



‘All things are in flux, like a river’, said Heraclitus of Ephesus. ‘Everything flows’, everything is becoming.

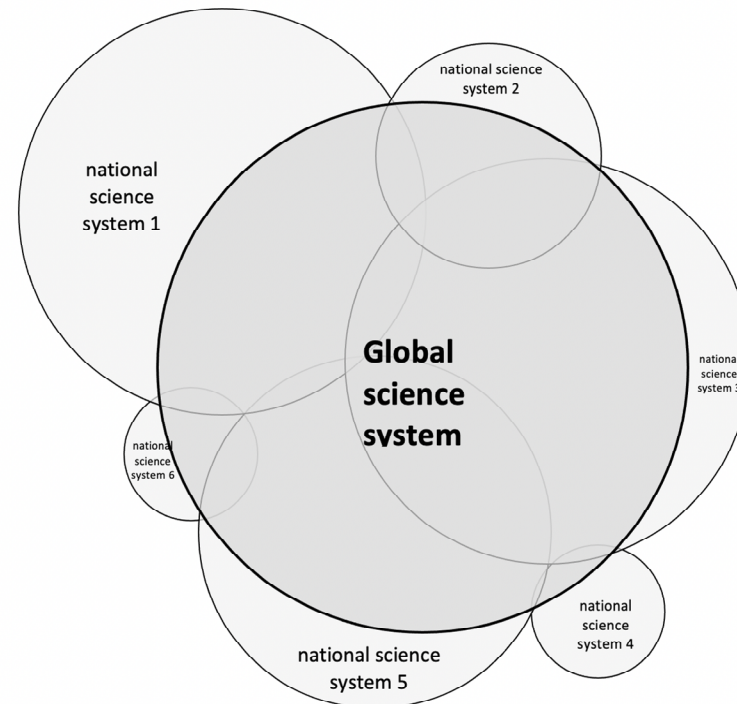
Change is always with us. At times it seems to accelerate

1. The global research system
2. International student mobility
3. The pandemic and after

1. GLOBAL RESEARCH SYSTEM

Since the 1990s a global science system has formed, based on the common pool of papers, and held together by extensive and growing cross-border citation and collaboration (joint papers) –

- the global science system is based on grass roots collaboration and has significant autonomy from national governments and national science systems – but the global system is ultimately supported by national and institutional funding and infrastructure
- many leading scientists wear two hats, (1) institutional/national and (2) disciplinary/global
- the longer-term future of the global science system is by no means certain

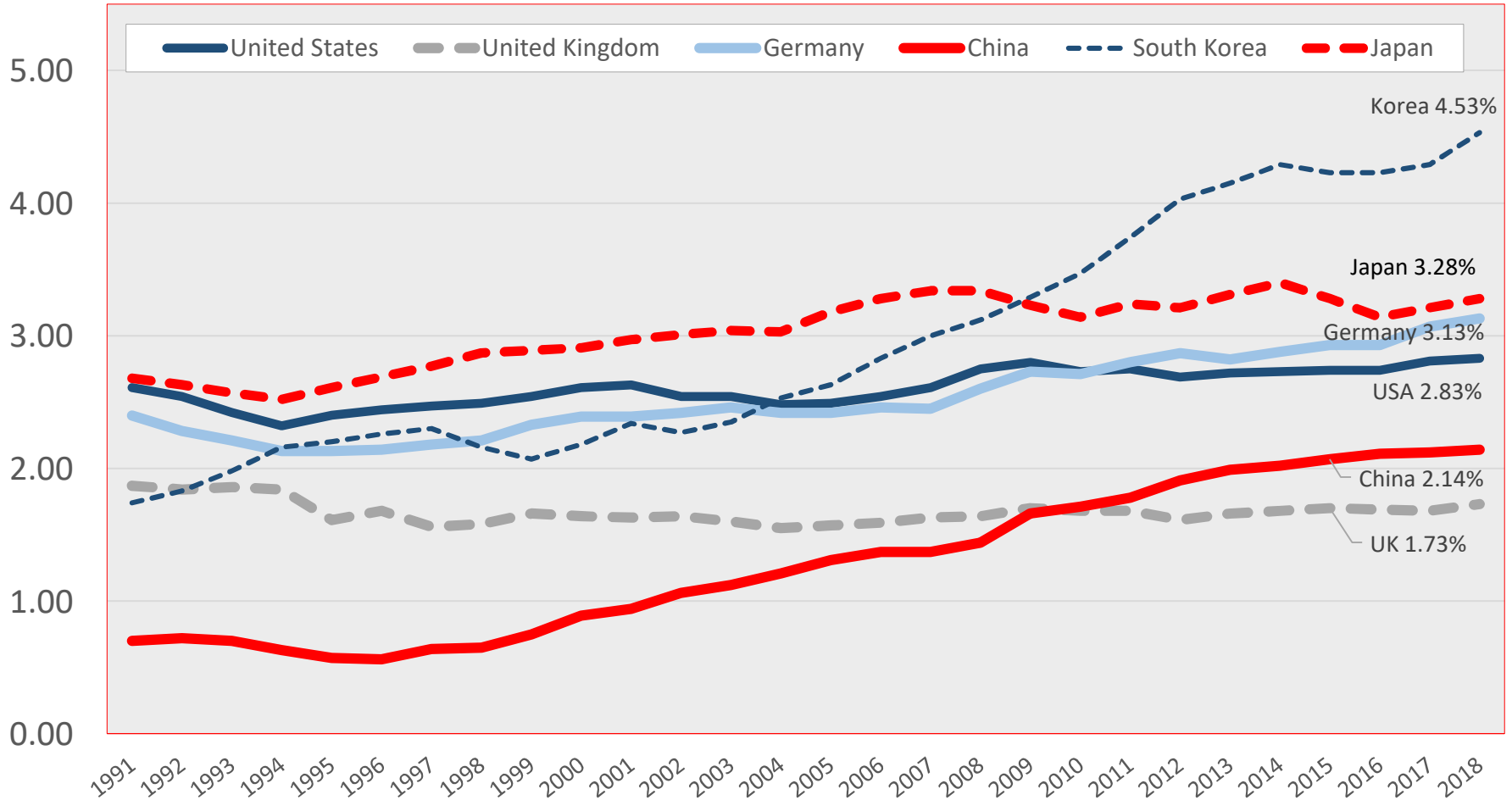


The global science system has proven very dynamic

- **Growth:** Rapid increases in many countries in R&D spending and growth of published science papers at 5 per cent a year from 2000-2018
- **Diversification:** Science no longer an oligopoly of North America, Europe and Japan. Spread of national science capacity to many more countries
- **Networked cooperation:** Rapid growth of co-authorship in science at both global and national levels, everywhere. International collaboration the main form of activity in leading research universities
- **Pluralisation:** Widening of group of leading science countries, rise of semi-independent systems in China, South Korea, India, Iran, Brazil etc (though US science remains very strong and globally central)
- **Global integration:** Increase in the weight and role of the global science system vis a vis national science systems. But geo-political tensions now threaten the autonomy of global scientific cooperation

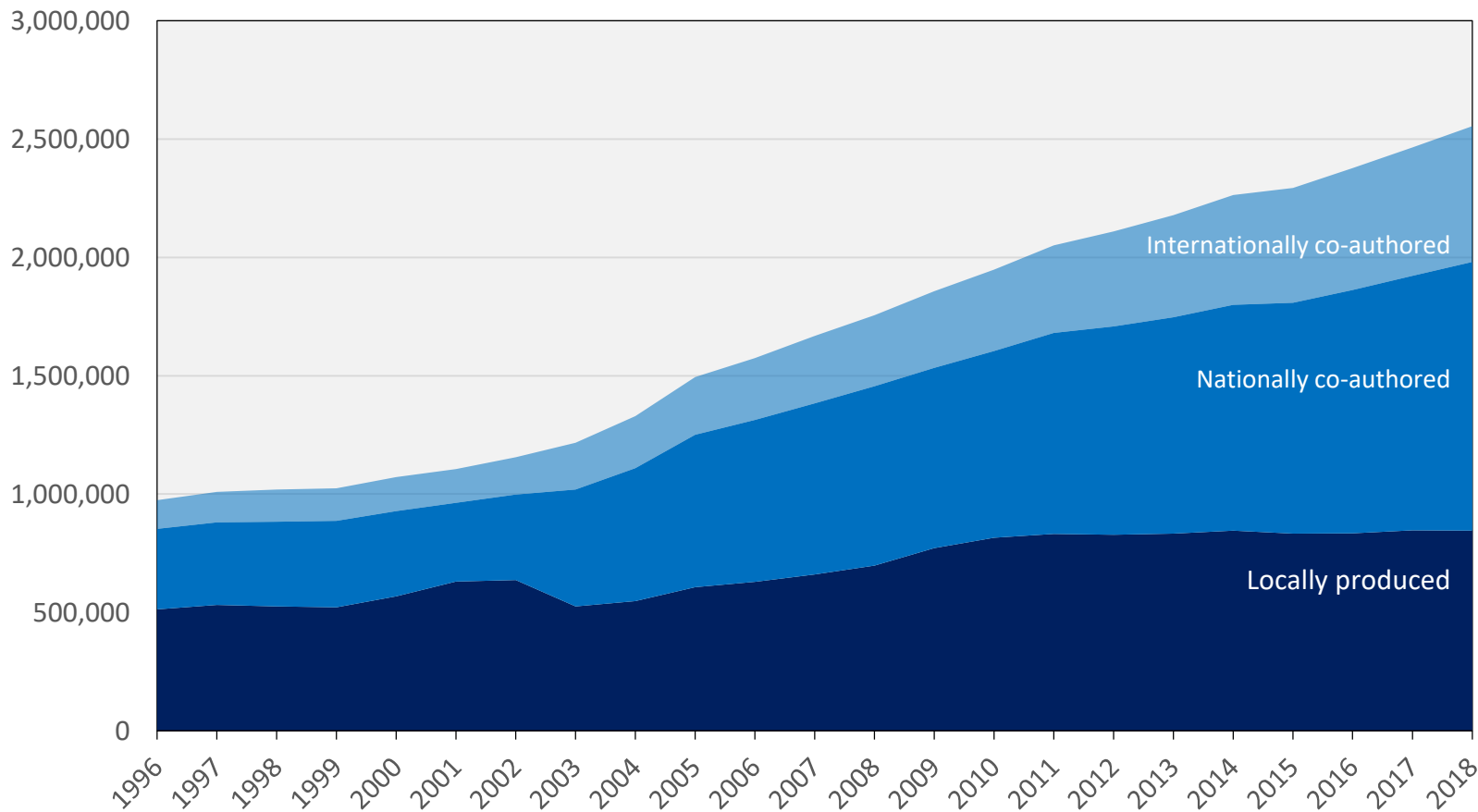
R&D as proportion (%) of GDP, 1991-2018:

