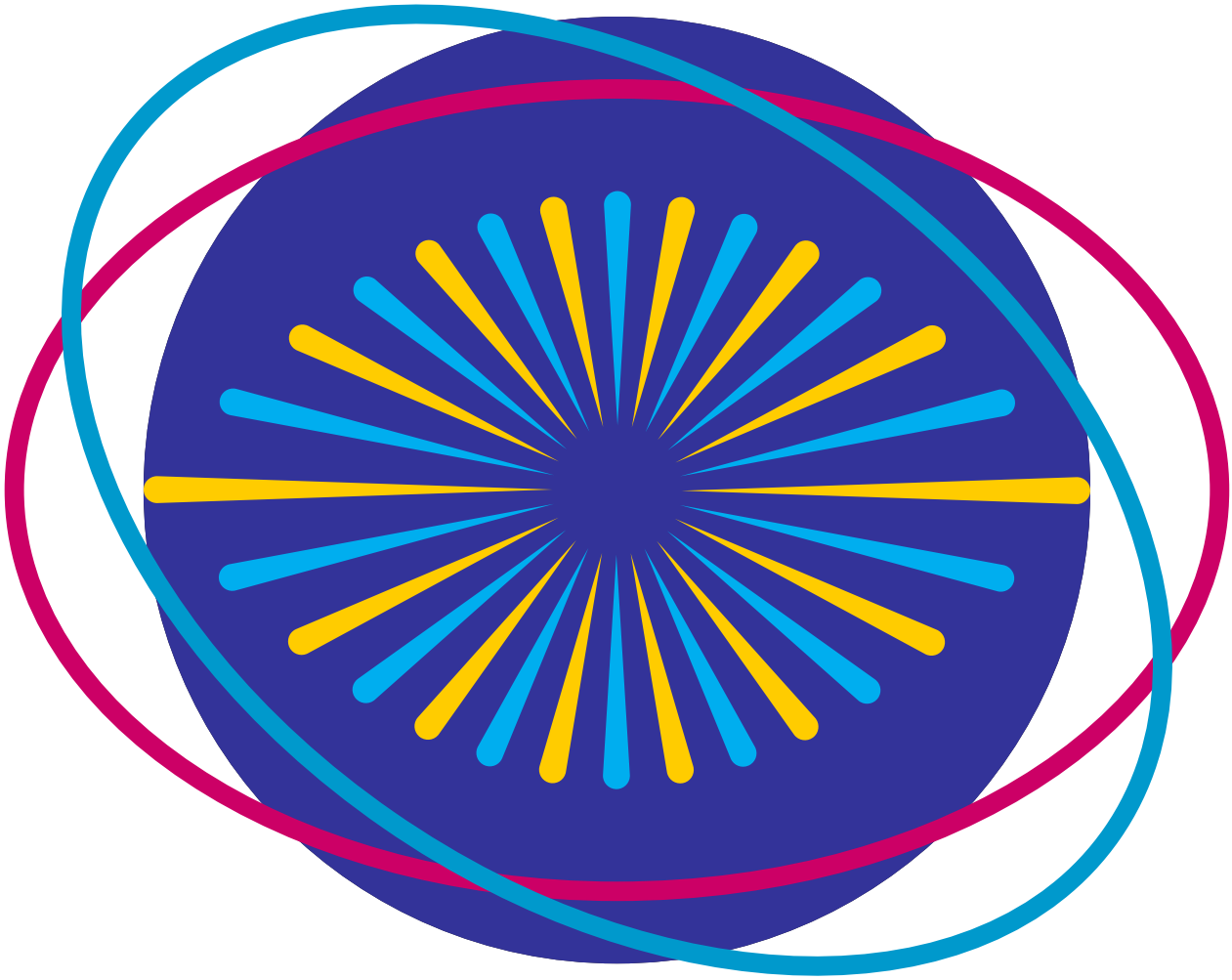
Global Neighbours Insights | No. 1

# CHINA–GLOBAL RESEARCH COLLABORATION AT STAKE

## The Decline of International Cooperation in Research and Publishing and its Effect on Scientific Progress

**Dr. Niels Peter Thomas**



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# ABOUT THE SERIES

"Global Neighbours Insights" is a new publication series launched by the Vienna-based think tank, Global Neighbours. This series will offer in-depth analyses and thought-provoking perspectives on international relations, global policy trends, and regional developments. Aimed at fostering cross-border understanding, the insights will serve as a valuable resource for policymakers, business leaders, academics, and engaged global citizens.

