



# Research Futures *Monitoring Framework*

Supplementary report to the study by Elsevier and Ipsos MORI, published February 2019  
See the full report: [www.elsevier.com/connect/elsevier-research-futures-report](http://www.elsevier.com/connect/elsevier-research-futures-report)

Through the charts in this report, we'll track progress towards the scenarios we've imagined in our Research futures report.

Monitor our page on [Elsevier.com](https://www.elsevier.com) to follow updates to this report.



## Scenario one: **Brave open world**

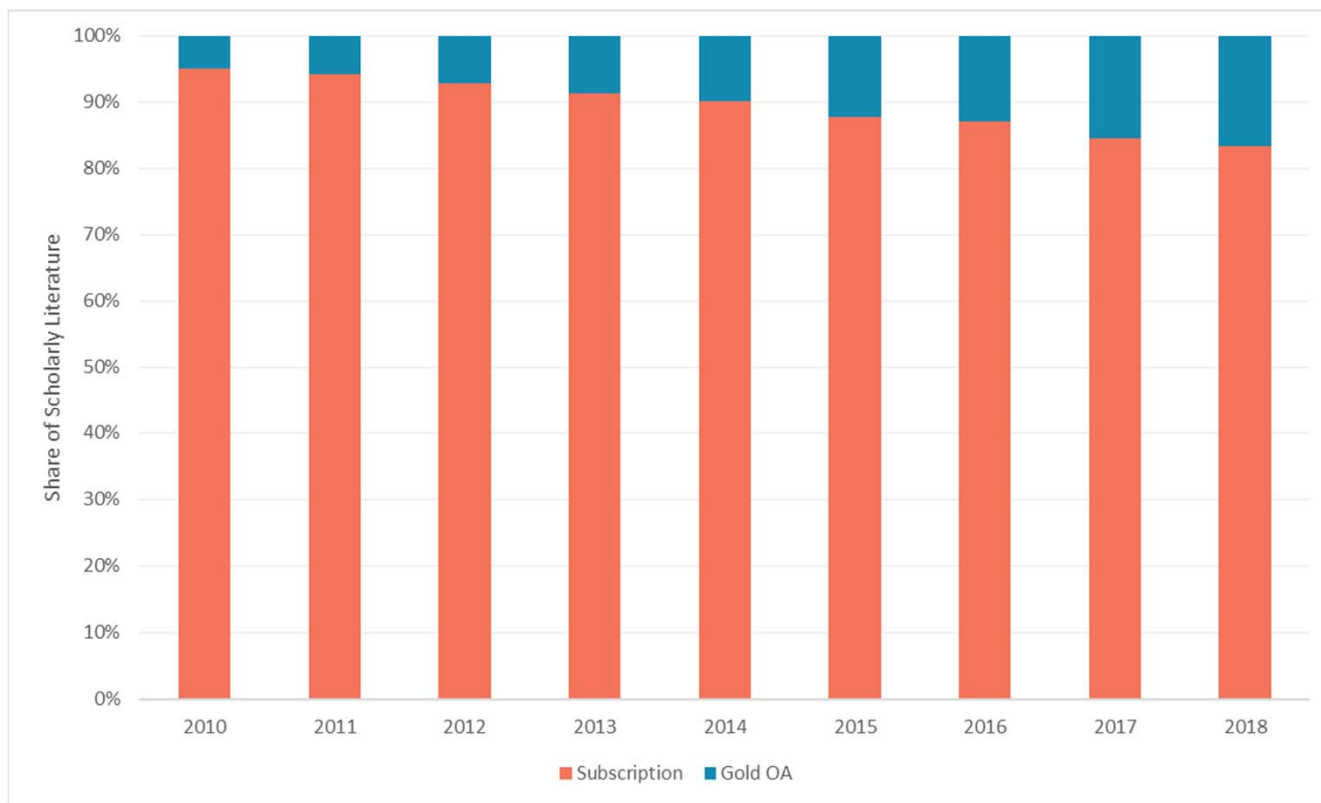
*Globally, state funders and philanthropic organizations have joined forces and pushed through the creation of platforms where the research they fund must be published open access (OA). But the form of that OA varies by region; Europe is mostly gold, while North America and Asia Pacific is generally green. Rapid advances in artificial intelligence (AI) and technology mean these platforms are flourishing – they are interoperable, and content is easy to access and showcase.*

*As a result, there are fewer subscription-based journals. A number of broad science, gold OA megajournals with low article publishing charges exist to publish content not captured by open platforms. Major society journals remain active, many operating a gold OA model, but struggle for manuscript submissions, so revenue is low. Preprints thrive in this world and are linked to the final article versions, which are still recognized as the authoritative version. Researchers benefit from access to data in a variety of ways, for example, via bite-sized publications and dynamic notebook-style articles.*

*The advances in AI and technology have also provided new methods of generating and communicating results. While research quality is still an important measure of performance, journal publication plays a diminishing role in determining a researcher's career progress. Increasingly, research is assessed against agreed societal impact standards.*



## How is gold open access growing?



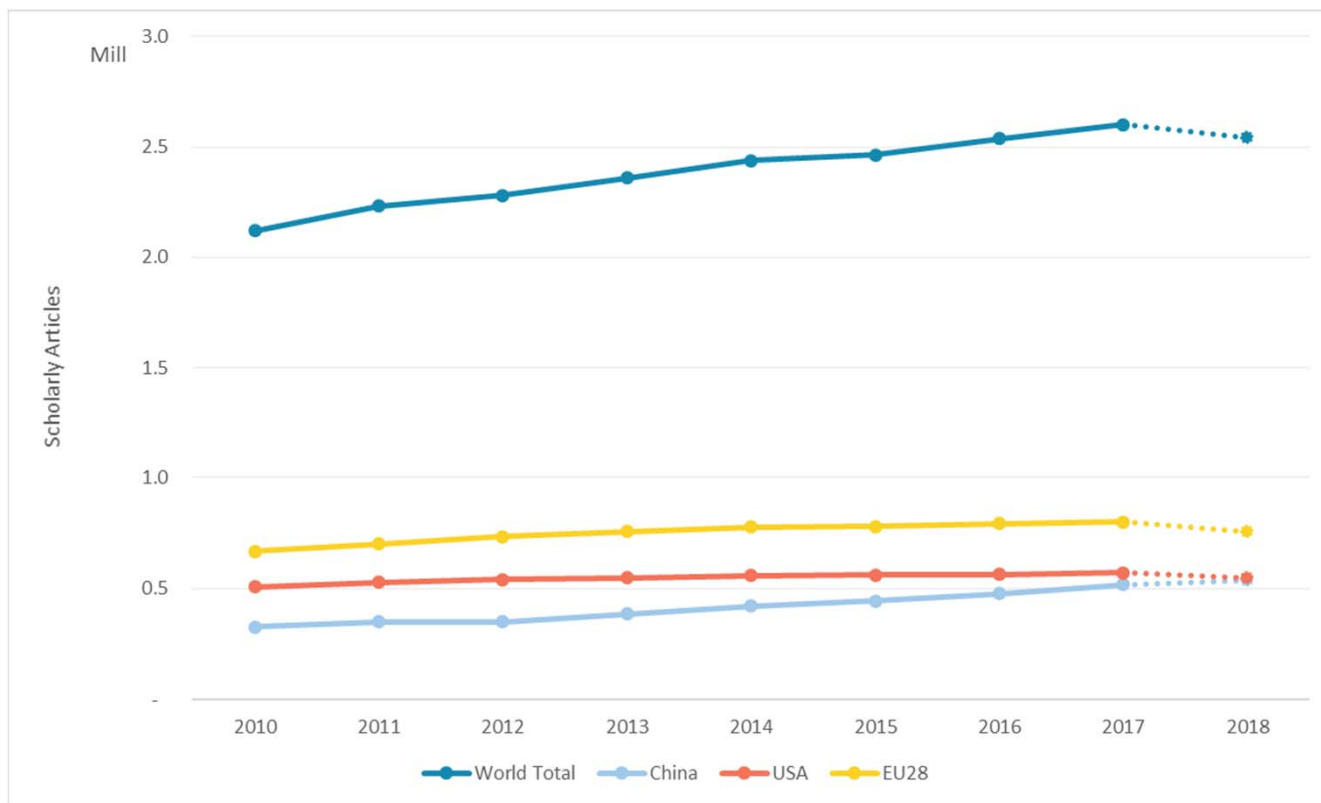
**Growth of gold open access (OA) articles as a proportion of all scholarly articles**

