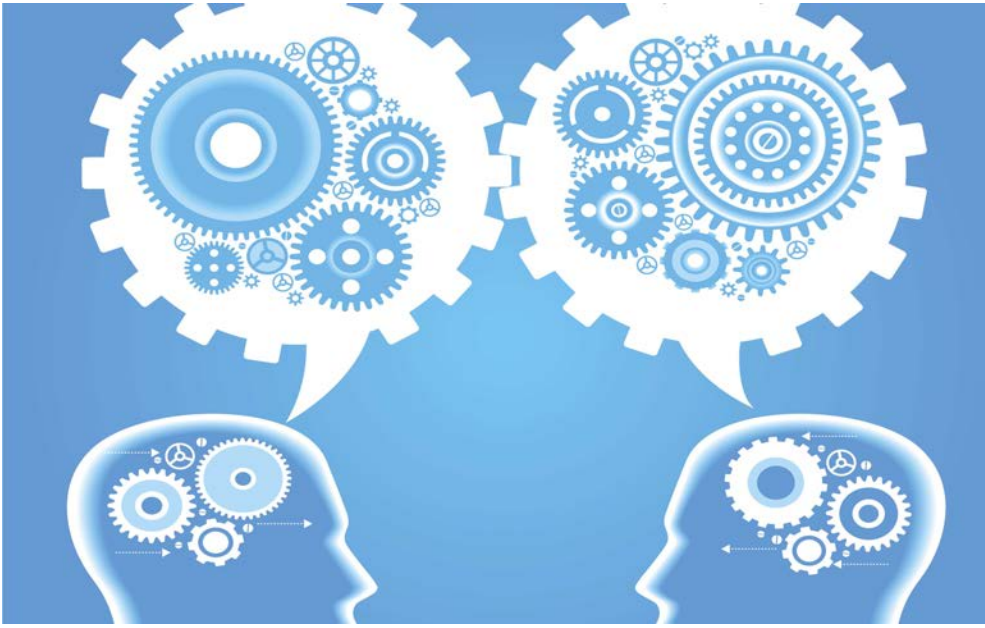

Swedish-Chinese Research Collaborations: Patterns and Approaches

STINT
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Preface

During the last decade, China has clearly established itself as a global node in science, technology, economy, and politics. China is now the second largest economy in the world and, based on publication numbers, the largest global producer of scientific knowledge. Since 2018, China has also surpassed the United States in the category of highly cited papers, i.e. those ranked in the top 1% by citations. Additionally, China now invests more in research and development than the European Union as a whole.

Unsurprisingly, collaborations and co-publications involving Swedish higher education institutions (HEIs) and their Chinese counterparts have steadily increased in recent years. Research collaboration between Sweden and China has particularly intensified over the past decade, with 14,442 Swedish–Chinese co-publications appearing from 2018 to 2021. These research relations are often initiated at individual level, although national priorities and funding structures may create additional incentives for collaborations. During 2021, Swedish–Chinese collaborations constituted 8.7% of all Swedish research publications and China was Sweden's fourth largest research partner, measured in number of co-publications.

Given this development, a more in-depth understanding of Swedish–Chinese research collaboration is needed. In this two-part report, we describe patterns in Swedish–Chinese research collaboration (Part 1), based on a bibliometric analysis of co-publications, as well as the approaches Swedish HEIs take to collaboration with China and Chinese actors (Part 2), based on interviews of representatives of Swedish university leaderships. This study was funded by STINT and Intsam, the Swedish public research councils' function promoting the funding and coordination of international research and innovation partnerships.

The report was authored by Dr Tommy Shih, Senior, Adviser, Responsible Internationalisation, STINT; Dr Hans Pohl, former Programme Director, STINT; and Dr Erik Forsberg, Representative in APAC, STINT. We would like to express our sincere thanks to Prof. Sylvia Schwaag Serger, Lund University, who has read and provided valuable comments on a draft version of the report.

Dr Andreas Göthenberg
Executive Director, STINT
July 2023

Contents

Part 1:
Patterns in Swedish-Chinese research collaboration

Erik Forsberg, Hans Pohl & Tommy Shih

Introduction

This report provides an overview of the patterns of collaborative research involving Sweden and China. Given scientists' propensity to publish their research results as rapidly as possible, journal publication count is a useful proxy indicator for research volume and by extension the extent of research collaboration between, for example, two nations. Thus, here we use the number of peer-reviewed journal publications with co-authors having affiliations in Sweden and China[1] as a measure of the collaboration intensity between these countries, as well as between Swedish and Chinese higher education institutions (HEIs) or research performing organisations (RPOs). Consequently, a reference to for instance 'growth in co-publications' in this report should be interpreted as 'growth in joint research activity'.

Publication data were extracted from Elsevier's SciVal® database, which includes a categorisation of publications by their number of co-authors. This makes it possible to filter out publications with a very large number of co-authors, such as those in experimental particle physics and global health studies. This is useful as publications with a smaller number of co-authors (typically ten or fewer) represent research results produced with active collaboration between all co-authors and are thus 'true' partnerships in the sense that personal connections have been established as part of the work. The data set include publications up to and including 2021.[2]

A specific feature of the publication analysis is the grouping of publications based on the number of countries represented. In a bilateral publication, at least two countries appear among the authors' affiliations and there are at least two co-authors. A bilateral publication including at least two co-authors and affiliations from at least two countries adheres to Elsevier's definition of an international co-publication. This approach allows for a more accurate study of the citation impact, as it reduces the bias caused by correlation between the citation impact and the number of co-authors. Moreover, it makes it easier to specify a threshold for when a publication represents Sweden – China collaboration and when not. In this report, we consider articles with at least 50% participation from Sweden and China, i.e., publications involving a maximum of four countries, as representative of collaboration between the two countries.

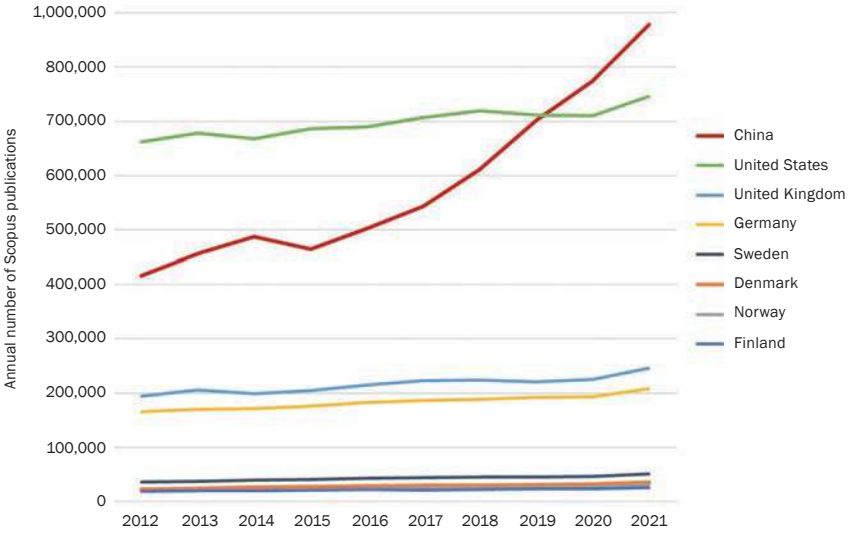
[1] At least one co-author with a Swedish affiliation and another with a Chinese affiliation were needed to classify the publication as a Swedish–Chinese co-publication.
[2] In May, Scopus data for the previous year is considered "complete".