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Niels Peter Thomas is Executive Vice President at Springer Nature Group, a leading scientific publisher. He is responsible for Springer Nature's global books business. Niels lived more than six years in China in four different decades. 1985, as a teenager, he attended middle school in Beijing; in 1990, he lived in Qingdao during his undergraduate studies, and in the 2010s and 2020s, he had different responsibilities for Springer and Springer Nature in China. His latest assignment was President Greater China during the COVID-19 pandemic from 2021 to 2023 in Shanghai. Niels holds a master's degree in industrial engineering and a PhD in Economics. He is a visiting professor at the Beijing Institute of Graphical Communication, a Beijing-based university focusing on publishing research. Niels lives in Germany near Frankfurt, is married, and has two children.

# ACKNOWLEDGMENTS

This is a working paper and ongoing work-in-progress, meant as an honest contribution to the discussion of how to advance global knowledge to support science to solve humanity's grand challenges ultimately. My gratitude goes to everyone joining the debate and providing valuable feedback. Thank you to Amy Lin for data analysis and insights.

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# Executive Summary

The contributions of Chinese scientists to the total number of peer-reviewed scientific journal publications have grown impressively in quantity and quality over the past decade. In the natural sciences, they already represent the most significant national share ahead of the USA (followed by Germany). Chinese scientists also lead in the high-quality segment. However, one publication segment has come under pressure since 2018. It has been shrinking since 2020 at the latest: publications with mixed author teams from China and other countries – while internationally, this segment is growing steadily. This decline in international academic collaboration is lamentable because this segment has traditionally been of very high quality: articles with mixed author teams have almost twice the citation rate of articles by authors or author teams from just one country. The overall view of the available data allows us to quantify the amount of scientific knowledge that is withheld from the world due to a lack of cooperation. The causes of this decline are partly political, partly due to the recent COVID-19 pandemic, and partly academic. Still, it is important to stop the trend of declining international cooperation not to risk an even bigger loss of scientific progress, which would be fatal for the grand challenges of humankind, that can only be improved by faster progress in science – worldwide.

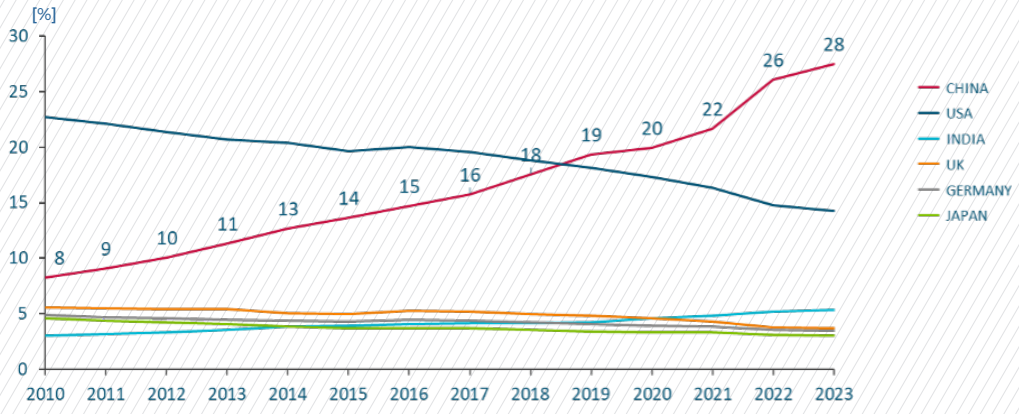
# Introduction: The Rise of Chinese Research Output

China has experienced remarkable growth in scientific output, rapidly becoming a global leader in research and innovation. This surge is impressive because it has transformed China from a developing nation into a scientific powerhouse within just a few decades. China's investment in education, research institutions, and technological infrastructure has dramatically increased published research papers, patents, and cutting-edge innovations, challenging long-established scientific leaders like the United States and Europe. This swift ascent highlights China's strategic focus on science and technology as key drivers of its economic and global influence.

For this analysis, we will look at English-language peer-reviewed journal articles only as a measure of scientific progress. This underestimates the true potential because there is also a significant growth in awarded degrees, patents, Chinese-language publications, applied research in industry, etc., which will not be considered here.

Considering the growing number of published articles in peer-reviewed international journals worldwide, the increasing share from Chinese authors is even more impressive, as you can see in the following chart:

**Figure 1** Top country's article share in global outputs




***Source:*** Source: Clarivate Incites, ESCI included, articles and reviews, country based on corresponding author affiliations.

