IMPACT SCIENCE

Navigating China's Academic & Research Landscape

A GUIDE FOR ACADEMIC PUBLISHERS AND SOCIETIES

CONTENTS

01.

EXECUTIVE SUMMARY

In the Fourteenth Five-Year-Plan (14FYP) of China, innovation and technological self-reliance are the key drivers of its modernization. Accordingly, the country has made R&D investments in the fields of artificial intelligence, quantum information, integrated circuits, life and health sciences, neural science, biological breeding, and aerospace technology. Additionally, funding in basic research will be raised from 6% in 2019 to an annual rate of at least 7% over the course of the 14FYP.

While the US is currently the top nation in R&D, China is fast closing in and currently harbors 1.87 million researchers (~440K more than the US). NSF Data from 2018 reveals that China has surpassed the US in science and engineering journal articles and conference papers. The US, however, still retains the top position in the top 1% cited articles, with the US at 29% and China at 21%. Additionally, while China has the largest number of publications in engineering, it lags behind the US, EU, Japan, and India in research related to health sciences.

From 2000 to 2019, Beijing has spent roughly 80% of its R&D budget on experimental development research, far surpassing other developed countries such as the US or Japan, which allot only just over 62%. However, China lags in funding for basic research, averaging only 5% of R&D budget between 2000 and 2018. Additionally, expenditure on applied research has dropped to 11% from 17%. In light of these facts, Li Keqiang, current premier of China, promises to boost spending on basic research in the 14FYP.

Overall, government policies have a major influence on Chinese scholars and with its latest policies of restoring "the scientific spirit, innovation quality, and service contribution" of research and promoting the return of universities to their academic aims, it will likely encourage the growth and development of Chinese journals.

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1.87 MILLION

Researchers
(~440K more than in the US)

80 %

R&D budget spent on experimental development research by Beijing
(~18% more than US and Japan)

02.

CHINA'S DEVELOPMENT PLAN

China plans its economy in five-year increments. These Five-Year Plans (FYP) are important guiding documents for the country's economic and social development. The Fourteenth FYP that was recently released is perhaps one of the more significant plans in their history. This plan coincides with the nation's celebration of achieving the first of its Two Centenary Goals in 2021, which were set out as China's future development goals. In 2012, when Xi Jinping became the President, he conceptualized the "Chinese Dream, the great rejuvenation of the Chinese Nation." He then declared that by 2021, the First Centenary, China would become a "moderately well-off society" and by 2049, the Second Centenary, "a modern socialist country that is prosperous, strong, democratic, culturally advanced and harmonious."

In the bold 14FYP, innovation and technological self-reliance are key drivers of China's modernization. Therefore, seven fields were highlighted for R&D investment: artificial intelligence, quantum information, integrated circuits, life and health sciences, neural science, biological breeding, and aerospace technology. Importantly, fundamental research funding will be raised from 6% in 2019 to an annual rate of at least 7% during the course of 14FYP.

In nominal terms, China's total expenditure in 2019 was 2.21 trillion Chinese yuan (US$322 billion) and investment in basic research stood at 133.56 billion yuan (US$20 billion).

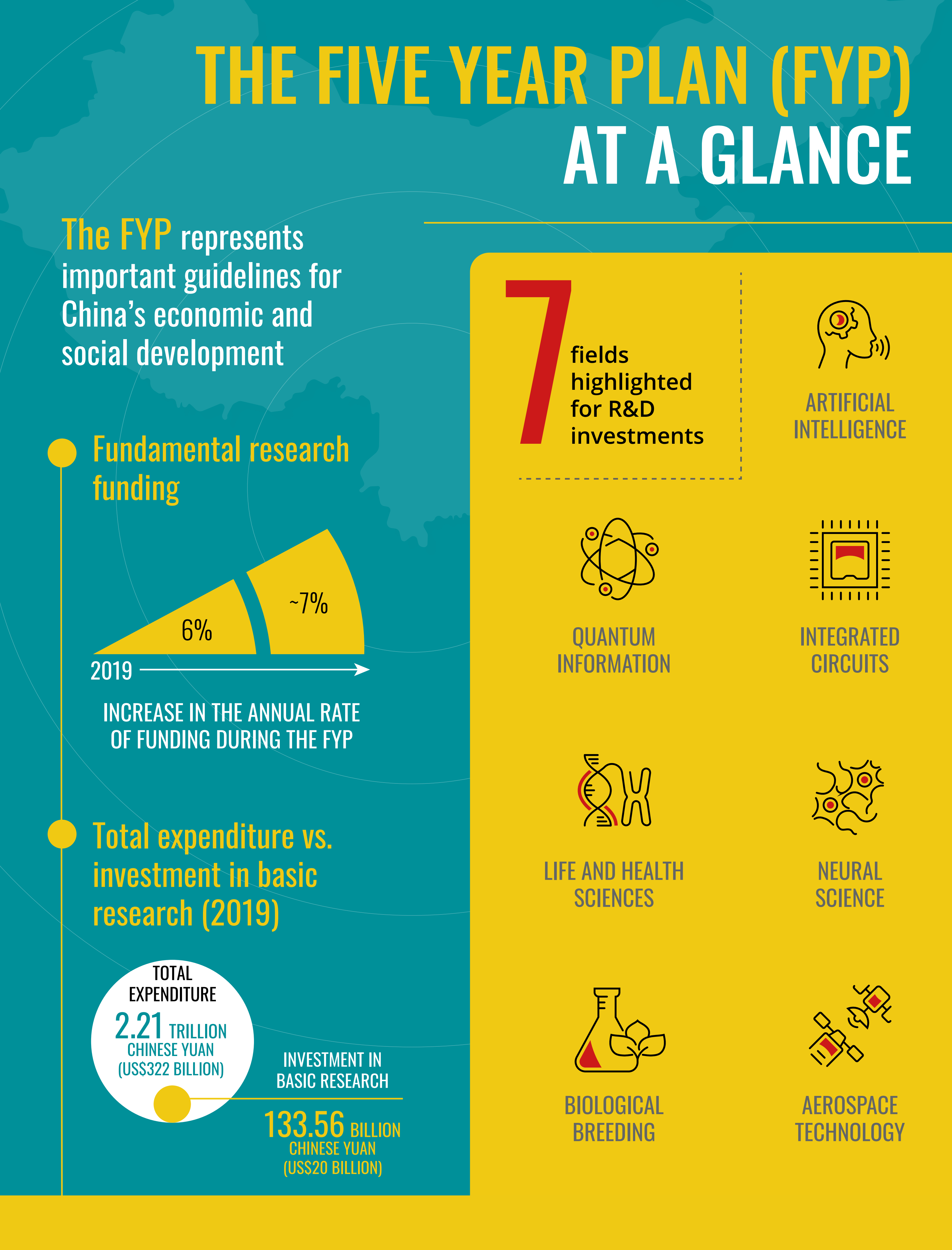
> *Basic research is the wellspring of scientific and technological innovation, so we will ensure the stable functioning of funding mechanisms for basic research and boost spending in this area by a considerable sum*

PREMIER LI KEQIANG

> *A 10% rise in government spending on fundamental science in 2021 would make it possible for scientists to study challenging topics without the pressure of having to deliver immediate results.*

PROFESSOR SONG HEFA,
Researcher at Chinese Academy of Sciences' Institute of Science and Development in Beijing

