



Origins, motives, and challenges in Western–Chinese research collaborations amid recent geopolitical tensions: findings from Swedish–Chinese research collaborations

Tommy Shih¹ · Erik Forsberg^{2,3}

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Abstract

Until recently, modern science had been dominated by a handful of Western countries. However, since the turn of the millennium, the global science landscape has undergone dramatic changes. The number of nations where a significant proportion of research done is of high international standard has now increased considerably. China particularly stands out and is today one of the leading science nations in the world. Overall, Chinese research collaborations with countries in the Western world exemplify the general trend towards increasing complexity in the global research landscape. It has gradually become obvious that differences between institutional settings need to be managed more systematically to promote cross-border research cooperation for shared benefits, from individual to institutional levels. An informed discussion of managing complex conditions necessitates an understanding of the relationship-level dynamics of research collaborations. In order to identify what aspects of international research collaborations are the most pertinent to systematically manage at individual and institutional levels, this paper investigates projects in a bilateral Swedish–Chinese funding program. The paper finds that the majority of collaborations funded had yielded positive impact in terms of publications, strengthened research capacity in research groups, and resource accumulation. The challenges found in the collaborations are related to needs such as improving transparency, ethical concerns, and imbalances in reciprocity.

Keywords Sweden · China · International collaborations · Research · Geopolitical tensions

✉ Tommy Shih
Tommy.shih@fek.lu.se
Erik Forsberg
erikf@zju.edu.cn

¹ Department of Business Administration, Lund University, Box 7080, 222 07 Lund, Sweden

² Center for Optical and Electromagnetic Research, Zijingang Campus, Zhejiang University, East Building 5, Room 211, Hangzhou 310058, People's Republic of China

³ STINT, Wallingatan 2, 111 60 Stockholm, Sweden

Introduction

Until recently, modern science had been dominated by a handful of Western countries. However, since the turn of the millennium, the global science landscape has undergone dramatic changes. The number of nations where a significant proportion of research done is of high international standard has now increased considerably (Royal Society, 2011). Some of these countries include China, Singapore, Pakistan, Iran, Qatar, and Saudi Arabia (SciVal® database¹). China particularly stands out and is today one of the leading science nations in the world. This development has been facilitated by the Chinese government's focus on enhancing China's scientific prowess (Wei & Johnstone, 2020). Rapid economic growth, increased amounts spent on research and development (R&D), and growth in the number of outbound Chinese students and researchers have all been important factors in China's scientific development (Cao et al., 2020).

A contributing factor in China's progress has also been an increasing number of collaborations between researchers from Chinese research institutions and partners from other countries. Although a majority of these collaborations contribute scientific value, an increasingly polarized geopolitical landscape has negatively affected the framework conditions for international collaborative activities (See Kirby & Van der Wende, 2019; Shih, 2020). Having relationships with Chinese research actors has especially been questioned in the USA and Australia. Some arguments include that China has taken advantage of the global open science system (see Marginson, 2021; Schwaag Serger et al., 2021). Although there are political concerns about continuing promoting research exchange with China, several studies note that Western–Chinese scientific collaborations have historically benefited collaborating countries as well as science globally (see Lee & Haupt, 2020; Schwaag Serger et al., 2021).

The European Commission has described China as a partner, competitor, and systemic rival (European Commission, 2019), emphasizing the complexity of collaboration with China. The approach taken by policymakers in the European Union towards China is, however, less antagonistic than that of the USA. Funding organizations and policy actors have identified the importance of continuing collaboration on a global scale. Problems such as climate change, environmental degradation, and infectious diseases cannot be addressed fully without global scientific collaboration (Schwaag Serger et al., 2021). Nevertheless, some European concerns associate collaboration with the loss of strategic autonomy, infringement on intellectual property rights, and weakened competitiveness (European Commission, 2022).

Overall, Chinese research collaborations with European countries exemplify the general trend towards increasing complexity in the global research landscape. Such a development has been discussed by several researchers (e.g., Lee & Haupt, 2021; Marginson, 2021; Schwaag Serger et al., 2021). However, it has gradually become obvious that differences between institutional settings need to be addressed more systematically to promote cross-border research cooperation for shared benefits, from individual to institutional levels (Shih et al., 2020; Sun & Cao, 2021). An informed discussion on addressing the underlying conditions necessitates a deeper understanding of the relationship-level dynamics of research collaborations in order to develop institutional arrangements for managing benefits and challenges. As the developments in the global research landscape are fairly recent,

¹ SciVal® database, Elsevier B.V., <http://www.scival.com> downloaded on 2022-01-15.

few studies have described Western–Chinese collaborations at a project level and amidst the increasing geopolitical tensions of the last couple of years. This paper aims to contribute a deepened understanding of origins, motives, and challenges in Western–Chinese research collaborations amid recent geopolitical tensions, and to detail the implications for the management of such collaborations. To that end, this paper investigates Swedish–Chinese research collaborations between 2015 and 2021 in the natural, engineering, and medical sciences in a bilateral funding program at a micro-level. Although not exhaustive, the study offers insights into Western–Chinese collaborative patterns, from the perspective of the “hard” sciences.

