Country Report – United States of America

STINT
Stiftelsen för internationalisering av högre utbildning och forskning

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Foreword

Recognising the importance of intelligence and analyses for the development of international strategies for higher education and research at various levels of the knowledge system, STINT has compiled a series of brief country reports focused on their academic profiles and performance.

Released as a pilot series covering 16 countries, these country reports aim to provide national overviews using current and reliable data. The selection of countries is based on STINT's existing collaborations and other criteria, not least that the selected portfolio provides an interesting illustration of developments in the academic world:

- Brazil
- Canada
- Chile
- China
- India
- Indonesia
- Japan
- Malaysia
- Kenya, Rwanda, Tanzania and Uganda
- South Africa
- South Korea
- United States of America
- Vietnam

The reports provide insight into each country's knowledge system as well as its demographic and economic context. Primarily, our intention is that both policy and decision makers, as well as practitioners within the Swedish higher education system, will utilise these reports in furthering international strategic collaboration at various levels.

Special effort has been made to include the latest available data. Data were collected in July 2020; for further details about the data and methods, see the Appendix. Several persons at STINT have been involved in the production of these reports: Erik Forsberg, Andreas Göthenberg, Niklas Kviselius, Tommy Shih and Hans Pohl, who was the project leader and developed the tables and figures.

Introduction

The rise of the United States of America from a British colony into a global superpower emphasises the country's innovation and embracing of productivity-enhancing technologies. Today the United States has the most technologically powerful economy in the world and its firms are at or near the forefront of technological advances in areas such as information technology, pharmaceuticals, and medical, aerospace, and military equipment. The United States is the world's largest importer and second largest exporter; it not only has the largest internal market for goods, but also dominates the services trade.

After the Second World War, the United States developed the world's arguably most effective national innovation system. Through a set of policies, and most importantly, vast government investment in research and development (R&D), mostly focused on maintaining a technological and military advantage over the Soviet Union, the United States became the clear leader in technology.

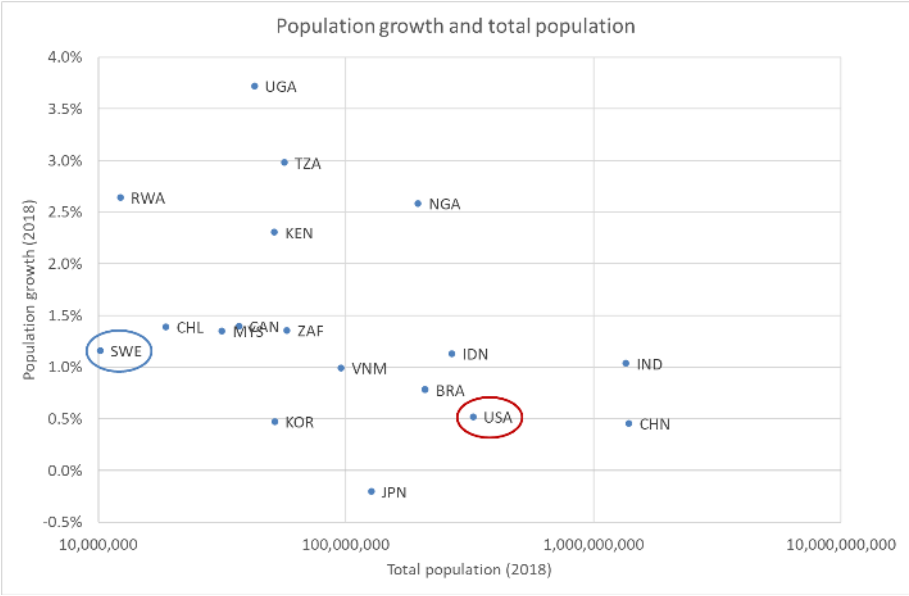
Policy experts disagree about the lack of urgency after the fall of the Soviet Union, with the gradual shrinking of federal funding, reduced focus on national innovation policies, and a slow awakening to the global ambitions of the People's Republic of China. As a case in point, while much of IT industry was still thriving in the 2000s, the United States lost over a third of its manufacturing jobs. The country went from running a trade surplus in high-technology products in 2000 to around a US$100 billion deficit a decade later. While the United States used to produce significant amounts of electronic products, including computers, much of that production has relocated to China.

Compared to other nations, funding for universities, federal labs, and other innovation inputs is decreasing in the United States, because of policymakers' unwillingness to prioritise this in the federal budget process. However, the state of US industrial innovation and competitiveness has gained renewed attention after the losses of the 2000s and the emergence of robust new technological competitors like China.

Population and economic development

The population of the United States is 332 million people, equivalent to 4.3% of the total world population.

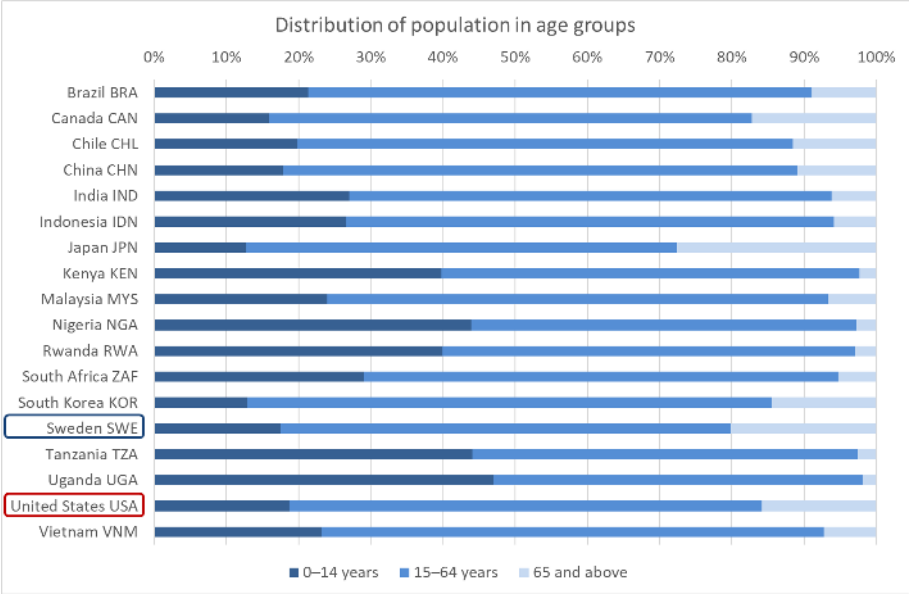
Figure 1: **Total population (logarithmic scale) and population growth**