Figure 1: China's R&D trends

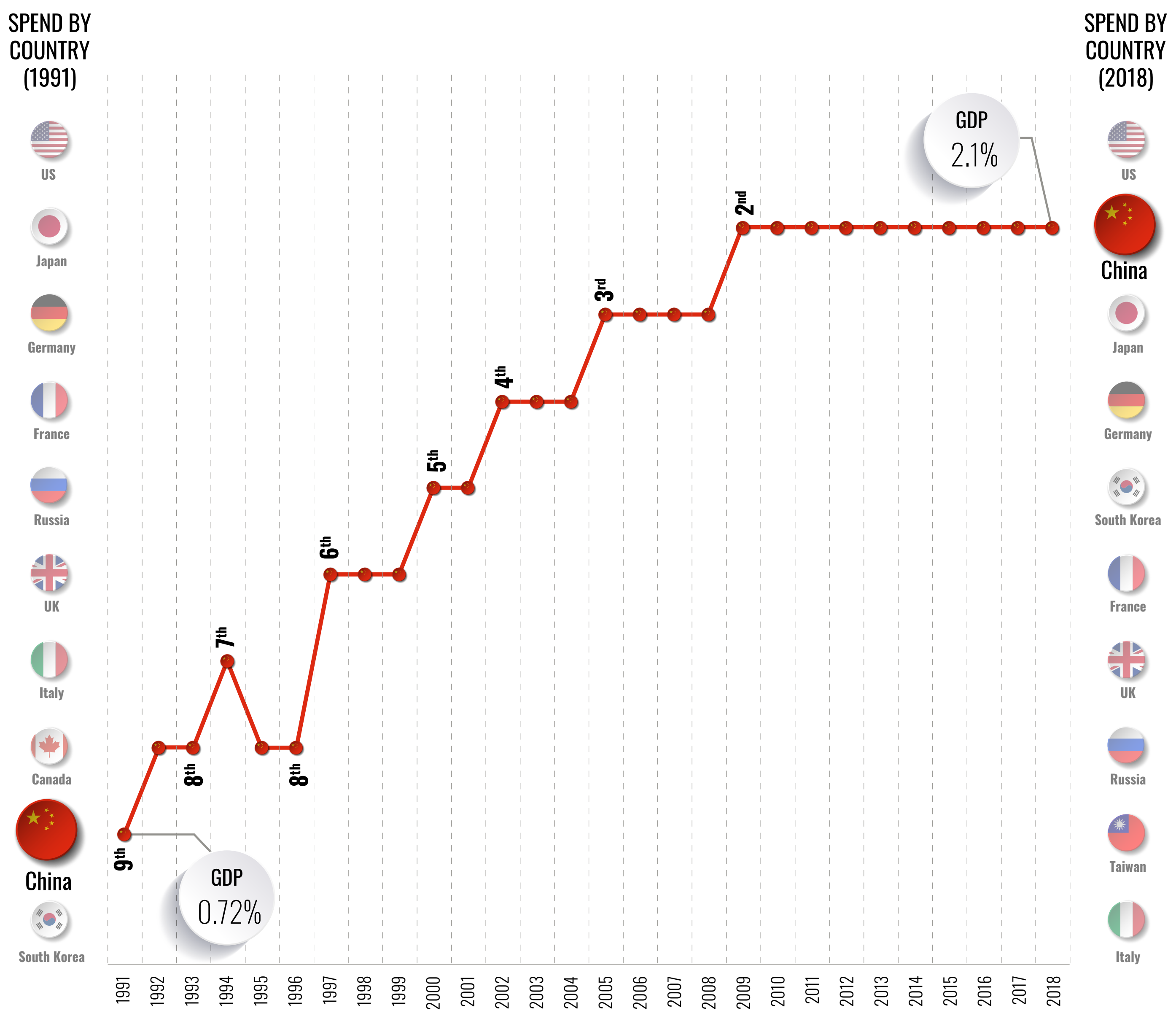


03.

EMERGENCE OF CHINA AS RESEARCH PUBLISHING SUPERPOWER

Based on figures from the Organisation for Economic Co-operation and Development (OECD), China's investment in R&D has leapt from just 0.72% of its GDP in 1991 to 2.1% of GDP in 2018. The figure rose further in 2019 when China narrowly missed the 2.5% target set in the 13FYP. Figure 2 shows the increase in China's R&D spend from ninth in the world to second in 2018.

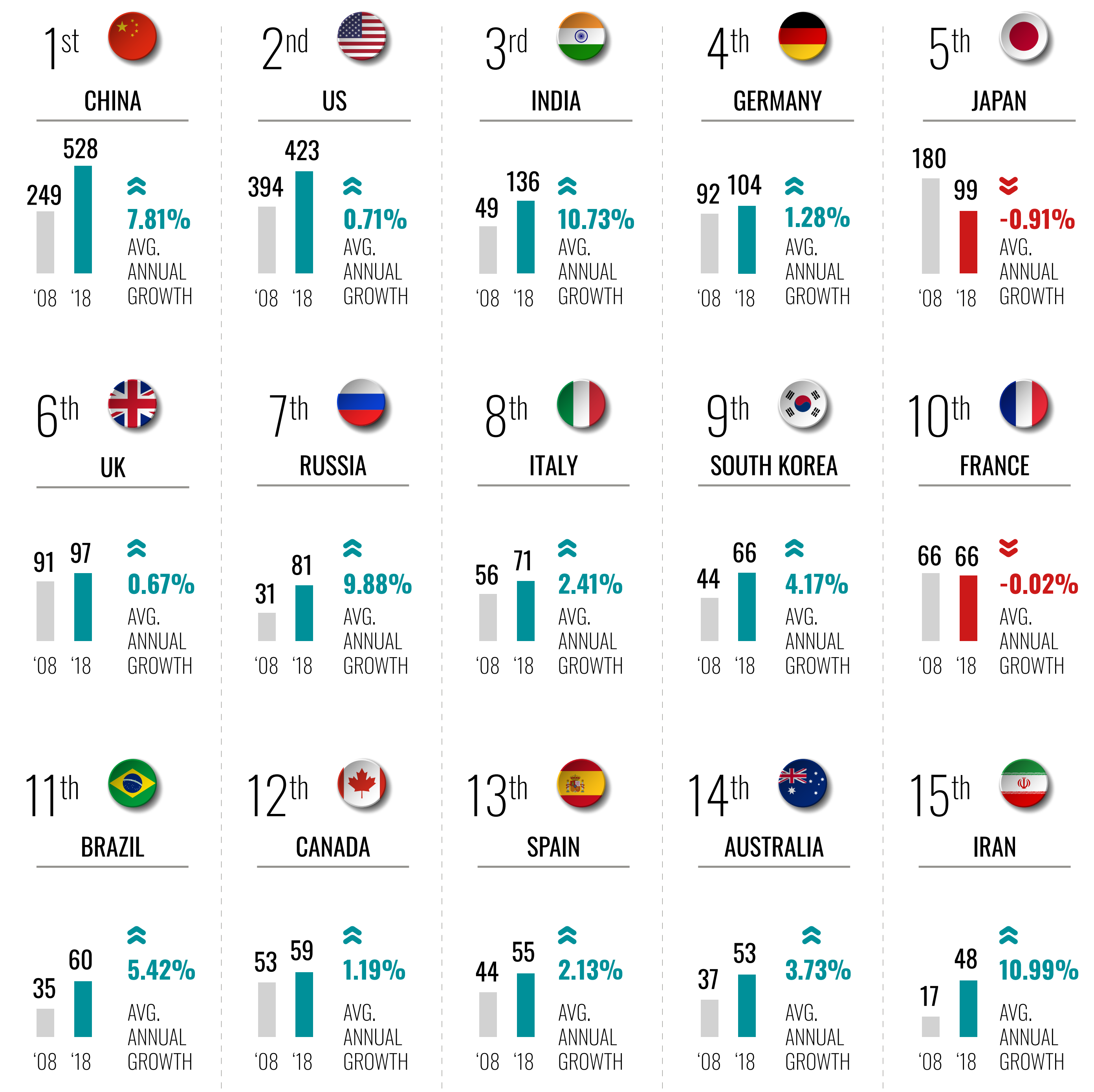
Figure 2: Top 10 countries with respect to R&D spending around the world (1991-2018)



Although the United States remains the top nation in terms of R&D, China is fast closing the gap and is now home to 1.87 million researchers, ~440K more than the US. National Science Foundation data from 2018 shows that China has already surpassed the US in science and engineering (S&E) journal articles and conference papers. Figure 3 shows China now generates 20.67% of world output, with the US at 16.54%.

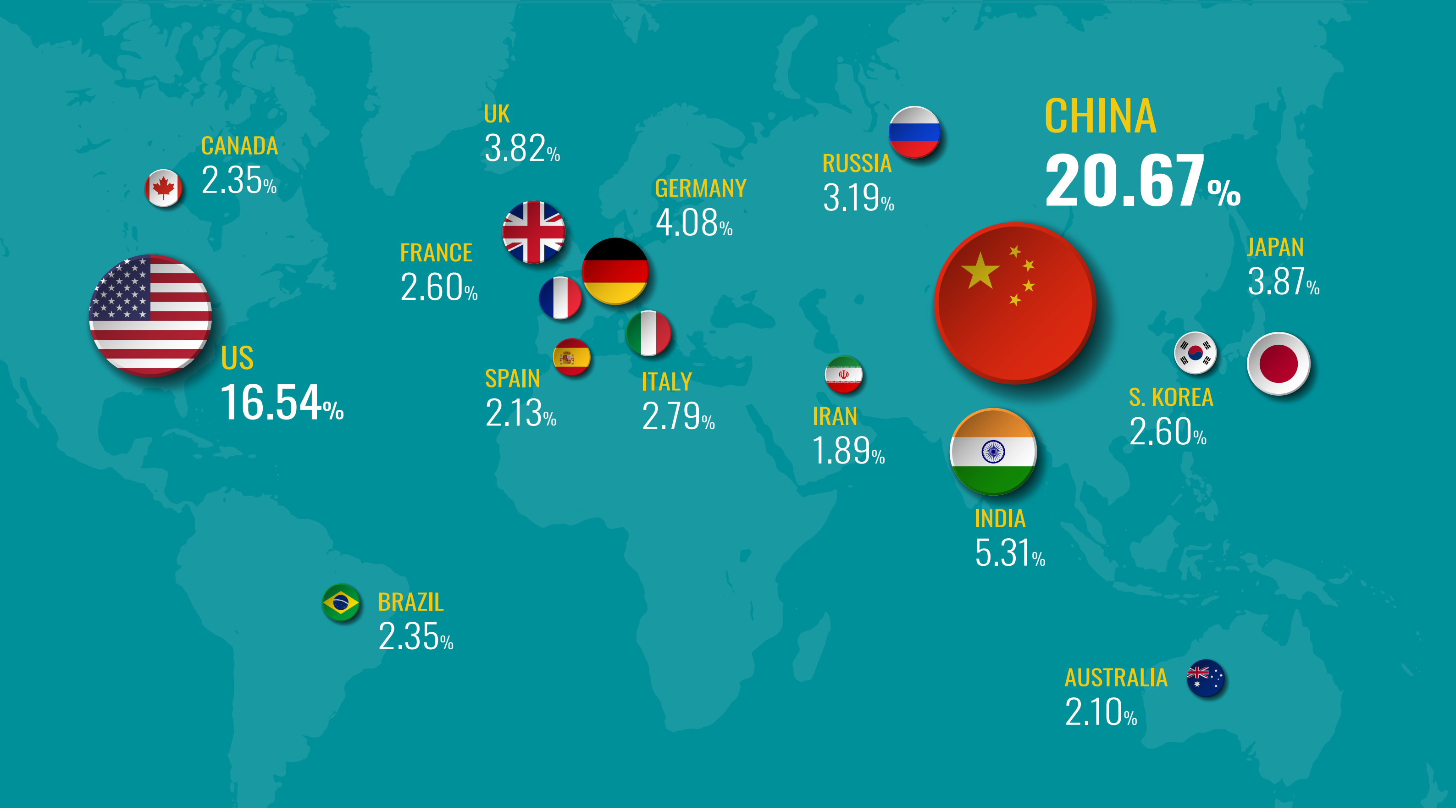
In absolute numbers, China and the US produced 528,263 and 422,808 articles, respectively. Between 2008 and 2018, China's average annual growth rate was 7.81%, versus the US at 0.71%. Although China has become the world's largest producer of scientific research articles, the US still outpaces China in the top 1% cited articles, with the US responsible for 29.3% and China, for 21.9%. 20.67% of world output, with the US at 16.54%.