Scientific production in Sweden and China

Growth in scientific output

Since 2019, China has been the largest producer of scientific publications in the world, which it is likely to remain in the foreseeable future, as can be seen in Figure 1. In 2021, the number of Chinese publications indexed in Scopus was close to 880,000 (see Table 1). Moreover, the citation impact, i.e., the quality of the output, is improving. The country's Field Weighted Citation Impact (FWCI) was 1.08 for the period 2017–2021, which means that Chinese scientific production was overall cited slightly more frequently than the world average. Chinese research has also improved in the last decade with regards to the share of publications ranked among the top 10% of the most frequently cited, and today China's share is similar to that of Sweden. A recent study also ranked China as the global leader in 37 out 44 critical technology research fields (with the US leading the remaining 7).[3]

Figure 1: **Development in scientific production**



[3] J. Gaida, J. Wong-Leung, S. Robin, and D. Cave (2023). *ASPI's Critical Technology Tracker – The global race for future power* (Policy Brief Report No. 69/2023). Australian Strategic Policy Institute.

Table 1: **Publications in China and Sweden**

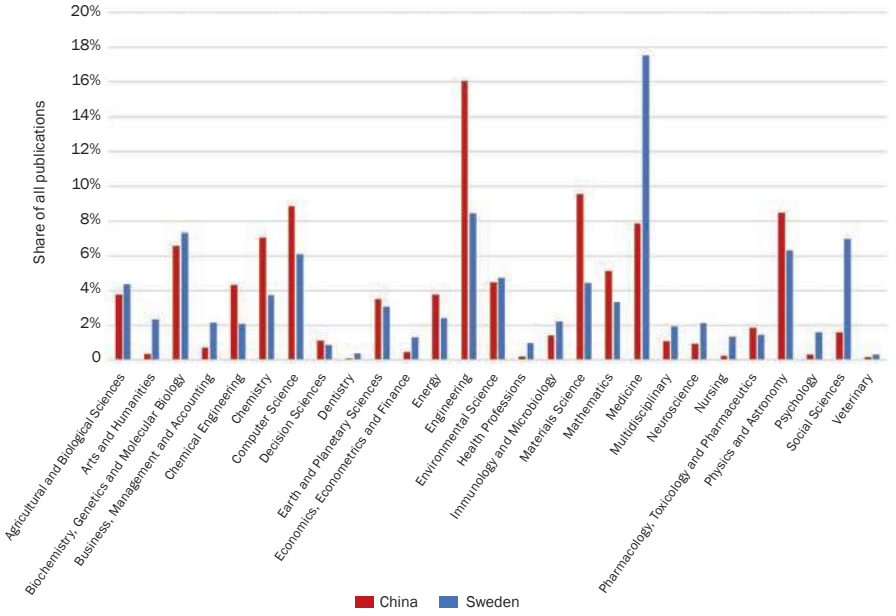
	Publication volume					2017-2021	
	2017	2018	2019	2020	2021	FWCI	Share in top 10% citation percentile
China	543,509	610,763	701,470	774,179	879,643	1,08	15%
Sweden	44,144	45,070	45,620	46,808	50,749	1,62	17,9%

Sweden has also increased its scientific production. However, compared to China this increase is modest. Most of the increase in the past decade has come through Extra-European/North American collaborations.[4] Overall, Sweden's FWCI is high; in the period 2017–2021 it was 1.62.

Areas of research

Research in China has a strong focus on the natural and engineering sciences. In Sweden there is a greater focus on medical sciences. Compared to China, Sweden also has a relatively larger share of research in the humanities and social sciences. Figure 2 below illustrates the relative shares of the different scientific fields in each country.

Figure 2: **Distribution of research areas in China and Sweden.**

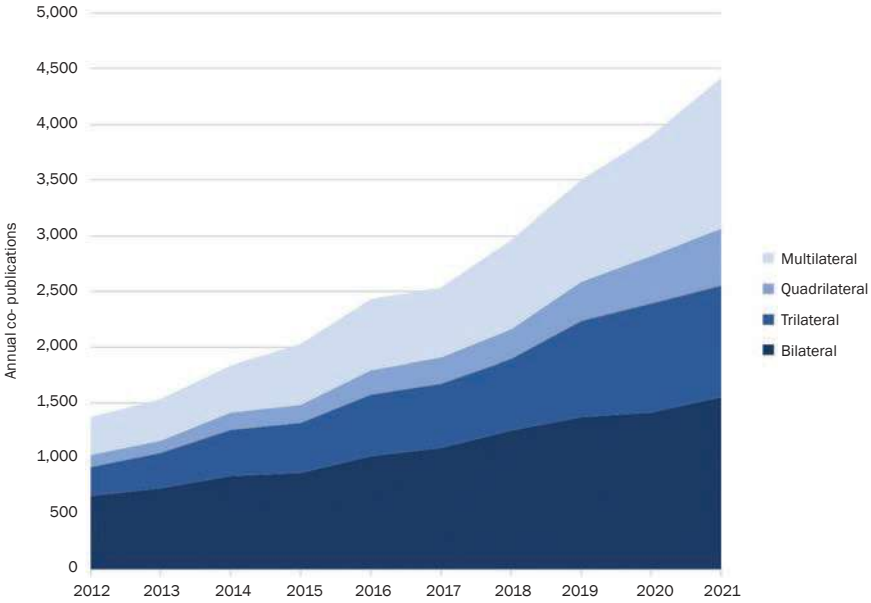


[4] Kwiek, M. (2021). What large-scale publication and citation data tell us about international research collaboration in Europe: changing national patterns in global contexts. Studies in Higher Education. Doi:10.1080/03075079.2020.1749254

Research collaboration between Sweden and China

Sweden is a small country with a high degree of international research collaboration. In 2019, 71% of Swedish publications were co-authored with international partners.[5] In China, 22.5% of publications were co-authored with international partners.[6] The growth of scientific collaboration between Sweden and China has been rapid in the last decade, as can be seen in Figure 3.

Figure 3: **Growth of co-publications including Sweden and China.**



In Figure 3 and below, 'multilateral' refers to a publication with co-authors from more than four countries. As explained above, focusing on publications with co-authors from a small number of countries provides a more accurate picture of Swedish – Chinese collaboration. Multilateral publications aside, the Swedish – Chinese co-publication volume tripled in the period 2012 -2021. The significant increase in the number of publications in relation to smaller increases in co-publications with other major research partners has made China a progressively more important research partner in Sweden. Table 2 shows that China was ranked as Sweden's 12th largest partner in 2012 and 4th in 2021.