The US population grew by less than 0.5% (see Figure 1in 2019 according to estimates by the US Census Bureau. This is the lowest growth rate since the Spanish flu killed 675,000 people in 1918. More deaths and fewer births were the greatest factors. Net foreign immigration also declined sharply in 2019, continuing a trend that started in 2017.

The slower population growth will accentuate the labour shortage and dampen demand for new housing and other durable goods, and a tight labour market is deemed to be a top business challenge in the following years. Slow population growth also indicates that employers will increase investments in robotics and automation to maintain or boost productivity.

Figure 2: **The percentage of the population in each age group**



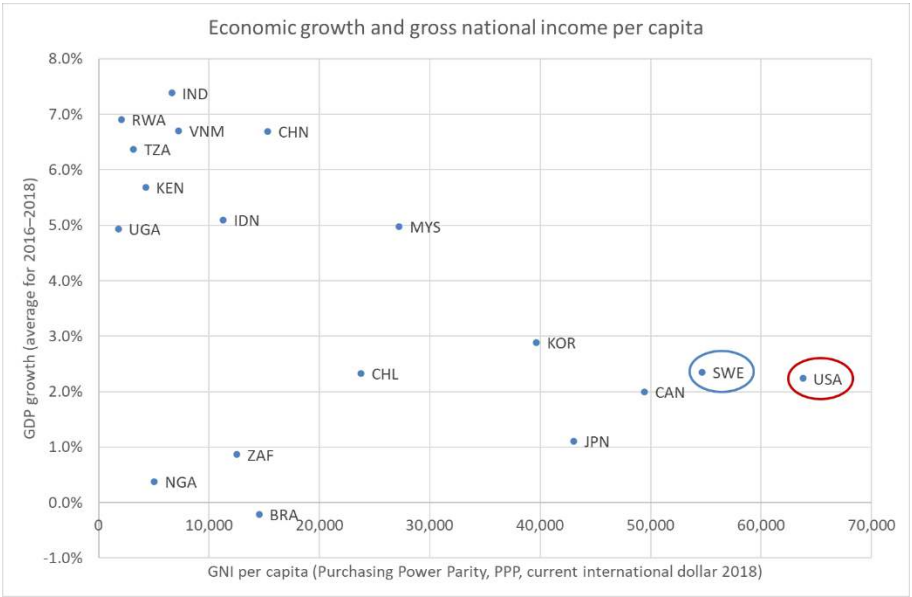
In general, the US population continues to grow older, with a median age above 40 in many states (see Figure 2). Some states, such as Florida and Maine, have large elderly populations because people retire there. In 2018, 52 million people were aged 65 and older. Their share of the population grew as well, from 12.4% in 2000 to 16.0% in 2018.

Ageing boomers – the roughly 76 million people born between 1946 and 1964 – will have a major effect on the United States in coming decennia but are not the only reason for an overall ageing population. Longer lives and record-low birth rates are other major factors. The overall fertility rate of US women is now 1.7 children per woman, below the 2.1 needed to replace the population.

Combined federal spending on programmes benefiting older adults (Social Security and Medicare) is projected to rise from 7.9% of gross domestic product (GDP) in 2019 to nearly 10% in 2029, accounting for about two-thirds of mandatory, non-defence federal spending. There is a need to address a shortage of caregivers as well, and recent restrictions on

immigration have further increased the challenges in recruiting nursing home and home care workers.

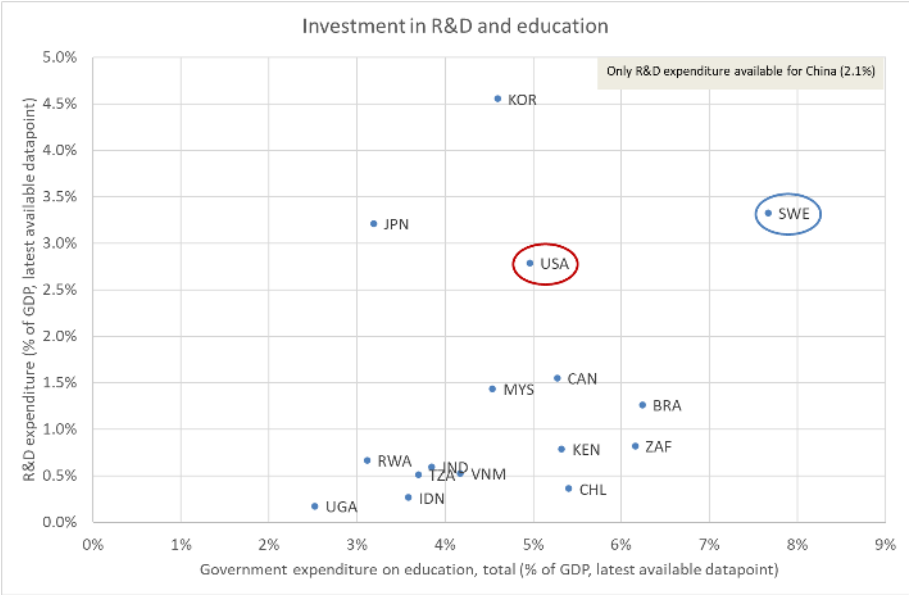
Figure 3: **Gross national income (GNI) and gross domestic product (GDP) growth**



Ten years after the end of the 2009 recession, the US economy is doing well on several fronts. GDP growth has fluctuated between 1.5 and 2.9% in recent years, peaking in 2018 with the best economic performance in a decade (see Figure 3). However, the 2020 Covid-19 recession has widely been described as the most severe global economic downturn since the Great Depression.

