The impact of Economic Sanctions towards China-US Scientific Collaboration: Evidence from the Civil Universities in the Entity List

Chao Lu[1] and Chengrui Xiao[1]

[1] Hohai University, Nanjing Jiangsu, 211100, China
xiaochengrui2005@126.com

Abstract. China and the United States have enjoyed a long period of scientific collaboration. However, the economic sanctions imposed by the U.S. government on China since 2018 appear to have disrupted this productive relationship. This study examines the potential impact of these sanctions on China-U.S. scientific collaboration, using the seven civilian universities, commonly referred to as SSND, as a case study. Drawing on scientific publication data from the Web of Science spanning more than 20 years, we assess how political tensions may have affected collaboration among individual researchers in both countries. Preliminary analysis of over 300,000 records suggests that, following China's entry into the World Trade Organization (WTO) and especially around the time of the 2008 Beijing Olympics, SSND universities formed increasingly strong partnerships with U.S. institutions, benefiting researchers in both nations. However, after the U.S. government issued the Entity List to restrict trade with Chinese companies and even civilian universities, SSND institutions—representative of many Chinese universities affected by the sanctions—showed a significant decline in collaborations with U.S. affiliations. Instead, they shifted toward partnerships with domestic organizations and institutions in other countries. From a publication output perspective, these sanctions have negatively impacted not only Chinese researchers but also their close American collaborators.

Keywords: Scientific collaboration, China-U.S. collaboration, Economic sanction

1 Introduction

Since the initiation of negotiations for China's entry into the World Trade Organization (WTO), the world has gained greater insight into China and its people. The 2008 Beijing Olympic Games provided a unique opportunity for global engagement with China, fostering face-to-face communication and mutual understanding. During this period, China and the United States established a strong foundation of mutual trust across various areas of cooperation, including scientific collaboration. The China Scholarship Council facilitated the exchange of students and academics between China, the U.S., and other countries, leading to significant progress in international scientific knowledge

production and the development of close partnerships through scholarly communication. However, this period of productive collaboration did not last indefinitely. In the final years of the Obama administration, the U.S. government became increasingly aware of China's growing economic strength and its potential challenge to the U.S.'s leading position in the global economy. In response, the succeeding administration implemented a series of sanctions aimed at restricting the export of high-tech products to China. An increasing number of Chinese companies, as well as several top civilian universities, were added to the U.S. Entity List. Among these were the so-called Seven Sons of National Defense (SSND), a group of prominent Chinese universities. As a result, growing numbers of students and faculty from these institutions were denied U.S. visas, leading to a significant cooling of scientific collaboration between the two countries.

In the domain of Library and Information Domain, related studies on international scientific collaboration usually focus on the strength [1], evolving trends [1-3], benefits [4], and metrics [5] of international scientific collaborations. However, international scientific collaboration is influenced by a variety of factors [6], including political factors [7].

This study is to understand the scientific collaboration between China and US, by taking the SSND universities as an example, in the past nearly 20 years. We want to know that how the economic sanctions as political actions shape the collaborating behaviors between Chinese and American scholars in scientific knowledge production. This study will help shed light on impact of politics on academic activities. It will help policymakers to cultivate better environment for sciences and scientific collaborations around the world.

2 Methodology

In this section, we will present the research questions guiding this study, describe the dataset we collected, and outline the data processing procedures.

2.1 Research Question

To address the identified gap, we have broken down the research question into the following components:

RQ1: What has been the overall trend in SSND-U.S. scientific collaboration over the past 20 years?

RQ2: How have the economic sanctions imposed by the U.S. government on China affected SSND-U.S. scientific collaborations, in comparison to collaborations with other countries or regions?

RQ3: How have scientists from SSND and the U.S. responded to these sanctions in terms of their scientific collaborations?

2.2 Data

Data Source. To address the research questions outlined above, we collected publication data by the SSND universities using the Web of Science Core Collection. The search query used is presented in Fig. 1. We focused exclusively on the SCI and SSCI

indexes, as these are the most commonly used metrics for evaluating scientific performance in Chinese universities. In total, we gathered metadata for 361,573 publications, including their references, authored by researchers from the seven SSND universities.