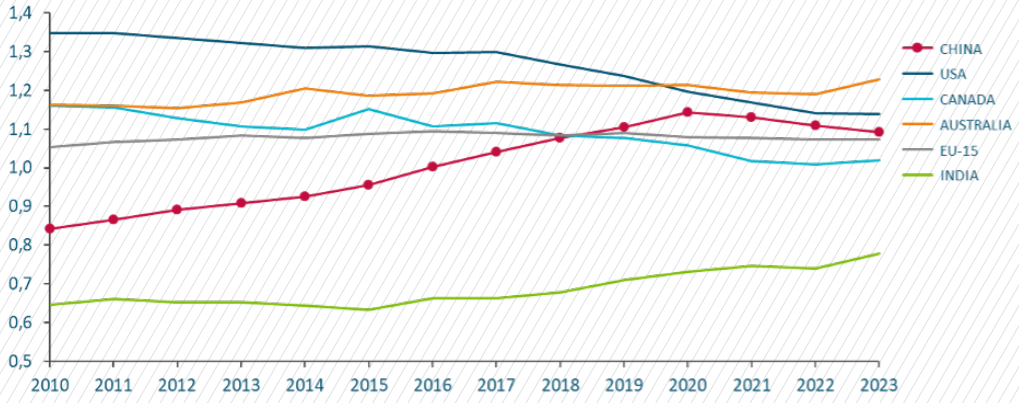
Articles with authors from different countries will be counted as one for each country. Article share is calculated as the country's article/global real total outputs, which means the sum of all country shares will be over 100% with the double count of articles from multiple countries

Within less than 15 years, the share of Chinese research of all published new knowledge has grown from a single digit to 28%, overtaking the USA, the previous most productive powerhouse of science & research. In 2020 and 2021, during the COVID-19 pandemic, the growth rates seemed to lower, while in 2022, the previous growth path was reached again.

However, whether China has completely overtaken the US as the largest source of new scientific knowledge is a matter of definition and largely depends on the selection of disciplines to be counted. In the social sciences and humanities, Europe and the US are certainly still leading; in health sciences, the US is still leading, but in natural sciences, most published articles undoubtedly are coming from Chinese labs and universities.[1]

While the previous chart shows only the quantity of published research, the quality from China also grew significantly. The quality of published research is difficult to measure. Still, we can look at indicators such as the impact factor of journals, citation rates, novelty and significance of findings, retraction rates, or reproducibility of results, and ultimately also at the influence of the work on future studies and real-world applications. Looking at citation rates as the most established indicator of the quality of a research paper, China has seen remarkable success in these areas over the last decade, with a significant increase in the number of highly cited papers and publications in top-tier journals. This growth reflects China's improved research standards and growing influence in shaping global scientific discourse.

**Figure 2** **Category Normalized Citation Impact by key country/region**




***Source:*** Clarivate Incites, ESCI included, articles and reviews, country based on corresponding author affiliations.

1. For more detailed analysis, see also Nature Index at https://www.nature.com/articles/d41586-023-01868-3 and https://www.nature.com/articles/d41586-023-01867-4.

The chart above shows the "Category Normalized Citation Impact" (CNCI) of the leading scientific nations and regions and their development over the last 15 years. The CNCI is the average of citations to all publications from that country or region[2]. As you can see in the chart, before 2016, the average citation of papers from China was below 1, which can be considered the benchmark of the world average of all published articles yearly. After 2016, the citations of publications from Chinese authors have been above the world average, growing until 2020. After 2020, we see a slight decline in citations of Chinese articles. However, it is still clearly above the world average level and the average of publications from the EU, Canada, and India.

Also, more detailed analysis, like the share of the most cited articles per country, leads in the same direction: the growth of quality and scientific relevance of publications from China is as impressive as the quantity. It demonstrates a remarkable success story over the last 15 years with clearly favourable effects on the worldwide expansion of knowledge, as each paper that is cited above the world average is a new contribution to knowledge and accelerates the global production of knowledge across borders.

## International Collaboration in Publishing Research and its Long-Term Trends

So far, we have looked at each country's contribution to the growth of knowledge – while many papers are written by groups of co-authors from different countries, either collaborating in a virtual network or while staying abroad for some time and forming international working groups. These collaborations are vital for the progress of science, as different perspectives and research backgrounds are brought together, and knowledge is therefore shared more globally, as well as an enabler for future research. The share of cross-border collaborations is often considered an indicator of research quality. International collaborations can enhance the quality of research by bringing together diverse expertise, perspectives, and resources that might not be available within a single country. These collaborations often lead to more innovative and impactful research, allowing for the exchange of ideas and the combination of complementary strengths. Additionally, research that involves cross-border collaborations tends to be published in higher-impact journals and is more likely to be

2. The CNCI of a document is calculated by dividing the actual count of citing items by the expected citation rate for documents with the same document type, year of publication and subject area. CNCI of a set of documents, is the average of the CNCI values for all the documents in the set.

cited, further reflecting its quality and significance in the global scientific community – we will look at this quantitatively below. Looking at 2023 data, almost 25% of all published research papers worldwide were published by mixed teams from different countries (and the rest either by one author or by a team of co-authors from the same country)[3]. Additionally, there is a consistent long-term trend in the global internationalization of research publications. While in 2010, less than 20% of all published articles in peer-reviewed journals were published by mixed teams, we are now at around 25% globally. The trend is even more apparent in the classic leading research nations. In the US, the share rises in the same period from 29% to 42%, in Germany from 47% to 60%, and in the UK from 45% to 68%.