The paper is organized as follows. The next section presents a literature overview followed by the method. Thereafter the empirical study is presented. Finally, the paper ends with a discussion and conclusions.

Relevant literature

Reasons for Western–Chinese research collaborations

The scientific map has been considerably redrawn since the millennium shift (Royal Society, 2011). While advanced Western nations still occupy the top positions with regard to high-quality scientific output, significant scientific development has occurred in non-Western countries in the new millennium. China in particular has made impressive strides and is since 2016 the largest producer of scientific publications in the world and invests more in R&D than the whole European Union (Tollefson, 2018). Amid this progress, 22.5% of China’s research publications are the result of international collaborations (SciVal® database). The growth since 2016 has been dramatic. Today, China is world-leading in several scientific areas, including agricultural, plant, and animal sciences; chemistry; materials science; mathematics, and information science (CAS & Clarivate, 2021).

The centrality of China on the collaborative map in several science areas has various explanations. Chinese government policies for the past 30 years have consistently increased the funding for the research sector alongside the growth of the economy (Cao et al., 2020). R&D investments amounted to 2.4% of GDP in 2020 (Schwaag Serger et al., 2021). The development is also reflected in strengthened relationships between advanced science nations and China. Moreover, Chinese students and researchers have traditionally preferred to seek opportunities in the West for overseas study or work (Cao et al., 2020; Jonkers & Tijssen, 2008). Hence, strong Western–Chinese research collaborations are expected as research cooperation usually develops due to established relationships but also resource accessibility and complementary competencies. The main motives described in the extant literature include research impact, building broader networks, leveraging national resources, and knowledge dissemination (Wagner et al., 2015). Moreover, Dusdal and Powell (2021) mention access to research funds, data, the mentoring of younger researchers, the development of new methods, equipment, laboratories, or science infrastructure as reasons for international collaboration.

China’s rise as a science power—a perceived challenge by Western science nations

Although Western–Chinese science collaborations overall have had a positive impact on research quality and advancement, the rise of China as an economic, military, and

technological power has triggered strong reactions from many parts of the world in recent years (Haupt & Lee, 2020). The USA in particular has undertaken significant measures to try to limit China's influence on the world stage (Simon, 2021). In areas such as trade, national security, science, and technology, actions have been taken by the US government to securitize and reduce interaction with Chinese counterparts (Silver, 2020). In its extreme form, politicians and observers, foremost in the USA, have argued for a decoupling from China (Wyne, 2020). The European Union has labeled China a systemic rival, competitor, and collaborator, viewing China as an important partner but also as a threat to Europe's strategic autonomy (European Commission, 2019). Scientific research has been impacted by this development as it is considered a source of regional and national competitiveness, an instrument for strategic use and a source of influence in international politics (Schwaag Serger et al., 2021). Although full decoupling is unlikely, the response is a reaction to clashes in norms on issues concerning, for example, democracy, human rights, openness, and scientific and technological leadership. As a result, as Marginson (2021) notes, global science is in a state of flux.

Observers have argued for a reset in academic collaborations (Simon, 2021), but have also highlighted the need to develop clearer institutional arrangements (Sun & Cao, 2021). The latter is necessary to manage the complexity of issues that arise in international cooperation and particularly with regard to Western–Chinese research collaborations (German Rectors' Conference, 2020). Although geopolitical tensions have increased during the last few years, including higher barriers to collaboration, Lee and Haupt (2021) show that in 2020 US–Chinese collaborations had increased. A similar pattern is seen in European–Chinese collaborations (Kwiek, 2021). The situation involves two concurrent processes. On the one hand, there is the scientific research endeavor, characterized by openness and the ambition to benefit humanity. On the other hand, there are global geopolitical developments, and walls have been erected in order to stem cross-border collaboration with certain countries and protect national interests. Researchers therefore have to try to conduct business as usual in a global science context, while at the same time having to relate to a policy landscape with increasing concerns about the protection of national resources and security. Nonetheless, as suggested by the European Commission (2019), the way forward is to continue collaboration with countries such as China but with a higher degree of awareness concerning the challenges that it entails.

Managing Western–Chinese relationships

The JASON report (2019), commissioned by the National Science Foundation in the USA, emphasizes that research integrity is of utmost importance to uphold in international research collaborations. As Wagner et al. (2015) describe, scientific research is performed in meta-organizations stretching across boundaries. Today, China accounts for roughly 20% of the world's research publications (Tollefson, 2018), suggesting a global impact on aspects such as ethics, integrity, academic freedom, and mobility (see Tang, 2019; Altbach & de Wit, 2021; Schwaag Serger et al., 2021). The Chinese science system has been characterized as driven by political goals and governed top-down (Cao et al., 2020; Tang, 2019). Such an approach reflects a more instrumentalist and technocratic view of science than the model of institutional autonomy prevalent in the West (Cao & Suttmeier, 2017). As the Chinese research system with its considerable resources is embedded in global science networks and attracts international partners, research norms will be impacted (Schwaag Serger et al., 2021).