USA, UK, Germany, China, Japan, South Korea

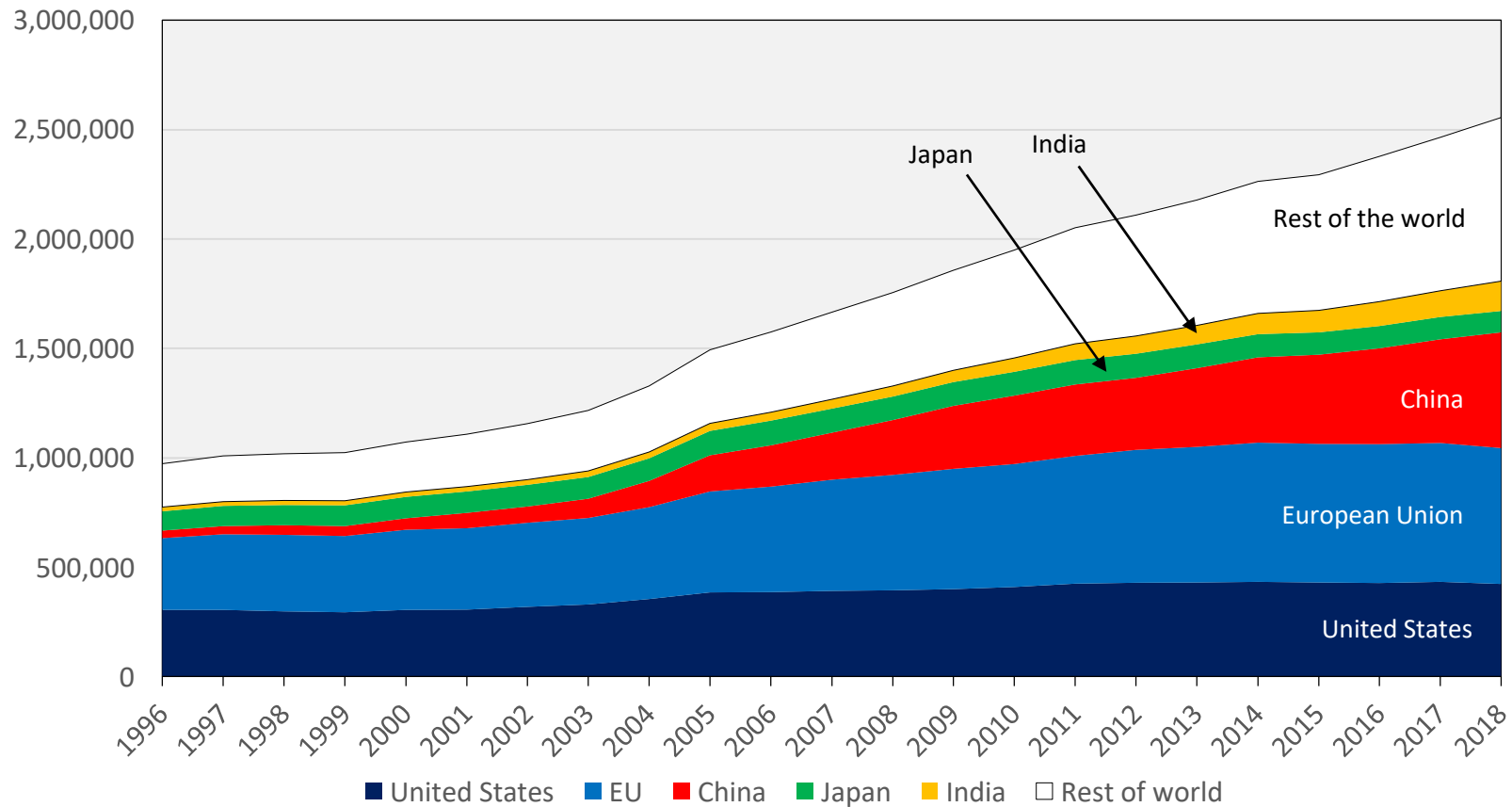


Data: OECD

Number of science papers in Scopus, by type of collaboration, world: 1996-2018



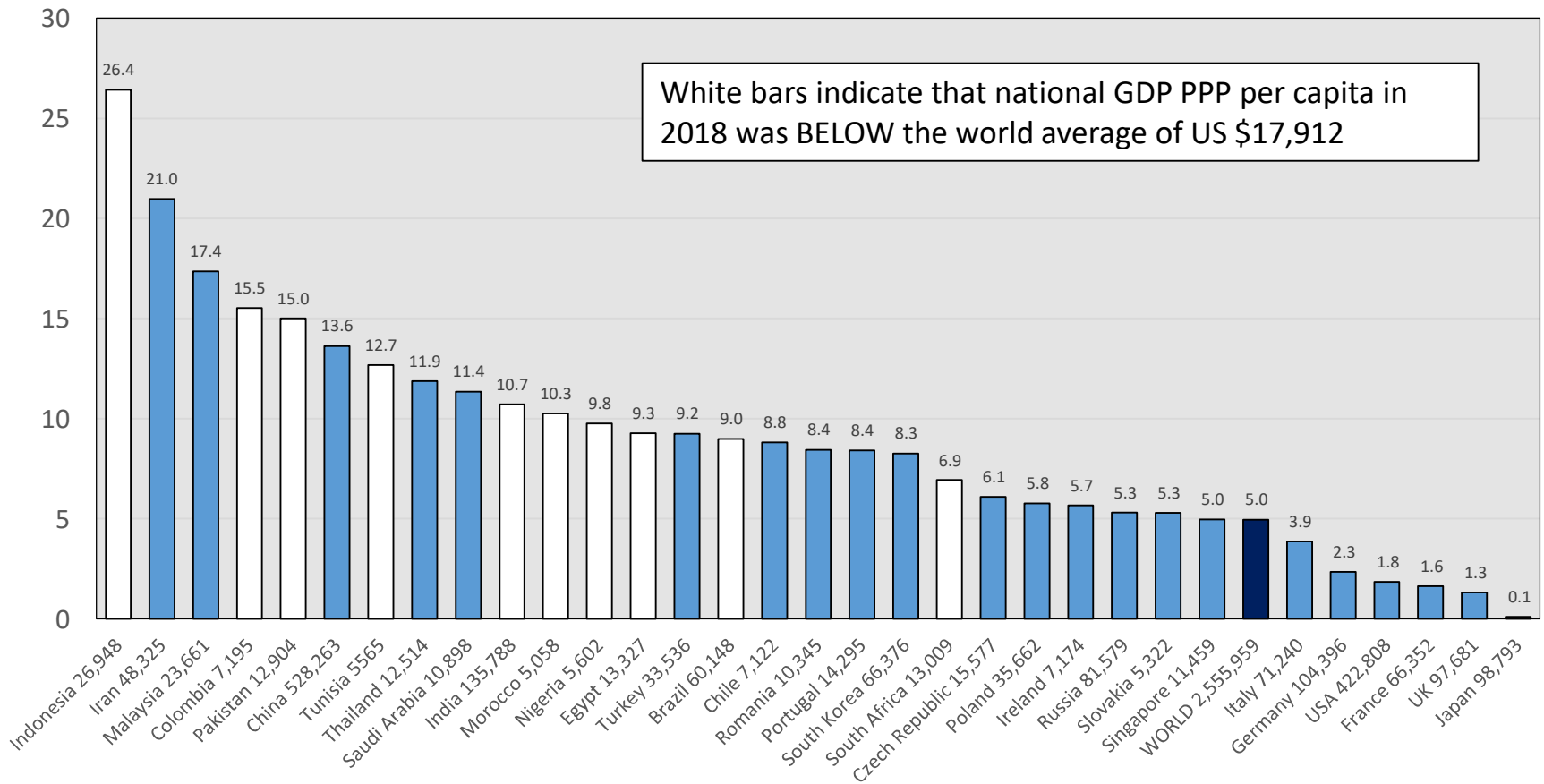
Number of science papers in Scopus by large world region: 1996-2018