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(OO=( Beihang University OR Beijing Institute of Technology
        OR Harbin Engineering University OR Harbin Institute of Technology
        OR Nanjing University of Aeronautics and Astronautics
        OR Nanjing University of Aeronautics & Astronautics
        OR Nanjing University of Science and Technology
        OR Nanjing University of Science & Technology
        OR Northwestern Polytechnical University)
 OR OG=( Beihang University OR Beijing Institute of Technology
        OR Harbin Engineering University OR Harbin Institute of Technology
        OR Nanjing University of Aeronautics & Astronautics
        OR Nanjing University of Science & Technology
        OR Northwestern Polytechnical University)
 OR AD=( Beihang University OR Beijing Institute of Technology
        OR Harbin Engineering University OR Harbin Institute of Technology
        OR Nanjing University of Aeronautics & Astronautics
        OR Nanjing University of Aeronautics and Astronautics
        OR Nanjing University of Science & Technology
        OR Nanjing University of Science and Technology
        OR Northwestern Polytechnical University))
AND (DOP=(1998-01-01/2023-12-31)) AND (EDN==("WOS.SCI" OR "WOS.SSCI"))
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Fig. 1. Search query used in this study for data collection from Web of Science

2.3 Methods

Data Processing

Identifying Collaborative Publications. After excluding single-author articles and those published before 2024, we identified 350,686 collaborative publications. The yearly distribution of these publications is presented in Fig. 2.

Leading Country Classification. In China, publications where scholars are listed as the first author and their affiliation is listed first are typically prioritized in scientific performance evaluations, including for funding applications, tenure-track evaluations, and academic promotions. Based on this, we classified the collaborative publications into three categories: 330,656 collaborations led by China, 4,827 led by the U.S., and 15,203 led by scholars from 113 other countries or regions.

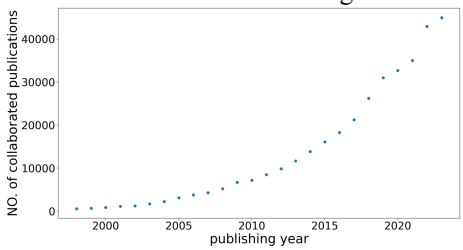

Fig. 2. Yearly distribution of collaborated publications with the SSND universities.

SSND-U.S. Collaborations. In this study, we are particularly focused on collaborations between China and the United States, using SSND universities as a case study. Thus, we concentrate on the publications from the first two categories of our classification, which consist of 335,483 records. In the first category, 249,151 publications were led by SSND universities, while the remaining 81,505 collaborations were led by other Chinese institutions in partnership with SSND universities. In the second category, we found 42 publications that lacked affiliation information for SSND universities, leaving

4,827 publications led by U.S. institutions in collaboration with SSND universities. Therefore, our final dataset comprises 253,978 publications from the Web of Science.

3 Preliminary Findings

3.1 Overview

Based on the data presented in Fig. 2, it is evident that since China's entry into the WTO, SSND universities have progressively increased their participation in international scientific collaborations, as reflected in their journal publications. This upward trend continued even during the COVID-19 pandemic (2020–2022), with a notable peak in collaboration during this challenging period. Therefore, we can conclude that SSND universities have steadily contributed to international journal publications since China's accession to the WTO. This provides a solid foundation for analyzing the scientific collaboration between China and the United States through the lens of the SSND universities.

3.2 Scientific Collaborations Led by SSND

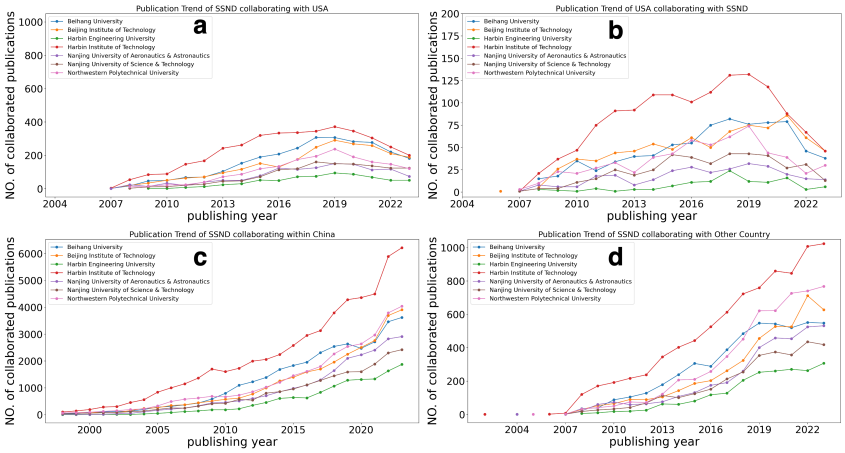

Fig. 3. Scientific collaborations by the SSND universities

To fully understand the scientific collaboration between SSND universities and U.S. institutions, we categorized the data into four groups: (1) scientific collaborations led by SSND universities with American organizations, (2) scientific collaborations led by American organizations with SSND universities, (3) scientific collaborations led by SSND universities with other Chinese institutions, and (4) scientific collaborations led by SSND universities with institutions from other countries and regions, such as France and Russia.