[5] The Swedish Research Barometer 2021 (VR2110, ISBN 978-91-88943-48-4). Swedish Research Council.
[6] SciVal® database

Table 2: **China's rank as partner country to Sweden**

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Rank	12	11	11	11	10	9	8	6	4	4

While China is now Sweden's largest science partner nation outside Europe and the United States, thus far the volume of Sweden's research production with China has been substantially lower than that produced with the United States, the United Kingdom and Germany (see Figure 4). However, in 2017–2018 Sweden's number of co-publications with China surpassed those with Norway and Denmark. In 2021, co-authors with Chinese affiliations contributed to 8.7% of Sweden's total publications. Given the very rapid growth of China's overall scientific output it would be surprising if Swedish – Chinese scientific collaboration did not experience significant growth as well. Figure 5 shows that bilateral co-publications have dominated, i.e., partnerships at a group-to-group level are the norm in Swedish – Chinese research collaboration. However, multilateral co-publications exhibit the largest relative increase during the period and in 2021 constituted more than 30% of all co-publications (see Figure 5).

Figure 4: **Growth of co-publications between Sweden and selected partner nations.**

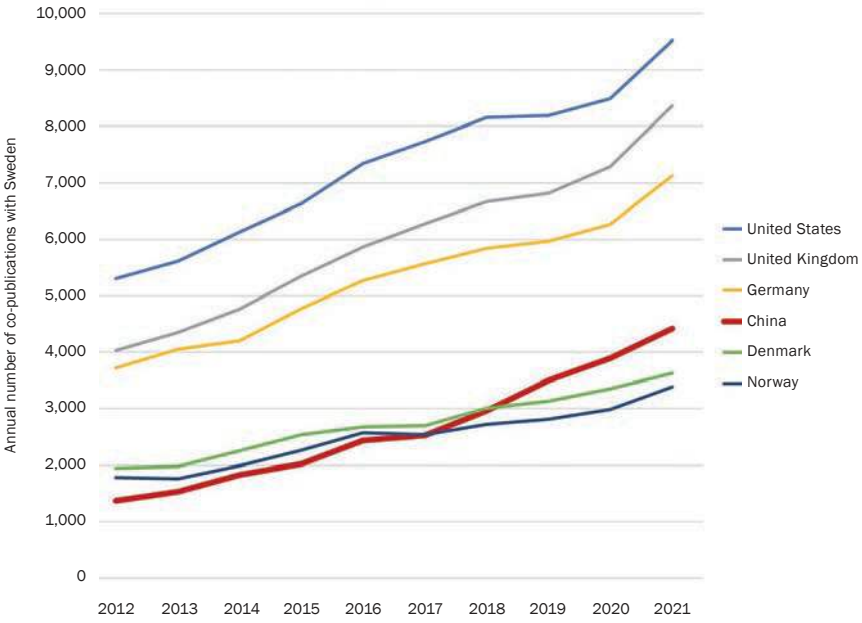
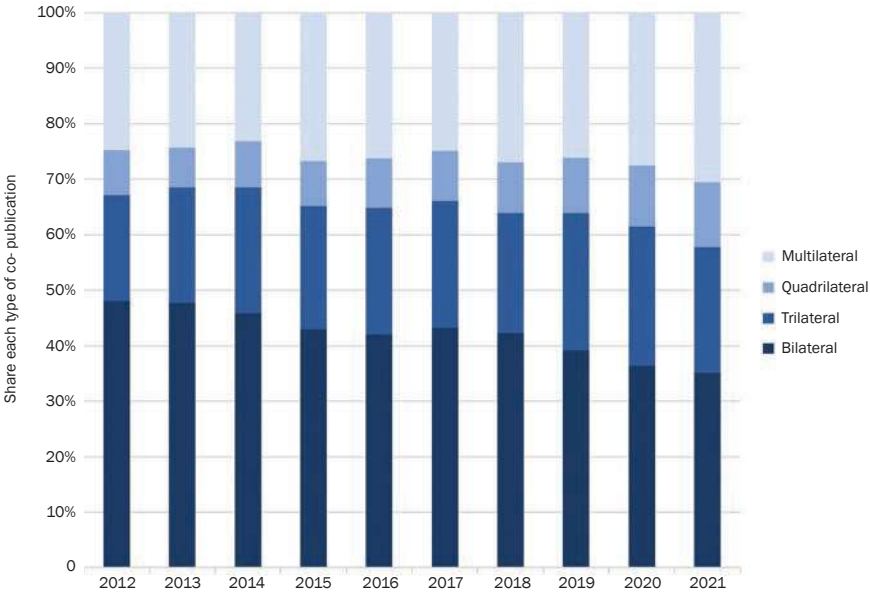


Figure 5: **Number of partners in Swedish-Chinese co-publications.**



Nevertheless, collaboration between Sweden and China is to a much higher extent dominated by bilateral publications than Sweden's collaborations with most other large partner countries. Table 3 shows the distribution of publications by number of participating countries for selected Swedish partner countries (data for 2017-2021). The high number of multilateral co-publications with Germany and the United Kingdom might partly be interpreted as a consequence of the EU Framework programmes, which often call for multilateral projects.

Table 3: **Distribution of Sweden's co-publications with selected partners by number of participating countries (2017–2021).**

	Bilateral	Trilateral	Quadrilateral	Multilateral
China	39%	23%	10%	27%
Denmark	23%	20%	13%	44%
Germany	17%	18%	13%	51%
Norway	27%	20%	13%	40%
United Kingdom	18%	20%	14%	47%
United States	23%	24%	14%	39%

In Table 4, the share of publications in trilateral collaborations including Sweden is given. When Chinese–Swedish publications include a third collaborator, this

researcher is most commonly affiliated with a U.S. institution. This is the case in 22.5% of all trilateral publications. For Norwegian–Swedish trilateral publications, the most common third party is from Denmark (14.9% of publications). These findings illustrate that China is a less important collaborator in Swedish trilateral publications than in bilateral ones.

Table 4: **Trilateral co-publications including Sweden and two more countries (2017-2021).**

China		United States		United Kingdom	
Country	**Share**	**Country**	**Share**	**Country**	**Share**
United States	22,5%	United Kingdom	15,1%	United States	20,7%
United Kingdom	7,7%	China	9,2%	Germany	8,1%
Germany	6,4%	Germany	8,8%	Australia	6,3%
Australia	5,5%	Canada	5,7%	Italy	4,7%
France	5,1%	Denmark	5,3%	Netherlands	4,6%
Germany		**Denmark**		**Norway**	
Country	**Share**	**Country**	**Share**	**Country**	**Share**
United States	15,7%	United States	16,9%	Denmark	14,9%
United Kingdom	10,4%	Norway	13,8%	United States	13,1%
Netherlands	5,8%	United Kingdom	9,6%	United Kingdom	11,0%
Switzerland	5,4%	Germany	9,2%	Finland	9,7%
Denmark	5,1%	China	6,4%	Germany	5,4%

The citation impact of the joint research, as measured by the FWCI, shows a positive development over the three periods included (see Figure 6). It should be noted that an inclusion of multilateral co-publications would have resulted in a higher FWCI. Figure 6 shows that China's FWCI has developed steadily, closing the gap to that of Sweden. In the last period included, the FWCI for co-publications is higher than that of publications only involving a single country for both Sweden and China.

Areas of collaboration

The distribution of the scientific disciplines in which Sweden and China collaborate, shown in Figure 7, follows the Chinese distribution more closely than the Swedish. Typically, the share of co-publications (the grey bars) is between the respective shares of the partner countries. This is also the case in Swedish–Chinese collaborations, except for some very international subject areas such as Physics and Astronomy. In the subject areas with very low shares in the Chinese portfolio, the share of co-publications is also very low.