Gross national income per capita has steadily been increasing the last four years, but it should be noted that the United States was ranked 41st of 156 countries regarding income inequality in 2017, and worst of all Western nations. The share of American adults living in middle-income households has decreased from 61% in 1971 to 51% in 2019. The wealth gap between upper-income and middle- or lower-income families is sharper than the income gap and is growing more rapidly.

Figure 4: **Expenditure on education and research and development (R&D), both as a percentage of GDP; data predominantly for 2017 or 2018**



The US government's expenditure on education is slightly less than 5% of GDP. However, expenditure on R&D is close to 3% of GDP. In comparison, Swedish expenditure is more than 7% of GDP for education and more than 3% of GDP for R&D (see Figure 4).

Higher education institutions in the United States

The higher education powerhouse of the United States constitutes the second largest higher education system after that of China, and the country is the top global destination for international students.

With more than 4,500 accredited degree-granting higher education institutions (HEIs) nationwide, the US higher education system is extremely diverse. There are no nationally standardised definitions of "university" or "college," and the name of an institution alone may not indicate exactly what type of institution it is. The federal system of the United States has also resulted in the nation's highly decentralised education system.

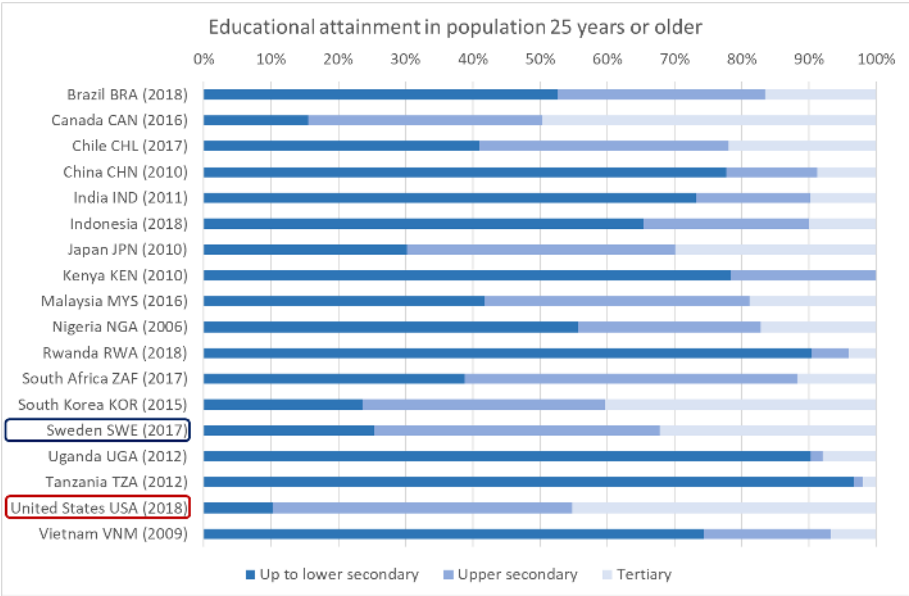
US higher education funding is complex, and many institutions have a wide variety of funding sources. Public institutions, which are under the authority of the states, have traditionally received most of their funding from state governments. Private institutions, which receive little or no direct government funding, have long relied on student tuition and fees for revenue.

The Ivy League is a group of eight historic private universities in the northeastern United States, including Yale, Columbia, Princeton and Harvard, and is perhaps the most famous university alliance in the world.

According to the 2020 QS World University Rankings, the highest ranked US universities are the Massachusetts Institute of Technology (MIT; ranked first in the world), Stanford University (ranked second), Harvard University (ranked third), California Institute of Technology (Caltech; ranked fifth), and the University of Chicago (ranked tenth).

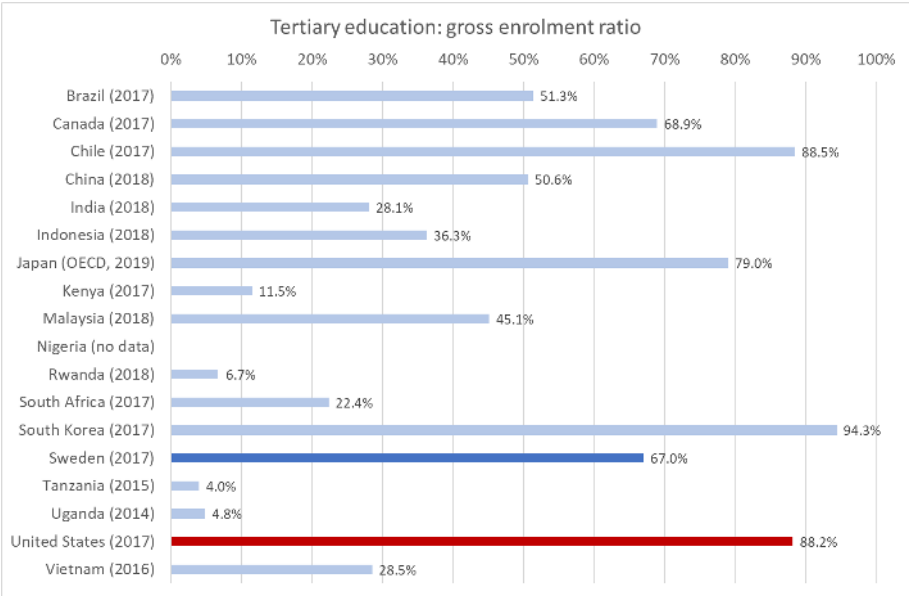
Educational attainment and student mobility

Figure 5: **Educational attainment**



The population of the United States is highly educated; more than 90% of the population (25 years or older) had attained upper secondary education or higher, which is about 15% higher than in Sweden. About 45% of the population had attained tertiary education, while another 45% had attained upper secondary education (see Figure 5). By comparison, in Sweden about 40% of the population had attained upper secondary and more than 30% tertiary education.