Efforts to manage the internationalization of research, driven in the West by the higher education sector, research funders, policy organizations, and state actors, have focused on the development of guidelines that address matters related to due diligence and risk management (d’Hooghe & Lammertink, 2020). Some of the issues include export control and intellectual property protection (European Commission, 2022), double affiliations (JASON, 2019), ethics dumping (Schroeder et al., 2019), or espionage (Silver, 2020). Nonetheless, international science collaboration cannot solely be evaluated on the basis of security or risks; attention must also be paid to building and nurturing relationships (Shih et al., 2020). Ulnicane (2015) notes that established relationships and intellectual synergies are integral to durable international research collaboration. Leahey (2016) states that cultural and social aspects as well as limiting and enabling factors within different science systems and research organizations must be understood to build relationships. The subsequent growth and development of collaborations depend on the building of cooperative goals, reflexivity, and developing trust (Brew et al., 2013), as well as having a good understanding of the institutional structures (European Commission, 2022). Hence, international research collaborations require dialogue, planning, coordination, and continuous exchange among teams. With regard to Western–Chinese collaborations, institutional arrangements are needed that can manage a range of issues (Sun & Cao, 2021). The JASON report suggests that research integrity should be used as an overarching principle to plan and implement international research collaboration. Shih et al. (2020) identify the notion of responsibility in internationalization, encompassing both responsibilities related to ethics and academic freedom but also relationship building.

Method

Research design

Research collaborations between Sweden and China have grown rapidly in the past decade, and in Sweden, collaborations with researchers in China constitute the fastest-growing source of scientific publications. In 2019, Swedish–Chinese research collaborations constituted 7.1% of all Swedish scientific publications (SciVal® database). A qualitative approach was taken to investigate Swedish–Chinese research collaborations. The examples from our empirical study provide insight into the origins, as well as opportunities and challenges generally presented by Western–Chinese research collaboration in the hard sciences. Investigating the interactions in the projects furthers an understanding of the varied strategies and practices researchers adopt in Western–Chinese interfaces. Following these descriptions, the empirical study provides recommendations for researchers, universities, and funding organizations on managing challenges and opportunities.

To investigate Swedish–Chinese research collaborations, we focused on the STINT²–NSFC³ Joint China–Sweden Mobility (JCSM) Program, established in 2015, which is also Sweden’s largest international bilateral program for researchers. The program is structured such that STINT funds the Swedish partner and NSFC the Chinese partner.

² The Swedish Foundation for International Cooperation in Research and Higher Education.

³ The National Natural Science Foundation of China.

Between 2015 and 2020, 135 projects were funded.⁴ The Swedish partner may apply for EUR 60,000 to be used for mobility activities over a period of three years. NSFC supports the Chinese partner to an equivalent amount. The funders first make separate evaluations after which a funding decision is made jointly. The program is open to researchers employed at Swedish universities or Chinese universities and research institutes, irrespective of their nationality. In some cases, there are Chinese nationals on both sides of the partnership. However, this is not regarded as negative by the funders since it often helps to reduce cultural and language barriers. Overall, a mix of nationalities was represented on the Swedish side, with the majority of participants being Swedish nationals and researchers of Chinese ethnicity. The Chinese partners sometimes included non-Chinese principal investigators (PIs) and group members.

The JCSM program is organized according to the NSFC's categorization of main funding fields: Engineering Sciences, Natural Sciences, Medicine, and Management Sciences. The primary focus is on the technical, medical, and natural sciences, reflecting the overall trend in Swedish–Chinese research collaborations. This empirical study can therefore mainly draw conclusions about research within these focal areas.

Although the JCSM program is based on mobility funding, the projects and data collected spanned a wide range of activities, including research, mobility, research training, and education. Data were not only collected on mobility activities, but also on what the researchers did before, during, and after the project. Through investigating these projects, we identified international interactions that had ranged over several years. The JCSM program is therefore suitable to follow in order to understand a broad range of academic activities.

Data collection

The study was carried out over a period of four years (2018–2021) and followed projects that had started as early as 2015. Data were collected using a combination of document analysis, in-depth interviews, and workshop discussions. The document analysis was performed using the grant applications and internal program documents. Publication data were also used to better understand Swedish–Chinese collaboration and obtain an overview of publication patterns between partners prior to their joint projects and up to 2022. Data collection and access was enabled due to the authors being insiders in both the Chinese and Swedish university systems and involved in program evaluation at one of the funding organizations studied. Being insiders was also advantageous with regards to understanding the issues investigated (see Smyth & Holian, 2008).