Overall, Asian countries have a lower level of research published by mixed teams – or in other words, it seems that in most cross-border papers, Asian researchers are underrepresented. India, Japan, and South Korea are above the world average with a 30%–36% internationalization rate (and therefore below the European and North American level), but also significantly contributing to the global trend towards more international exchange year by year.

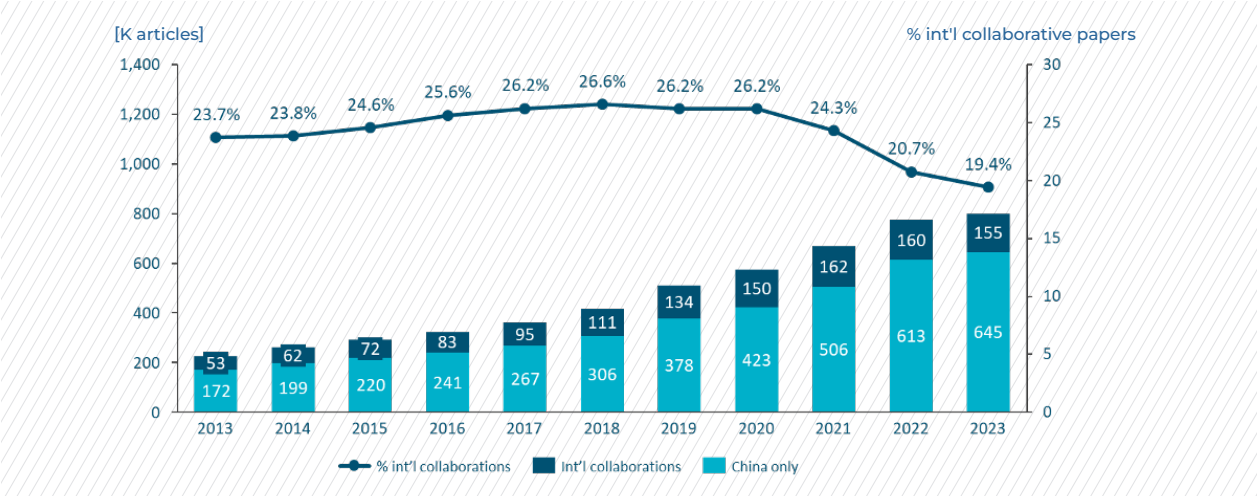
However, it is essential to note that the level of internationalization in publications itself is not necessarily a good indicator of a nation's attitude towards international research. Still, it is also heavily influenced by a nation's disciplinary profile. Different scientific disciplines have different typical numbers of co-authors. Some disciplines might have the most published articles from a single author, while others typically have many co-authors contributing to complicated lab research. Therefore, the trend of internationalization is more accurate as an indicator than the level itself.

3. Source: Clarivate Incites. Publication data does not reveal the nationality of authors. Therefore, the basis for allocating authors to countries is the location of the author's affiliation. This data may contain false positives (when two Chinese researchers work together, but one of them is (temporarily) affiliated at a foreign university, or false negatives when a research group uses one affiliation while the group itself consists of members of different nationalities. However, the available data likely gives a good and accurate overview of the share (and development) of international research collaboration.

# Chinese–Foreign Collaboration in Publishing Research and its Recent Decline

Let us now have a detailed look at the level and development of internationalization in China, which means looking at published articles with at least one Chinese author but also with at least one non-Chinese author. In this chart, you will see the development of international papers from China:

**Figure 3** Development of China int'l collaborative papers




Eleven years ago, in 2013, China's internationalization rate of its publications was above the world average (21%) but clearly below the most advanced scientific contributors like the USA, Germany, and the UK. However, in line with the rest of the world, we see an opening up and more inclusive research published in the next few years. This is remarkable as publications from China grew quickly in absolute numbers, and international publications with Chinese collaborators grew even faster.