Figure 3: S&E articles in all fields, for the fifteen largest producing regions, countries, or economies: 2008-2018 (No. in 000's)



(National Science Board | Science & Engineering Indicators | NSB-2020-6)

Figure 4: Percentage global split of production of S&E articles in all fields in 2018



In China, the largest number of publications based on field of science research are for engineering (25%), followed closely by health-related research (23%), then by computer and information sciences (13%) (Figure 5). Although China is behind the US, EU, Japan, and India for health-related research, it leads in Engineering.

Figure 5: The 2018 S&E research portfolio separated by the seven largest fields of science in the selected region, country, or economy

	US	EU	China	Japan	India
Health science and biological & biomedical sciences	47.95%	39.10%	22.96%	42.56%	24.41%
Engineering	12.84%	14.43%	25.47%	15.13%	17.56%
Computer and information sciences	7.66%	9.60%	13.24%	9.36%	18.41%
Physics	6.46%	8.39%	10.07%	12.87%	10.59%
Chemistry	3.56%	5.33%	9.61%	7.36%	8.46%
Materials sciences	1.30%	2.56%	6.48%	3.18%	9.32%
Social sciences	7.34%	6.86%	1.04%	1.45%	1.48%

(National Science Board | Science & Engineering Indicators | NSB-2020-6)

From 2000 to 2019, Beijing has spent roughly 80% of its funding on experimental development (China Power Team 2021). This spending allows quick adaptation by local manufacturers to the domestic market. Comparatively, other innovative countries like the US and Japan only devote just over 62% of R&D expenditure on experimental development research.

Basic and applied research is critical for increasing development of new scientific ideas and cutting-edge technologies. Unfortunately, China is lagging in this aspect, only averaging 5% of total R&D expenditure in basic research between 2000 and 2018. At the same time, R&D expenditure on applied research expenditure dropped from 17% to 11%. Therefore, Premier Li Keqiang's promise to boost spending on basic research in 14FYP generated considerable excitement, with its aim of driving China's scientific and technological innovation.

80%

R&D budget spent on experimental development research by Beijing
(~18% more than US and Japan)

04.

GOVERNANCE OF THE INNOVATION SYSTEM AND RESEARCH & INNOVATION FUNDING

The past 10-15 years have seen considerable central-level reforms to governance of the innovation system, as well as to research and innovation funding. Understanding the governance structure of research and innovation is critical. When policies are issued by the Central Committee of the Chinese Communist Party (CCPCC), the State Council is the highest-ranking governmental policy-making body responsible for co-ordination and implementation of said policies and state budget. As depicted in Figure 7, the governance structure of Chinese Science & Technology is centralized (Frietsch 2020).

Although the layout and relation between ministries have hardly changed over the years, their responsibilities and budget have. The funding system is constantly reviewed. Following the reappointment of Xi's administration in March 2018, the Ministry of Science and Technology (MOST) have been given even greater responsibilities. The National Natural Science Foundation (NSFC) and State Administration of Foreign Experts Affairs (SAFEA) are now under MOST jurisdiction. This reform is intended to set common rules and procedures for increasing efficiency and transparency.

Figure 6: The three reforms to set common rules and procedures for increasing efficiency and transparency

01

Identifying funding priorities and categories

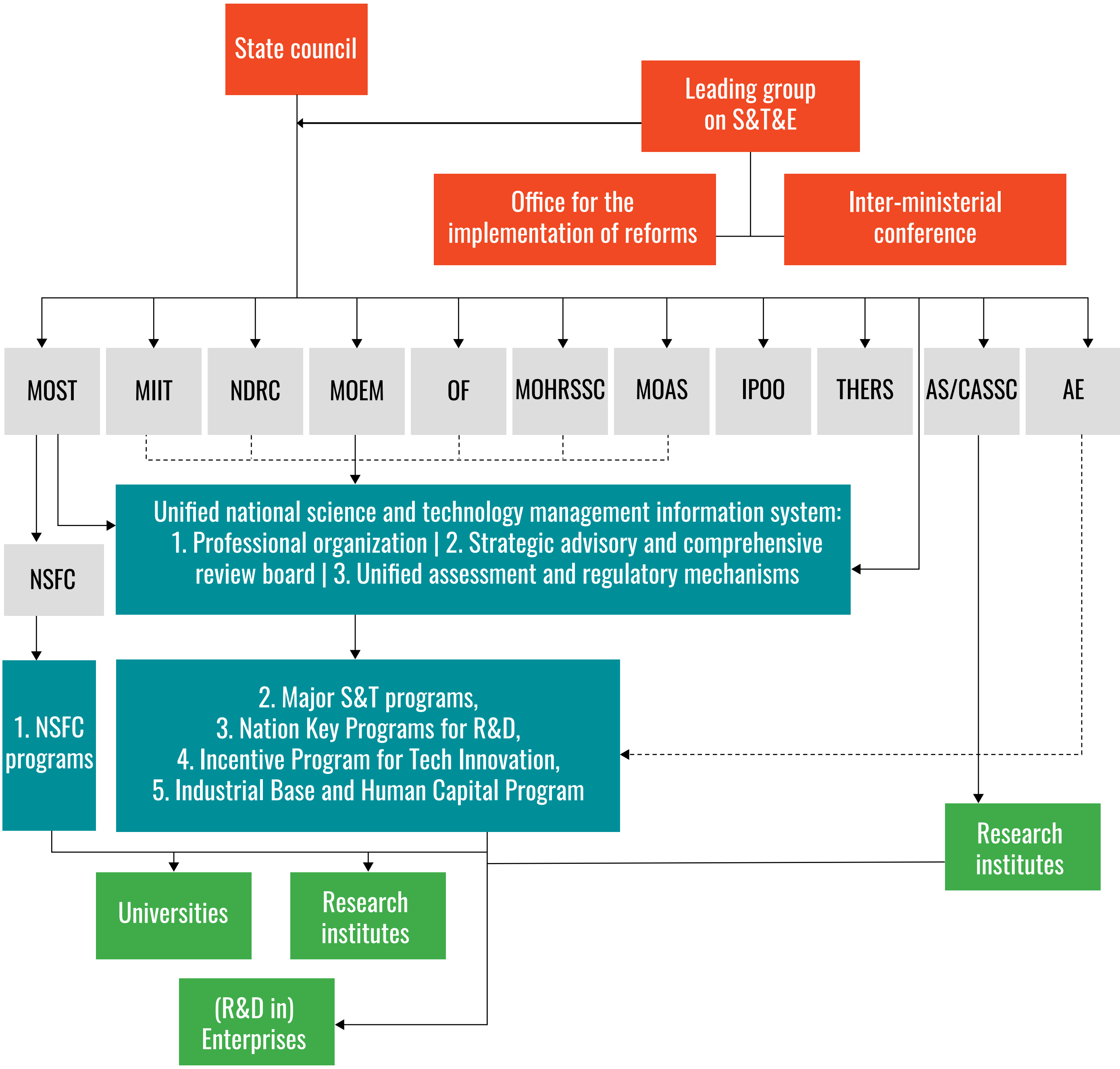
02

Improving evaluation mechanisms to guarantee timely support for original ideas based on scientific merit. The responsibility + credit + contribution (RCC) peer-review system was proposed

03

Optimizing the layout of research areas – this relates to their current disciplinary codes for application.