Interviews were conducted with 51 individuals, comprising a diverse set of stakeholders on both the Swedish and Chinese sides. The interviews were not recorded as some respondents did not consent; however, detailed summaries were made. The interviews were semi-structured with open-ended questions focusing on (1) origins, motives, and incentives for collaborations and (2) collaborative processes, including challenges. Due to our insider role, we were aware of possible bias and power relations impacting respondents' stories (Smyth & Holian, 2008). We therefore stated the general aims of the study and gave the respondents as much room as possible to talk about their experiences and also stressed that no personal evaluations were made based on any information given. The interviews

⁴ 25 projects were funded each year in 2015, 2016 and 2017, and 30 projects annually in 2018 and 2019.

have been important in understanding how researchers and universities in Sweden and China have forged collaborative projects. Researchers on both sides were asked about how research collaboration is influenced by cultural idiosyncrasies and differences in institutional conditions. In total, we interviewed representatives from 20 research projects (for 18 of the projects we interviewed PIs on both sides). The projects were distributed as follows: engineering (9), medicine (6), and natural sciences (5). No projects from the management field were studied. We conducted interviews with 24 researchers on the Chinese side and with 20 researchers on the Swedish side. Several follow-up interviews were conducted on the Swedish side, while only single interviews were done on the Chinese side. We further interviewed four funding directors (two on each side) and four program managers (two in Sweden and two in China). The total number of interviews (102) was the result of data saturation (Seidman, 2013). Appendix 1 provides details about the interview respondents. In addition, we had discussions with university leaders and administrative staff and other funders on Swedish–Chinese collaborations in general.

The study included workshop discussions focusing on aspects of the research collaborations. These discussions were arranged to co-create and gain input on documents and were included to collect data and insights that would be less accessible without the interaction found in a group setting—listening to others' verbalized experiences for instance stimulates memories, ideas, and experiences in participants (Lindlof & Taylor, 2002:182). Workshop discussions were conducted with three different groups, consisting of researchers participating in the projects and funders in both Sweden and China.

Data analysis

The study was designed to follow an abductive process (Tavory & Timmermans, 2014). The thematic areas of interest, such as motivations, project activities, and design, were initially identified via a document analysis of the project applications. This enabled us to pinpoint certain areas where sparse information necessitated further inquiry. The focus of the initial interviews was on understanding the processes involved in collaboration, including the handling of opportunities and challenges. A literature analysis also contributed to a better understanding of matters observed in relation to the collaborations.

The interviews with both sides of a project were conducted in parallel in Sweden and China. After gaining a basic understanding of the conditions, we organized a first workshop in Beijing in 2018, involving participants in five JSCM program projects with bilateral representation from Sweden and China. The aim of the workshop was to discuss the findings of our inquiry and follow-up on project progress. All the projects had been ongoing for at least 2 years or were about to finish. Bibliometric data were used to supplement the discussions and understand the progress of the projects. The researchers further mentioned the importance of training, education, and the formation of a mutual understanding of matters related to research and institutional structures. The interwoven processes of document analysis, a literature study, interviews, and workshop discussions continued from 2018 to 2021. A second workshop was held in 2019 and a third in 2021. Both these workshops involved the funders, including directors and program managers. The topic of the discussions centered around program management and how to set favorable conditions for reciprocal exchanges. The research design facilitated the gradual identification of drivers, motives, and challenges in Swedish–Chinese research collaborations as well as the pertinent issues that need to be systematically managed at individual and institutional levels.

Findings from the empirical study

Origins of the collaborations

The researchers initiated collaborations in various ways. Some of the most common ways described were:

we had met at a conference (respondent 18), we had previously been colleagues in the same laboratory as postdocs (respondent 18), through referrals from colleagues (respondent 34), or the researcher on the Swedish side is from China and the partnership originates from my network 'back home' (respondent 25)

A few partnerships originated from internet searches and emails suggesting collaboration. A large number of these projects resulted from established research relationships. Data on co-publications showed that in 26% of the funded projects, the researchers had previously published together. The most common prior relationship pattern was that the researcher on the Chinese side had previously worked at the Swedish partner's institution.

Roughly one-third of the JCSM projects involved a Swedish partner who was originally from China. In this category, there were some cases in which the project was in practice an extension of what can be characterized as an existing cross-border research group. For example, the Swedish PI in one of the projects interviewed had already been a guest professor at the Chinese partner university prior to submitting the project application. This Swedish PI was clearly the dominant party of the collaboration, as evident not only in how he was referred to by the interviewed Chinese researchers participating in the project, but also in the pattern of mobility exchange, which mainly consisted of the Swedish PI visiting the Chinese partner. While this may certainly be an effective research collaboration, the funders considered it questionable whether funding such projects represents an effective use of the JCSM program budget since relationship novelty is considered an important appraisal factor.