Source: Scopus

Notes: includes gold OA articles in gold OA and hybrid journals.



## Is the number of scholarly articles continuing to grow?



### Growth in scholarly articles published in Scopus.

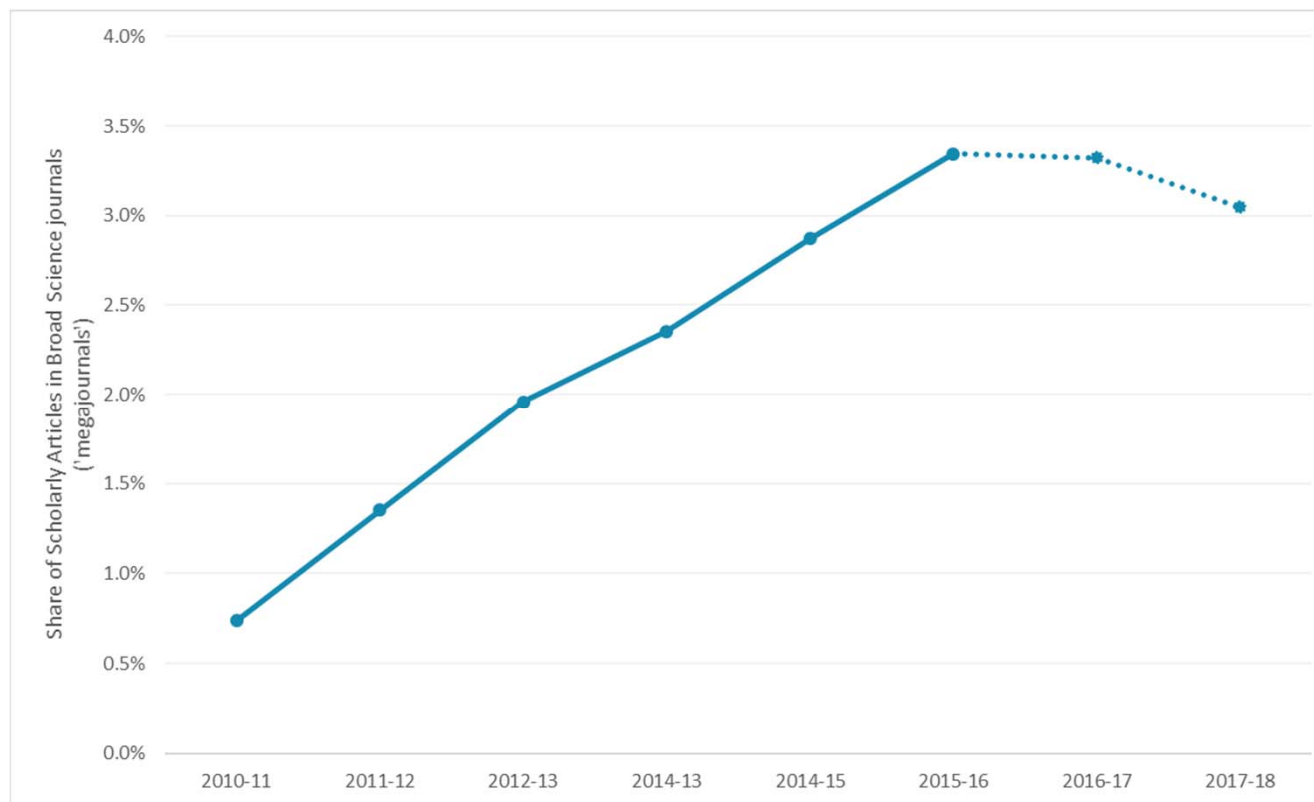
Source: Scopus.

Notes: Scholarly articles: articles, reviews, conference proceedings papers.

Dotted lines indicate volatile results that are likely to change when reported later in the year.



## Is the role of megajournals\* growing?



### Full list of journals captured:

- Heliyon
- Nature Communications
- PLOS ONE
- Royal Society Open Science
- Science Advances
- Scientific Reports
- SpringerPlus
- The Scientific World Journal
- ACS Central Science
- ACS Omega
- AIP Advances
- Biology Open
- BMJ Open
- Cell Reports
- EBioMedicine
- eLife
- F1000 Research
- IEEE Access
- Medicine
- PeerJ
- PLoS Biology
- PLoS Medicine
- RSC Advances
- Sage Open Trials
- G3
- Materials
- mBio
- Oncotarget

