5%
UK	DE	2,0%	24,3%
UK	IE	1,5%	4,3%
UK	FR	1,5%	15,9%
UK	NL	1,2%	16,3%
UK	CH	1,1%	19,3%
UK	SE	0,9%	9,2%
UK	ES	0,7%	17,9%

Nat PI	Country HI	Succ Rate	Share of Nat PI to UK
CN	UK	6,6%	32,1%
CA	UK	14,7%	42,1%
IN	UK	16,0%	41,4%
JP	UK	16,9%	34,8%
SG	UK	15,8%	44,2%
US	UK	17,4%	36,0%

Nat PI	Country HI	Succ Rate	Share of Nat PI to UK	Succ Rate Nat PI@Home	% Nat PI STAY
IT	UK	13%	7,8%	5,30%	75%
DE	UK	16%	10,5%	14,70%	66%
ES	UK	11%	5,3%	7,50%	85%
FR	UK	15%	5,3%	15,30%	81%
NL	UK	17%	6,5%	15,70%	80%
EL	UK	9%	15,3%	4,10%	65%
IE	UK	14%	25,3%	10,30%	63%

A multipolar global research world: *implications for Horizon Europe after Brexit*

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Engaging in globalisation and managing to benefit

Excellence in S&T capacity

- as a hub for in- and and outflows,
- as a bargaining chip for scientific cooperation, trade and ideas networks
- as absorptive capacity

Open circulation intra-EU

- to allow specialization in hot spots,
- to attract foreign talent
- to allow diffusion of results

> while avoiding circulation diversion

Openness at borders (IN & OUT with non-MS partners, incl UK after Brexit)

- International students & scholars
- Collaboration

A step change in extra-EU openness in Horizon Europe needed compared to the past

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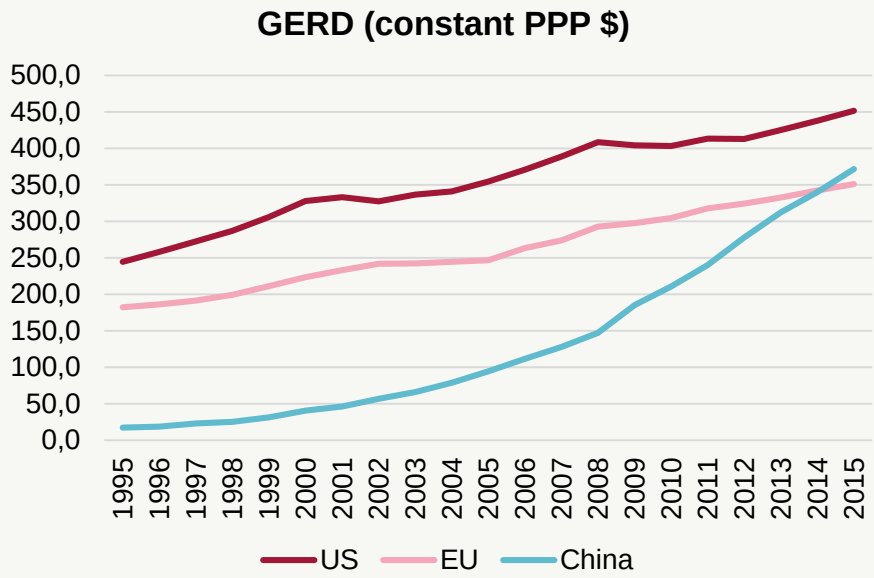
Background material

Shifts in the global R&D landscape: *the rise of China*

Year	United States	EU	China
GERD/GDP (%)			
1995	2,40	1,59	0,57
2000	2,61	1,67	0,89
2005	2,49	1,66	1,31
2010	2,73	1,84	1,71
2015	2,74	1,96	2,07