The JCSM program provides mobility grants to facilitate interaction between groups. Grants cannot be used for equipment, consumables, or salaries.⁵ Funds are thus predominantly used for researcher exchanges at both junior and senior levels as well as for arranging workshops and conferences. PhD students mainly account for longer stays with the partner group, but there is a clear asymmetry in the exchange of students, in that it is more difficult to get Swedish PhD students to stay longer periods of time in China. Chinese PhD students come more willingly and more frequently to Sweden and stay for longer periods than their Swedish counterparts do in China. Senior researchers are also involved in the exchanges. However, there was generally an inverse proportionality between the seniority of the researcher and the length of their stays as senior researchers typically have many commitments making longer stays difficult to arrange practically. PIs tended to come for shorter visits such as project meetings, workshops, and lectures.

Incentives for collaboration

The reasons for collaboration were diverse but respondents generally mentioned:

⁵ Except for PhD students and postdocs for shorter periods of up to a few weeks.

New research opportunities (respondent 26), additional resources (respondent 9), training of researchers (respondent 13), or increased research strength and status (respondent 39)

Moreover, the interviewed researchers often cited the opportunity to frame new research questions through the combined skillset and resources of the collaborating groups as important. To conduct research that would otherwise not be possible separately was also a key motivator for collaborations, enabling more impactful research. An example is collaborative research on butterflies, in which the theories of the researcher on the Swedish side, an international authority in the field, could be verified and refined through the collaboration. Important factors in this project included the fact that China has a larger and more diverse fauna than Europe and the Chinese research partner was well known for its research and fieldwork in this field in China. In another example, the Chinese partner's internationally leading characterization technology enabled the Swedish partner to push boundaries on its development of THz graphene detectors. Here the research conducted on the Chinese side was very advanced and complementary to the research on the Swedish side. In several projects, the Chinese research group sought to improve their knowledge of basic research, which was the strength of the Swedish group, whereas their Swedish partners were motivated by the opportunity to work on practical applications of their research, which was the strength of the Chinese side. In some projects, the skills and level of research of the collaborating groups were similar and the interest in collaboration primarily lay in pushing knowledge in a certain area where the research groups on both sides had a high level of expertise.

A key motivating factor for collaborations was access to additional resources, including research personnel, data, instruments, and knowledge. Here there were some general differences in motivations between the Swedish and Chinese sides. From the Swedish side, the motivation for collaboration was often related to access to large datasets, for example, in a clinical setting. This was for example the case in a study on cancer in which the Chinese partner institution was one of the key cancer hospitals in China. Similarly, the ability to study problems on a larger scale, for instance in projects related to public health, epidemiology, water, and pollution, was also a motivation. One such project tested novel approaches to city drainage on a scale impossible in Sweden given the overall small population sizes in Swedish cities. Access to advanced instrumentation or know-how was also a cited reason, more often from the Chinese side. The interviews showed that one project appeared to a large extent to be tailored to enable the Chinese partner to access experimental time at a synchrotron source in another European country.

Training of PhD students and young faculty was an important aspect in most of the JCSM program projects, although predominately on the Chinese side. In many cases, the possibility for Chinese PhD students to visit a Swedish lab or research environment was a key motivator for the Chinese partner. Such training could be in the use of advanced equipment, but several PIs on the Chinese side stressed the greater attention paid to research ethics and methodology through work with, and at, the Swedish partner institution as a benefit of the joint projects. This observation was confirmed by several PIs on the Swedish side who noted that Chinese PhD students visited Swedish universities more commonly than vice versa. Some Swedish project leaders specifically mentioned the difficulty in getting PhD students from Sweden to undertake longer research stays in China as a disappointment. Many PIs also stated that longer stays (3–6 months or more) for junior researchers were preferred. If experimental work were to be conducted, longer

stays are often necessary, because initial training is needed and some experimental work can be time-consuming. A Swedish researcher mentioned (respondent 25):

It's difficult to get Swedish students to go to China for longer period of times. They sometimes have children and they don't necessarily get better career opportunities after they have been abroad. It is usually better for them to build networks in Sweden.

Moreover, longer stays also enable PhD students and young faculty to become part of the partner lab when conducting their research and thereby further enhance both their skills as scientists and develop their peer network, as was pointed out by one of the Swedish PIs. Both the skills and network acquired were viewed as beneficial, and potentially significant for their future careers. Some Chinese PhD students mentioned that time spent at a foreign research institution could make it easier for them to find a faculty position in China, be an important steppingstone towards an international career, or a requirement to graduate. PIs on the Chinese side viewed a foreign partnership as offering a route to enhanced career opportunities. Some Chinese researchers mentioned that having an international partner and collaboration was a formal requirement to advance their careers, for example, for promotion to professor, or to be allowed to apply for certain grants or positions.