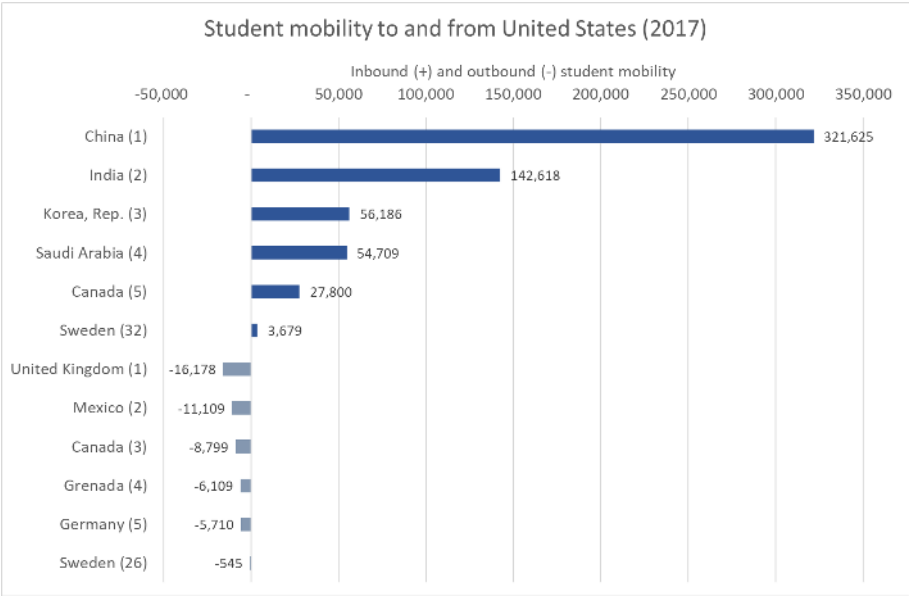
Figure 6: **Gross enrolment ratio for tertiary education**



The gross enrolment ratio (GER) for tertiary education is indicated in Figure 6. This is the ratio of students enrolled in tertiary education divided by the 5-year age group starting from the official secondary school graduation age. The GER indicates the capacity of the education system to enrol students of a particular age group.

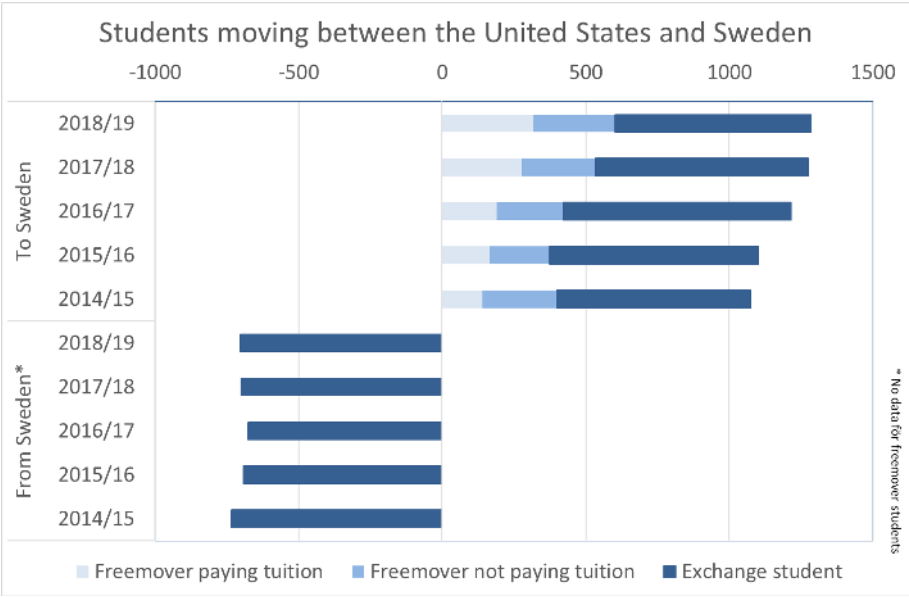
In the United States, the GER for tertiary education is 88.2%, which is very high internationally. The corresponding GER for Sweden is 67%.

Figure 7: **Inbound and outbound students, origins and destinations**



The United States is globally the most popular study destination for international students. Most international students come from China and India (see Figure 7). Students from South Korea and Saudi Arabia also constitute large groups at US universities and colleges. In 2017, 3,679 new students from Sweden studied in the United States. The number of outbound students from the United States to Sweden was modest at 545. Although there is a large student population, American students prefer to complete their tertiary studies domestically. The highest number of outbound students went to the United Kingdom.

Figure 8: **Inbound and outbound students to and from Sweden per year**



The number of exchange students moving between the United States and Sweden has remained fairly balanced over the years (see Figure 8). No data are available on inbound fee-paying students to Sweden. The number of freemover students from Sweden studying in the United States has slightly increased since 2014/15.

Figure 9: **Inbound and outbound students to and from Sweden 2018/19, per higher education institution**