Figure 7: Layout of the science and innovation governance structure



NDRC: National Development and Reform Commission
MOF: Ministry of Finance
MOC: Ministry of Commerce
NSFC: National Natural Science Foundation of China
MOST: Ministry of Science and Technology
CAE: Chinese Academy of Engineering
CAS: Chinese Academy of Sciences
MOP: Ministry of Personnel
MOE: Ministry of Education

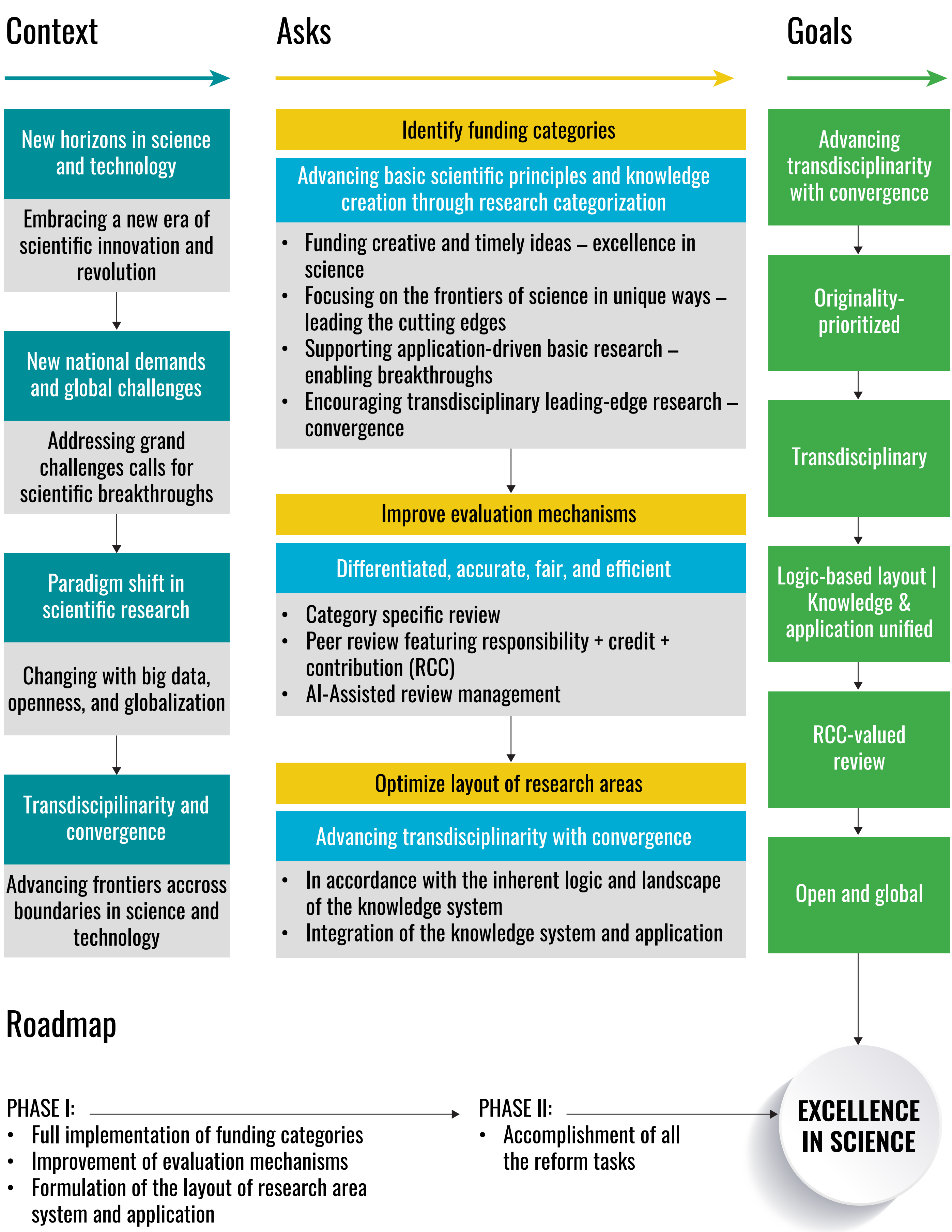
KEY

- Political level
- Program level (R&D funding allocation)
- Ministries and organization
- Research performers

Note: Figure from Current R&I Policy: The future development of China's R&I system)

The full interview, found here, will provide specifics on the three reforms. Highlights of NSFC reforms are as follows:

Figure 8: Highlights of NSFC's reform



05.

OPEN ACCESS IN CHINA

Open Access (OA) has been gaining in momentum in China. Publishing in this format grew more quickly than the average publication rate in China (2014-2018 CAGR: OA 18.51% vs. China average 12.04%).

An important milestone was when leading scientific institutions (i.e., Chinese Academy of Sciences [CAS], China's National Science Library, and the National Science and Technology Library) reaffirmed the importance of OA and joined the global OA2020 initiative. The major Chinese OA funders—namely CAS, MOST, and NSFC—have also established policies for self-archiving, green OA.

Figure 9: OA gaining in momentum in publication growth in China (2014-2018 CAGR)

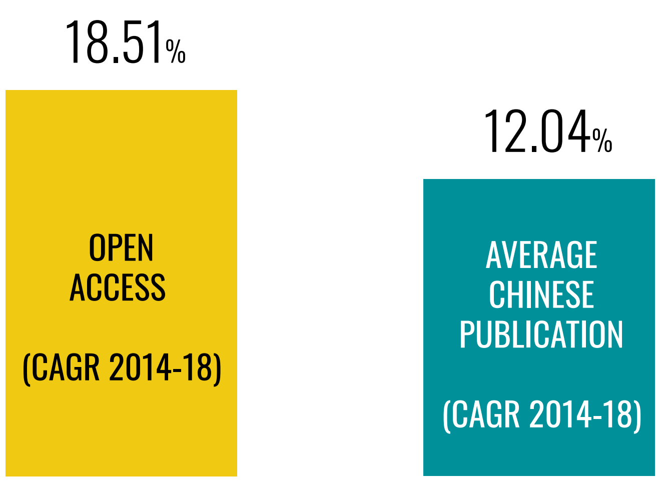
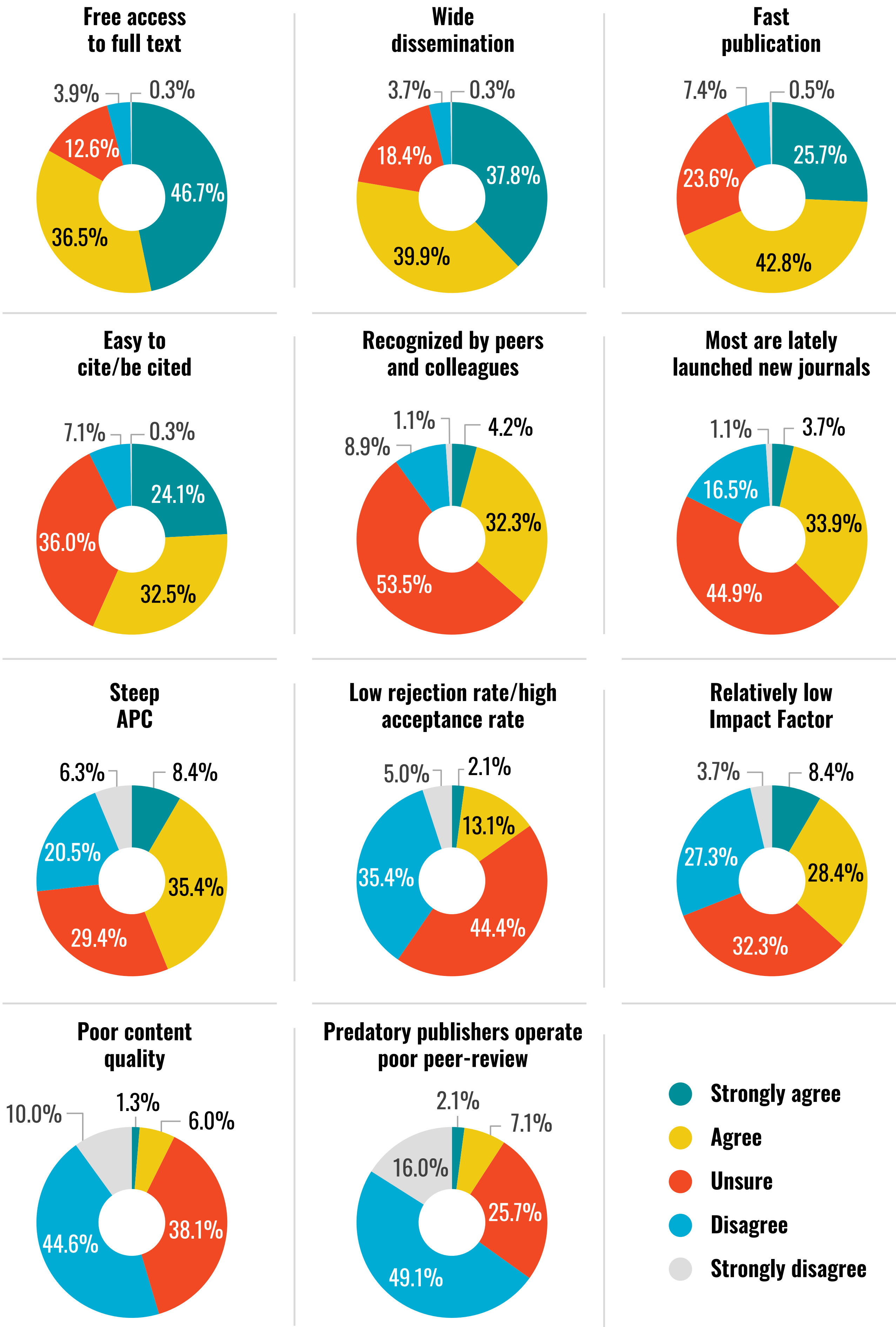