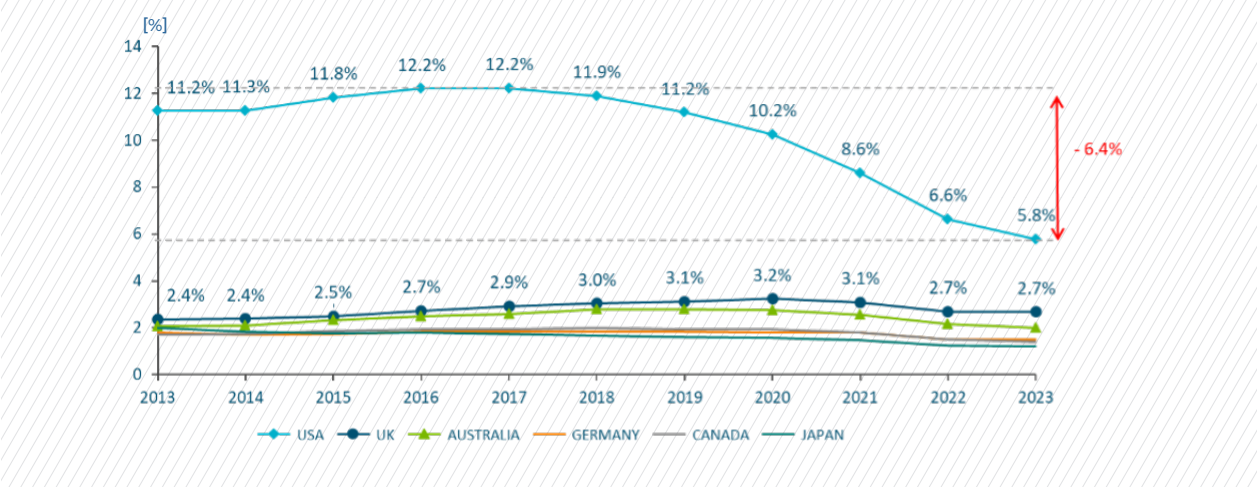
This trend of a growing share of international papers from China continued until 2018 when the share peaked at 26.6%. This means that more than every fourth paper from Chinese labs was done collaboratively with at least one international contributor.

Since 2019, the share of international–Chinese co-publications has been declining, while their absolute number is still growing, just growing much slower than publications from Chinese researchers

alone. In 2022, we saw the most significant decline in the share, from 24.3% to 20.7%, in just one year. In the last two years, 2022 and 2023, we have seen an absolute decline in papers published internationally – while overall, the capacity of Chinese research in general is still growing fast.

Let us look at the Chinese–international publication cooperation with different individual countries to give this effect more nuance – which is illustrated in the following chart:

**Figure 4** Percentage of China Int'l collaborative papers in China total outputs, with key countries




When working internationally, most Chinese researchers work with researchers from the US; more than half of all international Chinese publications have co-authors with US affiliations. However, we see a decline from 2018 after plateauing in 2017, when 12.2% of all Chinese papers had US co-authors, to only 5.8% of Chinese papers. US–China collaborations have more than halved in the last six years.

Other significant collaborators come from the UK, Australia, Germany, Canada, and Japan. In the chart illustrated with data from the UK, they all follow the same trend: their share within China's research output individually is relatively modest, but they grow longer until 2020 and decline only starting from 2021. UK–Chinese collaborations in 2023 are back at only the level of 2016, and it is unclear if the trend will continue or has now stabilized at a lower share.

German–Chinese collaboration follows the same trend, which is impressive in the long term: while in 2010, only 2,529 papers were published by a Chinese–German mixed authorship team, in 2020, it was already 10,355, so it almost quadrupled within ten years. This is already a reasonable growth rate in comparison with the growth of Chinese scientific output, but even more impressive if you look at the relatively lower growth rates of German scientific output in the same time frame – indicating an evident willingness to grow scientific cooperations between the two countries in those ten years. However, German–Chinese papers are also declining again in 2022, both relatively and in absolute terms.

Adding up all countries collaborating with China in their publication output, the decline of the US was compensated by other countries in 2018. Still, starting in 2019, we see an overall decline because of the dominance of US–Chinese research collaborations. This decline is China-specific. China is the only country in the top ten world contributor nations to scientific publications with declining international collaboration in the last ten years.

Separating different countries is just one possibility for a deep dive into the details and nuances of this effect. Another possibility would be to look at the different subject disciplines to check if the decline is concentrated in a few key disciplines. Interestingly, there is a universal decline in all big disciplinary areas: humanities and social sciences, science, technology, and medicine all see similar patterns. The effect does not seem to be limited to some sensitive key disciplines but is a general trend overall in academic topics.