For some PIs on the Chinese side who had recently returned to China and were in the process of establishing new research groups, an international partnership offered a connection to the international forefront of their field during the period of establishing their group. One young new faculty member at a university in Zhejiang province, who had recently returned from the UK, explicitly stated this as one of the key motivations for her project in the JCSM program, although the specific choice of partner was based on scientific complementarity. Another recently returned scientist from Sweden maintained a closed partnership with the Swedish university and although this was not explicitly stated, the JCSM program project was quite clearly an important component in his capacity building in China. A related incentive for collaborations for overseas Chinese was that working with Chinese researchers not only presents an opportunity to gain access to resources, ideas, and publications but also a chance to “go back home.”

At the group or university level, a number of the interviewed university leaders specifically emphasized that some of the collaborative relationships were seen as strategic partnerships for the present and future with respect to resources, scientific quality, and students. In some cases, the collaboration was also in many ways a learning experience for the Chinese group as a whole. Working with a stronger partner from Sweden exposed the Chinese team to new ideas and provided access to more advanced equipment or methods, thereby enhancing the scientific prowess of the team as a whole. This clearly was the case when there was a strength differential between the two groups or when there was a significant focus on the educational aspects of the project beyond student exchange, such as through courses taught by Swedish researchers in China, joint workshops between the groups, as well as involving many group members in the project. Group learning went in both directions; however, according to the PIs' collective descriptions, learning most frequently took place on the Chinese side in the projects studied here.

Main outputs

Enhanced publication opportunities were important goals for collaboration. Some researchers in Sweden especially noted the faster rate of publishing in China compared to that in Sweden or as one PI (respondent 16) mentioned:

The Chinese researchers publish generally more than we do and they often work longer hours in the lab.

Scientific output in the form of new ideas stemming from these relationships was also a direct outcome. According to the interviewed researchers, collaborative research was conducted by PhD students and postdocs who directly spent time in the partner's lab or for instance resulted from combining theoretical knowledge with clinical or experimental work. Joint publications were later products of the collaborations that directly followed from the research. While inter-group and international collaborations per se do not equate to inter- or multidisciplinary work, this was more often than not the case for the JCSM program projects. A Swedish program manager explained this as the result of the various incentives for collaboration discussed in the previous section, which included several motivations related to combining non-intersecting scientific excellence and practical know-how. New ideas generated in the projects thus frequently came through work done at the intersection of different disciplines and would probably not have materialized in the absence of mobility funding, according to several of the researchers interviewed.

New connections and networks were other key outputs from the projects and were stated as the main objectives of the program. Reportedly, the exchange of students was often perceived as a positive outcome in discussions of the appraisal board meeting of the funders. Long visits to Sweden or China for Chinese or Swedish PhD students generally held long-term benefits for the individuals as well as the research groups. While the partnerships were rooted in research collaborations, they however quite often ended up extending to educational activities too. Moreover, an important outcome was the fact that the scientific results generated, and the strength of the partnerships developed during project execution, formed the basis for developing new funding applications. A key outcome was thus the development of long-term partnerships. Based on the interviews with the project leaders, it was evident that the key JCSM program objective of fostering durable new partnerships was met in a clear majority of cases. Interviewed participants in almost all projects studied had made plans to continue the partnership after the end of the JCSM grant period. Some had already secured continued funding; others were in the process of applying, while the rest were looking into their options. In some cases, the partner groups were both generally well funded and able to continue the collaboration based on existing grants. In these cases, the JCSM grant acted more as a catalyst to the partnership, although in some cases, as mentioned above, the JCSM grant added little additional value to an existing collaboration.

Challenges

Reciprocity

The exchange of faculty and PhD students was generally imbalanced. While the visits of senior project members seemed overall to be basically balanced, this was not the case for students and younger faculty. Chinese PhD students and young faculty tended to spend extended periods in Sweden, whereas their Swedish counterparts generally made fewer visits to China for shorter periods. The net effect of this was that Chinese PhD students and junior researchers, on average, gained more international experience from the joint projects than their Swedish counterparts did. The program managers on both sides were concerned about this lack of reciprocity, as bilateral exchange should include the development of social relationships between groups on all levels. However, institutional factors such as incentive systems, cultural aspects, practical matters (e.g., related to family and research

group responsibility), and sometimes just a lack of interest, all played a role in the physical mobility of the researchers in the projects.

The cultural distance was sometimes a source of challenges. Swedish researchers often stated that they were not used to the Chinese environment and culture. The challenges faced by PIs to arrange longer stays often made it difficult to bridge this gap. Moreover, it appeared that when the PI from the Swedish side was either Chinese or overseas Chinese, this increased the likelihood of longer and more frequent trips to China. An obvious rationale was that the cultural difference was either significantly lower or non-existing, and there were also sometimes family reasons for the trips.