Figure 6: **FWCI for Swedish, Chinese, and joint Swedish–Chinese publications (*up to and including quadrilateral publications)**

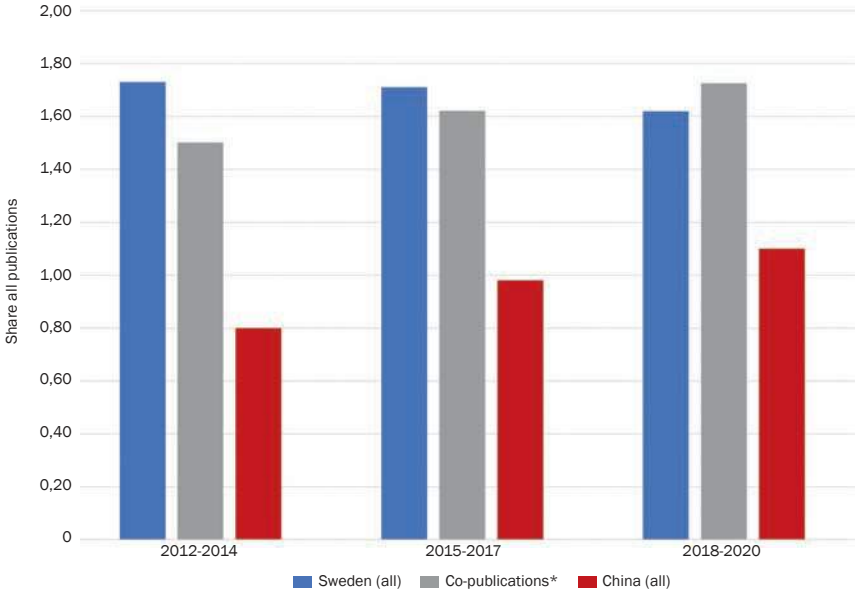
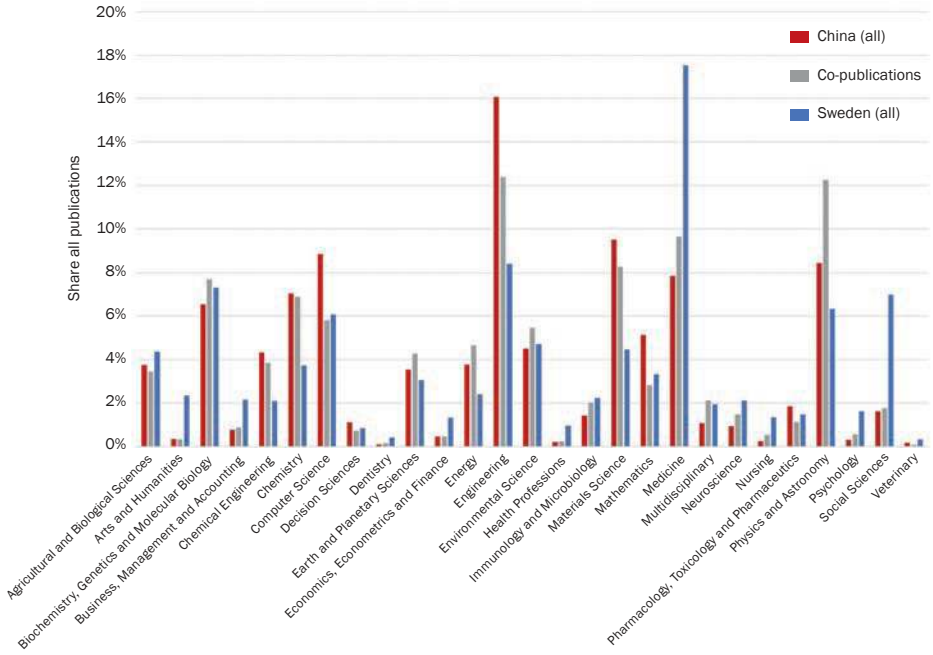


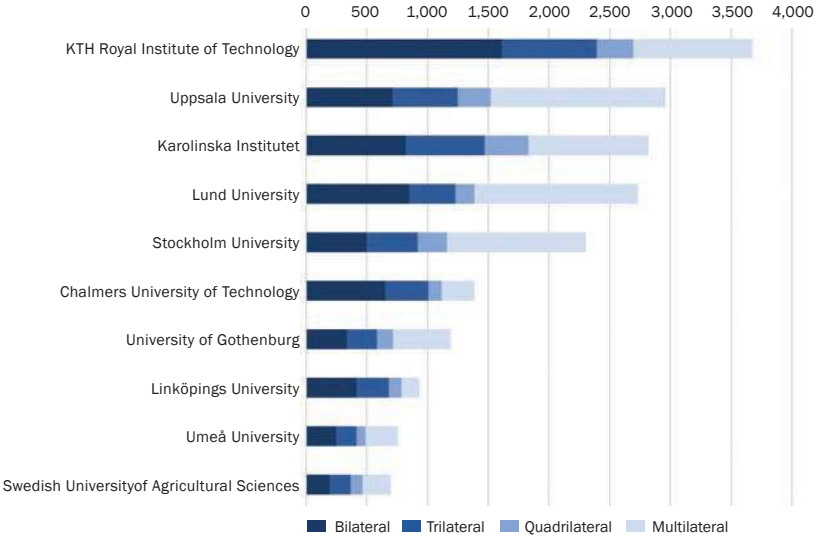
Figure 7: **Distribution of publications per subject area (2017–2021)**



Who collaborates with Chinese research actors?

With the exception of the Swedish Defence University, all Swedish HEIs had collaborations with Chinese partners in the period studied (2017–2021), although with large variations in volume. Figure 8 lists the ten Swedish universities with the highest numbers of co-publications with Chinese partners.

Figure 8: : **The ten Swedish institutions with the highest number of co-publications with China (2017–2021)**



The Chinese picture corresponds to the Swedish one. Most of collaborations were with the larger research institutions (see Figure 9).

KTH Royal Institute of Technology stands out as the Swedish HEI with the strongest connection with China, as it has by far the largest number of co-publications with Chinese partners. Obviously, Figure 9 mainly includes large research-intensive universities. If the share of co-publications with China up to and including quadrilateral publications is used as a selection criterion, the list changes slightly (see Table 5). While the largest comprehensive universities have a sizeable number of co-publications with Chinese partners, such publications constitute an insignificant portion of their total publication volumes. As seen in Table 5, the HEIs with higher shares of co-publications with Chinese partners are either technical universities, which can be expected given the dominance of natural and engineering sciences in Swedish–Chinese scientific collaboration, or smaller universities.