Fastest growing national science systems

Average annual growth (%) in science papers: 2000-2018

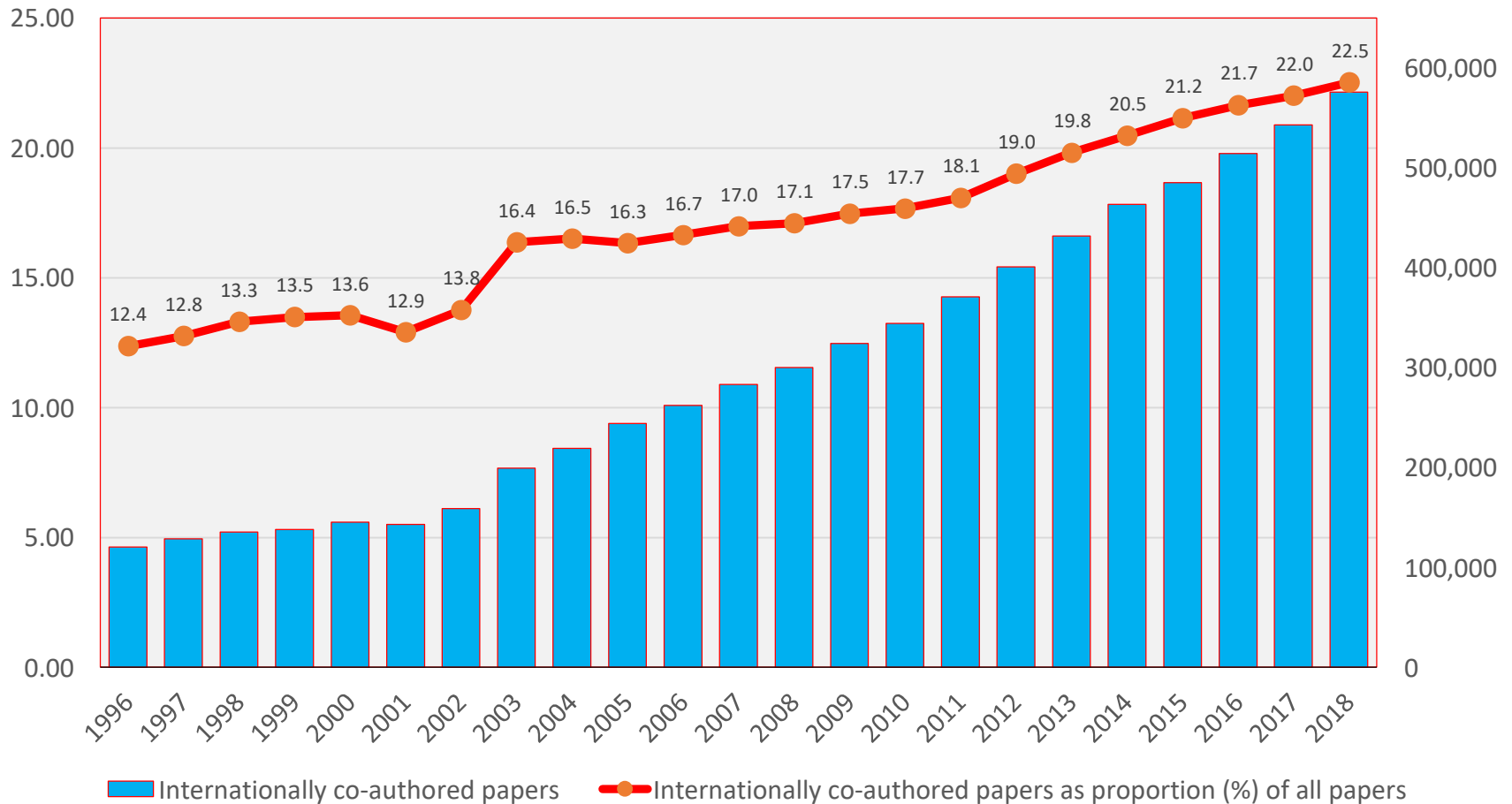
Countries with growth rate above the world average of 4.95% per year and producing more than 5000 papers in 2018



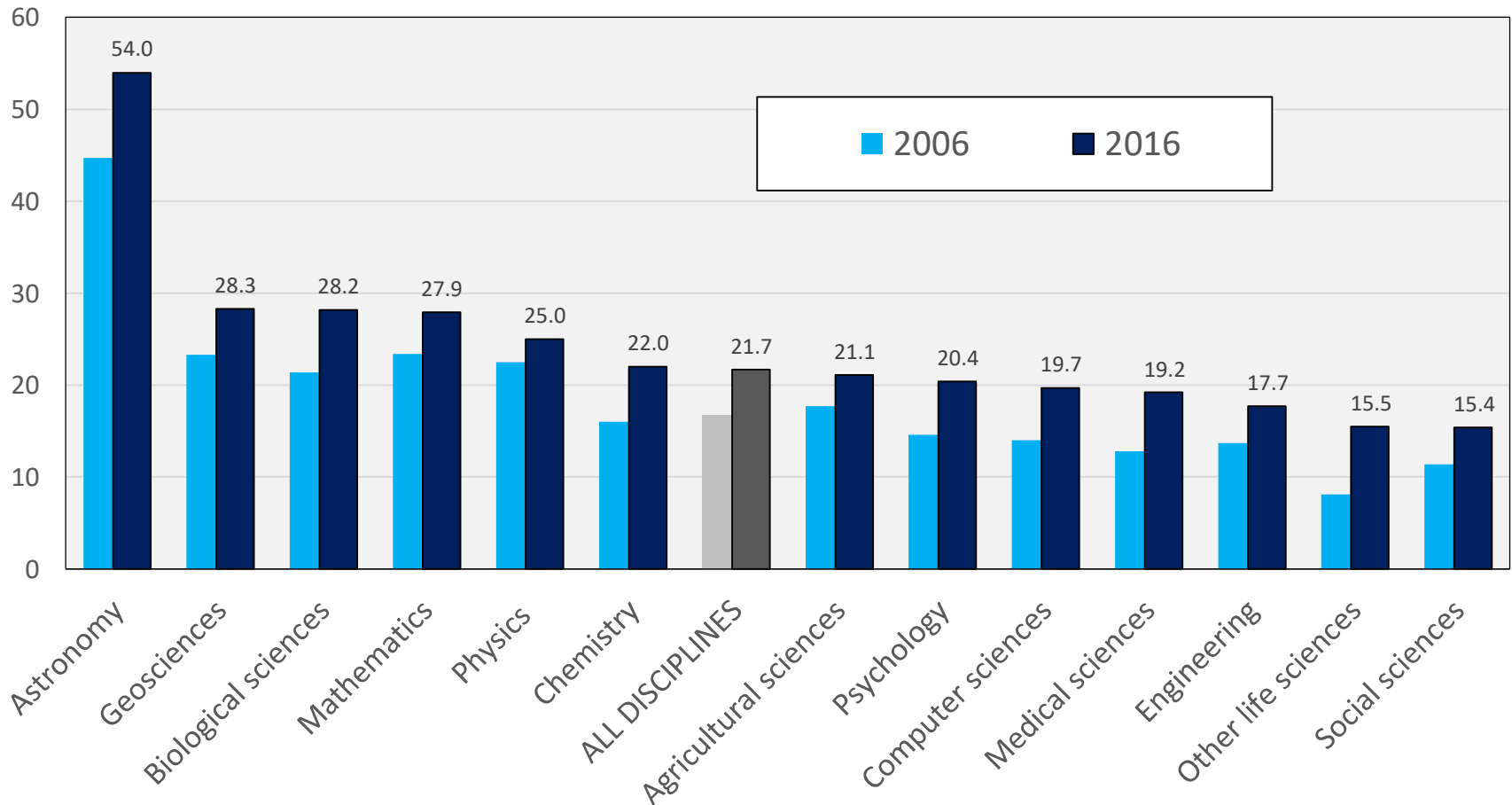
Deconcentration of country shares of world science papers, 1987-2016

	1987	1997	2007	2017
number of countries with 50% of world science papers	3 USA, UK, Germany	4 USA, Japan, Germany, UK	5 USA, China, Japan, Germany, UK	6 China, USA, India, Germany, Japan, UK
number of countries with 75% of world science papers	9	11	14	16
number of countries with 90% of world science papers	20	23	26	32

Growth in internationally co-authored science papers, all countries: 1996-2018



Proportion of science papers that were internationally co-authored, by discipline group: 2006 and 2016



Internationally collaborative papers: 2015-2018

university	country	Cross-border papers	Cross-border % 2006-09	Cross-border % 2015-18
Harvard U	USA	40,877	36.0	52.0
U Oxford	UK	26,707	54.6	69.1
U Toronto	CANADA	25,454	43.7	56.5
U College London	UK	24,693	50.4	65.9
U Cambridge	UK	22,832	50.7	69.7
Imperial College London	UK	21,120	53.9	69.3
Sorbonne U	FRANCE	20,076	54.0	67.0
Johns Hopkins U	USA	18,448	33.3	44.8
U Copenhagen	DENMARK	18,067	55.5	65.8
National U Singapore	SINGAPORE	17,814	46.6	66.9
Katholieke U Leuven	BELGIUM	17,549	56.1	70.2
Stanford U	USA	17,488	31.8	45.9
U Melbourne	AUSTRALIA	17,269	40.9	56.7
U British Columbia	CANADA	17,093	46.8	60.1

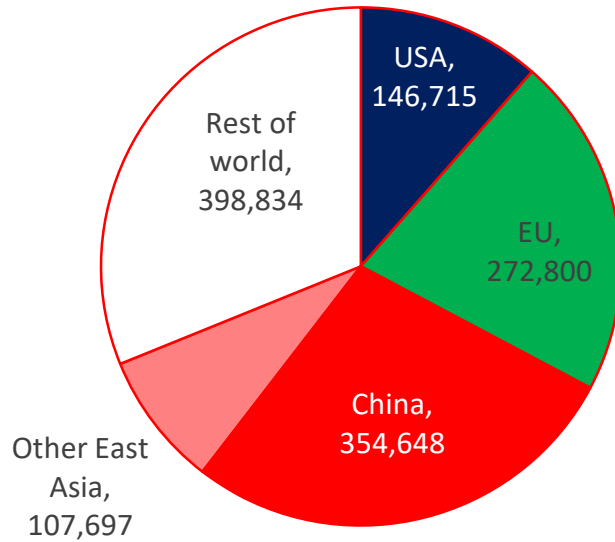
Anglophone systems lead in co-authored papers