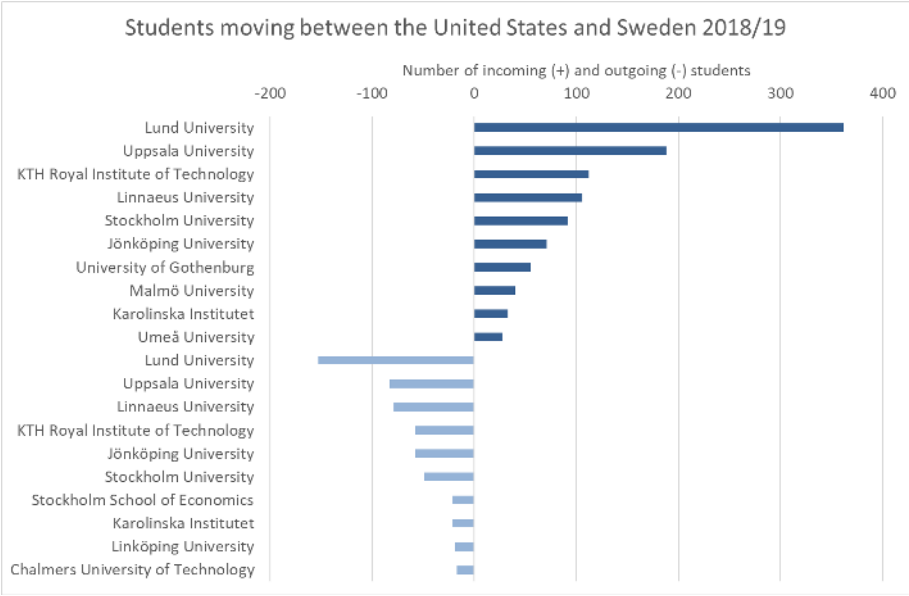


Figure 9 illustrates the inbound students from the United States to specific Swedish HEIs. By far the highest number of students go to Lund University. Uppsala University is the second most popular destination. The outbound students, comprised by exchange students, come from a heterogenous group of HEIs, including larger comprehensive universities such as Lund University and Uppsala University. Linnaeus University also has a relatively high number of outbound students.

Research and collaboration with Sweden

The United States is one of the world's strongest science nations with most of the top 100 universities in the world. During the period 2015–2019, the United States also had the largest average annual production of research publications. Measured by their field-weighted citation impact (FWCI), the average quality of US publications is 1.42. Although large countries tend to have more autarkic productions, the United States' share of international co-publications is particularly low at 0.86. Strong science nations with large production volumes and resources can keep production within their borders in a way smaller countries are unable to.

Table 1: **Selected publication indicators**

Based on publications 2015–2019							
Country	Annual publication volume (average)	Share of world	Annual volume growth 2015–2019	Citation impact	Share of int'l co-publ	Share of ac.-corp. co-publ.	Collaboration intensity with Sweden
		%	%	FWCI	FWIS	%	$NCII_{100}$
Brazil	79,128	2.54%	4.4%	0.90	0.79	2.1%	72%
Canada	110,493	3.55%	2.0%	1.51	1.31	4.2%	75%
Chile	13,929	0.45%	5.9%	1.22	1.42	2.0%	70%
China	559,913	17.98%	8.7%	1.02	0.55	2.4%	47%
India	164,707	5.29%	6.5%	0.82	0.43	1.2%	55%
Indonesia	24,572	0.79%	54.3%	0.92	0.58	0.7%	31%
Japan	133,011	4.27%	1.0%	0.95	0.69	5.4%	70%
Kenya	3,082	0.10%	7.2%	1.73	1.92	4.5%	124%
Malaysia	32,636	1.05%	5.8%	1.01	1.06	1.5%	30%
Nigeria	8,476	0.27%	14.0%	0.98	1.17	1.3%	36%
Rwanda	427	0.01%	11.2%	3.30	2.40	5.2%	203%
South Africa	24,423	0.78%	6.2%	1.26	1.29	2.9%	111%
South Korea	85,265	2.74%	2.0%	1.05	0.69	4.5%	35%
Sweden	42,975	1.38%	2.2%	1.68	1.55	8.3%	n/a
Tanzania	1,660	0.05%	7.8%	1.81	1.98	3.4%	178%
Uganda	1,741	0.06%	7.1%	1.76	2.04	4.8%	170%
United States	685,704	22.02%	0.9%	1.42	0.86	4.7%	74%
Viet Nam	7,649	0.25%	24.9%	1.43	1.67	2.2%	40%
World	3,113,580	100.00%	2.8%	1.00	1.00	2.6%	n/a

See the Appendix for detailed explanations of some of the indicators in Table 1.