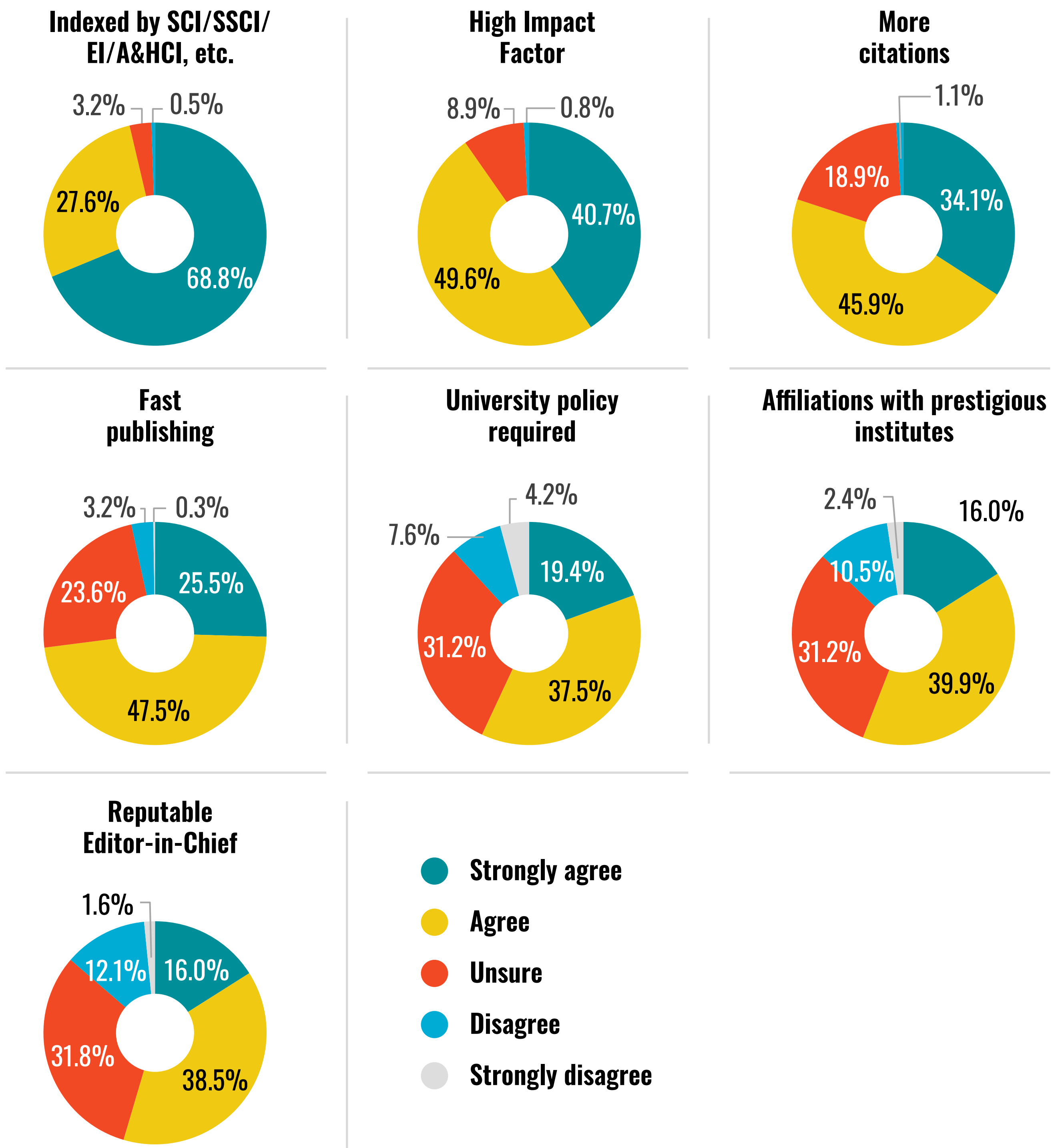
Figure 10: Chinese researchers' perceptions of OA journals



Initially, Chinese researchers had misunderstandings and distrust regarding OA (Xu et al. 2016). However, in the latest survey on Chinese researchers' perceptions and use of OA journals (OAJs) (Xu et al. 2020), a positive attitude towards OAJs was common, and three-fourths of scholars had published in OAJs. Chinese researchers now trust, read, and cite OAJs frequently.

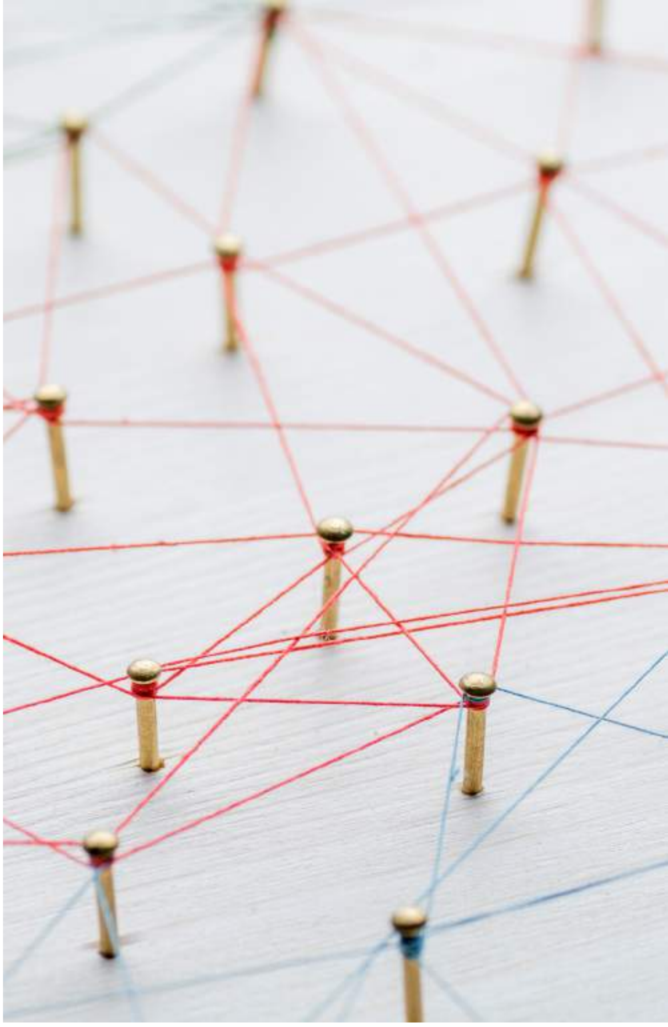
The survey found that most respondents do not think OAJs publish poor content quality or were predatory journals (Figure 10). Furthermore, the top three factors influencing the decision to publish in OAJ includes being indexed in databases such as SCI/SSCI/EI/A&HCI, journals with high impact factors and more citations (Figure 11).

Figure 11: Why do you publish in OAJs?



06.

COLLABORATION AND COMMUNITY



A study by the National Center for Science & Technology Evaluation and Clarivate Analytics revealed that China's international scientific collaboration has expanded gradually. In 2015, China's international collaborative publication increased by 4.4× compared with 2006, reaching 71,000 (18.6% of the international total in the same year).

Thus, China is actively integrating into the global scientific community. The percentage of China's collaborative publications in the international total was close to the percentage of China's overall publications in that total (Figure 12).

Figure 12: China's collaborative publications and overall publications as a percentage of the global total

