

China overtakes the EU in high-impact publications

Headlines

- Over the last decade China's performance in the top scientific excellence has been rapidly improving, while the performance of the EU has been stagnant.
- China has overtaken the EU in 2016. Its scientific output now has a higher percentage of the most elite articles.
- International collaboration, scientific mobility and fast growth of the Chinese science budget played a decisive role in the rapid emergence of the Chinese science system.
- This offers a wake-up call for the EU. More investment in R&D are needed.

The output of China's science system has been increasing exponentially since the turn of the century (Leydesdorff et al, [2014](#)). The volume of China's production is impressive; more impressive is the growth in quality as measured by citations. Using traditional measures, the quality of Chinese science has been improving just as fast as output, if not faster.

Quality of science is difficult to measure. The most commonly used proxies are based on the number of citations. For individual papers, this is widely recognised to offer imperfect measures, but for research organisations and research systems, it allows for more reliable proxy measures given the higher levels of aggregation that cancels out individual biases and noise. The standard indicator of relative scientific impact, and thus presumed quality of a science system is the percentage of documents in top 1% indicator is the top one percent most cited document in a given subject category, year and publication type divided by the

total number of documents in a given set of documents. A value of "1" for a set of documents represents that one percent of the publications in that set is in the top one percent of the world regardless of subject, year and document type – every nation with a "1" would be considered to be performing at the world average. A value above "1" represents that more than one percent of papers in the set are in the top one percent of the world (InCites following Tijssen et al., 2002). A similar definition holds for the top 10% of articles. China now performs above the world average at a higher rate than the EU. A higher value is considered to be higher performance.

Over the last decade China's performance in the top scientific excellence has been rapidly improving. China's scientific output now has a higher percentage of the most elite articles—performing better than the EU. The exact point at which this happened depends on the publication database used and the methods adopted: In Clarivate's Web of Science, using the InCites platform, it can be seen to occur in 2016, in the broader Scopus database (Elsevier), using the Scival platform, it is observed in 2017. Either way, it is clear that China has reached a quality benchmark ahead of any expectations.

Figure 1 shows shares of top 1% and top 10% most highly cited papers using Clarivate's InCites Platform. In the share of top 1% most highly cited, China overtakes the EU in 2016. In the top 10% this event takes place one year earlier, 2015, showing that the EU probably still had a slight advantage on the very top of excellence, but it lost

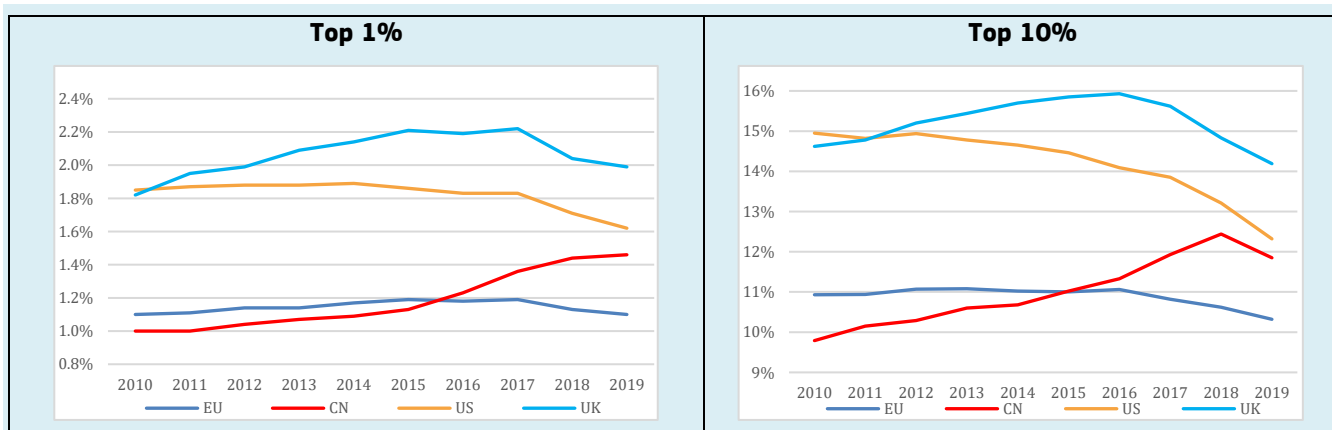


Figure 1. Output in top 1% and top 10% highly cited publications, % (notes, letters, articles and reviews)
Source: JRC elaboration based on InCites (Web of Science) data. Last update: 10/03/2021

this advantage in the following year. The point in time at which China overtakes the EU is based upon whether the United Kingdom is counted as in or out of the EU block because the UK's average share of highly cited publications is above the EU average. The data on the share of top 10% publications after 2018 should not be over-interpreted, as the citation window is very short.

At a recent ESOF panel, Sylvia Schwaag Serger, Cong Cao, Caroline Wagner, Xabier Goenaga and Koen Jonkers discussed the factors that have led to this rapid emergence of the Chinese science system. Apart from international collaboration (Wagner and Jonkers, 2017), scientific mobility plays an important role. As Cong et al (2019) show: Chinese scientists who have returned to China after doing research in the US and EU are responsible for a considerable share of China's highest impact publications, as are international collaborations. The rapid growth in China's research and development budget allocated through the National Natural Science Foundation of China is another important factor.

Finally, the Chinese government and Chinese research organisations have until recently actively incentivised scientists to publish good science in high-impact international journals. The Chinese government announced a reconsideration of the latter strategy. The exact nature of this change is

still unclear and its impact may likely be seen only after a few years. Schwaag et al (2021) also point towards the risk of China's decoupling more from the global science system, as described in the most recent 5-year plan. Given the crucial importance of international collaboration in scientific performance, such a development, if it does occur, may actually hinder the performance of the Chinese science system in the global realm.

Governments in the EU and US should meanwhile realise that China is no longer only catching up. In many ways it has already become a world leading nation in science. From a competitive perspective this may stir these governments to invest more in science in order to remain competitive in the global knowledge economy. At the same time, the emergence of this large new player can yield important contributions in the tackling of the large societal challenges the world is facing the coming decades.

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