### Share of scholarly articles that are published in megajournals

Source: Scopus

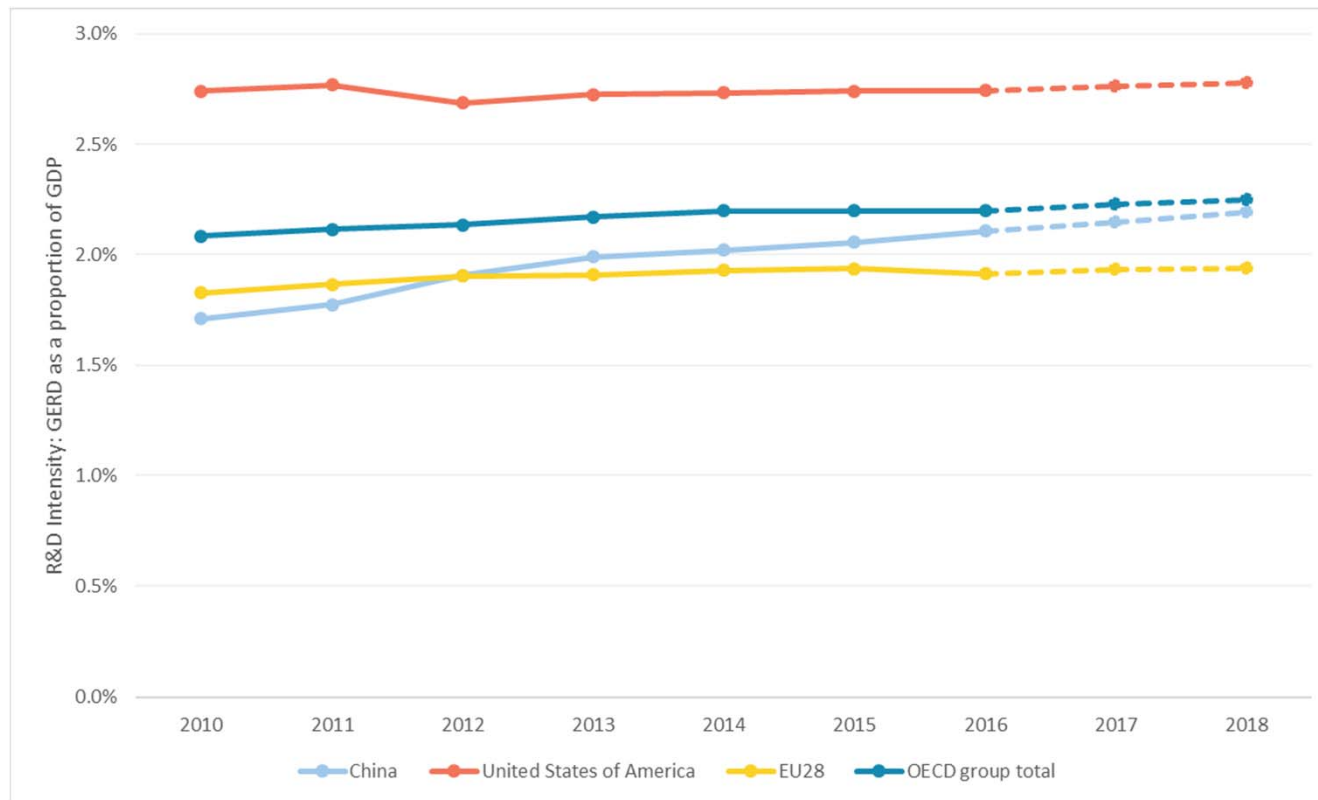
Notes: Scholarly articles: articles, reviews, conference proceedings papers.

Dotted lines indicate volatile results that are likely to change when reported later in the year.

\*Broad or all science journals, typically gold open access. Full list of journals captured listed to the right.



## Is R&D intensity\* overall growing?



### Growth of \*Gross Expenditure on Research & Development (GERD) as a proportion of GDP.

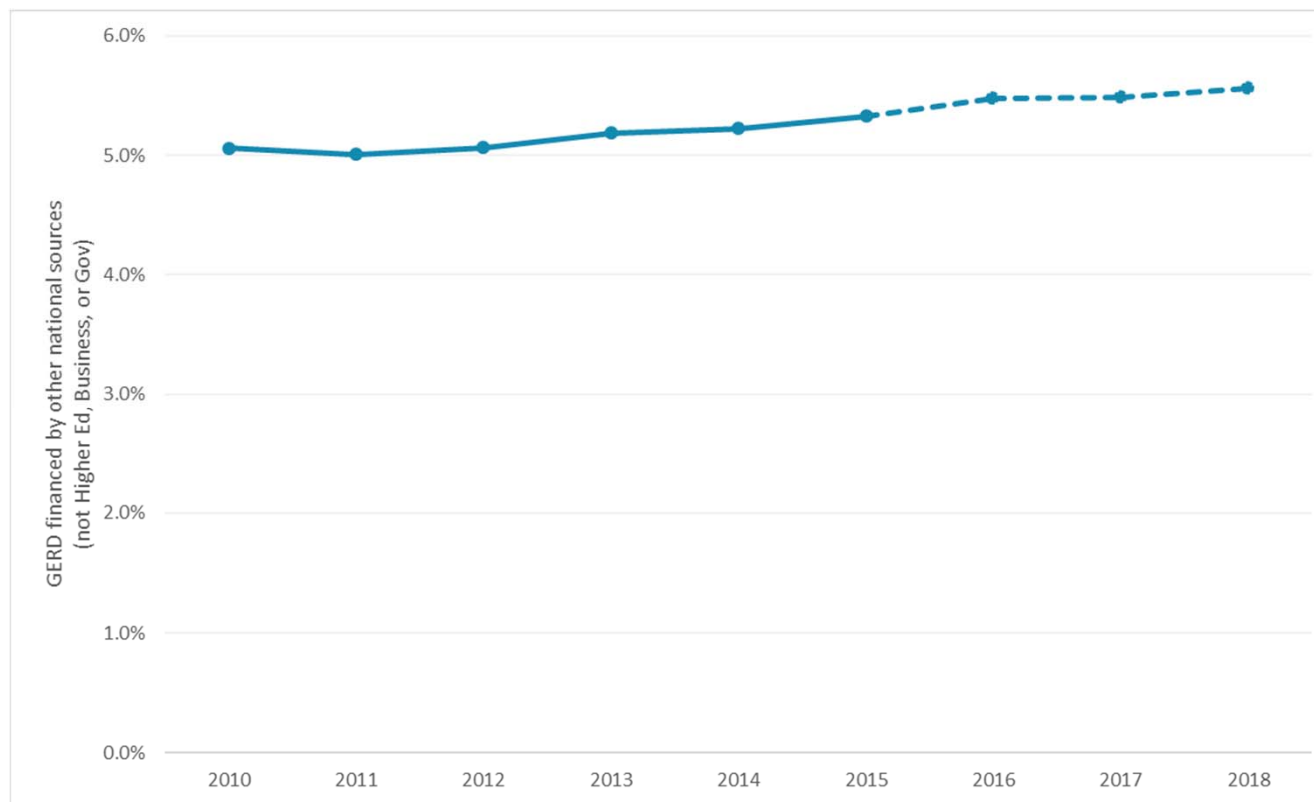
Source: OECD. Based on GERD and GDP presented as US\$, constant prices, 2010 base year, PPP

Notes: Includes all OECD member countries, plus Russian Federation, Singapore and South Africa.

Dashed lines represent forecast data, calculated through linear extrapolation of available data.