Figure 9: **The ten Chinese institutions with the highest number of co-publications with Sweden (2017–2021)**

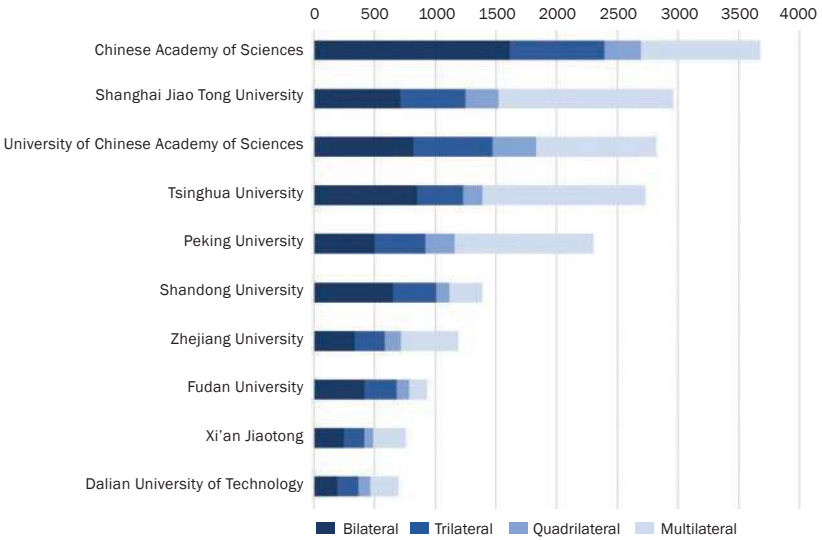


Table 5: **The Swedish HEIs and RPOs with the largest share of Chinese co-publications**

Publications 2017-2021	With China	All	Share China	Share China excl multilat
University of Borås	146	1,127	13%	10,9%
KTH Royal Institute of Technology	3,673	26,522	13,8%	10,2%
Mälardalen University	269	2,613	10,3%	9,8%
Luleå University of Technology	633	6,062	10,4%	9,1%
Swedish Museum of Natural History	176	1,404	12,5%	7,5%
Chalmers University of Technology	1,386	15,566	8,9%	7,2%
Dalarnas University	128	1,231	10,4%	6,4%
NORDITA	102	1,006	10,1%	5,4%
RISE Research Institutes of Sweden	200	3,412	5,9%	5,2%
Linköpings University	933	15,046	6,2%	5,2%

The relatively small total publication volume at the smaller universities means that individual research collaborations can have a significant impact on the share of co-publications with Chinese partners. For example, the research output of two individual scientists accounts for close to 90% of Mälardalen University's total number of co-publications with Chinese partners. University management's active focus on China or a specific Chinese partnership may similarly have a large impact.

Table 2 illustrates China's rank among Sweden's most important partner countries over time. It is instructive to look at this rank for different categories of Swedish universities, as shown in Table 6. This further highlights the technical focus of Swedish – Chinese scientific collaboration: China is, on average, one of the most important partner countries of the technical universities. This is especially so from 2016 and onwards. China does not feature among the most important partner countries of the large comprehensive universities or the non-technical, single-faculty universities, although a rise can be seen at the end of the period.

Table 6: **China's rank among the largest partner countries of different types of Swedish HEIs, in terms of the largest number of co-publications.**[7]

Year	Large comprehensive universities	Technical universities	Singe-faculty universities
2012	14	7	15
2013	13	5	15
2014	13	5	15
2015	13	5	15
2016	12	3	15
2017	13	3	15
2018	11	3	16
2019	9	2	12
2020	8	2	10
2021	8	3	8

Among the smaller universities not included in Table 6, we note that China was the most important partner country for Mälardalen University, Dalarna University, and the University of Borås by the end of the 2010s (see Table 7 for collaboration shares).

[7] On average for the large comprehensive universities (Göteborg, Linköping, Lund, Umeå, Uppsala and Stockholm), the three largest technical universities (Chalmers University of Technology, KTH Royal Institute of Technology, and Luleå University of Technology) and the two largest non-technical, single-faculty universities (Karolinska Institutet and the Swedish University of Agricultural Sciences).

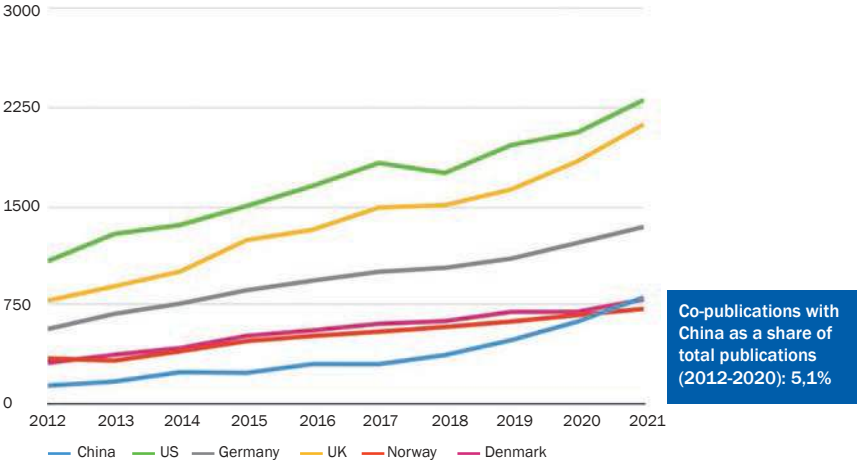
Table 7: **Types of research partnerships at Swedish HEIs and RPOs.**

	Bilateral	Trilateral	Quadrilateral	Multilateral	With China	All	Share China	Share China excl multilat
KTH Royal Institute of Technology	1,614	786	299	985	3,684	26,439	13,9%	10,2%
Uppsala University	716	542	270	1,450	2,978	33,222	9,0%	4,6%
Karolinska Institutet	830	655	362	999	2,846	42,524	6,7%	4,3%
Lund University	857	374	163	1,351	2,745	34,192	8,0%	4,1%
Stockholm University	499	423	239	1,149	2,310	24,252	9,5%	4,8%
Chalmers University of Technology	642	349	112	271	1,374	15,513	8,9%	7,1%
University of Gothenburg	340	245	133	474	1,192	26,209	4,5%	2,7%
Linköpings University	415	268	103	147	933	15,056	6,2%	5,2%
Umeå University	250	167	79	269	765	13,044	5,9%	3,8%
Swedish University of Agricultural Sciences	192	175	98	232	697	10,454	6,7%	4,4%
Luleå University of Technology	298	179	72	80	629	6,007	10,5%	9,1%
Mälardalen University	137	90	28	13	268	2,406	11,1%	10,6%
Örebro University	108	60	28	71	267	5,796	4,6%	3,4%
Swedish Museum of Natural History	36	38	32	70	176	1,399	12,6%	7,6%
University of Borås	29	71	23	23	146	1,123	13,0%	11,0%
Dalarnas University	39	32	6	49	126	1,238	10,2%	6,2%
AstraZeneca		40	17	68	125	2,616	4,8%	2,2%
Malmö University	40	31	22	21	114	2,762	4,1%	3,4%
Linnaeus University	39	26	18	31	114	3,824	3,0%	2,2%
Mid Sweden University	71	12	7	13	103	1,937	5,3%	4,6%
NORDITA	12	20	21	48	101	1,000	10,1%	5,3%
University of Gävle	44	25	6	10	85	1,453	5,8%	5,2%
Jönlöping University	11	14		43	68	2,444	2,8%	1,0%
Royal Swedish Academy of Sciences	7	8	11	40	66	1,188	5,6%	2,2%
Karlstad University	24	18	10	12	64	2,307	2,8%	2,3%
Ericsson AB	31	11	7	8	57	2,007	2,8%	2,4%
Blekinge Institute of Technology	37	10		4	51	1,271	4,0%	3,7%
SHT Smart High Tech AB	43				43	60	71,7%	71,7%
ABB Group		26	8	7	41	2,750	1,5%	1,2%
Public Health Agency of Sweden	7	6	5	22	40	502	8,0%	3,6%
Halmstad University	10	13	7	9	39	1,201	3,2%	2,5%
IVL Swedish Environmental Research Instit.	8	5	2	21	36	439	8,2%	3,4%
Stockholm EnvironmentInstitute	6	5		19	30	763	3,9%	1,4%
Stockholm School of Economics	7	4	3	15	29	981	3,0%	1,4%
Swedish Meteorological and Hydrological Institute			5	24	29	665	4,4%	0,8%
University West		9		17	26	448	5,8%	2,0%
University of Skövde	7	10		9	26	1,261	2,1%	1,3%
Vattenfall	20	5			25	101	24,8%	24,8%