Overall, intellectual property rights (IPR) were an overlooked aspect of the projects and often at best treated as an afterthought. This was at least the case from a Swedish perspective; researchers from the Chinese side had in general more incentives from the academic system in securing IPR for work developed in the projects. In one project, which was very applied in nature and close to commercialization, the Swedish partner had clearly given no thought to handling IPR issues, whereas the Chinese partner had introduced a Chinese industry partner to the project. As mentioned by other project researchers, there are nonetheless some examples of a joint structured approach, typically by agreeing that the Chinese partner applies for a patent in China while the Swedish partner applies for an EU patent.

The collaborations were generally beneficial to the Swedish side, but there was an element of perceived missed opportunities for Swedish researchers as noted by the Swedish funder. The director of STINT (respondent 1) noted:

A young faculty member spending an extended period of time working in China will gain a deep understanding of China as well as develop a professional network there that can be utilized throughout the course of his or her scientific career. Given the scale and rapid growth of quality of research in China, this could potentially be of great value for the individual researcher and very likely the same for Sweden as a science nation.

Ethical challenges and a lack of transparency

Some ethical challenges were encountered in relation to some of the applications to the program. During the appraisal process, certain recurring patterns were identified as potentially problematic. The possibility to conduct research across borders can form gray areas due to unclarities in the jurisdiction and a lack of clear control mechanisms. Some projects were designed to fast-track certain research based on such gray areas. For example, a quick “bench to practice” possibility was sometimes argued in applications as an opportunity to rapidly gain reciprocal interaction between theory-driven research and the clinical setting. Such research could potentially override safety mechanisms put in place to protect patients or stringent animal testing protocols as mentioned by the Swedish program manager. Overall, the percentage of considerable ethical challenges identified by the evaluators in the program applications received was in the low single digits. Those applications were also not granted funding.

The transparency of researchers about their backgrounds or previous collaborations varied across the applications. Many of the applicants were open about their prior relationships and commitments to the partner universities in case there were such affiliations, whereas a smaller number of applicants avoided reporting on earlier collaborative activities (such as neglecting reporting prior stays and affiliations as well as earlier co-publications).

The funding organizations, program managers, and appraisal board members did state that a higher degree of transparency was desirable. For the Swedish counterpart, the reasons included an increasing concern about challenges faced at the national level, in the media, and political spheres. As noted by a program director (respondent 2):

It is necessary that funding goes to projects that are the most suitable according to the program requirements.

The funded projects also included cases where material, data, samples, and other research items were transferred without proper procedures. A practice mentioned by several researchers was bringing samples and materials in their suitcases across borders without consideration as to appropriacy. It was for example not always clear whether proper protocols had been followed when handling the material. Sometimes, PhD students would transport research samples and materials, leading to additional questions concerning consent. However, the vast majority of the PIs stated that their funded projects were generally executed in an ethically and scientifically sound manner. For the reviewed project applications, a program officer at STINT (respondent 3) reported:

Around 5% of the applications raise questions about scientific integrity, ethics or non-transparent reporting of affiliations. After closer evaluation we generally identify around a third of those as highly unsuitable projects.

Discussion and concluding remarks

Swedish–Chinese collaboration, and international research collaboration generally, continues to increase. Researchers need to navigate an increasingly complex landscape when engaging in international scientific collaborations (see, e.g., Marginson, 2021; Schwaag Serger et al., 2021). This study has looked at projects in the fields of engineering, medicine, and natural sciences in a bilateral Chinese–Swedish funding program, exemplifying a subset of Western–Chinese science cooperation. These three fields studied make up the majority of Swedish–Chinese research collaborations overall. There are some disciplinary differences, for example, researchers in the medical sciences are more concerned with the ethical aspects of human and animal testing compared to researchers in the other areas. The technical areas generally pay greater attention to security concerns and dual use, while the natural sciences are likewise concerned about dual use. There is less Swedish–Chinese collaboration in the humanities and social sciences, areas that traditionally have experienced substantial government control in China, and in these areas concerns often center on academic freedom and individual rights.

International research collaboration is generally viewed as desirable and important, but political measures to restrict cooperation and the more cautious approaches of university leaders have recently become increasingly prominent (Simon, 2021). This predicament necessitates better analyses of the situation (JASON, 2019), and how institutional arrangements can be devised to support the relationships (Sun & Cao, 2021). More studies are needed on the forms international research collaborations take and how their management can be improved for meaningful outcomes (Brew et al., 2013; Shih et al., 2020). There are few studies that look at how Western–Chinese research relationships are developed on the micro-level amidst the current geopolitical landscape. Nonetheless, there is a corpus of literature examining international research collaborations (e.g., Dusdal & Powell, 2021; Ulnicane, 2015). It is of interest how some of

these findings apply to the strained Western–Chinese institutional relationships, as well as how challenges can be managed. Our empirical study suggests that at an aggregated level, the program benefits Swedish–Chinese scientific collaborations, with regard to publications and research impact. These findings are in line with several studies, which note that Western–Chinese research collaborations have historically benefitted both countries as well as science globally (Cao et al., 2020; Lee & Haupt, 2020; Schwaag Serger et al., 2021). The overall motives for collaboration in the JCPM program also align with those proposed by Dusdal and Powell (2021), including access to research funds, data, accessibility to young researchers, development of new methods, equipment, laboratories, or science infrastructure.