## Is research becoming less dependent on funding from government and business?



**Growth of the share of Gross Expenditure on Research & Development (GERD) funding other national sources: this excludes government, business and higher education funding. Will include philanthropic funding.**

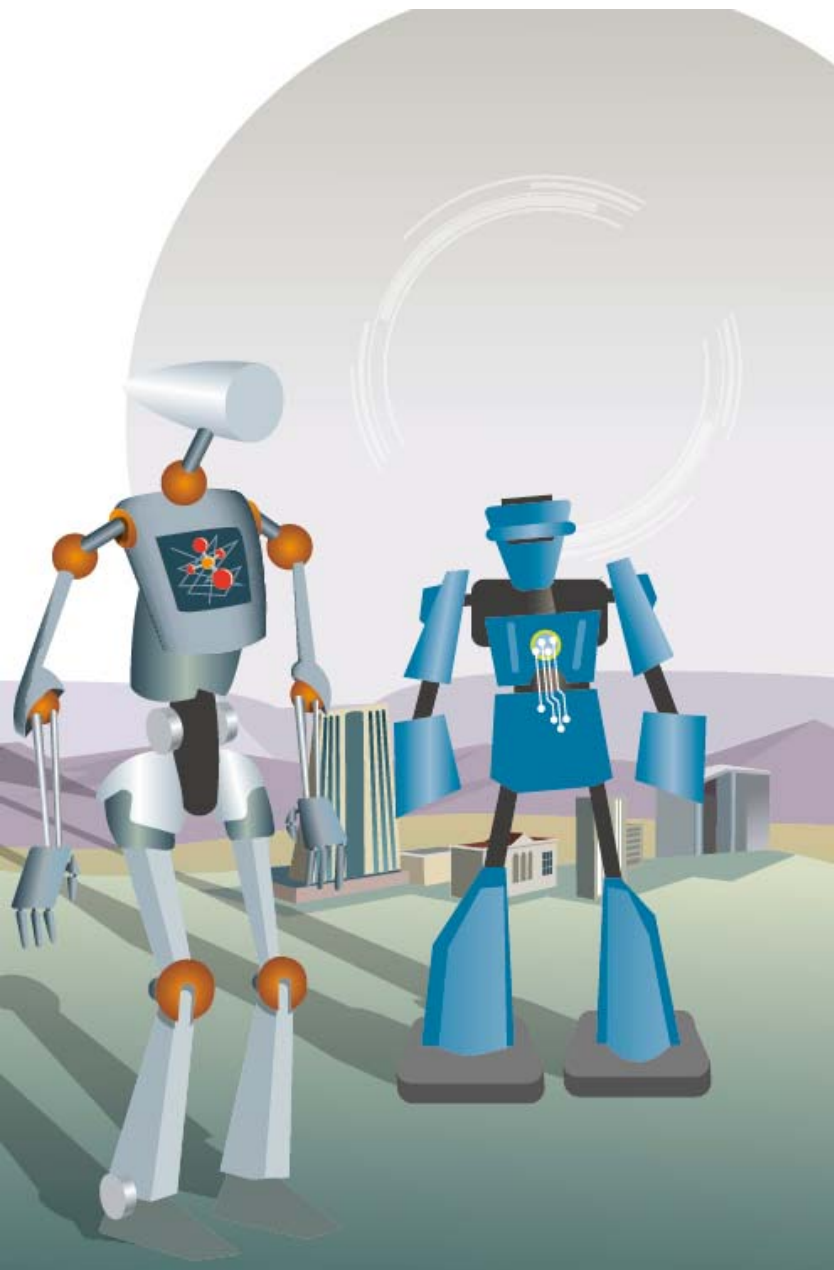
Source: OECD. Based on GERD presented as US\$, constant prices, 2010 base year, PPP

Notes: Includes all OECD member countries, plus Russian Federation, Singapore and South Africa.

No data available for the following OECD member countries: Australia, China

Dashed lines represent forecast data, calculated through linear extrapolation of available data.





## Scenario two: Tech titans

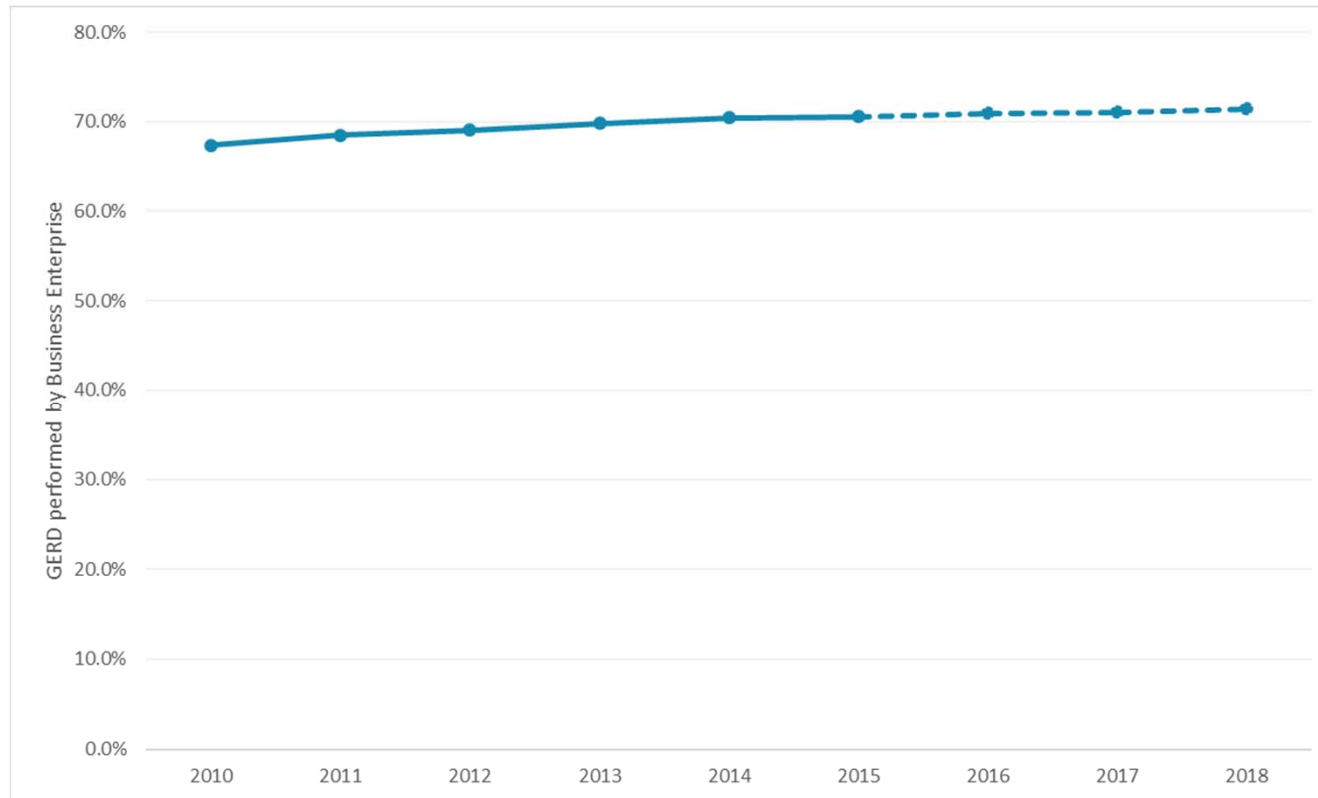
*Industry and philanthropic foundations are the principal research funders, with far-reaching consequences for the research community. Some are feeling this impact more than others, for example, academic institutions with a focus on life sciences struggle. There have been significant advances in machine learning with sophisticated artificial intelligence (AI) products driving innovation. This has led to large technology and data analytics companies becoming the curators and distributors of knowledge.*