Country pairs of over 9000 jointly-authored papers in 2018

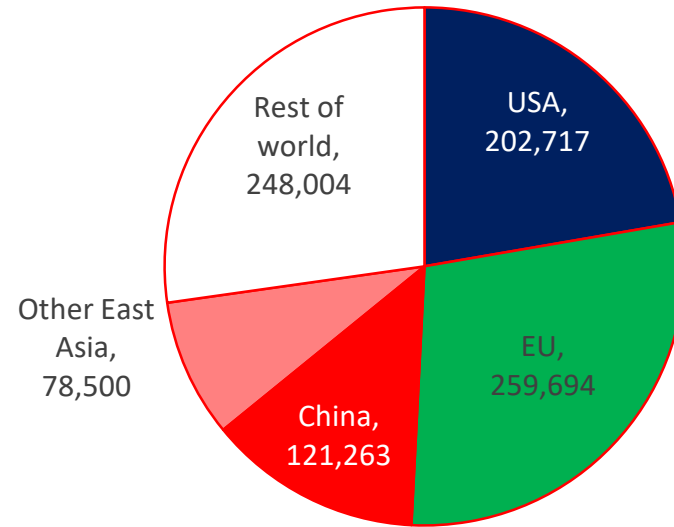
Country pair	Joint papers
China-USA	55,382
UK-USA	28,616
Germany-USA	23,616
Canada-USA	21,968
France-USA	15,422
Germany-UK	15,327
China-UK	14,763
Australia-USA	13,939
Italy-USA	13,804
China-Australia	13,138
Japan-USA	11,533
Italy-UK	11,198

Country pair	Joint papers
France-UK	11,015
<i>Germany-France</i>	<i>10,664</i>
Spain-USA	10,236
Australia-UK	10,207
Netherlands-USA	9,984
South Korea-USA	9,761
<i>Germany-Italy</i>	<i>9,729</i>
China-Canada	9,449
Switzerland-USA	9,403
<i>Germany-Switzerland</i>	<i>9,060</i>
<i>France-Italy</i>	<i>9,048</i>
Netherlands-UK	8,880

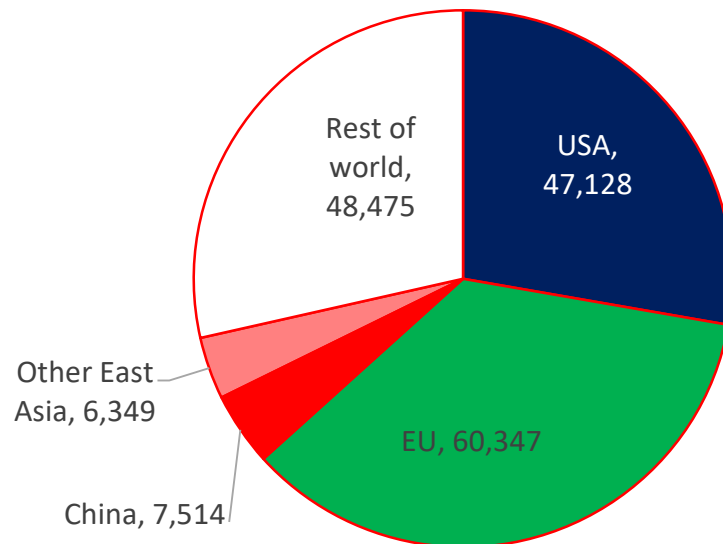
Physical sciences STEM



Biological and Health

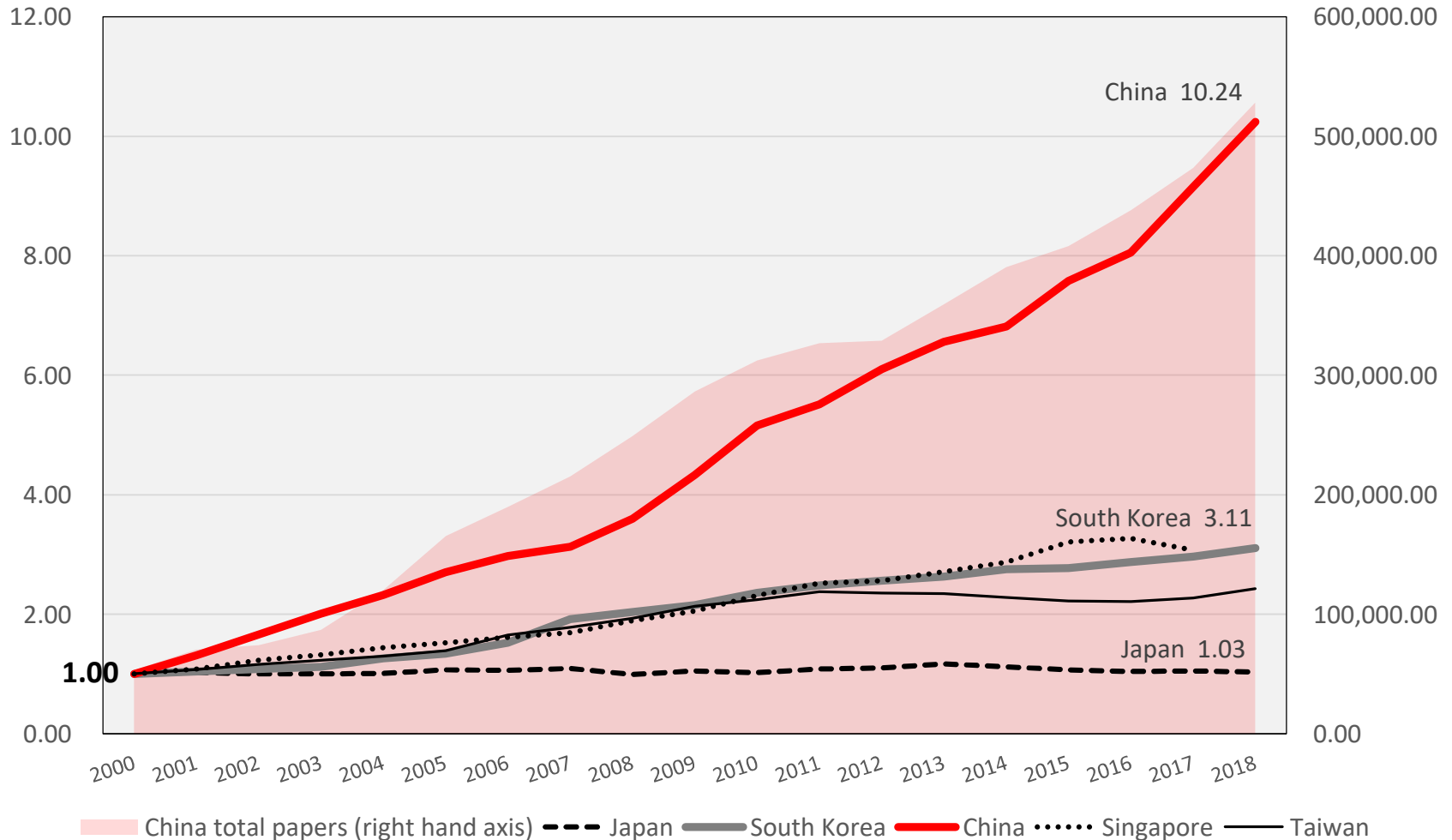


Social sciences and Psychology



Total papers, by large discipline cluster, 2018

Growth in spending on R&D in higher education, East Asia: 1996-2018



Growth in high citation (top 5%) papers

selected East Asian universities: 2006-09 to 2015-18

University		Top 5% papers 2006-2009	Top 5% papers 2015-2018	Growth 2006-09 to 2015-18 p.a.
Tsinghua U	CHINA	401	1451	15.36%
Zhejiang U	CHINA	335	1263	15.89%
Shanghai Jiao Tong U	CHINA	299	1050	14.98%
National U Singapore	SINGAPORE	511	948	7.11%
Peking U	CHINA	302	910	13.04%
Huazhong U S&T	CHINA	117	874	25.04%
Nanyang Technological U	SINGAPORE	290	861	12.85%
Harbin IT	CHINA	180	790	17.86%
Sun Yat-sen U	CHINA	154	742	19.09%
Tokyo U	JAPAN	668	637	- 0.53%
Seoul National U	STH. KOREA	348	543	5.07%
U Hong Kong	HONG KONG	305	465	4.80%
National Taiwan U	TAIWAN	273	303	1.17%
MIT	USA	1221	1578	2.89%
ETH Zurich	SWITZERLAND	667	933	3.80%

Top universities in STEM research

(1) physical sciences and engineering, and (2) mathematics and complex computing, papers in top 5 per cent of their field by citation rate, World: 2015-2018

University	System	Physical sciences & engineering
Tsinghua U	CHINA	830
Massachusetts IT	USA	687
Zhejiang U	CHINA	569
Stanford U	USA	563
Nanyang TU	SINGAPORE	533
Harvard U	USA	532
U Calif., Berkeley	USA	531
U Science & T.	CHINA	500
Harbin IT	CHINA	455
Xi'an Jiaotong U	CHINA	455
Shanghai JT U	CHINA	439
U Cambridge	UK	424
Huazhong U S&T	CHINA	419
ETH Zurich	SWITZERLAND	417

University	System	Maths & computing
Tsinghua U	CHINA	300
Harbin IT	CHINA	252
U Electronic S&T	CHINA	217
Xidian U	CHINA	201
Beihang U	CHINA	197
Zhejiang U	CHINA	197
Huazhong U S&T	CHINA	195
Nanyang TU	SINGAPORE	181
Massachusetts IT	USA	180
Shanghai JT U	CHINA	153
Stanford U	USA	151
Northwestern P. U	CHINA	149
Southeastern U	CHINA	148
NU Singapore	SINGAPORE	140