Co-publication data for a select number of individual HEIs

The following figures illustrate the development of collaborations with some key nations for a selected subset of Swedish HEIs, indicating the changes of China's relative rank as a partner, in the years 2012 to 2021 (Figures 12–16).

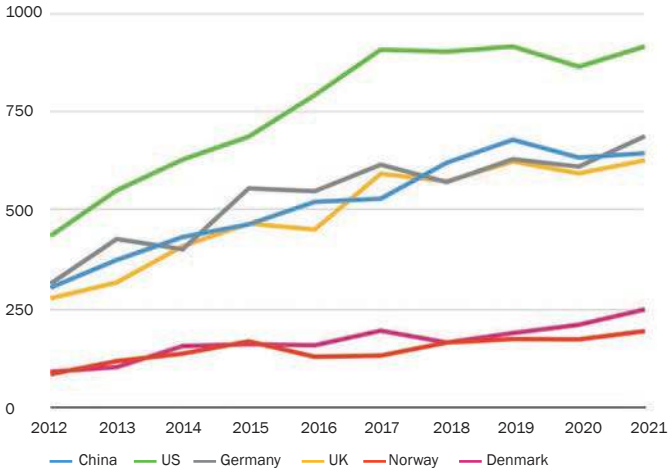
Figure 10: **Karolinska Institutet (KI)**



CHINA'S RANK AS PARTNER

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Rank	16	15	15	15	14	15	15	13	12	8

Figure 11: **KTH Royal Institute of Technology (KTH)**

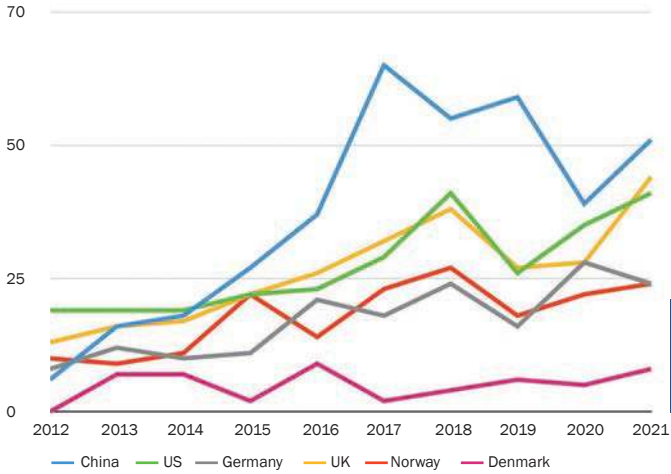


Co-publications with China as a share of total publications (2012-2020): 10,3%

CHINA'S RANK AS PARTNER

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Rank	3	3	2	4	3	4	2	2	2	3

Figure 12: **Mälardalen University (MDU)**

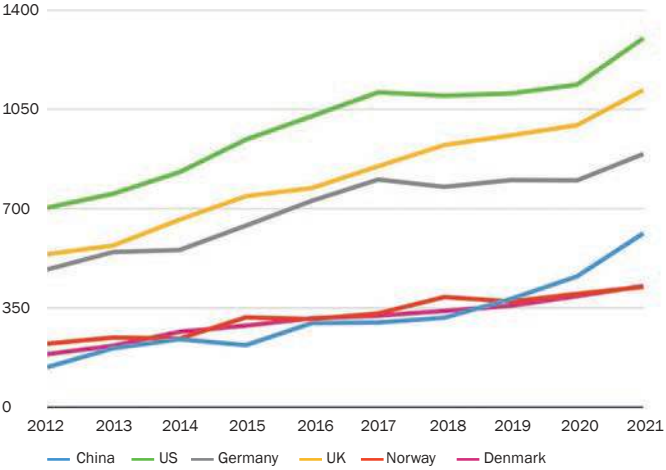


Co-publications with China as a share of total publications (2012-2020): 8,3%

CHINA'S RANK AS PARTNER

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Rank	11	2	2	1	1	1	1	1	1	1

Figure 13: **Uppsala University (UU)**



Co-publications with China as a share of total publications (2012-2020): 5,3%

CHINA'S RANK AS PARTNER

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Rank	13	11	10	13	11	11	11	7	5	4

In Table 8 below the major Chinese partners of the Swedish HEIs mentioned in Figures 11–15 are listed by contribution size.

Tabell 8: **Main Chinese research partners of selected Swedish HEIs**

	UU	KTH	KI	MDU
1	Chinese Academy of Sciences	Nanjing Tech University	Fudan University	Tianjin University
2	Dalian University of Technology	Chinese Academy of Sciences	Jilin University	East China University of Science and Technology
3	Fudan University	Shanghai Jiaotong University	Shandong University	Tianjin University of Commerce
4	Peking University	University of Science and Technology Beijing	Peking University	China University of Petroleum–Beijing
5	Beihang University	Southeast University	Shanghai Jiaotong	Tsinghua University
6	Tsinghua University	Nanjing Forestry University	Chinese Academy of Sciences	Shandong University
7	Wuhan University	China University of Mining and Technology	Chinese Academy of Medical Sciences	Xi'an Jiaotong University
8	Shanghai Jiaotong University	University of Electronic Science and Technology of China	Sun Yat-Sen University	Beijing Institute of Technology
9	Zhejiang University	North Minzu University	Capital Medical University	Beijing Normal University
10	Northwestern University	Harbin Institute of Technology	Zhejiang University	Tongji University

Concluding remarks

This report shows that research ties between Sweden and China have grown rapidly in the past decade. Researchers at Chinese institutions are becoming increasingly important collaborators. At the same time, Swedish – Chinese collaborations are increasingly being criticised in Sweden due to concerns related to China's authoritarian system, and risks for direct military links, human right violations, or ethics dumping. Nevertheless, a recent study of Swedish – Chinese funding applications to STINT's Joint China Mobility Programme showed that fewer than 2% of the project proposals were at risk of severe and direct infringements of individual rights, dual use, or ethics dumping.[8] A more granular understanding of collaboration patterns is needed to develop useful tools and frameworks for managing risks and building meaningful relationships in Swedish – Chinese collaborations. As a step in that direction this report has described the most common forms of collaborations as well as the scientific areas and actors concerned.