*Research articles and journals play a much reduced role, with preprint servers and analytical layers over online content replacing some of their traditional functions. The article has become atomized with each part of a research publication created and hosted separately, but all elements are linked. Large technology companies have created a market shift toward AI-driven evaluation of these research outputs; however, current systems have proved susceptible to manipulation and there is pressure to increase their security. Not all aspects of research are open; for example, where industry is funding research, key research data is not always made available so companies can retain a competitive and financial advantage.*

*For researchers, the developments in technology and consolidation of analytical services have revolutionized the way research is performed, enabling many to work independently of institutes and even funders – “science-as-a-service” is emerging as barriers to entry are reduced or removed.*



## Is a greater proportion of research being performed by industry?



### Growth of the share of Gross Expenditure on Research & Development (GERD) performed by business enterprise.

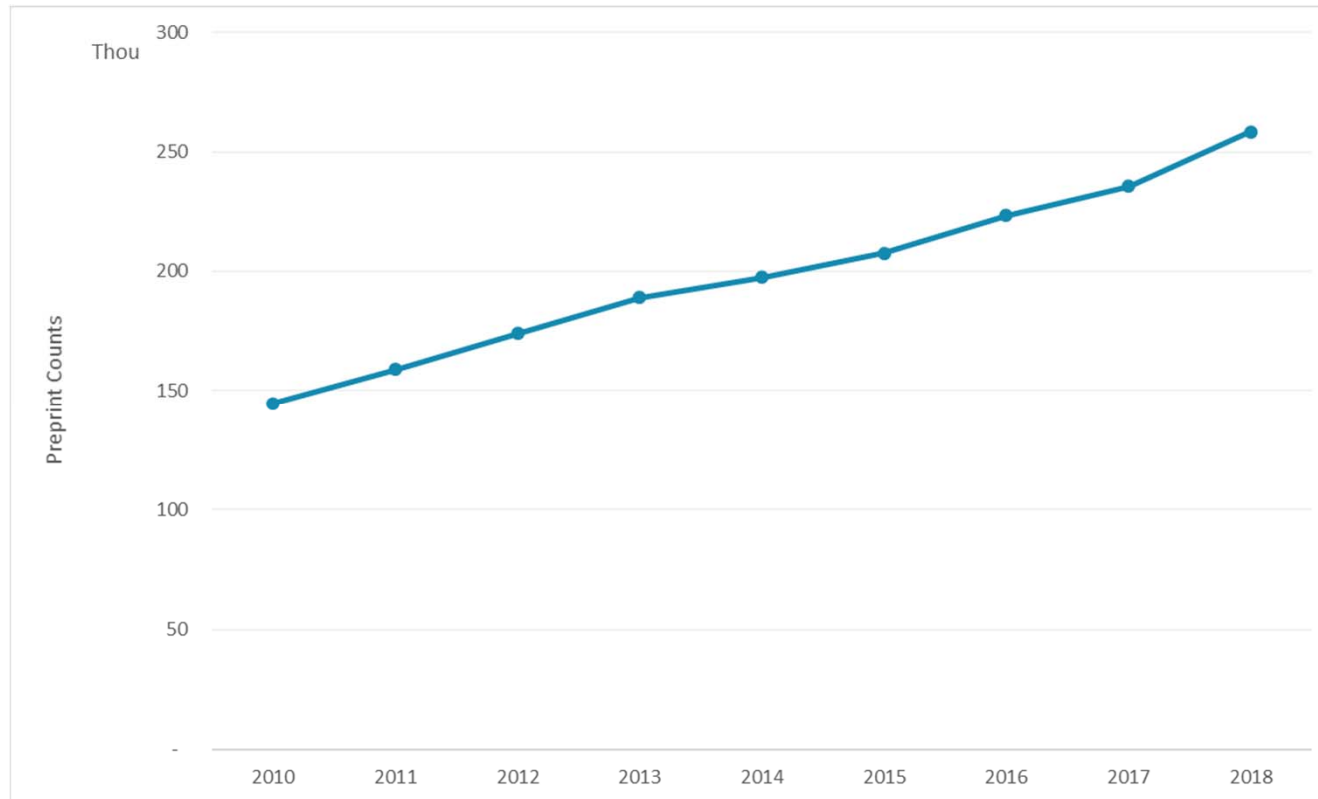
Source: OECD. Based on GERD presented as US\$ constant prices, 2010 base year, PPP

Notes: Includes all OECD member countries, plus Russian Federation, Singapore and South Africa.

Dashed lines represent forecast data, calculated through linear extrapolation of available data.



## Are preprints continuing to grow rapidly and into new fields?



### Growth of the number of preprints.

Source: Total counts across arXiv, bioRxiv, peerj preprints and repec.

Notes: preprint servers will continue to be added



## Scenario three: Eastern ascendance

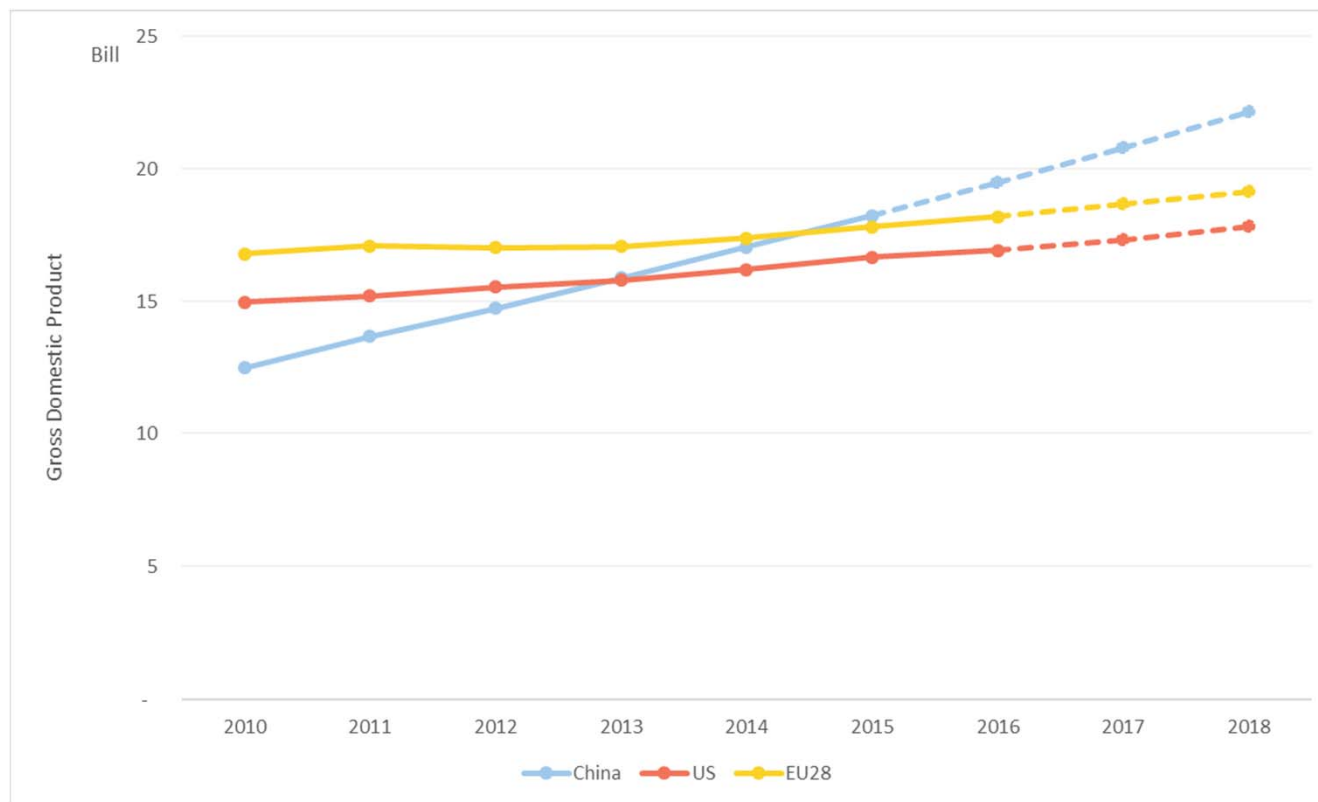
*China's desire to transform into a knowledge-based economy has led to heavy public investment in research and development (R&D) and the systems and processes to capitalize on this in industrial and economic terms. As a result, China's level of R&D funding is proportionally much higher than the West's and continues to grow, changing the shape of scientific research. The sheer volume of investment by China, and other research nations in the region, has made the East a magnet for international researchers.*