Figure 10: **Annual co-publications per number of co-authors**

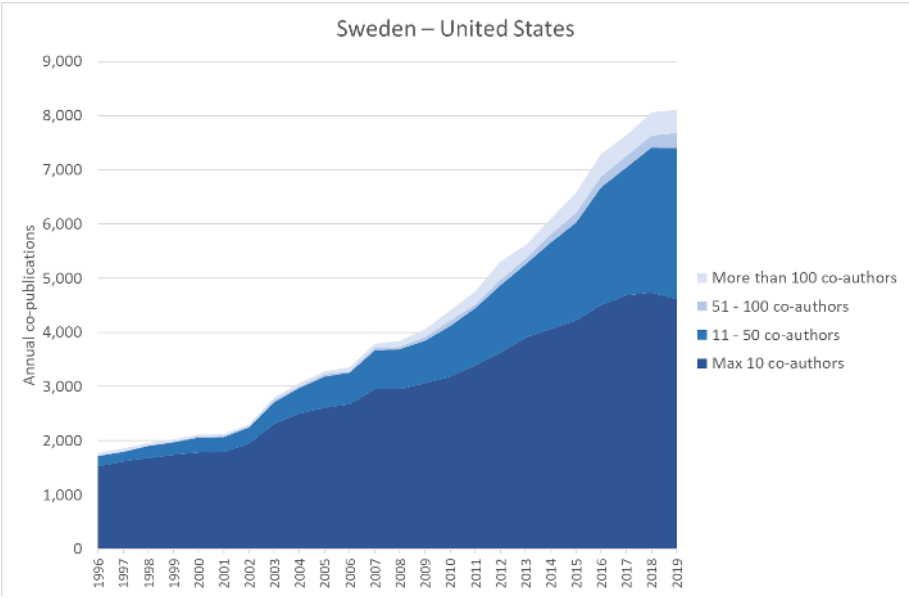
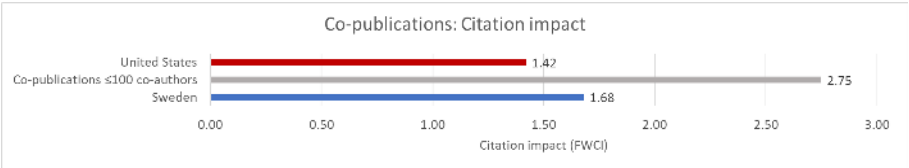
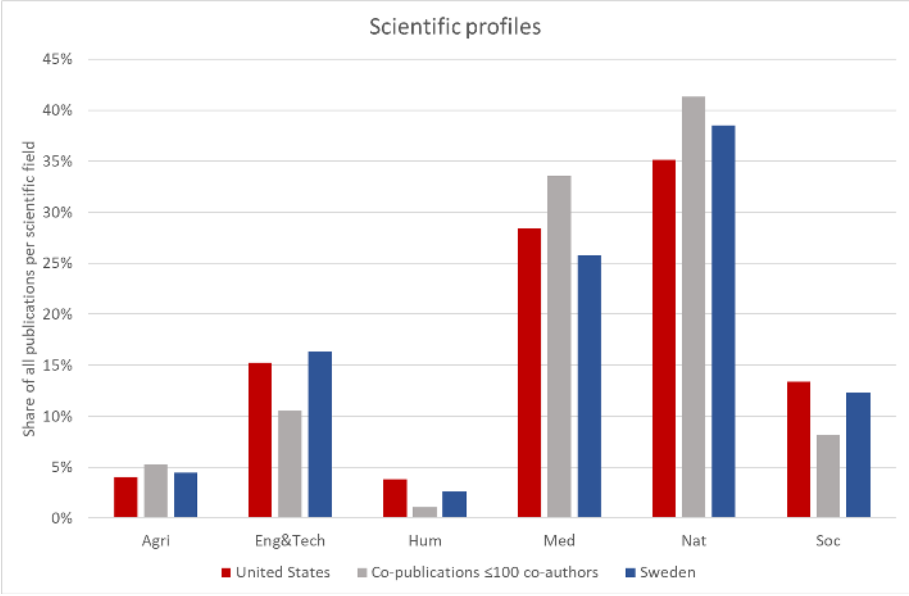


Figure 11: **Field-weighted citation impact for each country and their co-publications with ≤100 co-authors (2015–2019)**



About half of the co-publications between Sweden and the United States are produced by small cooperations involving up to ten co-authors, as indicated in Figure 10. During the last decade, the number of co-publications between Sweden and the United States has doubled. The growth is especially constituted by cooperations involving up to 50 co-authors. Both Sweden and the United States benefit when researchers work together. As can be seen in Figure 11, co-publications (with up to 100 co-authors) have a significantly higher FWCI than that of each country.

Figure 12: **Distribution of publications per scientific field (2015–2019)**



In Figure 12, the scientific profiles of research collaborations between Sweden and the United States are compared with the overall profiles of these countries in various fields. For example, approximately 15% of the publications with US participation are within engineering and technology. In Sweden, the share is similar at 16%. If all scientific fields collaborated internationally to the same extent, the shares of co-publications involving both countries would typically lie between the national shares. Interestingly, this is not the case in any field, probably partly because of the similarity between the scientific profiles of the United States and Sweden.

The agricultural, medical and natural sciences are slightly overrepresented in the collaboration at the expense of the other three fields. The relatively low shares of co-publications in the humanities and social sciences are slightly surprising, as Swedish collaboration in these fields tend to be predominantly with English-speaking countries.

Figure 13: **Word cloud based on co-publications with ≤100 co-authors (2015–2019)**

The word cloud in Figure 13 was produced using Elsevier's Fingerprint Engine. It shows the most prominent keyphrases occurring in publications with co-authors affiliated to Swedish and US institutions, based on their titles, abstracts and keywords. Large, green words signal highly relevant and growing keyphrases.

Two of the prominent keyphrases are 'odor' and 'safety assessment'. A closer look reveals that 347 co-publications are in the journal *Food and Chemical Toxicology* and concern the safety assessment registration of different fragrances. Lund University is involved in this research.

Otherwise, keyphrases in medicine dominate. 'Sweden' occurs, but 'United States' does not. This may indicate that the collaborative research has a stronger focus on the Swedish context.

Figure 14: **Wheel of science based on co-publications with ≤100 co-authors (2015–2019)**

Publications involving Swedish and US researchers almost completely cover the wheel of science (see Figure 14). Given the high number of co-publications, all bubbles are of the same size. The bubbles appear to be denser in medicine (red) whereas engineering (turquoise) appears a bit less prominent in the collaborative research. A relatively high number of bubbles in the centre of the wheel indicate that collaborations are also multidisciplinary to some extent.

Table 2: **The 20 institutions in Sweden with the highest share of co-publications with ≤100 co-authors (2015–2019). Only institutions with at least 300 publications during the period are included**

Institution	Co-publications with the United States (≤100 co-authors)	Share of all publications at the Swedish institution	FWCI
NORDITA	357	39.0%	1.83
Royal Swedish Academy of Sciences	157	38.9%	5.55
Karolinska Institutet	8130	22.6%	3.25
Swedish Museum of Natural History	290	21.8%	2.02
Stockholm University	3672	20.3%	2.57
Swedish Meteorological and Hydrological I	118	19.8%	2.99
Stockholm School of Economics	173	19.3%	3.91
Lund University	5602	17.7%	2.59
Stockholm Environment Institute	119	17.7%	5.61
Uppsala University	5165	17.5%	2.71
University of Gothenburg	3790	16.7%	3.44
Örebro University	712	15.5%	3.30
Swedish University of Agricultural Science	1405	15.5%	2.72
Umeå University	1868	15.4%	2.58
KTH Royal Institute of Technology	3007	13.7%	2.11
Chalmers University of Technology	1997	13.6%	2.07
Linköping University	1799	12.7%	2.94
Södertörn University	96	10.0%	1.43
University West	84	9.8%	1.78
Kristianstad University	54	9.2%	2.62

Table 2 ranks Swedish HEIs and research institutes based on their co-publications with the United States (with up to 100 co-authors) as a share of their total publication output. NORDITA and the Royal Swedish Academy of Sciences have co-publication shares with the United States that are significantly greater than the US share of the global publication volume (22.02%); Karolinska Institute is slightly above this mark while the rest are below, thus explaining the United States' normalised research collaboration intensity with Sweden of 74% (Table 1).