Scientific collaborations led by SSND universities with American organizations (Fig. 2(a)). The data in Fig. 3(a) shows that SSND universities began collaborating with American institutions in 2007—six years after China joined the WTO and just before the 2008 Beijing Olympic Games. Harbin Engineering University, a leading institution in China, was the first SSND university to establish collaborations with U.S. institutions, followed by the other SSND universities. From 2007 to 2019, these collaborations demonstrated steady growth. However, after 2019, there was a noticeable decline in SSND-U.S. collaborations. This decline aligns with political changes, as the Trump administration began imposing tariffs and trade barriers on China in 2018. In May 2019, Harbin Engineering University and Harbin Institute of Technology were added to the U.S. Entity List, and by the end of 2020, all SSND universities were included. This sharp drop in collaboration reflects the significant impact of these political shifts on China-U.S. scientific partnerships.

Scientific collaborations led by American organizations with SSND universities (Fig. 2(b)). Fig. 2(b) shows a trend similar to that in Fig. 2(a) for scientific collaborations led by U.S. institutions with SSND universities. These collaborations also began in 2007 and saw nearly a decade of steady growth before declining sharply in 2019. However, a major difference between the two groups is the scale: collaborations led by SSND universities far outnumber those led by U.S. institutions (203,112 vs. 4,407). This disparity may be due to differences in research practices and incentive policies in the two countries. In the U.S., researchers are often politically encouraged to collaborate with colleagues from other institutions, and co-authors are frequently acknowledged for their contributions, regardless of who leads the publication. Despite these differences fostering a mutually beneficial relationship, the situation appears to have dimmed in recent years.

Scientific collaborations led by SSND universities with other Chinese institutions (Fig. 2(c)). The data shows that SSND universities began collaborating with other Chinese institutions to publish in SCI/SSCI-indexed international journals at the start of the 21st century, several years before initiating collaborations with U.S. institutions. The publication rate for SSND universities continued to grow consistently, reaching a peak in 2023. Notably, during the COVID-19 pandemic, scientific collaborations within China were not disrupted but rather intensified, as evidenced by a sharp increase in collaborative publications in 2022. This surge might be attributed to the effects of the pandemic lockdown and the U.S. sanctions, which likely prompted Chinese universities to increase their domestic collaborations and publication output [8].

Scientific collaborations led by SSND universities with institutions in other countries and regions (Fig. 2(d)). The trend for collaborations between SSND universities and institutions in other countries (e.g., France, Russia) mirrors that of collaborations within China (Fig. 2(c)). These collaborations also began at the start of the 21st century, showing stable and steady growth by 2007, just before the Beijing Olympics, and continuing through 2023. U.S. sanctions did not appear to significantly affect SSND collaborations with other countries. Some institutions, such as Harbin Engineering University, even saw a marked increase in their collaborations with foreign partners. The trends in Fig. 2(c) and 2(d) suggest that while China-U.S. collaborations were minimally impacted by the COVID-19 pandemic, the U.S. sanctions had a significant effect,

pushing the SSND universities to strengthen their collaborations with other Chinese institutions and foreign partners.

4 Conclusions

China and the US enjoyed a long period of scientific collaboration with each other, creating a win-win situation for the researchers from both countries. However, since 2018, U.S. economic sanctions on China have seemingly disrupted this productive exchange. To investigate the potential impact of these sanctions on China-U.S. scientific collaboration, this study examines the collaborative relationship between China and the U.S. over the past two decades, using seven Chinese civilian universities, collectively known as SSND, as a case study. The aim is to understand how political actions might adversely affect scientific collaboration for individual researchers from both nations.

Preliminary findings indicate that since China's entry into the WTO, particularly around the time of the Beijing Olympic Games, SSND universities have developed a steady and expanding partnership in scientific research, benefiting researchers on both sides. However, with the issuance of the U.S. Entity List, which restricted trade with Chinese companies and institutions, including SSND universities—there has been a significant decline in collaborations with American affiliates. Instead, SSND universities have increasingly turned to partnerships with other Chinese organizations and international entities. From a publishing perspective, these economic sanctions have not only affected Chinese researchers but also their American collaborators. The preliminary results suggest that political actions have a tangible impact on scientific endeavors, and irrational policies can significantly hinder scientific progress. This study underscores the need for policymakers to foster a more conducive environment for global scientific collaboration.

This preliminary study has some limitations and areas for further investigation. First, we have not yet quantified the causal effects of the economic sanctions on China-U.S. scientific collaborations. Future work will address this aspect. Second, our current analysis focuses solely on the quantity of scientific collaborations between China and the U.S. Subsequent research will explore how sanctions affect the quality of these collaborations and their impact on scientific innovation in both countries, aiming to provide additional political insights.

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