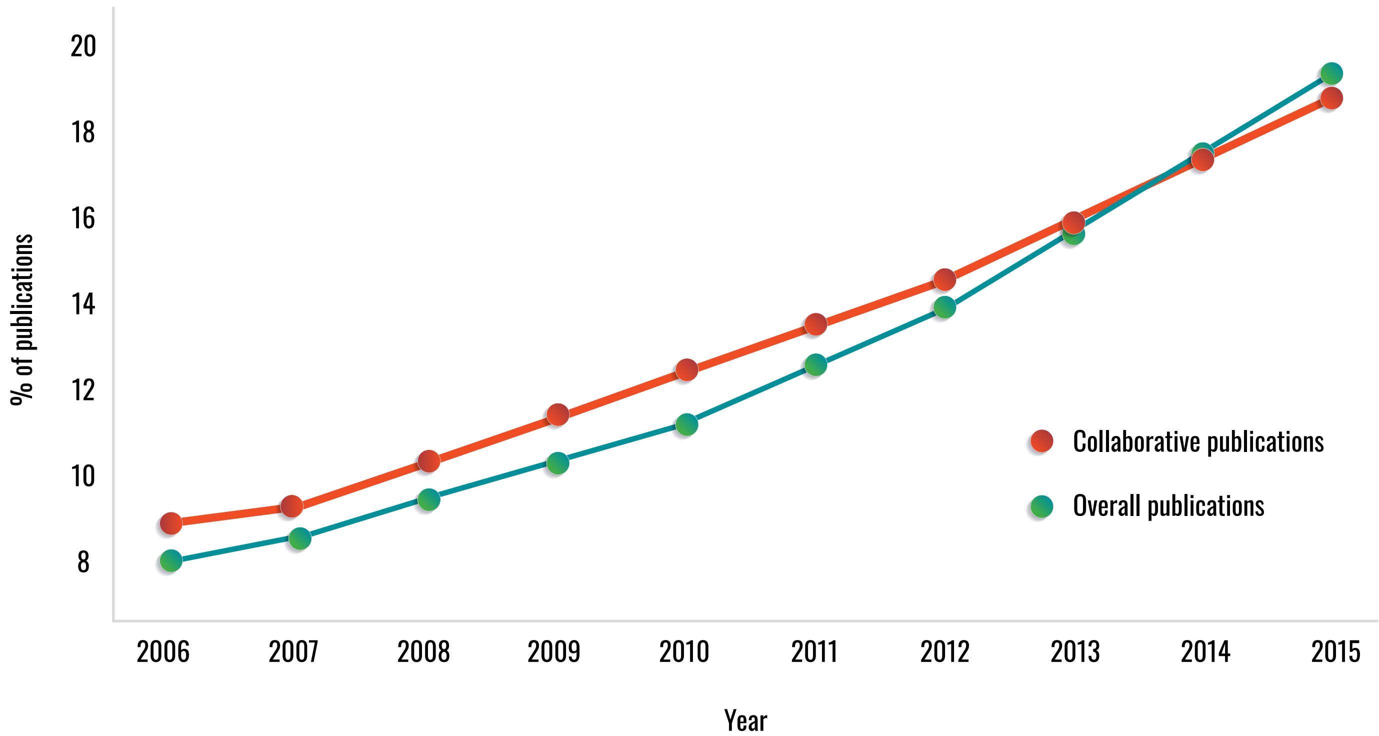
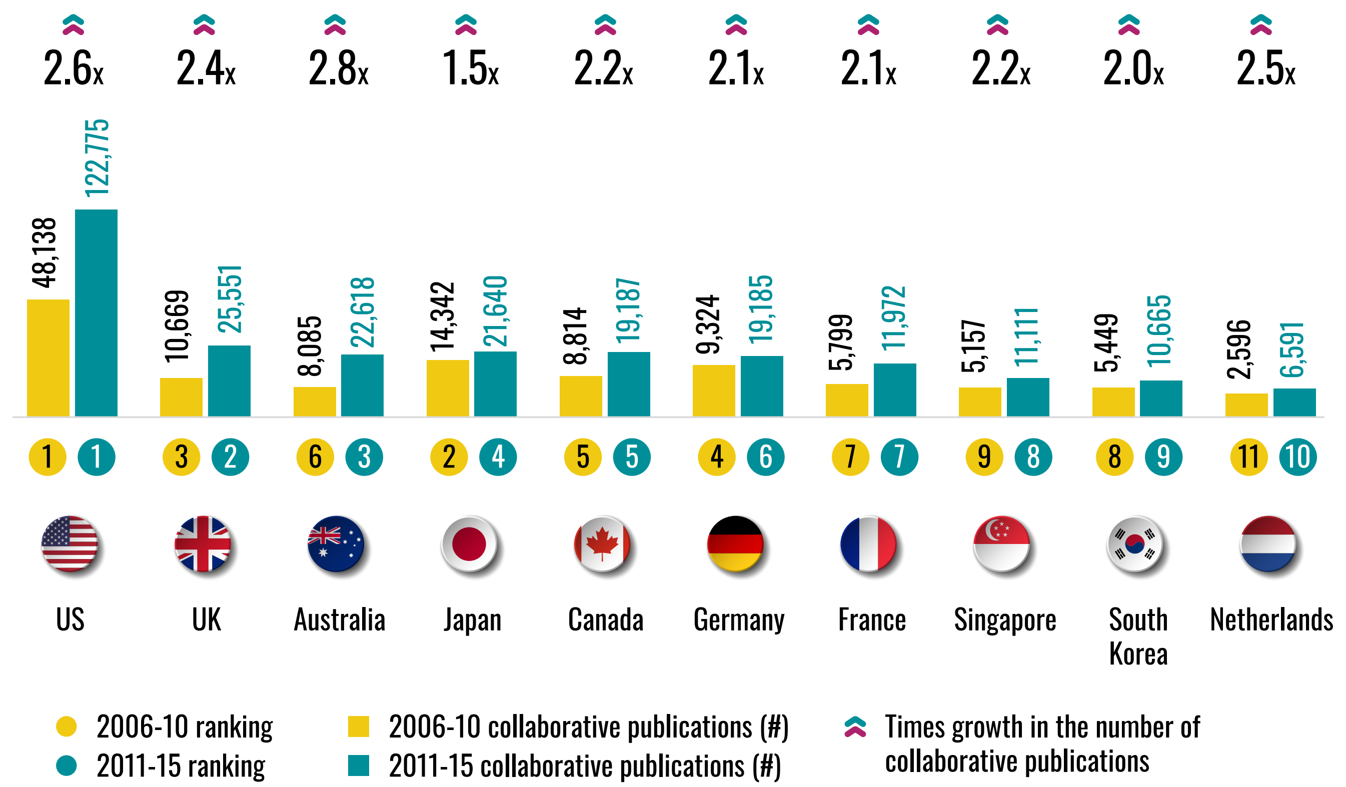


Figure 13 shows China's international collaborative publication with top 10 partner countries from 2006 to 2015. All had increased by a large margin, but the biggest collaborative publication growth for China during this period was with the US.

Figure 13: China's collaborative publications with its top ten partner countries during 11FYP and 12FYP



China's international collaborative publications have had a positive impact on its citations (Figure 14). Furthermore, the citation impact of China's publications with its top ten partners has improved from 2006-2010 (green line) vs 2011-2015 (orange line) (Figure 15).

Figure 14: Citation impact of China's collaborative publications and overall publications

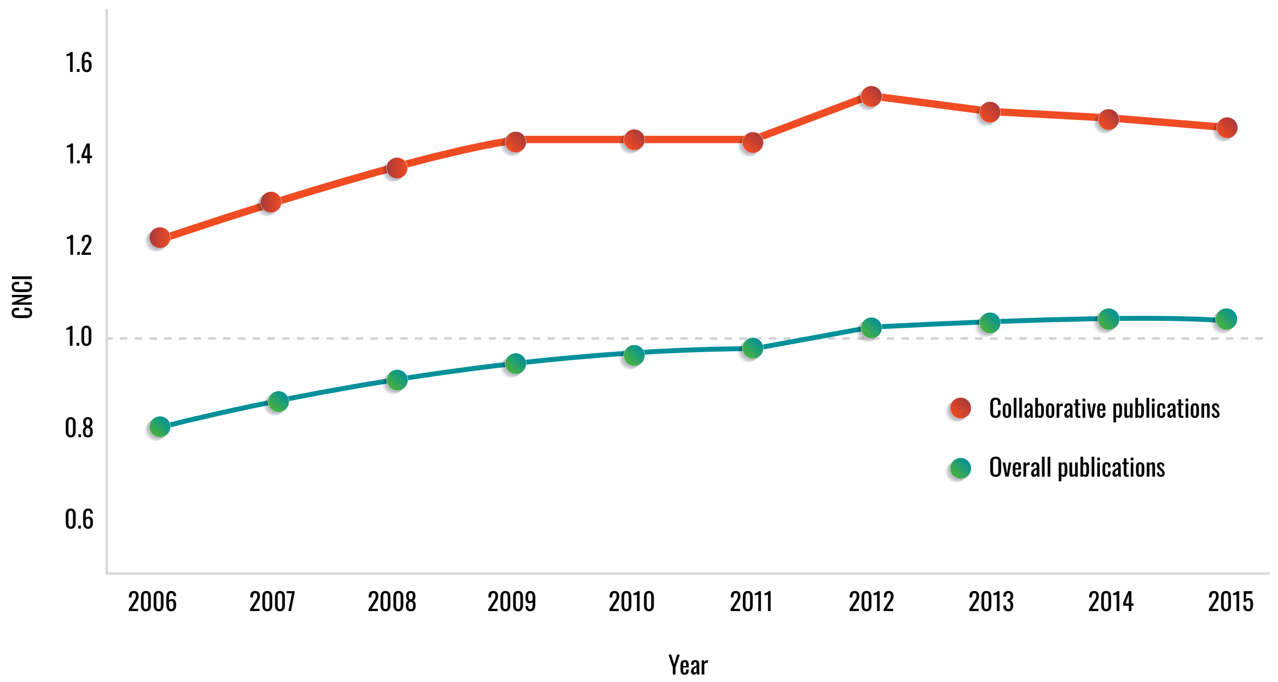
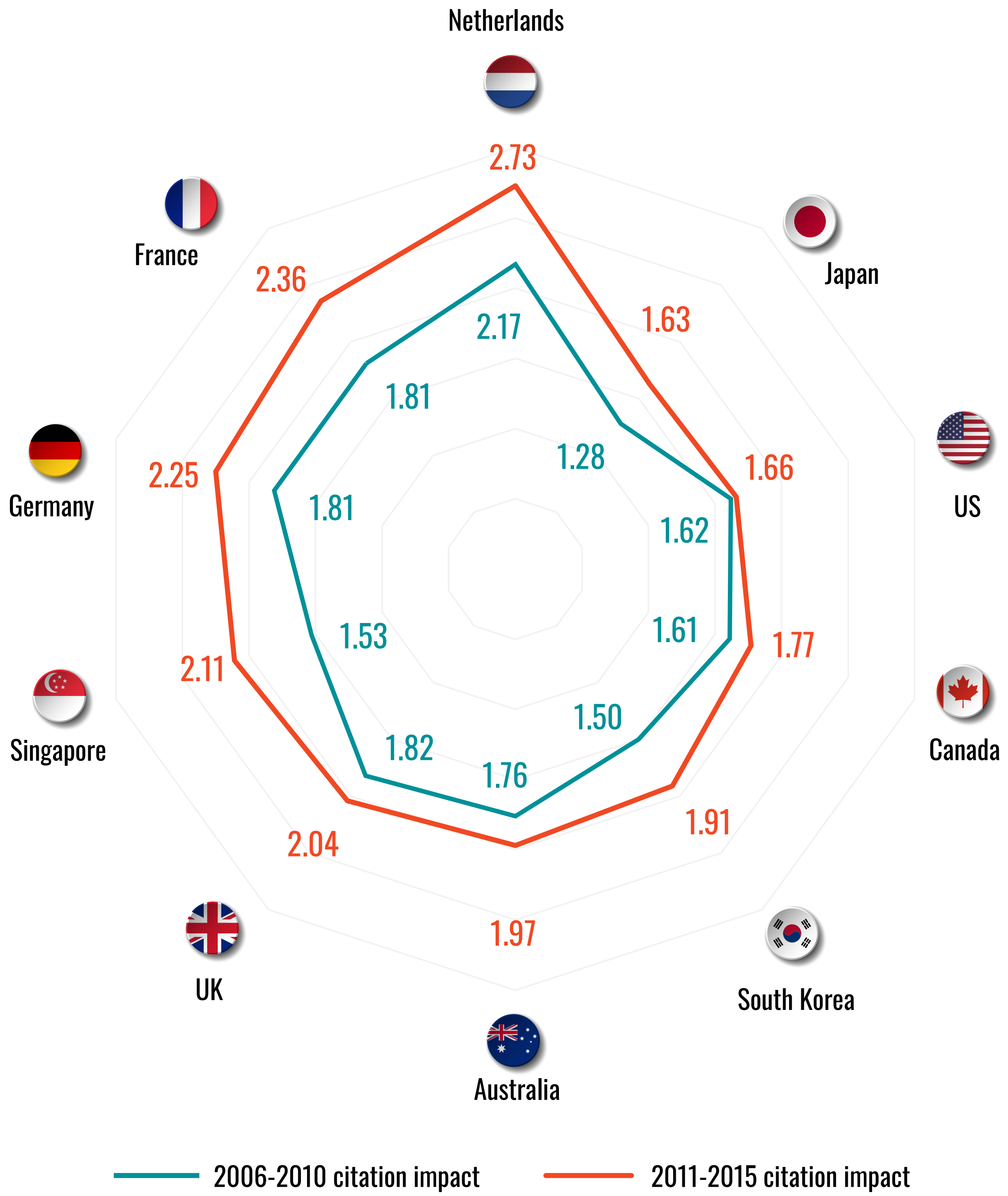