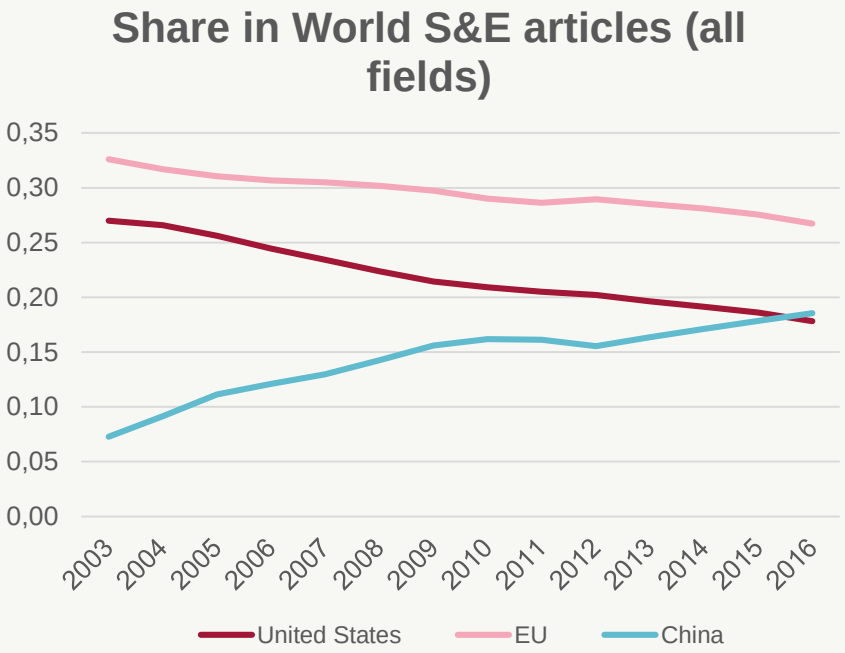
	United States	EU	China
Annual Growth of GERD			
CAGR 2000–10	2,1	3,1	18,0
CAGR 2010–15	2,3	2,9	12,0
Annual Growth of GDP			
CAGR 2000–10	1,6	2,2	10,6
CAGR 2010–15	2,2	1,6	7,8



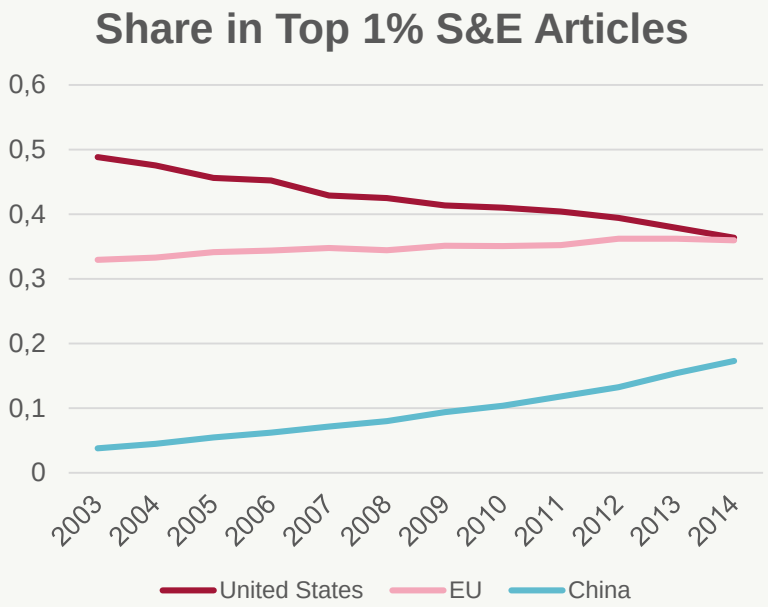
- US accounts for 26% of global R&D in 2015
- US and China account for 47% of global R&D in 2015
- US, China and EU account for 67,5% of global R&D in 2015

Source: Bruegel calculation based on NSF, SEI 2018

Mapping the new geography of research: a multipolar global world with China a new rising star scientific (top) publications