Leiden ranking

Top universities in other fields

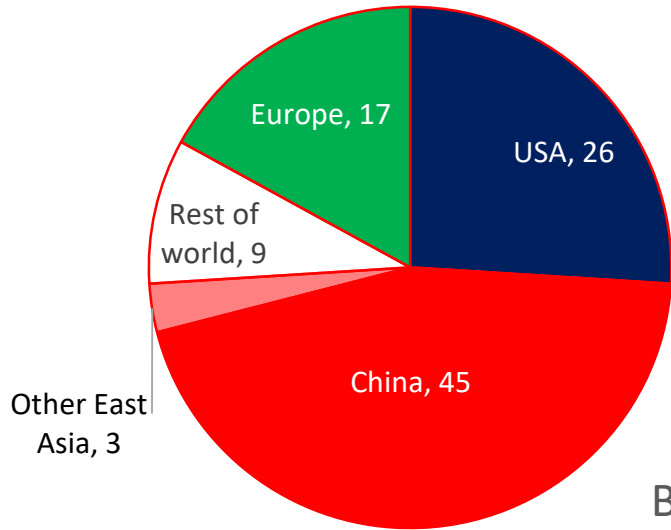
(1) biomedical and health sciences, and (2) life and earth sciences, papers in top 5 per cent of their field by citation rate, World: 2015-2018

University	System	Biomedical & health sciences
Harvard U	USA	2983
U Toronto	CANADA	1103
Johns Hopkins U	USA	1074
UC, San Francisco	USA	976
Stanford U	USA	927
U Pennsylvania	USA	834
U College London	UK	831
U Michigan	USA	752
U Oxford	UK	742
UT, HSC Houston	USA	705
Yale U	USA	702
U Wash., Seattle	USA	694
Columbia U	USA	674
UC, San Diego	USA	635

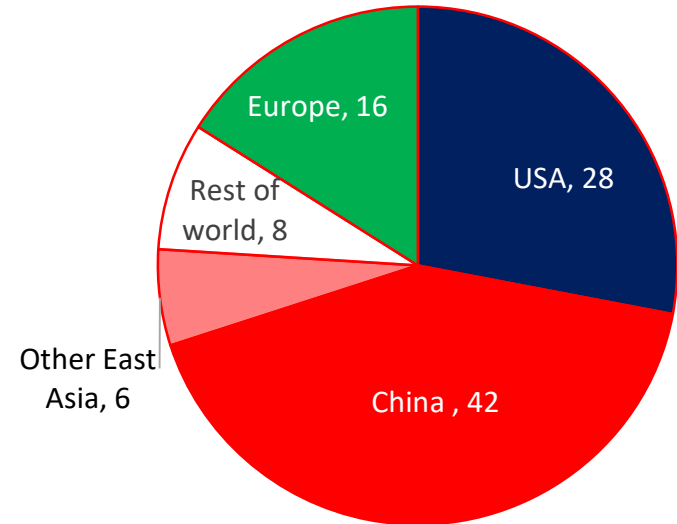
University	System	Life & earth sciences
Wageningen U	NETHERLANDS	252
ETH Zurich	SWITZERLAND	229
Harvard U	USA	227
U Wash, Seattle	USA	217
UC, Berkeley	USA	216
UC, Davis	USA	211
U Oxford	UK	205
Cornell U	USA	202
Stanford U	USA	199
Zhejiang U	CHINA	188
U Br. Columbia	CANADA	187
U Queensland	AUSTRALIA	182
U W-Madison	USA	177
Nanjing Ag U	CHINA	170

Leiden ranking

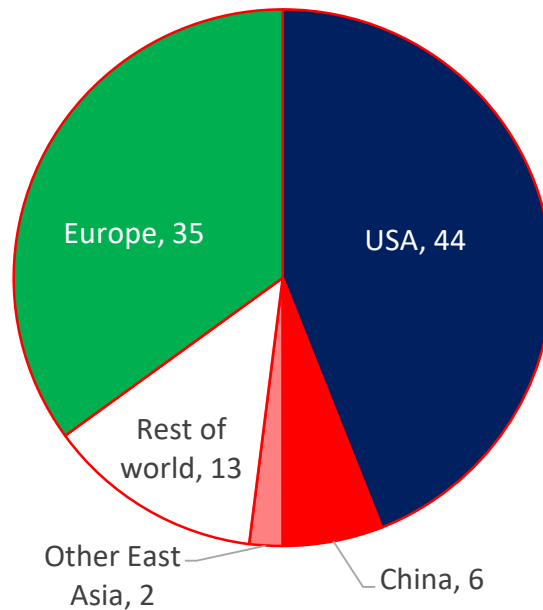
Maths and Computing



Physical Sci and Engineering



Biomedical and Health Sci



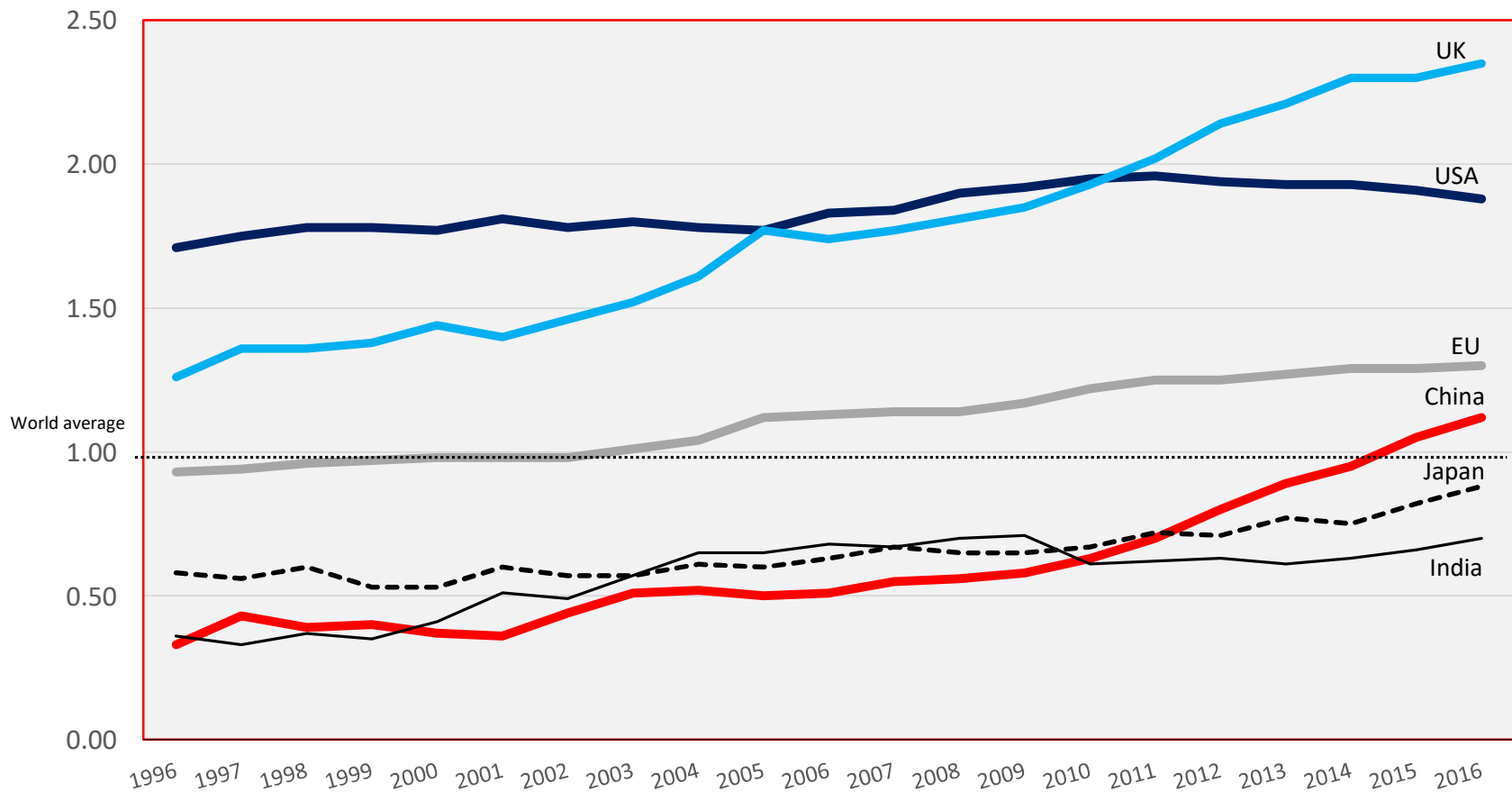
**Top 100 universities
on basis of number
of top 5% papers,
2015-2018**