The challenges are similar what is described in the extant literature, including cultural and organizational issues (e.g., Wagner et al., 2015; Leahey, 2016). However, there are also specific challenges tied to Swedish–Chinese collaborations, including a consistent lack of reciprocity in some areas, and the overall problem with gray areas. Such challenges also appear to be persistent in Western–Chinese research collaborations more generally (see d’Hooghe & Lammertink, 2020). Increasing value creation out of international collaborations should be the goal for participating sides but imbalances can impact the longevity and interest in collaborations at various levels. Reciprocity can be viewed from various perspectives, such as mobility, scientific gains, or resource sharing (European Commission, 2022). With respect to mobility, the research groups on the Chinese side were overall more mobile, especially the junior researchers. For the Swedish side, this meant benefits such as more research personnel. However, the situation leads to imbalances in relationship building and understanding of the partner. Incentive structures on both sides can to a large degree explain the imbalance. There are more incentives on the Chinese side to be mobile for career development purposes. Ways of achieving more balanced exchanges should be discussed at organizational levels.

Another observation was the gray areas arising in Swedish–Chinese collaborations. One example is the risk of ethics dumping (see Schroeder et al., 2019) due to practices and laws varying between countries. Both evaluation committees and program managers raised ethical concerns regarding some of the projects, and in the evaluation process, due to considerable differences in research practices incentive structures and laws between Sweden and China. However, since ethics approval laws are only applicable in the country of legislation, international research can often end up in gray areas. As such, transparent discussions in collegial networks concerning appropriate boundaries are important (as discussed by Tang, 2019). This concerns not only ethics, but also dual use, data management, or working conditions. It is important to develop institutional arrangements, as noted by Sun and Cao (2021), and policies that align with the responsible management of gray areas. Such policies need to be developed bilaterally, and ideally multilaterally, as gray areas by definition appear due to differences in legal frameworks, incentive systems, and cultural practices (see also Shih et al., 2020). While gray areas can arise in all international research collaborations, they especially need to be mitigated in Western–Chinese collaborations due to the deteriorating relationship between the West and China.

The JCPM program had only a handful of potential cases related to graver concerns, e.g., espionage, military–civil fusion, and human right infringements. If such problems were to occur, priority should be given to solving them. However, given their infrequent occurrence, it would be more meaningful to first direct attention and resources to the management of gray areas and imbalances. A focus on the red areas risk impacting how the majority of relationships are viewed.

Implications for funding organizations, researchers, and universities

In order to benefit from international research collaboration, challenges need to be managed. Challenges must be handled through shared responsibility between organizations and researchers within the confines of a country and across borders. Funding mechanisms typically offer a suitable way to induce changes in behavior, and coordination between funding organizations can be driven in a fairly nimble and flexible way through the development of a commonly accepted and implemented code of conduct that researchers applying for funding are required to adhere to. It is recommended that funding organizations inform researchers in more detail about the requirements and expectations of successful projects. Providing stricter guidelines in the application process and also more explicitly stating the expectations and importance of truthfulness (including consequences of transgressions) is recommended in order to manage gray zones.

It is important that individual researchers evaluate the intended gains from the collaboration to ensure that these are achieved, i.e., the collaboration should have a clear vision and purpose. Greater awareness should be promoted of the potentially significant outcomes that these collaborations can generate beyond scientific results. Some of the most important of these, as discussed in this study, are the development opportunities for PhD students and young faculty. Additionally, opportunities for commercializing research should be explored and the management of IPR resulting from the project should be planned. These actions could make relationships more reciprocal.

While benefits were clear for research and research groups, the institutional benefits should also be considered. Such aspects can relate to the development of educational programs associated with the research conducted, new or strengthened research environments, or reciprocal development of national research areas. Here it is essential that funders and research organizations analyze what appropriate incentives should be developed to stimulate international collaboration that is embedded in the research prioritizations of both sides.

When planning a project, it is crucial to consider its ethical and legal aspects. This is certainly important for all research projects and international collaborations; however, more attention than usual should be paid to these aspects if project partners are based in countries that have significant cultural differences or disparate political and legal systems, as is the case in Western–Chinese collaborations. Universities must provide support and knowledge to their faculty members engaging in international collaboration projects. Institutional support should be in place, ultimately aiming to inform and educate staff so that no projects cross “red” (ethical or legal) lines. It is important to create institutional awareness and memory, ensuring the automatic promotion of “good” projects (both in terms of ethical soundness as well as being the most beneficial to researchers, students, research groups and the universities) at department and school levels.

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Declarations

Conflict of interest Tommy Shih works as a consultant for the Swedish Foundation for International Cooperation in Research and Higher Education (STINT) and Erik Forsberg is employed part-time at STINT.

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