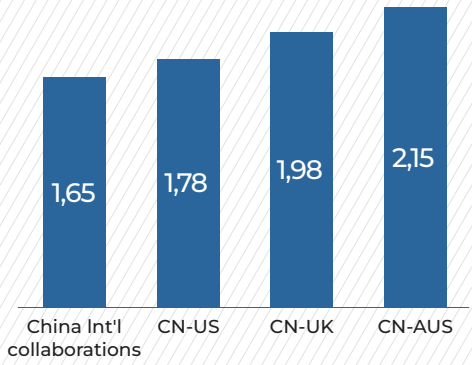
One could argue that the collaboration between China and other countries is not needed anymore, with China already dominating the worldwide output in many disciplines. Let us, therefore, quantify the "loss" of fewer international papers. For this purpose, we will look again at the "Category Normalized Citation Impact" (CNCI) as a measure of the number of citations expected from a segment of publications.

In the following chart, you will see a comparison of CNCIs for papers published by either one author or authors from one country versus papers published by a mixed team of contributors from at least two different countries:

**Figure 5**

**'Category Normalized Citation Impact' (CNCI) of Int'l collaborative papers with China**

[Publications in 2021-22]




**'Category Normalized Citation Impact' (CNCI) of Domestic collaborative papers for kev countries**

[Publications in 2021-22]

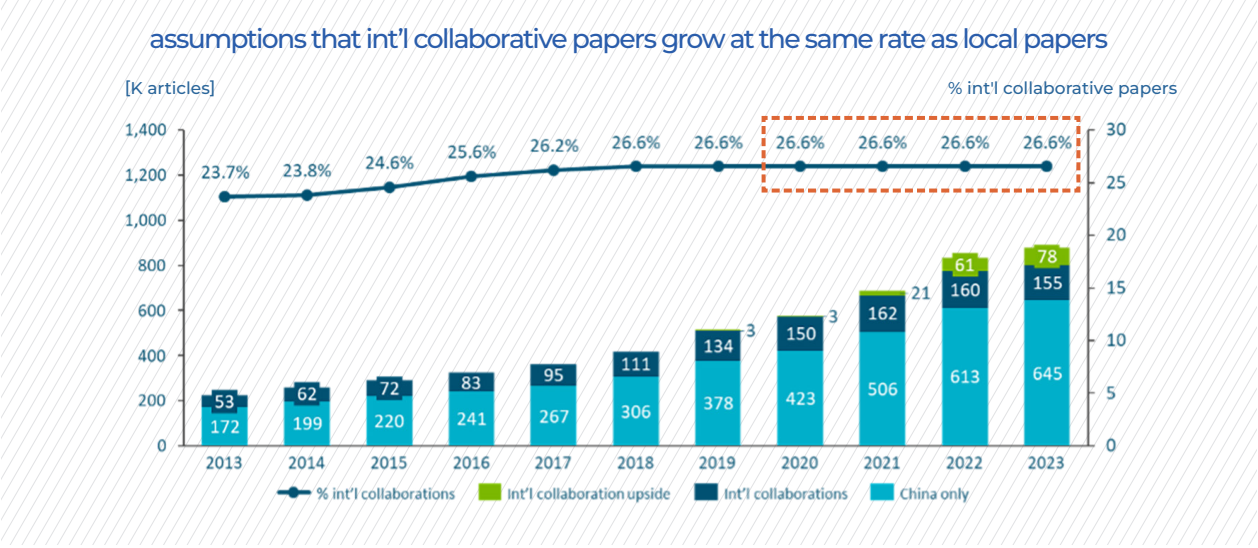
According to our data, remarkably, papers published consistently by contributors from different countries consistently have a higher expected number of citations. Papers from China and at least one other country's researcher have a CNCI of 1.65, while papers from China alone are at 1.08 – both above the world average of "1" and independent of the country of origin of the collaborator. However, there are combinations of countries where a collaboration typically is even more successful, like Chinese–US joint papers. Here, the expected citation rate doubles with the collaboration from 1.08 to 2.15, and, remarkably, it's not US researchers "helping" the Chinese paper to be successful; it is quite symmetrical: also, Chinese–US joint papers are significantly more successful than US-alone papers, as the chart clearly shows.

It is fair to note that we do not know precisely from this data why the CNCI is consistently higher for papers from different countries. It is an obvious hypothesis that diversity in authorship enriches the quality of the paper and, therefore, leads to higher citations. However, it is also possible that researchers from a particular region are more likely to cite other researchers they know or from a well-known affiliation. If that is true, Chinese researchers will be more likely to cite Chinese papers, and Western researchers will be more likely to use Western research. While this behavior may not be entirely rational, it still has the same effect: a collaborative paper gets more attention from different communities, resulting in a better perception of the global academic community. Therefore, even if the citation effect does not always come from an increased quality but rather from "prejudices" within the different communities, there is still an actual loss because of the reduced attention given to papers without international collaborators.