Leiden ranking

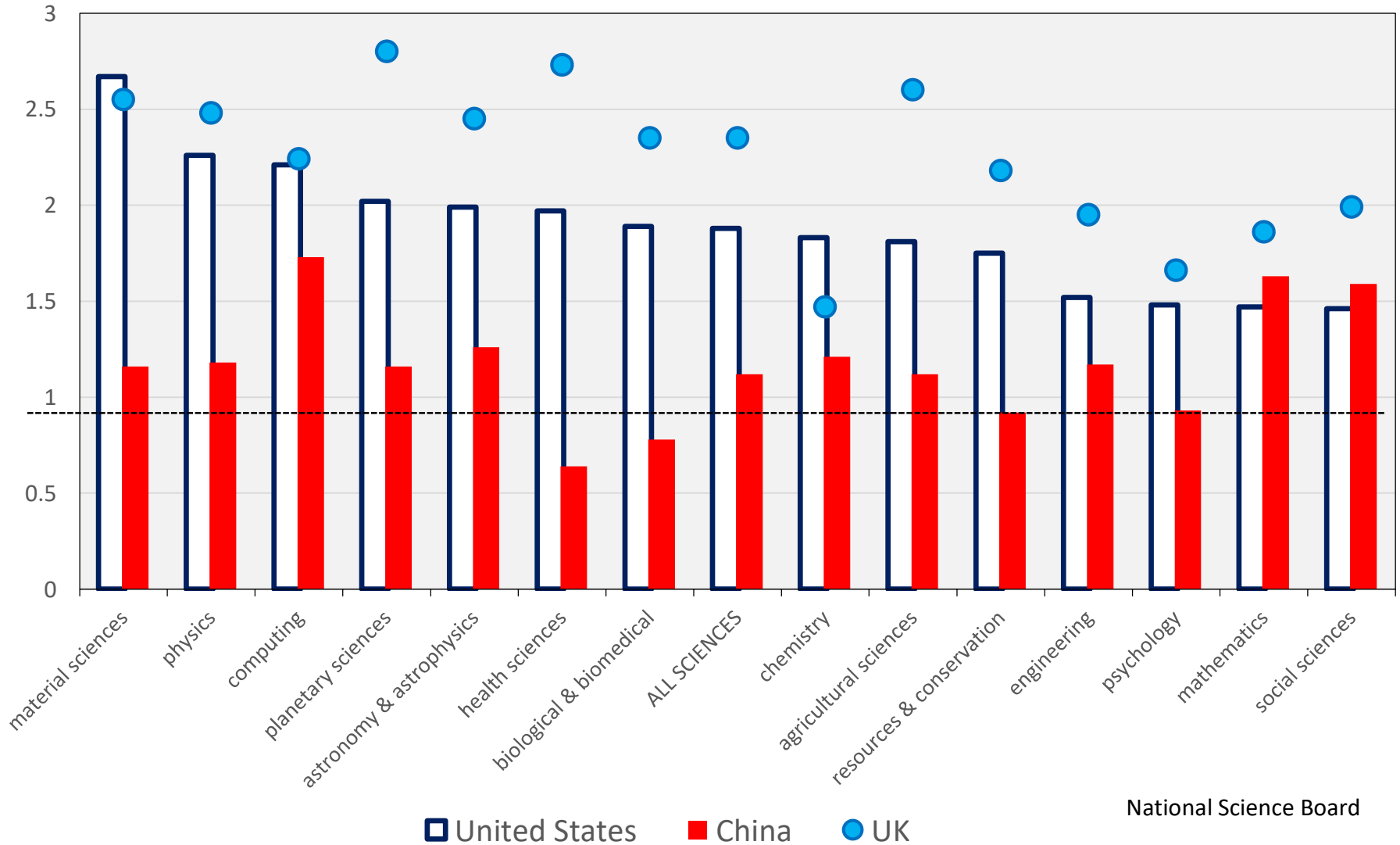
Papers in top 5% by citations 2015-18: Leiden

university	country	Top 5% papers	all papers	% of all papers in top 5%
Harvard U	USA	4282	33,722	12.7
Stanford U	USA	2078	16,161	12.9
U Toronto	CANADA	1691	22,995	7.4
U Oxford	UK	1610	15,353	10.5
MIT	USA	1578	10,563	14.9
U Michigan	USA	1473	18,598	7.9
Tsinghua U	CHINA	1451	19,902	7.3
U College London	UK	1424	14,742	9.7
Johns Hopkins U	USA	1407	17,215	8.2
U Cambridge	UK	1370	13,485	10.2
U Washington Seattle	USA	1329	14,730	9.0
U California - Berkeley	USA	1313	10,671	12.3
U Pennsylvania	USA	1266	13,414	9.4
Zhejiang U	CHINA	1263	23,510	5.4

Proportion (%) of all papers in world top 1% on basis of citations, leading countries/regions, 1996-2016 (world average = 1.00)



Proportion (%) of papers in top 1% of their field, US, China and UK: 2016 (world average = 1.0)



Will China-US scientific collaboration survive?

And will the same issues play out in UK?

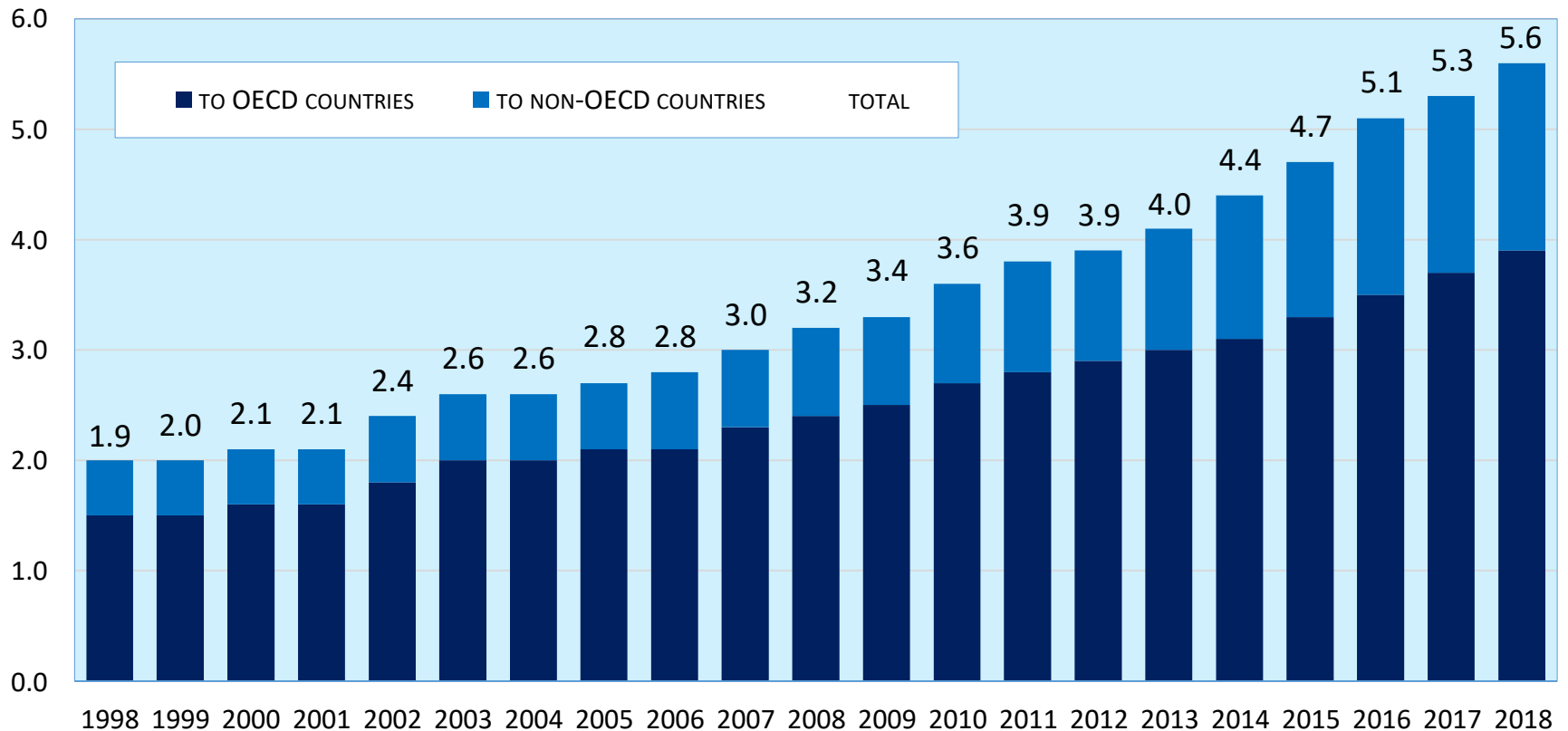
- Scientific globalism versus technological nationalism (Lee and Haupt 2020)
- In 2018 scientists from China and the United States collaborated on 55,382 jointly authored papers in Scopus. There were *26 times* as many China-US papers in 2018 as in 1996. This was by far the largest nation-to-nation collaboration in world science (UK-China was 14,763, UK-US 28,616)
- In Covid-19 research 20% of papers with China authors and 43% with US authors have international co-authors, over two thirds are open access
- Measures taken by the US to retard exchange and cooperation in science (e.g. visa restrictions, border hostility to doctoral students, pressure to relinquish joint appointments and multiple projects) are strongly opposed by many scientists and university leaders in both countries
- China, prone to greater regulation, may start to retard internationalisation
- *University autonomy and academic freedom are crucial*, if scientists are to maintain cooperation amid geo-strategic rivalry and securitisation agendas