*A lack of global alignment on grand challenges has resulted in inefficiencies in the international research system. Open science practices have been adopted in some countries and regions, but not all. Journal publishing is a mixed model of open access (OA) – gold and green – and subscription publishing. Individual research outputs can be accessed separately, but are always linked to the final article; for example, research findings, data and code.*

*Governments, industry and other research funders compete for scientific advantage through the controlled distribution and trading of data. When data is believed to hold no further commercial value, it is released so it can be linked back to its related research outputs.*



## Is the economic growth of China continuing to outperform that of the US and EU28?



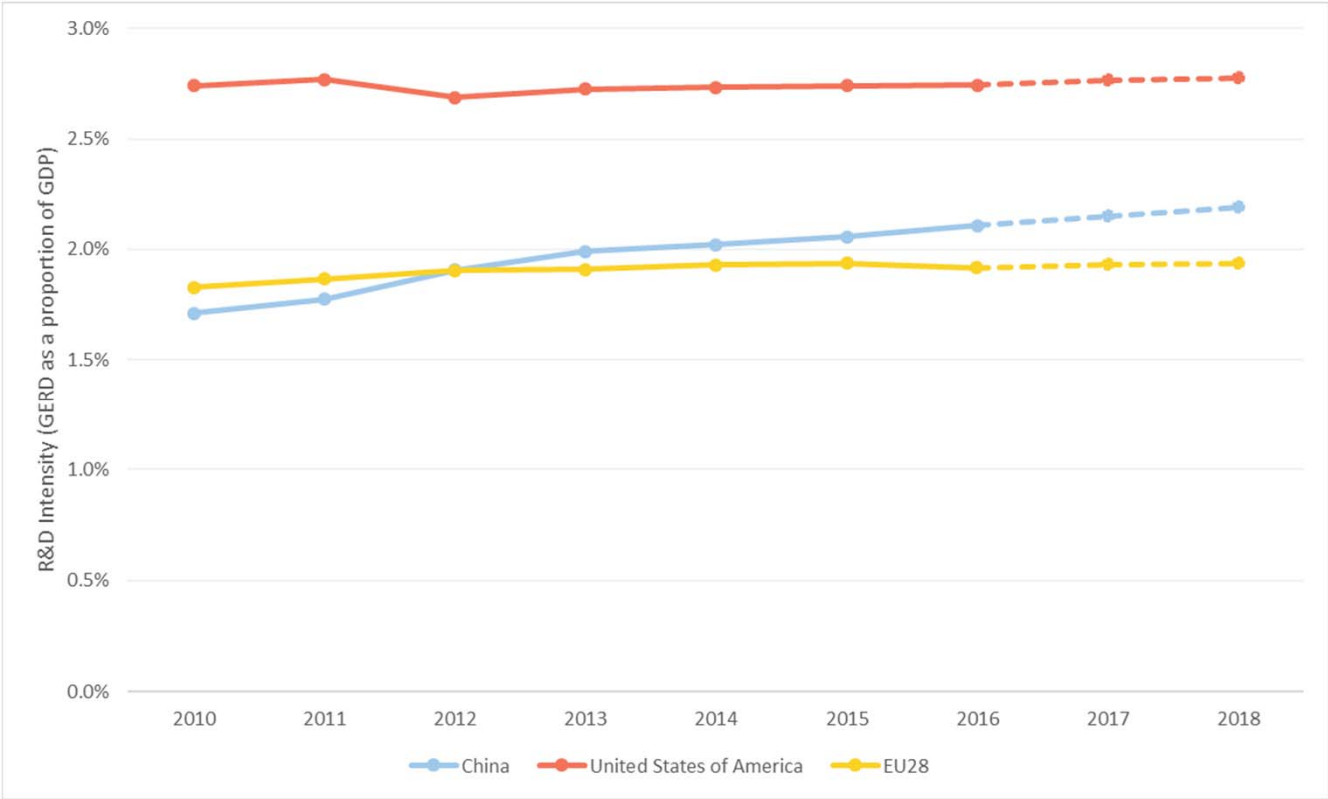
### Growth Domestic Product.

Source: OECD. US\$ billions, constant prices, 2010 base year, PPP

Notes: Dashed lines represent forecast data, calculated through linear extrapolation of available data.