# Quantification of "Loss" for International Science by Reduced Cooperation

With all the data above, we can quantify the loss for advancing worldwide science in the following way. Let us first estimate the number of papers with international collaborators that could have been published additionally by Chinese authors if the collaboration had not declined since 2018. For this purpose, we assume that starting in 2019, papers from China with global participation could have grown in line with the rest of China's scientific output so that the level of internationalization would have been stable at the peak rate of 26.6% of cooperation papers, which is illustrated in the following chart:

**Figure 6** Development of China intl collaborative papers




With that assumption, we can calculate that we are missing about 78.000 English language papers worldwide due to the decline in cooperation between China and the rest of the world in 2023 only, or more than 150.000 articles in the last years accumulated. Considering that according to the global trend, the level of internationalization should have grown further, this is assumed to be a conservative estimation.[4]

Given that the expected citation rate is significantly higher for collaboration papers than for single-country papers, we see that the effect described here hinders global scientific progress

4. Of course, some of the articles that were not published due to reduced cross-border collaboration could have been published with Chinese-only authors, but then at least we know that there was still a loss in citation expectation due to the reduced diversity in authorship.

considerably. ***Scientific output worldwide last year could have been more than 3% higher than it was, with papers having a citation expectation almost double the world standard, if China had not seen an ongoing decline in international scientific collaboration.***

If the trend continues and more Chinese–foreign joint papers are not written, we are looking at a growing number of world research outputs at stake. Of course, if researchers do not collaborate anymore, they will use their time to work together within their country (or work alone) and publish other papers than the collaborative ones. However, as we have seen that the growth of the collaborative sector was growing fastest in comparison to all individual countries' growth (even faster than the Chinese growth of research), it is plausible to assume that the total amount will drop or at least growth rates will decline.

## Some Aspects of an Interpretation

To interpret this trend, it is essential to acknowledge that there are legitimate reasons why individual research projects are put on the test or why existing or potential new research projects are carefully evaluated and, in some cases, not carried forward. Hesitation can come from both sides. Western researchers might have the following rationale:

- **Geopolitical Tensions:** Increasing political tensions between China and Western countries may create an atmosphere of distrust, leading researchers to avoid collaboration to avoid potential conflicts or backlash. The coincidence of 2018 as the start of the Trump Administration in the US and the reduction of US–Chinese joint papers makes this reason seem a plausible (partial) explanation.

- **Legal and Practical Constraints Due to the COVID-19 Pandemic:** It is not a complete surprise that starting in 2020, meeting researchers in China was nearly impossible for Western academics. Working groups may have continued to publish their results, but no new research groups could likely be formed or work together in many different disciplines. However, as the growth of collaboration in general is picking up speed globally, more is needed to explain the continuous reduction in collaboration with Chinese researchers, especially in 2023 and 2024.

- **Fear of Political Repercussions:** Researchers might fear being caught in the crossfire of political disputes or being targeted by their governments for collaborating with Chinese institutions, leading to reputational or professional risks.

- **Competition for Scientific Dominance:** China's rise as a scientific superpower may be seen as a challenge to Western dominance in research. Some Western researchers might view collaboration as contributing to this shift

and prefer to focus on strengthening their institutions' positions instead.

• **Government Influence and Oversight:** The perception that Chinese research is heavily influenced or controlled by the government may raise concerns about academic freedom, scientific integrity, and the transparency of research findings.

• **National Security Issues:** Some Western governments view certain research areas, particularly technology and defense, as sensitive. Collaborating with Chinese researchers in these fields might be considered a national security risk.

• **Human Rights Concerns:** Ethical concerns about China's human rights record might lead some Western researchers to avoid partnerships, fearing that their work could be used in ways that conflict with their personal or institutional values.

• **Funding Restrictions:** Western governments and institutions increasingly restrict funding collaborations with Chinese researchers, particularly in strategically important or sensitive areas.

• **Cultural and Communication Barriers:** Differences in research culture, language barriers, and communication styles can create challenges in collaboration, leading some researchers to prefer partnerships within more familiar cultural contexts.

• **Intellectual Property Concerns:** Some fear collaborating with Chinese researchers might lead to intellectual property theft or unauthorized use of proprietary research, which could discourage partnerships.

• **Research Integrity Issues:** Concerns about the integrity of research, including issues related to data fabrication, plagiarism, or other unethical practices, might lead some Western researchers to be cautious about collaborating.