2. INTERNATIONAL STUDENT MOBILITY

Before the pandemic

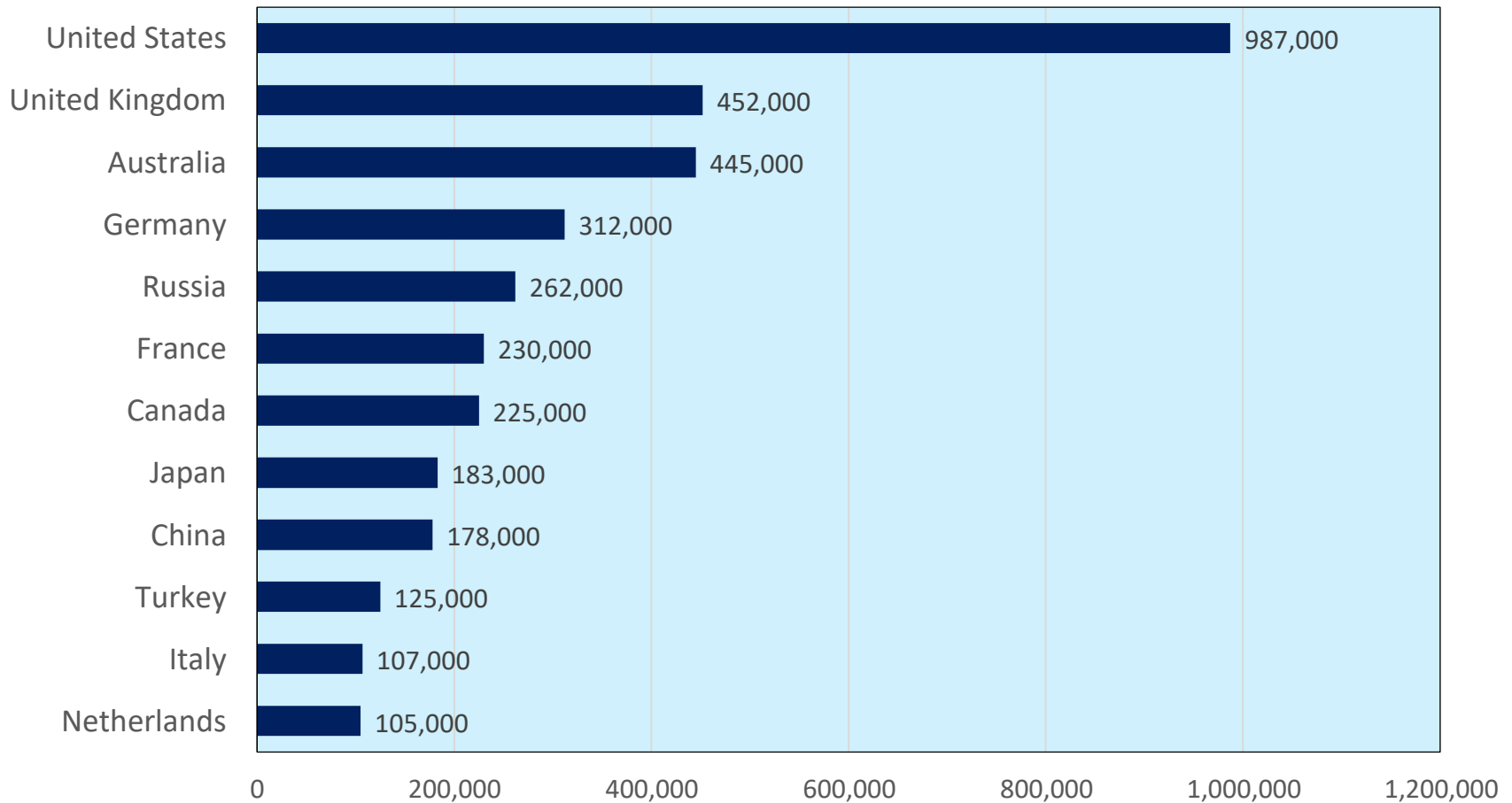
International/ foreign students in tertiary education,
worldwide numbers, 1998-2018 (millions)

OECD data 2020



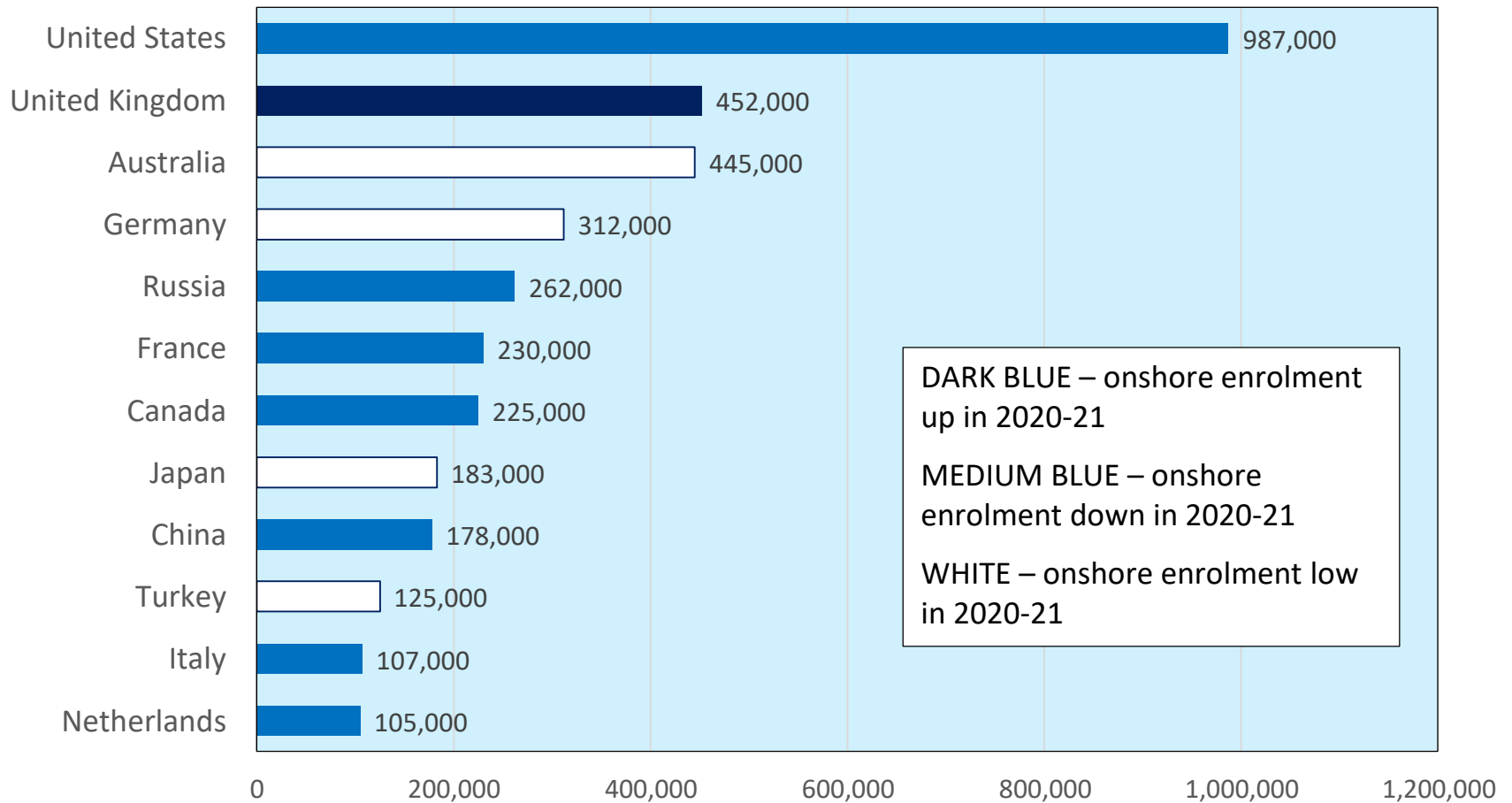
International student mobility in 2018

(5.6 million students for education of one year or more)



International student mobility in 2020-21

compared to 2018 enrolment numbers



The pandemic and international student mobility

‘The crisis has affected the safety and legal status of international students in their host country, the continuity of learning and the delivery of course material, and student perception of the value of their degree, all of which could have dire consequences for international student mobility in the coming years’ - OECD, *Education at a Glance 2020*

- **UK** (452,000 students in 2018): hybrid basis, accepting 7% more non-European international students, growth is in high prestige universities
- **US** (987,000), 14% drop in 2020-21 and will fall further - 4-year restriction
- Inward plane travel is partly or largely blocked into **Australia** (445,000 students in 2018), **Germany** (312,000), **Japan** (183,000), **Turkey** (125,000)
- **Germany** international applications down 20%, **Netherlands** down 50%
- International enrolment impaired in many other countries including **Canada**, **New Zealand**

East Asia:

Stable public higher education systems with state support are proving to be largely pandemic proof

- In East Asia there is a high level of support for government management of common systems in the common interest
- In East Asia lockdown policies in higher education have been managed centrally not left to institutions to decide
- Private sectors in higher education have struggled but national research universities are financially sustained
- In China there is extensive ministry funding of online development
- In South Korea Ministry has offered funding to support institutions that discount the tuition cost of online provision
- East Asian systems all seem to manage the pandemic relatively effectively and this will boost international education across the region in future

The pandemic in East and Southeast Asia

Country	Deaths attributed to Covid-19 (27.10.20)
China	4,739
Japan	1,725
South Korea	460
Vietnam	35
Singapore	28
Taiwan	7
Indonesia	13,411
Philippines	7,039
Myanmar	1,122
Malaysia	236
Thailand	59

US campuses are struggling

- In the US more than 100,000 confirmed cases on campus since March including 3000 at the U Georgia, 2000 U Alabama, 2000 U South Carolina
- As in UK the main problems are in student residences and student accommodation in university towns, and sudden local spikes in the pandemic are forcing lockdowns and switch to online only
- 24 September figures suggest 2020-21 enrolment is down by 4% including a 16% drop in first-year enrolment; the decline is mostly in community colleges which have seen a drop of 9%, and 23% in first-year enrolment
- International student mobility was down 14% in September and is further threatened by Trump's new policy of 4/2 year visa limits



Australia:

From international students as one third of all enrolled students in higher education, to . . .