Figure 15: Citation impact of China's collaborative publications with its top ten partners



In the same study, of the top twenty international institutions with the most collaborative publications with China, the US takes up 50% (Figure 16). Publications were mainly focused on physics, chemistry, engineering, materials science, and clinical medicine.

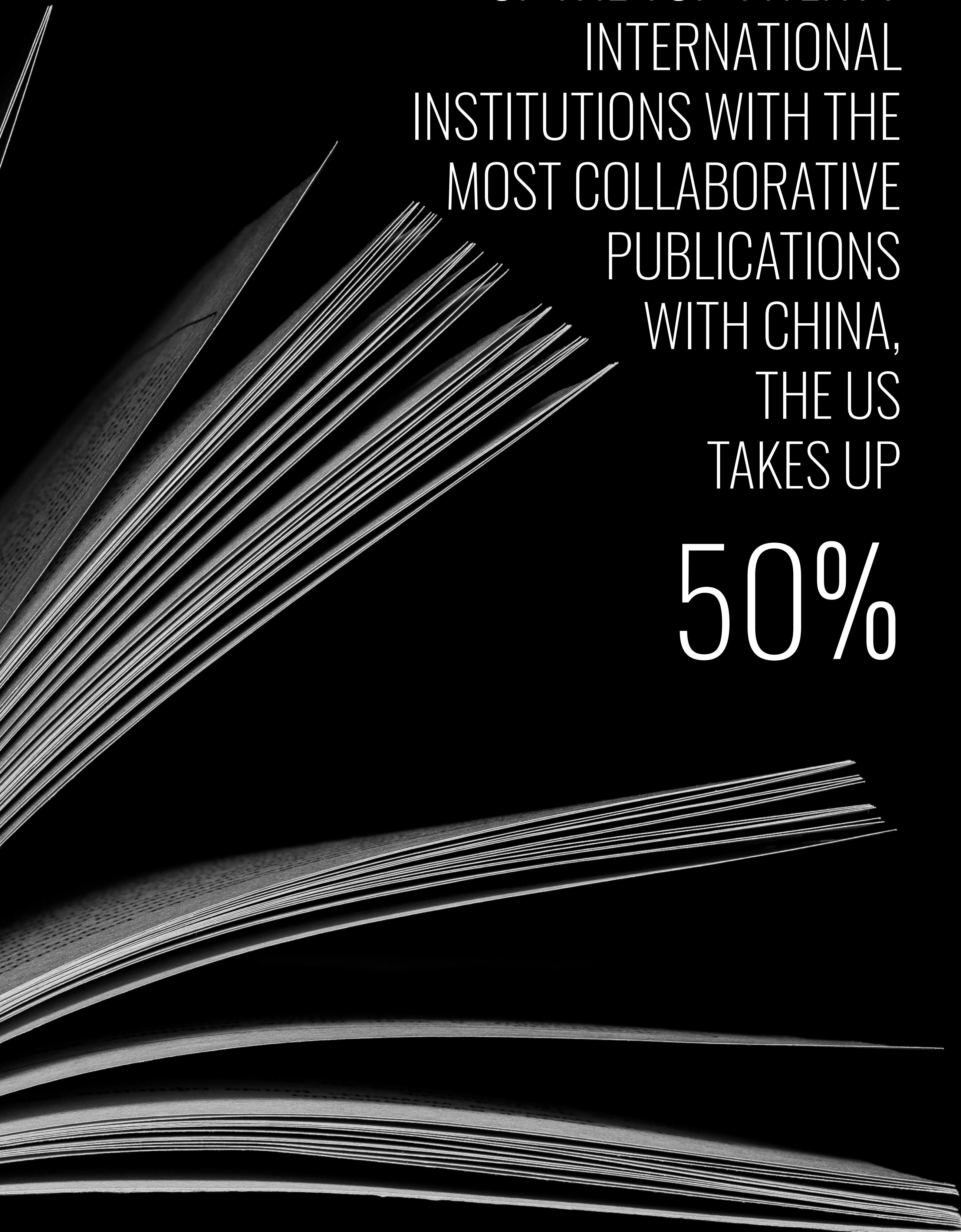
Despite geopolitical tension and nationalistic agendas during the COVID-19 pandemic, Jenny Lee and John Haupt found that cross-border scientific research between China and the US rose, especially in early 2020. The number of US-China COVID-19 collaborations was higher than pre-COVID-19 and non-COVID-19 articles. Reassuringly, scientists seem to be looking at a broader agenda, beyond the interests of nation states.

Figure 16: Publications co-authored by top twenty international collaborative partners and China

International institution	Country	No. of publications	Citation impact of collaborative publications	% of HCP among collaborative publications
CNRS	France	9,592	2.3	4.4
Institutions affiliated to DOE	US	9,013	2.9	6.3
National University of Singapore	Singapore	7,384	2.0	3.6
Nanyang Technological University	Singapore	6,993	2.0	4.1
Harvard University	US	6,631	3.0	5.6
Max Planck Society	Germany	5,656	2.8	6.3
University of Michigan	US	4,338	2.6	4.5
University of California Berkeley	Japan	4,230	2.7	4.9
University of Tokyo	US	4,201	3.4	7.0
Russian Academy of Sciences	Russia	4,120	2.8	5.5
Universitè Paris-Saclay	France	4,073	3.1	6.7
UCLA	US	3,993	2.7	5.2
The University of Chicago	US	3,828	3.4	6.9
The University of Sydney	Australia	3,559	2.7	4.1
University of Toronto	Canada	3,473	2.9	5.6
The Ohio State University	US	3,467	3.1	5.7
NIH	US	3,419	2.9	5.6
MIT	US	3,387	3.8	7.8
Tohoku University	Japan	3,371	1.7	2.5
The Pennsylvania State University	US	3,297	2.1	4.2

OF THE TOP TWENTY INTERNATIONAL INSTITUTIONS WITH THE MOST COLLABORATIVE PUBLICATIONS WITH CHINA, THE US TAKES UP

50%



07.