Figure 15: **Top ten Swedish institutions with the highest number of co-publications with ≤100 co-authors (2015–2019)**

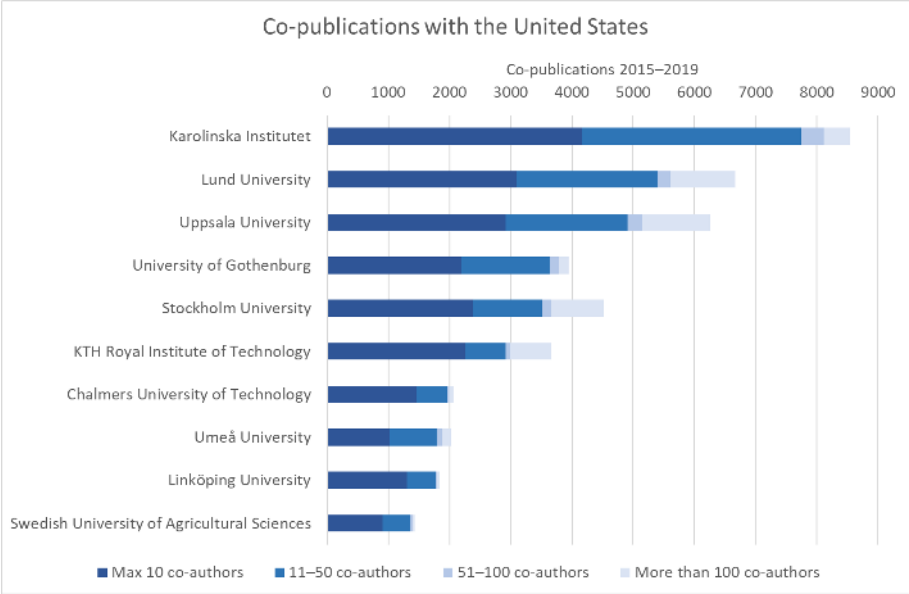


Figure 15 lists the ten Swedish universities with the highest numbers of co-publications with the United States, ranked according to the number of co-publications with up to 100 co-authors. The ranking is almost identical to that of the top ten Swedish universities by overall publication volume, with the exception of Stockholm University which ranks one place higher here than overall. Given the size and breadth of research collaboration between the United States and Sweden, it is unsurprising that the most research-intensive Swedish universities dominate this ranking.

Figure 16: **Top ten US institutions with the highest number of co-publications with ≤100 co-authors (2015–2019)**

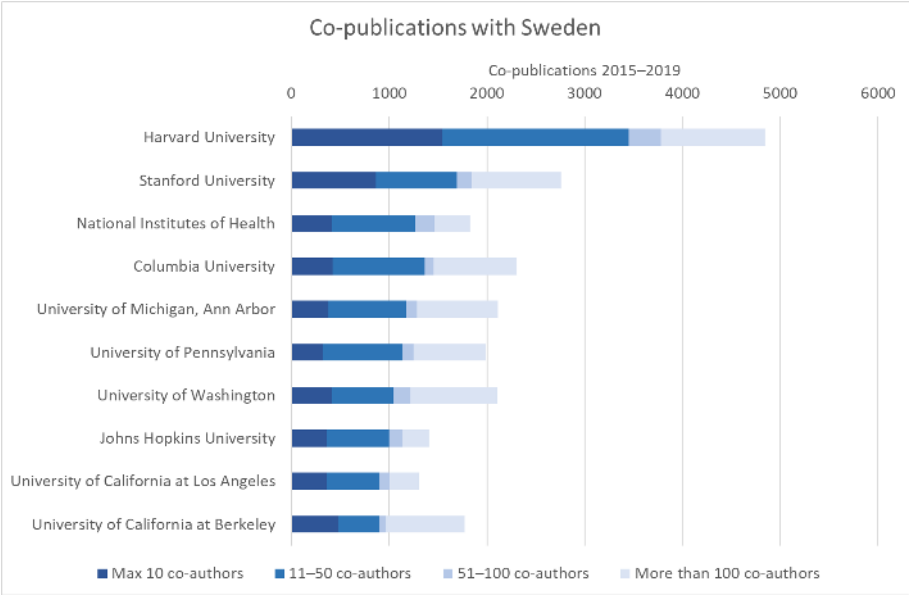


Figure 16 lists the ten US universities and research institutes with the highest numbers of co-publications with Sweden, ranked according to the number of co-publications with up to 100 co-authors. With the exception of the University of California at Berkley, all also ranked in the top ten largest institutions in the United States by publication volume. Again, this is unsurprising given the great volume and scope of research collaborations between the United States and Sweden. The US universities listed are all also ranked among the top thirty universities in the world by the most commonly referred to university rankings. Together with the high average FWCI of Swedish–US co-publications (see Figure 11), this indicates that research conducted collaboratively between the countries generally is of a very high quality.