From a similar, but not entirely identical perspective, Chinese researchers may also have additional reasons to avoid collaboration with Western researchers, such as:

• **Political Pressure and National Priorities:** The Chinese government may encourage or pressure researchers to focus on domestic projects that align with national priorities, such as technological self-reliance and innovation. This could lead to a shift away from international collaborations, especially with Western countries.

• **Concerns Over Data Security and IP Protection:** Just as Western researchers might be concerned about intellectual property (IP) theft, Chinese researchers may worry about their own data and IP security. They might fear that collaborating with Western researchers could lead to exploiting or appropriating their ideas or innovations without proper credit or compensation.

• **Increased Domestic Funding and Resources:** With significant investment in research and development within China, Chinese researchers may have less incentive to seek international collaboration. Available ample funding and state-of-the-art facilities domestically might reduce the perceived need for partnerships with Western institutions.

• **Perceived Bias or Discrimination:** Some Chinese researchers feel their work is undervalued or subject to bias in international collaborations, especially if they perceive Western institutions as dominant or dismissive of Chinese contributions. This could lead to a preference for collaborating with other Chinese or non-Western researchers who they feel may better respect and recognize their work.

• **Geopolitical and Diplomatic Strains:** Rising geopolitical tensions and diplomatic conflicts between China and Western countries could make Chinese researchers cautious about engaging in politically sensitive collaborations. They might avoid partnerships that could be seen as compromising national interests or that could expose them to scrutiny or criticism from their government.

It seems that from an individual, or in many cases from a national perspective, there are always reasons to be found not to engage in cross-border research collaboration, while we at the same time know that the global slowdown of scientific progress is harmful to everyone, and therefore also to individual and national interests. This seems to be a kind of prisoner's dilemma, where from a national perspective, reduction of cooperation appears to be rational, while in total, we are sure that everyone will lose. Of course, some reasons mentioned above are legitimate concerns and should be taken seriously. However, as we see the reduction of collaboration to a similar degree throughout all disciplines and regions, it seems more likely that hesitation towards scientific cooperation is the rule rather than the exception and, therefore, a sub-optimal outcome from a global perspective.

This contradiction or dilemma is not straightforward to solve, but it is imperative not to continue the trend of "separation." If the share or total number of collaborative research projects and joint publications continues to be reduced, the stakes are even higher. Rather than just missing out on potential additional publications, it may then seem possible to separate Chinese and non-Chinese publications, at least partially, by seeing more local language publications from Chinese researchers, which would, in return, again significantly harm the worldwide progress of knowledge creation.

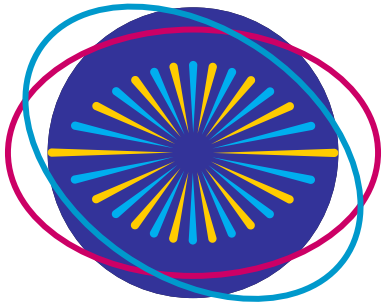
# Conclusion

Suppose we believe in the benefit of scientific progress as a necessary condition to solve the most significant challenges to mankind. In that case, we need to reverse the trend of reduced cooperation. In areas where there is (still) a broad consensus across the globe, like in research areas defined by the UN's Sustainable Development Goals (SDGs), that progress on all fronts is needed, encouragement of open-minded researchers on both sides is highly recommended. This is not only limited to the often-quoted climate research but to all 17 SDGs touching a great variety of disciplines from humanities and social sciences to science, medicine, and applied technologies.

The list of potential reasons above may lead to different starting points for this encouragement. Some are difficult to influence individually, like all geopolitical issues and reasoning. Still, many can be addressed by better information and transparency, better and targeted funding, solutions for mutual concerns over data protection and responsible use of research results, etc., and lead to a more conscious decision where cooperation makes sense and potentially leads to global benefit.

Ultimately, we need to remind ourselves that research results are generally supposed to be global public goods everyone should benefit from; we do have a responsibility to look at overall results and not limit total research by trying to use scientific knowledge within nations. This is not a new perspective. Max Weber already expressed a similar view on science, particularly its ethical and societal role, as discussed in his lecture "Wissenschaft als Beruf"[5] ("Science as a Vocation"), delivered not later than 1917. In this lecture, Weber emphasizes the idea that science transcends national boundaries and serves as a shared endeavor for the pursuit of knowledge. This Weberian view about science's role in society and scientists' ethical responsibilities can help us now overcome a significant threat to the further globalization of scientific progress.

5. Weber, Max. Wissenschaft als Beruf. In: Geistige Arbeit als Beruf. Vier Vorträge vor dem Freistudentischen Bund. Erster Vortrag. München, 1919.



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