CHINA'S DIGITAL LANDSCAPE AND THEIR USER BEHAVIOR

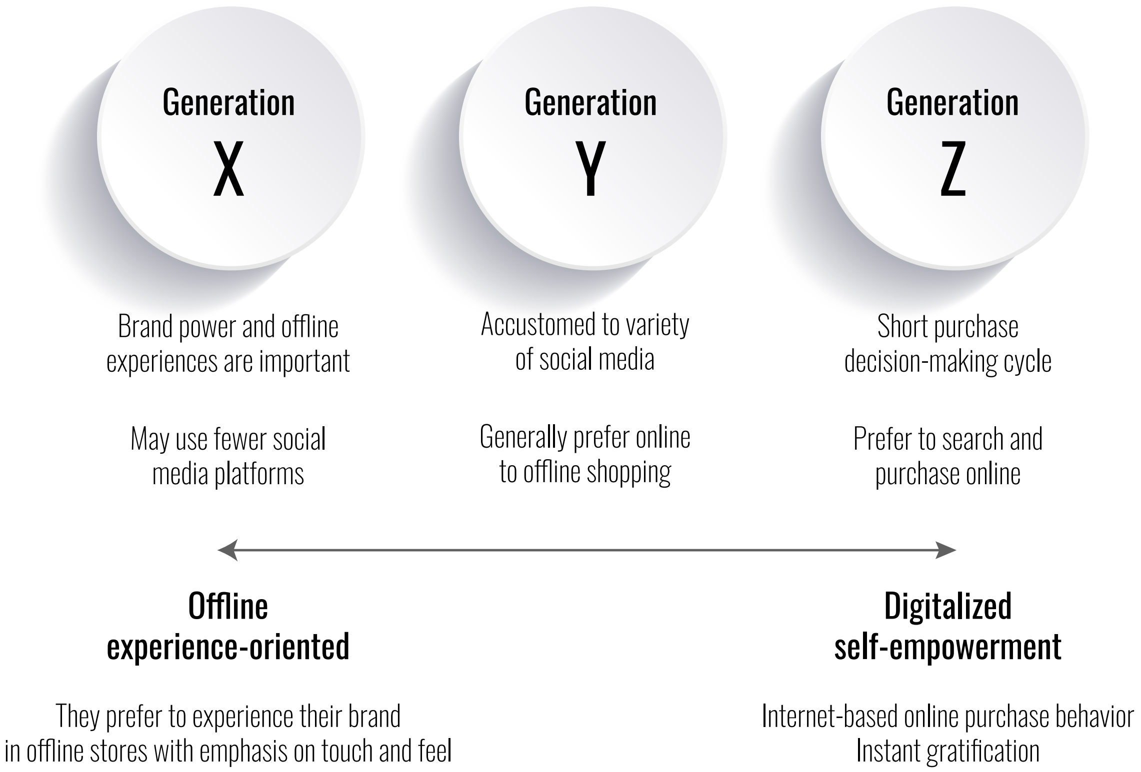
China is a digital market with over 70% of its ad spending in the digital space, and 80% of that is targeted at a mobile audience. The nation is truly mobile first, with 95% of citizens accessing internet via their smartphones. Most cannot live without their mobile phones because the various apps function as wallet, map, books, and other important tools. Previously, China had relatively lax regulation on data collection. However, Chinese netizens are increasingly standing up for their digital privacy. The Civil Code of the People's Republic of China that took effect in January 2021 is a major step toward a legal framework for governing individual data privacy. The forthcoming Personal Information Protection Law and Data Security Law is expected to address concerns with personal information, data breaches, data loss, or unauthorized use.

In addition, China has a growing number of internet platforms that are fast becoming more complex and multi-functional "Omni-media." These consist of various purposes including communication, search, networking, gaming, and purchasing. WeChat, QQ, Alipay, and Taobao are the most representative Omni-media platforms in China. In 2020, WeChat had 1.2 billion active users monthly; Weibo, 523 million; QQ, 660 million, Douyin, 800 million; and Alipay, 758 million. To remain competitive in China, brand building is critical. Most brands tend to use more social media platforms in China than in other countries. Therefore, significantly more content is required to support businesses in China, as local social media platforms are very robust. Figure 17 is an example of WeChat content in the food category:

Figure 17: Examples of marketing endeavors via WeChat accounts from companies in the food industry (Kantan CIC Intelligence)


CHINA IS TRULY MOBILE FIRST, WITH
95%
OF ITS CITIZENS ACCESSING THE INTERNET VIA THEIR SMARTPHONES

Figure 18: Generation view on purchasing behaviour



Across different generations, social behavior has shifted from offline interactions to online experiences. Interestingly, the younger generations also exhibit more trust in authorities, now that they have greater self-empowerment to find and share information.

This generic consumer behavior also provides a good representation of researcher behaviors. A study by Xu et al. on Chinese early-career researchers (ECRs) found that social media and online communities are more frequently used as supplementary channels for scholarly communication. The ECR segment is a majority constituent in Chinese scientific research. In a 2015 report by the China Association for Science and Technology, over 60 million (or 60%) of ECRs were thirty to forty years old.

Xu et al. showed that Chinese ECRs like to use WeChat to follow and disseminate scholarly content. They also access academic literature through ResearchGate. Table 8 shows changes in social media usage for scholarly communication among Chinese ECRs. Official WeChat accounts are useful to follow for the latest information in their fields, with some accounts provide academic writing tutoring, journal information, submission guidelines, and other assistance. Although social media is hugely popular with Chinese ECRs, they remain uncomfortable citing social media.

The same study also revealed that Chinese scholars use social media more widely than scholars in other countries. To Chinese ECRs, online scholarly networks lead to greater collaboration and connectivity, helping them build a reputation. Commonly used academic search engines include Google Scholar (accessed via proxy servers), Baidu Scholar, and Microsoft Academic.

Figure 19: Changes in social media usage for scholarly communication among Chinese ECRs

Social media platform	Reading 2016	Reading 2017	Disseminating 2016	Disseminating 2017	Networking 2016	Networking 2017
WeChat	8 (62%)	13 (93%)	1 (8%)	4 (29%)	13 (100%)	14 (100%)
QQ	10 (77%)	12 (86%)	2 (15%)	1 (7%)	12 (92%)	12 (86%)
新浪微博 weibo.com	6 (46%)	8 (57%)	1 (8%)	1 (7%)	8 (62%)	7 (50%)
facebook	5 (38%)	6 (43%)	1 (8%)	0 (0%)	8 (62%)	8 (57%)
LinkedIn	4 (31%)	9 (64%)	2 (15%)	1 (7%)	9 (69%)	8 (57%)
Twitter	2 (15%)	4 (29%)	0 (0%)	0 (0%)	2 (15%)	2 (14%)
YouTube	8 (62%)	10 (71%)	4 (31%)	6 (43%)	4 (31%)	9 (64%)
RESEARCH GATE	8 (62%)	10 (71%)	4 (31%)	6 (43%)	4 (31%)	9 (64%)
ACADEMIA	1 (8%)	2 (14%)	1 (8%)	1 (7%)	1 (8%)	1 (7%)
SCHOLARMATE	1 (8%)	1 (7%)	0 (0%)	0 (0%)	1 (8%)	0 (0%)

% (Total out of 13 for 2016) % (Total out of 14 for 2017)

08.

HOW MAY THE LATEST POLICY IMPACT CHINESE SCHOLARS' PUBLISHING BEHAVIOR?

Government policies heavily influence the behavior of Chinese scholars. In February 2020, MOST and the Ministry of Education published a two-policy document with the following objectives (Zhang and Sivertsen 2020):

- Restore "the scientific spirit, innovation quality, and service contribution" of research
- Promote the return of universities to their academic aims.

These new policies will likely change publishing behavior. In the past, researchers were often encouraged to publish in internationally indexed journals. Such publications became core indicators for research evaluation, career promotion, awards, university or disciplinary rankings, funding, and resource allocation. Even individual cash bonuses were offered. Unfortunately, over the years, this system has stifled innovation and given rise to research misconduct. Under the new policy, universities and research institutes are banned from setting publication quotas for researchers or providing financial incentives for publications. Additionally, the Science Citation Index (SCI) will not be used as the most important criteria when recruiting and promoting personnel, nor will SCI be used for university rankings.

This change will encourage the development and growth of Chinese journals. Although China is now the largest contributor to international journals, only around 200 of the 11,000 indexed journals in Web of Science are Chinese. Moving forward, if the individual scholar is in pursuit of a national grant or award, they can choose no more than five representative papers annually, and one-third must be published in Chinese journals. The official list of 285 high-quality Chinese scientific journals selected for the "Action Plan for Excellence of Chinese STM Journals" is found here. Currently, more than 60% of these journals are published in English. Interestingly, in a statistical review by Christos Petrou, founder and Chief Analyst at Scholarly intelligence, the new policy may impact the OA industry first, because almost 30% of the OA science journals have originated from researchers affiliated with Chinese institutions.

09.

CONCLUSION

China is an exciting and complex market. China's historical record has allowed the world to experience and see its growth trajectory. In an interview, Donald Samulack, Head of Global Stakeholder Engagement at Cactus Communications, and Lyndsey Dixon, Editorial Director of APAC Journals at Taylor & Francis Group, praised the phenomenal work ethic and efficiency of the Chinese government. Only China could build a hospital in six days, as seen during the Covid-19 pandemic.

Therefore, to succeed in the world of academic publishing in China, a local presence is important, whether that is direct or via a partner. Being on the ground enables the publisher to be homed in on new FYP policies related to ministerial reforms and cultural issues, or better understand nuances that are uniquely Chinese. Proactively engaging with the Chinese research community enables the publisher to build relationships (or guanxi) and deepening this trust will enable publishers to form suitable connections, build a strong editorial board, and attract the desired authors.

With the dominance of internet platforms in China, a digital and mobile first strategy will be required for all publishers to launch and build their brand in the Chinese research community. As global social media platforms are only available through proxy servers, publishers will need to be well versed in both global and local social media platforms. Whether targeting the general consumer or the academic audience, running a campaign on WeChat or Weibo is vastly different from global social media platforms. Chinese researchers engage in both platforms due to their need for international and local connections.

10.

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