- In 2019 one third of higher education students were international students, almost 500,000, mostly from East, Southeast and South Asia, *one quarter of income* of higher education institutions was from international students
- 60% of Australia's research was funded from universities' own resources, mostly revenues from international education. This has put seven Australian universities into the ARWU top 100
- Modest pandemic death toll in Australia. But international education has been brought to a halt, with inward flights largely stopped
- New government policy package reduces funding rate for *domestic* students by an average 6% and enforces 6-month 'work ready courses'
- Universities are now expect to lose one staff member in every ten, research is the largest concern but all operations are affected
- Government is imposing an approval process in relation to universities' China links, has banned selected Chinese scholars with long histories of engagement

Bad times for higher education in India

- New national policy provides forward pathway for higher education BUT
- Nationally 119,502 deaths attributed to Covid-19 by 27 October 2020; it is likely that this is a substantial under-estimate
- Unevenness by state, with Kerala the standout in managing Covid-19
- Strong reliance on online education which Modi government hopes to take into the post-pandemic era
- However, digital divide is very severe with only 36% of the population having smart phone access, less than one in ten students outside major cities having adequate facilities for online, lower in caste groups



Vulnerable to drop in non-EU international fees

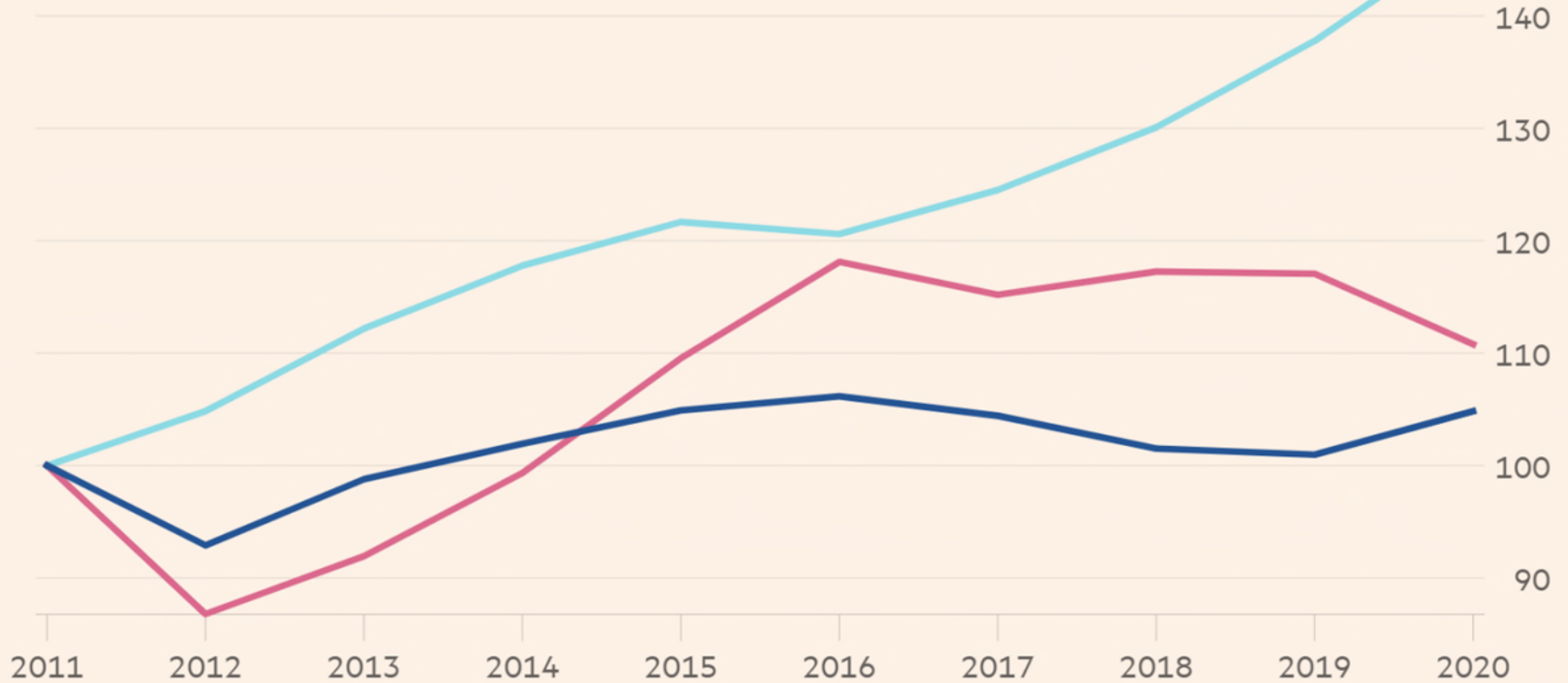
Institution	£s 2018-19	% income
Inst Marangoni	5,583	56.7
AA S Architecture	10,736	54.5
Regent's U Lon	21,435	48.4
Royal College Art	30,601	40.9
Heriot-Watt U	87,890	37.0
U Arts London	116,221	36.1
London Bus Sch	52,603	31.6
City U London	76,610	31.4
U London	52,395	29.9
Coventry U	111,259	27.7
LSE	113,774	27.0
U Sunderland	35,095	25.4
U St Andrews	64,800	25.2
U Warwick	116,731	24.2

Institution	£s 2018-19	% income
Goldsmiths	31,316	23.6
Queen Mary UL	113,476	23.5
U Westminster	47,702	22.7
U Durham	86,106	22.6
Co Dance & Drama	5,099	22.2
U Manchester	242,202	22.1
U Sussex	71,025	21.9
U Liverpool	125,612	21.7
U Reading	67,377	20.9
U Sheffield	148,951	20.8
U Glasgow	141,969	20.6
U College London	299,751	20.2
U Lancaster	63,863	20.0

International admissions have increased at UK universities

Number of new students (rebased to 100)

UK EU Non-EU



Source: UCAS

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As a teacher in Thailand, I know Covid will stop my students going to UK universities

Sadie Collins

Students in east Asia are choosing to study at home rather than in a country mishandling the pandemic



▲ 'Historically, many students have focused on going to the UK, Europe, the US or Canada, to continue their education at university. This year is different.' Photograph: Alamy



verheard in my classroom, at an international sch

“My dad doesn’t think it’s a good idea to go to t

The effect will be more modest than suggested here: some impact on demand, but not at game-changing levels

Where will global student mobility recover best?

- **East Asia** (China, South Korea, Taiwan, Singapore, Japan) and some **European** countries (e.g. Finland, Denmark, Germany) have managed the pandemic best and will spring back in higher education. Their universities have strong government support. All these countries can gain ground in the global student market if they want to increase recruitment
- Recent Navitas survey of agents in international student market suggests that **USA** (especially) and **UK** have suffered reputational damage because of the high incidence of Covid-19 cases and deaths
- But US and UK will remain very high demand nations (so numbers will remain supply driven). UK boosted by the medium-term weakening mobility into US
- **Australia** has a lower Covid-19 death toll, but is blocking inward flights. Weaker demand than US/UK, slow recovery to pre-pandemic levels.
- **Canada** looks like a long-term winner. It is offering support measures targeted at students affected by the virus, including additional work rights, and access to unemployment benefits

3. THE PANDEMIC AND AFTER

Shanghai ARWU top 10 countries, 2020

	top 100 universities	top 500 universities
United States	45	137
United Kingdom	8	36
Australia	7	23
China (mainland only)	6	71
France	5	17
Switzerland	5	8
Germany	4	30
Canada	4	19
Netherlands	4	12
Japan	3	14

UK universities in Shanghai ARWU ranking 2020

position	universities
1-100	Cambridge (3), Oxford (9), UCL (16) , Imperial (25), Manchester (36), Edinburgh (42), Kings College London (47)
51-100	Bristol (64)
101-150	Birmingham, Leeds, Liverpool, Nottingham, Sheffield, Southampton, Warwick
151-200	Cardiff, Exeter, Glasgow, LSE, Sussex
201-300	Aberdeen, Durham, London School of Hygiene and Tropical Medicine, Newcastle, Queen Mary, Reading, York
301-400	Bath, Dundee, Lancaster, Leicester, St Andrews, Surrey
401-500	Queen's Belfast, Strathclyde

A further 29 UK universities are ranked between 501 and 1000. The ARWU is an exclusively research-based ranking

5. In higher education, unless there is system collapse, domestic student demand will grow during and after the pandemic despite frequent recourse to online only provision. But graduate under-employment and social equity problems will intensify
6. Online will not replace face to face provision in general, but there will be more debundling and online only provision in mass higher education in some countries (e.g. India)
7. Face to face and online higher education will become more differentiated, emerging as distinct products and in some countries, different tuition prices
8. International student mobility will take at least five years to recover; old demand/supply patterns will prove resilient but with some modification

Covid-19 hit amid worsening geo-political rivalry, weakening of multilateral institutions, implosion of national politics, and increasing state controls

1. The pandemic shows that collaboration between nation-states is not solving global problems, but cooperation between research universities works well: common values
2. The impact of the pandemic in society/economy, and in higher education, is highly differentiated by divergent state policies and political cultures. East Asia has done well. The differentiating effects between systems will have long term effects
3. In the crisis the public good model of higher education is strengthened (Western Europe, East Asia). Financial sustainability of institutions is a major issue in the marketised systems (e.g. Anglophone) and emerging countries (e.g. India and Brazil)
4. The research intensive university, but not all institutional models, has proven fairly robust. However its autonomy is under greater pressure from some governments

Changing global landscape

- The world Gross Tertiary Enrolment ratio reached 38% prior to the pandemic and growth may now quicken (recession shelter effect)
- Higher education is growing in all world regions, though graduate under-employment is an issue in many countries
- But global student mobility may take 3-5 years to recover from the pandemic
- The United States remains the world-leading system, especially in research, but is under-funding its public universities and colleges
- Globally the main change has been the spectacular rise of China, South Korea and Singapore in higher education and science, and they have been strengthened in comparative terms in the pandemic period
- Universities and science in Western Europe are stronger than ten years ago
- India, Iran and Brazil are emerging as large, important regional systems and sub-Saharan Africa is beginning to rise
- Trajectory of the UK is hard to estimate (Brexit, geo-politics), internal financing may take a hit after the pandemic, but international demand is robust