Table 3: **Co-publication matrix for the top ten in both countries showing the number of co-publications with ≤100 co-authors (2015–2019)**

Publications 2015–2019 with up to 100 co-authors	Harvard University	Stanford University	National Institutes of Health	Columbia University	University of Michigan, Ann Arbor	University of Pennsylvania	University of Washington	Johns Hopkins University	University of California at Los Angeles	University of California at Berkeley	With the United States
Karolinska Institutet	1,576	488	765	375	237	311	368	457	334	83	8,110
Lund University	663	407	255	566	512	587	211	186	153	92	5,604
Uppsala University	559	379	215	141	146	112	169	169	235	206	5,153
University of Gothenburg	563	170	114	146	116	143	158	110	97	71	3,781
Stockholm University	245	252	49	146	119	57	140	116	97	214	3,665
KTH Royal Institute of Technology	126	212	16	48	107	32	49	62	163	148	2,997
Chalmers University of Technology	108	74	-	17	62	21	25	36	37	50	1,993
Umeå University	362	79	144	41	38	33	113	106	53	49	1,876
Linköping University	110	85	88	31	36	46	42	33	39	37	1,795
Swedish University of Agricultural Sciences	38	35	10	12	10	17	39	-	12	47	1,400
With Sweden	3,778	1,846	1,464	1,454	1,285	1,251	1,219	1,142	1,008	970	11,911

The co-publication matrix in Table 3 shows the co-publications (with up to 100 co-authors) between the top ten collaborating institutions in Sweden and the United States and thus gives an indication of distribution of the collaborations between US and Swedish HEIs. The blue/green bars represent the ratio of the number of co-publications between two HEIs to the total number of co-publications (for the Swedish institution). Harvard University is rather dominant in Swedish–US research collaborations, contributing to more than 30% of all co-publications between the countries. Even so, Swedish–US research collaborations are overall quite well distributed and involve a broad range of institutions.

Appendix: Data and methods

Data

The report is based on data from the following organisations, accessed in June/July 2020:

- Population and economic data: World Bank, see https://databank.worldbank.org/home.aspx
- Educational attainment and student mobility: UNSCO, see http://data.uis.unesco.org, and the Swedish Higher Education Authority (UKÄ), see https://www.uka.se/statistik--analys/statistikdatabas-hogskolan-i-siffror.html (with one data point from the OECD for Japan)
- Research: Publication data from Scopus, the broadest available publication database, see https://www.elsevier.com/solutions/scopus?dgcid=RN_AGCM_Sourced_300005030

In some cases, there are clear differences in the student mobility data from UNESCO and UKÄ. Different reporting periods and definitions (see below) might explain some of these differences.

Methods

According to the UNESCO Institute for Statistics, an internationally mobile student is an individual who has physically crossed an international border between two countries with the objective to participate in educational activities in a destination country, where the destination country is different from his/her country of origin. For measuring international mobility in education, UNESCO, OECD and Eurostat have agreed that the preferred definition of the country of origin should be based on students' educational careers prior to entering tertiary education. See http://uis.unesco.org/en/methodology#Q5

The research section includes several indicators and figures that might require further explanation.

Table 1, Selected publication indicators. The annual growth is calculated by using linear regression to approximate the volume development during the period 2015–2019. The field-weighted citation impact (FWCI) is a normalised indicator comparing the citations a publication receives with other publications in the same scientific field, from the same year, and in the same type of publication. If the FWCI is above one, the publication is more frequently cited than the world average, and vice versa. The field-weighted internationalisation score (FWIS) is normalised in a similar manner. A FWIS above one means that the publications are more international (include more international co-authorships) than the world average, and vice versa.[1] Academic–corporate co-publications include at least one academic and one corporate affiliation and at least two co-authors. Finally, the normalised collaboration intensity index (NCII) illustrates how the collaboration differs from a situation when Sweden (or another entity) collaborates with all countries in proportion to their share of all international co-publications globally. For example, authors with an affiliation in the United States participate in 16% of all international co-publications globally. In Sweden's international co-publications, the share of US co-authors is 11%. The NCII is calculated as the actual share divided by the 'expected' share, i.e. 11/16 = 67%, which indicates that US collaboration is underrepresented in Sweden's portfolio of international co-publications.[2]

Figure 12, Distribution of publications per scientific field (2015–2019). The scientific profile is calculated using the OECD categorisation of publications in six scientific fields: agricultural sciences, engineering and technology, humanities, medical sciences, natural sciences, and social sciences. For each field, the share of publications is calculated using the

[1] For more details, see Pohl, H., Warnan, G. and Baas, J. (2014), 'Level the playing field in scientific collaboration with the use of a new indicator: Field-weighted internationalization score', *Research Trends* 39, 3–8.

[2] For a more detailed description, see Pohl, H. (2020), 'Collaboration with countries with rapidly growing research: supporting proactive development of international research collaboration', *Scientometrics* 122(1), 287–307. https://doi.org/10.1007%2Fs11192-019-03287-6

number of publications within the field and the total number of publications in the dataset.

The **word cloud (Figure 13)** is a feature in SciVal, which uses the Elsevier Fingerprint Engine to extract distinctive keyphrases within the publication set. For more information, see https://www.elsevier.com/solutions/elsevier-fingerprint-engine

The **wheel of science (Figure 14)** is another feature directly available in SciVal. Each bubble represents a topic. The size of the bubble indicates the output of the entity on that topic. The position of the bubble is based upon the All Science Journal Classification (ASJC) categories of the journals in which the scholarly output is published. The position is related to the topic as a whole and is not affected by the entity examined. The greater influence an ASJC has over a topic, the closer the topic is dragged to its side of the wheel. As a result, the topics closer to the centre of the wheel are more likely to be multidisciplinary, compared to the topics along the edge of the wheel.

Note that a topic may be placed at the edge of the wheel, but still be considered multidisciplinary because it is equally influenced by a number of ASJCs that are located on the same side of the wheel.

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.

STINT promotes knowledge and competence development within internationalisation and invests in internationalisation projects proposed by researchers, educators and leaderships at Swedish universities.

STINT promotes internationalisation as an instrument to:

- Enhance the quality of research and higher education
- Increase the competitiveness of universities
- Strengthen the attractiveness of Swedish universities

STINT's mission is to encourage renewal within internationalisation through new collaboration forms and new partners. STINT for example invests in young researchers' and teachers' international collaborations. Moreover, STINT's ambition is to be a pioneer in establishing strategic cooperation with emerging countries in research and higher education.

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