Share of US & EU & China of all SciPub in 2016 is 63%



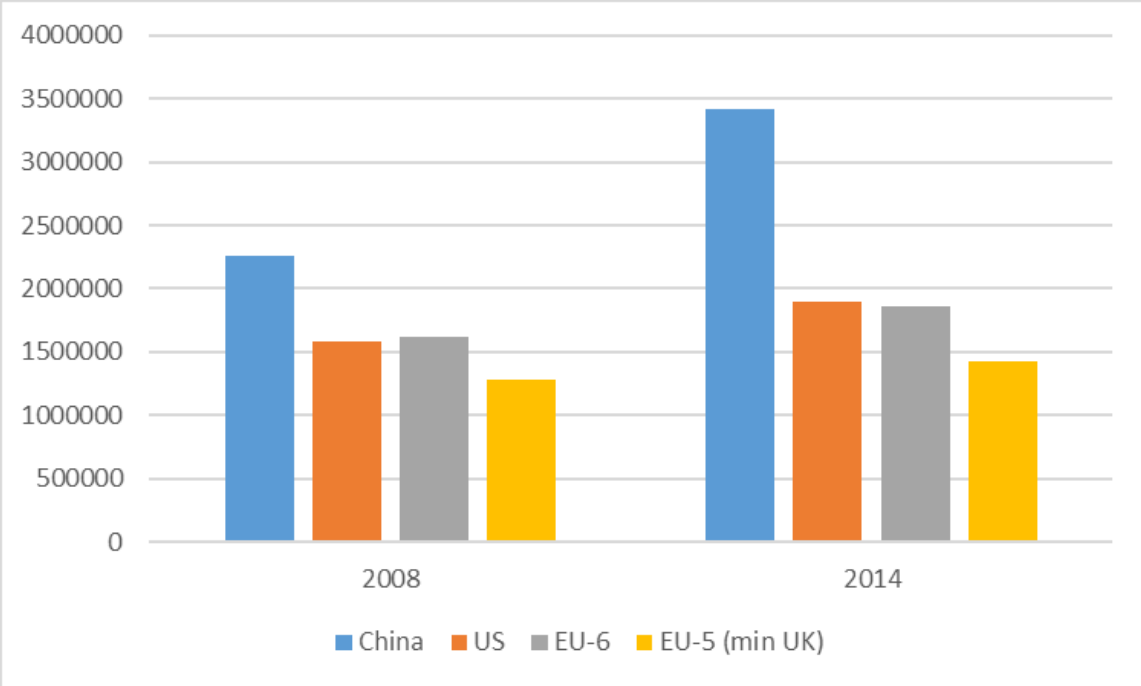
Share of US & EU & China of all TOP SciPub in 2016 is 90%

Source: NSF, S&E Indicators 2018

Mapping the new geography of research: a multipolar global world with China as a new rising star

training the next research workforce

S&E First University degrees (all fields)



Source: Own calculations on basis of NSF, SEI 2018
EU-6: FR, DE, UK, IT, ES, PL
EU-5: FR, DE, IT, ES, PL

Mapping the new geography of research: Universities at the global frontier

Number of Universities in Top ANRU Ranking

2017	Top20	Top100	Top200	Top500
United States	16	48	70	135
United Kingdom	3	9	20	38
Switzerland	1	5	7	8
China		2	13	57
2012	Top20	Top100	Top200	Top500
United States	17	53	85	150
United Kingdom	2	9	19	38
Switzerland		4	6	7
China			7	42

Number of Universities in TOP ANRU Ranking: By Field

TOP20 (2016)	SCI	ENG	LIFE	MED	SOC
United States	15	9	16	16	16
United Kingdom	2	2	3	3	3
China		5			
TOP100(2016)	SCI	ENG	LIFE	MED	SOC
United States	44	29	49	44	57
United Kingdom	9	6	13	14	11
China	7	27			1
Top 100 (2011)	SCI	ENG	LIFE	MED	SOC
United States	52	46	57	54	71
United Kingdom	8	6	10	11	8
China	1	13			1

Source: Own calculations based on ANRU (sourced 5/2018)

The UK attracting foreign students

	94-95	13-14
% foreign students in UK Undergraduates (All S&E fields)	8.8%	13.7%
Share from Top 4 EU countries	35% (Greece, Ireland, Germany, France)	28% (Greece, France, Germany, Roumania)
Share from Top 4 Asia countries	23.4% (Malaysia, HK, Sing, China)	13% (China, HK, Mal, India)
Share from US	3.5%	3.2%
% foreign students in UK: Graduates (All S&E fields)	28.9%	47.5%
Share from Top 4 EU countries	19.7% (Greece, Ger, Ire, France)	13.9% (Ger, Greece, Italy, France)
Share from Top 4 Asia countries	15.6% (Mal, China, HK, Sing)	30% (China, India, S.Arabia, Mal)
Share from US	3.8%	4.3%

Source: Own calculations on basis of NSF, SEI 2016

Some Bruegel References

- Veugelers, R., 2018, **Are European firms falling behind in the global corporate research race?** Bruegel Policy Contribution 18-06, Bruegel, Brussels.
- Veugelers, R., 2017, **The challenge of China's rise as a science and technology powerhouse**, Bruegel Policy Contributions 21154, Bruegel.