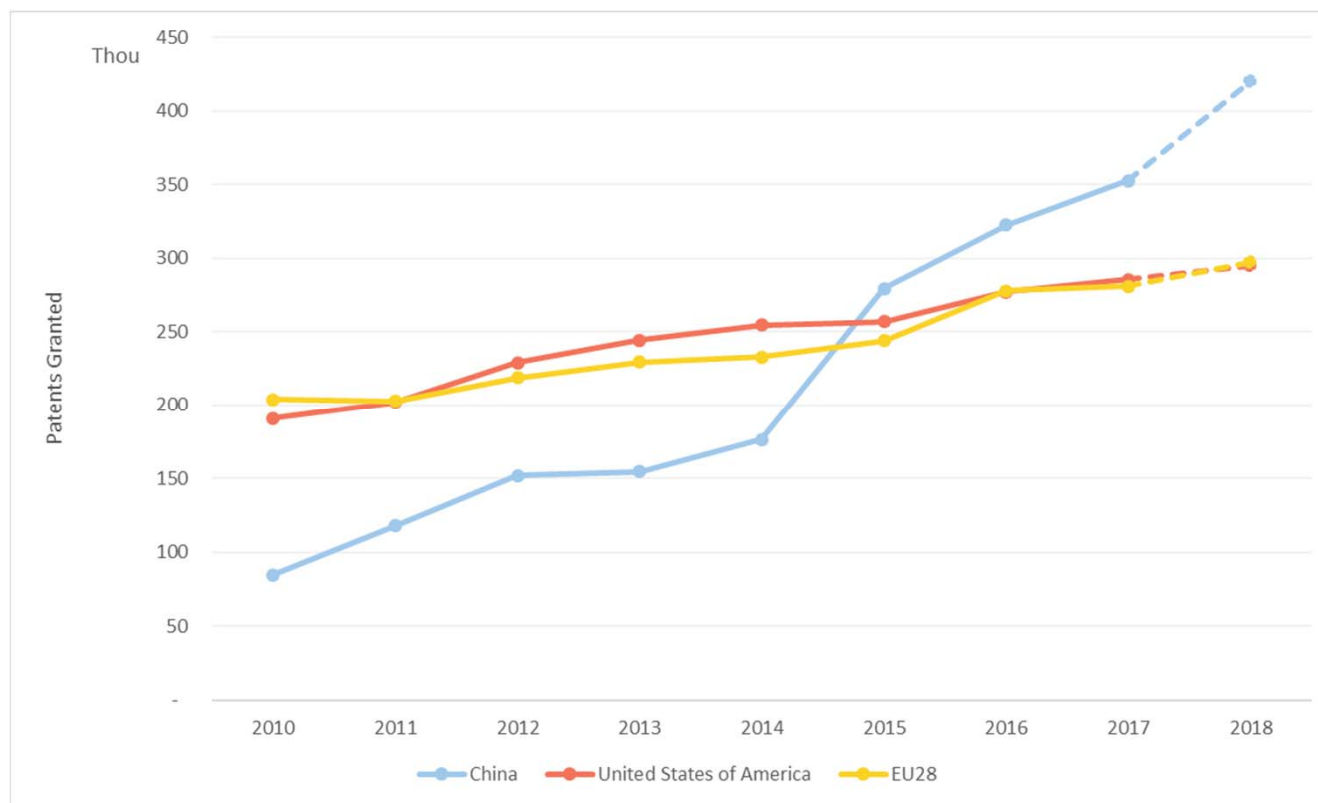
# Is the R&D intensity\* of China continuing to grow, and nearing that of the US?



**Growth of \*Gross Expenditure on Research & Development (GERD) as a proportion of GDP.**  
Source: OECD. Based on GERD and GDP presented as US\$, constant prices, 2010 base year, PPP  
Notes: Dashed lines represent forecast data, calculated through linear extrapolation of available data.



## Is the number of patents granted in China growing – especially relative to the number in the US?



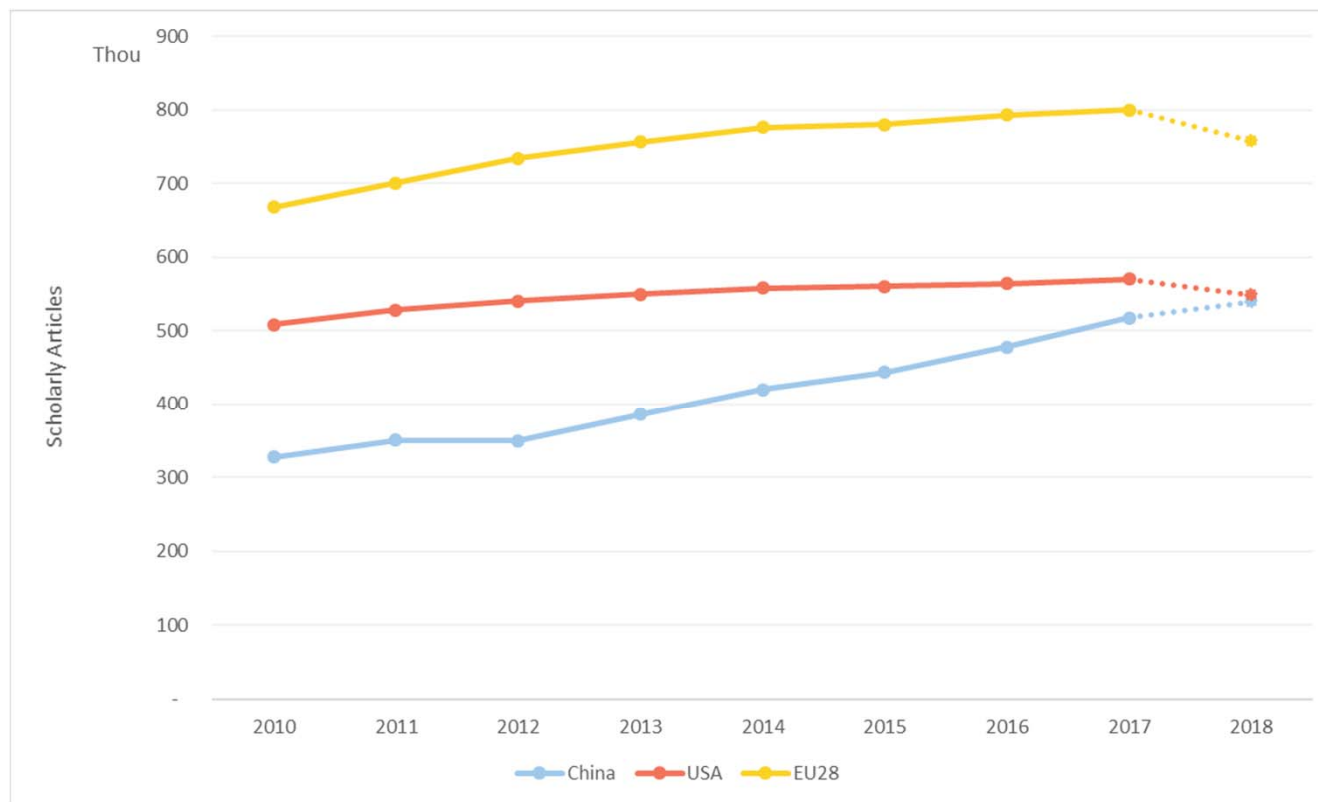
### Number of patents granted.

Source: WIPO.

Notes: Dashed lines represent forecast data, calculated through linear extrapolation of available data.