[8] STINT. (2021). Swedish–Chinese research collaborations:
Experiences from the Joint China–Sweden Mobility programme (R 21:01, ISSN 1404–7209).

Part 2:
Swedish universities' approaches to collaboration with Chinese institutions

Tommy Shih and Erik Forsberg

Introduction

In keeping with China's development as a major science power, collaboration between Swedish higher education institutions (HEIs) and Chinese research actors has intensified, as described in Part 1 of this report. This is hardly surprising, given the increased volume and quality of Chinese research. A similar development can also be seen in other 'traditional' science powers.[9] At the Swedish HEI level, the interview respondents noted that, the development of Swedish – Chinese research collaborations has generally been characterised by bottom-up initiatives, a reactive approach to Chinese proposals for research partnerships and structures, as well as a lack of institutional understanding of the Chinese context. At a national level, Sino-Swedish S&T agreements as well as funding initiatives specifically for Chinese collaboration have had an important role in promoting Swedish-Chinese collaborations. Many Swedish HEIs have at some point drawn up China strategies, but generally there is no active approach to the development and management of collaborations with research actors in China. The return to stricter authoritarian rule in China has in recent years caused concerns in Sweden and other countries, particularly in the West. This has also led to an increased focus on how researchers and HEIs should handle academic collaboration with China. In pace with the steadily growing number of collaborations in an increasingly complex global research landscape, Swedish research actors are seeking more information to better understand the underlying conditions of collaboration, including collaboration patterns.

However, the main issue is not whether Sweden should engage in research collaboration with China. Decoupling is neither likely nor desirable, as it would have considerable immediate and long-term consequences. The Swedish research base would shrink, for example, and collaborative efforts to meet global challenges would be affected. Researchers at Swedish HEIs should aim to continue collaborating with excellent researchers internationally to conduct high-quality research, but they need increased awareness of challenges and better skills in dealing with the complexity of international research collaborations. This is particularly important when collaborating with researchers and HEIs operating in countries and contexts that differ significantly from the situation in Sweden.

This part describes different approaches followed by Swedish HEIs in academic partnerships with China and is based on in-depth interviews of representatives of the leaderships and support staff at selected HEIs.

[9] STINT (2018). Academic collaboration: Sweden–China (R 18:01, ISSN 1404–7209).

Strategies and agreements

None of the HEIs invited to participate in this overview has in recent years developed China-specific strategies. Some HEIs have previously formulated China strategies, as for example Uppsala University, KTH Royal Institute of Technology, and the Swedish University of Agricultural Sciences (SLU), but these are generally almost a decade old. However, internal discussions have been lively at Swedish HEIs, particularly regarding the actors with which universities want to collaborate and appropriate tactics for building relationships and managing challenges. Most HEIs have action plans for internationalisation and a handful have or are developing such specific to China (e.g. Lund University and Karolinska Institutet). These often discuss identifying prioritized partners in and focus areas of prospective collaborations. Long-term strategies are absent for various reasons, including a lack of interest or resources, the absence of continual trend analysis for China and insufficient relevant competence to describe the complexity of Swedish–Chinese collaboration. Action-oriented plans with shorter timeframes therefore present simpler alternatives to HEIs.

However, there are many agreements between Chinese and Swedish HEIs that have been initiated by individual researchers or teachers, or by departments, faculties, and universities. The signatories to these may be located centrally in the organisation (university vice-chancellors), at faculty level (deans), or at department level (heads of department). In Sweden, the trend is to be more restrictive regarding entering new agreements with Chinese parties. Somewhat simplified, Swedish HEIs have generally taken a reactive attitude to collaboration agreements, which have often been drawn up in response to Chinese initiatives. Agreements have therefore often been signed when requested, with considerations of how these fit into the overall strategy of the HEI as secondary concerns (though this has not necessarily been unique to collaborations established with partners in China but rather a more general problem). Many existing agreements were signed at a time when China grew rapidly while gradually becoming more open and with the hope that the country would also become more democratic. In recent years, such expectations have been disappointed: China has become more authoritarian under Xi Jinping, while the Chinese academy is increasingly being controlled by state apparatus.

Swedish HEIs have agreements with a great variety of Chinese institutions. Generally and relative to their own rankings, Swedish HEIs have entered into more collaboration agreements with lower-ranked Chinese HEIs than higher-ranked ones. However, this is changing. University leaderships, particularly at larger Swe-

dish HEIs, today more clearly emphasise gaining an overview of all existing cooperation agreements and being more selective and strategic when entering new ones, particularly if they involve countries very dissimilar to Sweden as regards economics, politics or culture. Many Chinese universities have also climbed in international rankings.

Central agreements and memoranda of understanding between Swedish and Chinese HEIs are often broadly formulated. They mainly regulate student exchange but sometimes also research collaboration. Swedish students have shown relatively limited interest in studying in China. Twice as many outbound exchange students from Swedish HEIs go to Japan than to China, and four times as many to South Korea.[10] Swedish HEIs often fail to fill their quotas of student numbers in the exchange agreements with Chinese partners. Similarly, the Chinese partners also often fail to fulfil exchange agreements in terms of student numbers, except at a handful of Swedish HEIs (again, this stands in sharp contrast with agreements with HEIs in Hong Kong, Singapore or Taiwan). It should however be noted that more Chinese students come to Swedish HEIs on their own than through exchange agreements.

Overarching collaboration agreements at central university level seldom interest individual researchers, who generally build their collaborations independently. Cooperation agreements signed on the basis of existing collaborations (particularly in research) are often more active, as they partially are based on established activities and the efforts of pioneers. Such collaborations often fail to institutionalise collaboration beyond the researchers already involved, and therefore tend to peter out over time or end when key individuals disappear. According to our respondents, additional reasons for not renewing agreements when their terms expire include a lack of reciprocity in student exchange, a lack of substance in research partnerships, and more recently, the generally negative image of China in Sweden.[11]

The large single-faculty universities often have agreements that cover teaching and research in various disciplines. At the comprehensive universities, collaboration naturally occurs over a broader disciplinary spectrum, but not necessarily with the same partner university. Generally, the large universities have agreements at central as well as at faculty level, with a few at departmental level. Large universities also more frequently receive proposals and requests for partnerships from

[10] Bengtsson, A et al. (eds.) 2022. Universitet och högskolor: årsrapport 2022. Stockholm: Universitetskanslersämbetets publikationer. DOI: https://doi.org/10.53340/UKAP-5

[11] Nationellt Kunskapscentrum om Kina. (2022). Få skillnader i svensk folkopinions syn på Kina (Brief No. 3 2022).

foreign universities than smaller HEIs. At the larger HEIs, partnerships at departmental level are frequently initiated by individual researchers and teachers. At smaller HEIs, central cooperation agreements are often much more focused on specific areas and frequently result from personal relations, similar to the departmental agreements at large HEIs. Sometimes long-term collaborations have led to broader partnerships, for example at Mälardalen University, Luleå University of Technology, and Dalarna University.