## Is the number of scholarly articles from China growing strongly – and are they outpacing the US or the EU28?



**Number of scholarly articles (articles, reviews, conference proceedings papers)**

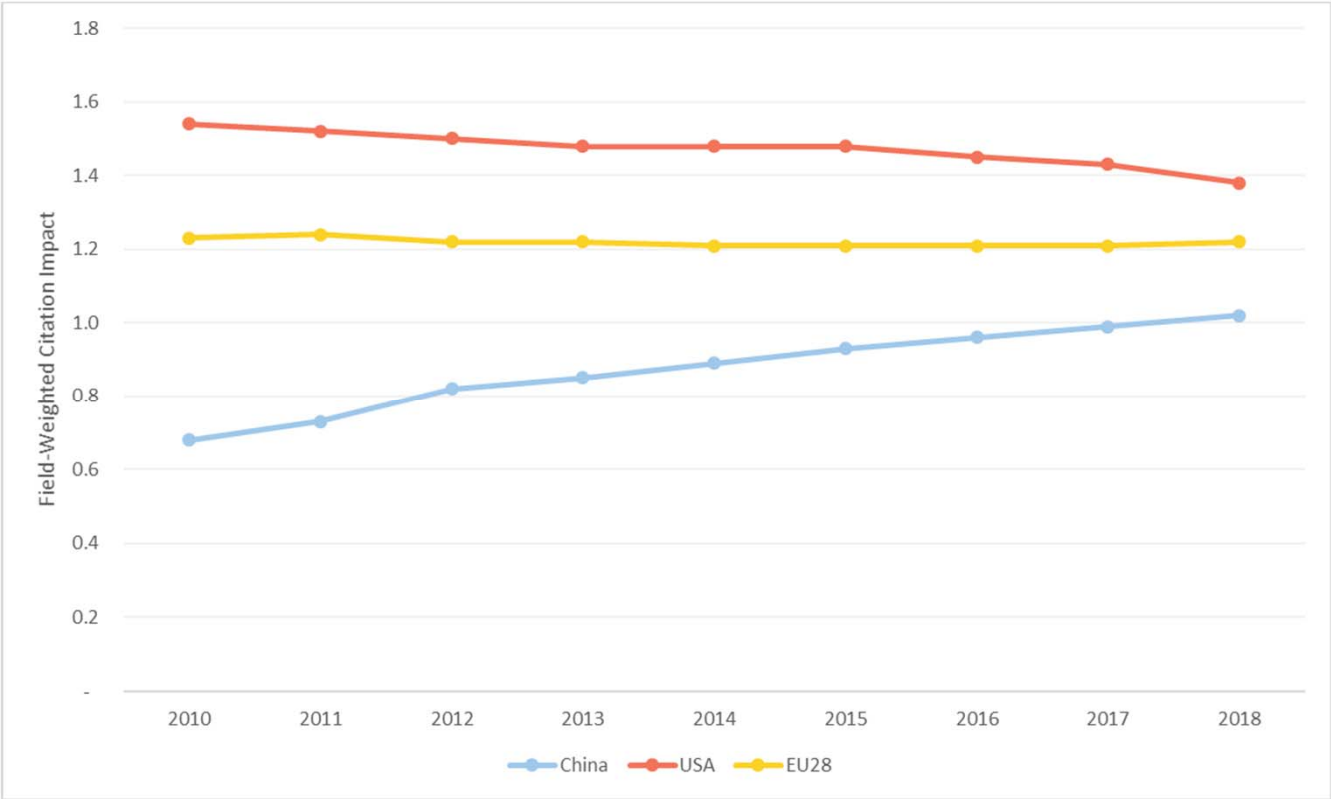
Source: Scopus. Whole counts of papers

Notes: Dotted lines indicate volatile results that are likely to change when reported later in the year.





# Is research from China showing good impact, and is the country's output performing well relative to the US and EU28?

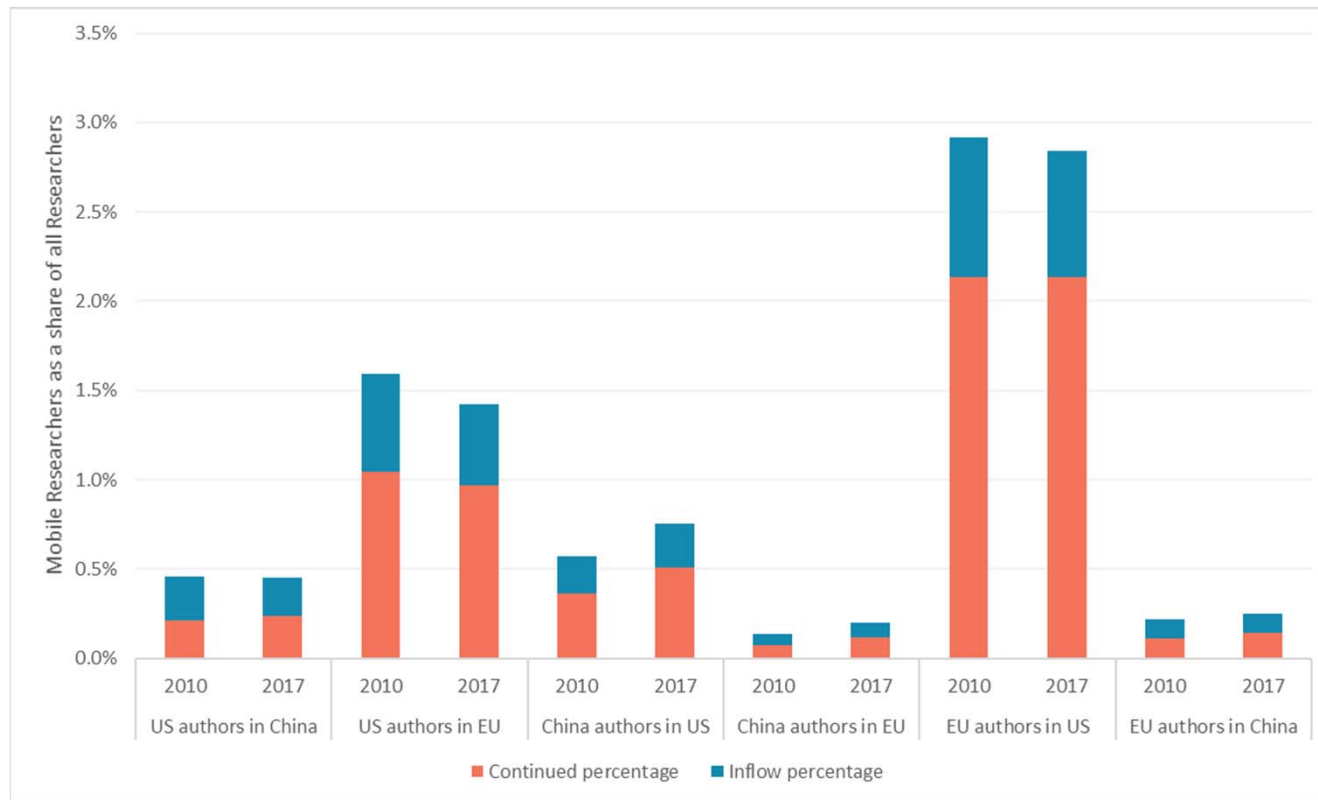


Field-Weighted Citation Impact

Source: Scopus.



## Is the number of researchers moving between the West (US and EU28) and the East (China) increasing and is there more movement West > East than vice versa?



Field-Weighted Citation Impact

Source: Scopus.