Students from China and Swedish representation in China

Chinese students constitute the largest group of foreign students from outside the EU at Swedish HEIs.[12] During the 2019/20 and 2020/21 academic years, new inbound students from China to Sweden have numbered 1,600 and 900, respectively.[13] About half of the Chinese students at Swedish HEIs pay study fees. Although Swedish HEIs regard fee-paying students as an asset, Swedish universities are not financially dependent on Chinese students. In contrast, many HEIs in the United Kingdom, United States and Australia are currently experiencing considerable financial difficulties due to the decrease in Chinese students of recent years.

KTH has the most Chinese students of all Swedish HEIs, followed by Lund University, Uppsala University and Stockholm University. Many HEIs try to maintain a balance between the number of foreign students admitted and quality, which is generally seen to deteriorate with higher admissions. There is considerable variation in the prior knowledge of foreign students admitted to Swedish HEIs and accordingly in their prospects of successfully completing their studies. In response, some Swedish HEIs have supplemented the formal admission criteria (such as grades and proven English language skills) with for instance interviews to identify academically suitable applicants. KTH has been successful in attracting Chinese students through targeted initiatives and direct recruitment from some of the largest Chinese universities (e.g. Zhejiang University, Shanghai Jiaotong University and Tongji University). Most Swedish HEIs recruit students via agents or fairs. Agents are however used to a lesser extent than before due to bad experiences with unethical procedures or insufficient quality assurance of potential students' qualifications. Some smaller HEIs have attracted Chinese students through targeted initiatives through local offices in China. Linnaeus University and Dalarna University have for example previously stationed staff in China, and

[12] Calculated based on the country from which they obtained their previous academic qualification.
[13] Bengtsson, A et al. (eds.) 2022. Universitet och högskolor: årsrapport 2022. Stockholm: Universitetskanslersämbetets publikationer. DOI: https://doi.org/10.53340/UKAP-5

these HEIs have also admitted high numbers of Chinese students, relative to their total intake of foreign students.

Karolinska Institutet is the only Swedish HEI that has an official presence in China through the Ming Wai Lau Centre for Reparative Medicine in Hong Kong, founded in 2016 with a large donation from Ming Wai Lau, a Hong Kong businessman. Karolinska Institutet has been criticised for the Centre due to corruption allegations against Ming Wai Lau. The appropriacy of a branch in China has also been questioned in Sweden.[14] During 2022, Karolinska Institutet decided that the Ming Wai Lau Centre will be closed by the end of 2023.[15]

Swedish HEIs have long collaborated with Fudan University via the Nordic Centre, founded in 1995. Today, HEIs in five Nordic countries collaborate with Fudan. The University of Gothenburg has chaired the Centre since 2021 and a further five Swedish HEIs are members: Uppsala University, Lund University, Umeå University, Södertörn University, and Stockholm University. The Centre funds both research and teaching activities. In recent years, however, several Swedish HEIs have chosen to withdraw from the network.

Many Swedish HEIs have also established a series of formal[16] joint research or teaching centra with partners in China. KTH was for instance a forerunner, with the Joint Research Center of Photonics (JORCEP) with Zhejiang University (founded in 2003),[17] Joint Research and Education Centers on System-on-Chip with Zhejiang University and Fudan University (2004), and the Joint Research Center for Industrial Ecology with Shandong University (2005). Such centra have shown varying vitality and collaboration intensity. Generally, partnerships that included education tended to stand a greater chance of long-term survival. The era of establishment of Swedish – Chinese joint centres seems to, for the time being, be over.

Responsible internationalisation

Today there is an extensive and at times heated debate at Swedish universities on collaboration challenges with Chinese researchers and HEIs. Concerns include the weak institutional autonomy of Chinese HEIs, increased encroachments on academic freedom, risk of contributing to the development of dual-use technology, potential connections to the People's Liberation Army, as well as ethics dumping. At the same time, large numbers of excellent researchers in China coupled

[14] https://universitetslararen.se/2017/09/12/kis-riskanalys-av-hongkong-gjordes-forst-i-efterhand/
[15] https://blog.ki.se/rektor/2022/11/25/ming-wai-lau-centre-for-reparative-medicine-i-hongkong-avvecklas-vid-arsskiftet-2023-2024/
[16] Based on agreements between HEIs.
[17] Lund University formally joined JORCEP in 2010.

with the country's resources, infrastructure and significant scientific advances ensure that Swedish researchers and HEIs retain great interest in collaboration with China. Actual collaboration between Swedish and Chinese researchers has steadily intensified over a long period and has led to a rapidly increasing number of Swedish – Chinese co-publications. Today China is Sweden's fourth largest research partner[18] and this trend is set to continue, despite greater concerns and worsening institutional conditions for collaboration. As mentioned above, research partnerships are generally initiated at the level of individual researchers, and STINT has recently mapped the reasons why individual researchers at Swedish HEIs choose to collaborate with their Chinese counterparts.[19]

There are differences between Swedish concerns at researcher and leadership levels. Reputational risk associated with Chinese collaboration for instance is increasingly important to university leaderships to handle. Reputation is important to individual researchers too, but academic incentive structures promote publishing and gaining resources. Therefore, a risk for researchers is to not achieve those latter goals. Here an important rationale for Swedish – Chinese collaborations have been accessing resources and publications. Nevertheless, there is today great uncertainty among individual researchers as well as university leaderships on what an appropriate attitude to relations with China would entail. This applies to aspects such as ethics, integrity, academic freedom, self-censorship, personal safety, data protection, etc. However, views on these issues differ considerably between researchers, disciplines, and sometimes even HEIs.

More efforts to work with responsible internationalisation are needed at Swedish HEIs. Here other public authorities and research funders may provide support, though at the end of the day, the usefulness of such support depends on the HIEs having a clear idea of what it wants to achieve and allocating the time and resources necessary to pursuing and anchoring such objectives Although there clearly is uncertainty regarding aspects of collaboration with Chinese partners, no Swedish vice-chancellors advocate completely relinquishing such partnerships. Nevertheless, there is consensus that healthy awareness is needed.

Summary

Swedish HEIs' collaboration with China in education, and particularly in research, has dramatically intensified during the past two decades. The proportion

[18] After the United States, United Kingdom, and Germany. Measured in the number of research co-publications in 2021.
[19] STINT. (2021). *Swedish–Chinese research collaborations: Experiences from the Joint China–Sweden Mobility programme* (R 21:01, ISSN 1404–7209).

of students and researchers from China at Swedish HEIs has likewise increased. This part of the report has described different approaches taken by Swedish HEIs. In general, no formal China strategies at central level are actively employed at present, although some HEIs do implement action plans. Collaborations with Chinese partners usually take place at researcher level or on an ad hoc basis.

Historically, Swedish HEIs have been reactive regarding the establishment of formal cooperation agreements with Chinese parties. At present there are few active initiatives from university leaderships to establish relations with Chinese HEIs. Given China's strength and size as a science nation, as well as increased geopolitical tensions, it is of great importance that Swedish HEIs develop strategies and action plans regulating the proactive development and management of partnerships with China, the aims of such collaborations, and their expected benefits. Such efforts are both necessary to maximise the value of collaborations for Sweden as a science nation and to ensure that collaborations proceed responsibly.

STINT, The Swedish Foundation for International Cooperation in Research and Higher Education, was set up by the Swedish Government in 1994 with the mission to internationalise Swedish higher education and research.

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