Country Report – Brazil

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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

Brazil is the most populous country in South America. The country's economy is the largest on the continent and ninth largest in the world. Brazil is part of the BRICS group of emerging economies[1] and is classified as an upper middle-income country.

Gradually greater investments have been made in higher education institutions (HEIs) and research and development (R&D) in recent years. In comparison with other countries at similar levels of development, Brazil makes significant investments, especially in education. In 2017, 51.3% of the school-aged population at the tertiary level was enrolled in higher education programmes. In 1999, the proportion was only 16%.

These investments in R&D and education have, to some extent, facilitated transition into a wider value-added economy. The investments have been almost equally spread between the state and the private sector. Although traditional industries (agriculture, oil and gas, and steel) remain dominant, there are signs of industrial transformation. Considerable investments have been made in areas such as information and communications technology, artificial intelligence, financial technology, renewable energy, and agricultural technology.

However, the varying stability of relationships between the federal government and states, political conflicts, corruption and high levels of inequality create a volatile environment that impedes further development.

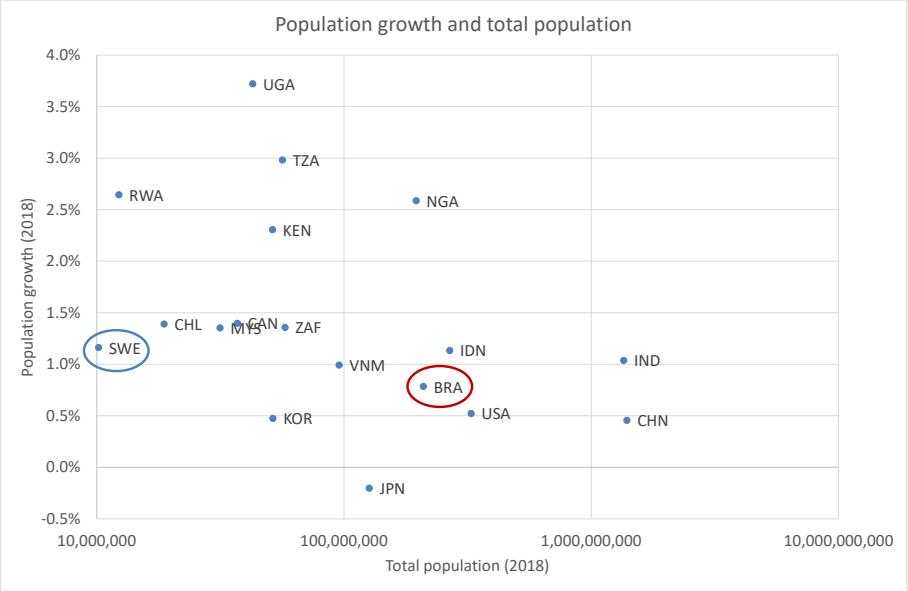
In recent years, the change brought on by a populist government has led to the defunding of universities and increased government control over educational content.

[1] Brazil, Russia, India, China, and South Africa.

Population and economic development

In 2019, Brazil had a population of 213 million people, and the country's population growth is in steady decline due to an overall decreasing fertility rate. In 1951, the growth rate was 3.0% and in 2019 it was 0.72%. After reaching a peak of 230 million in 2045, Brazil's population is expected to decrease slowly.

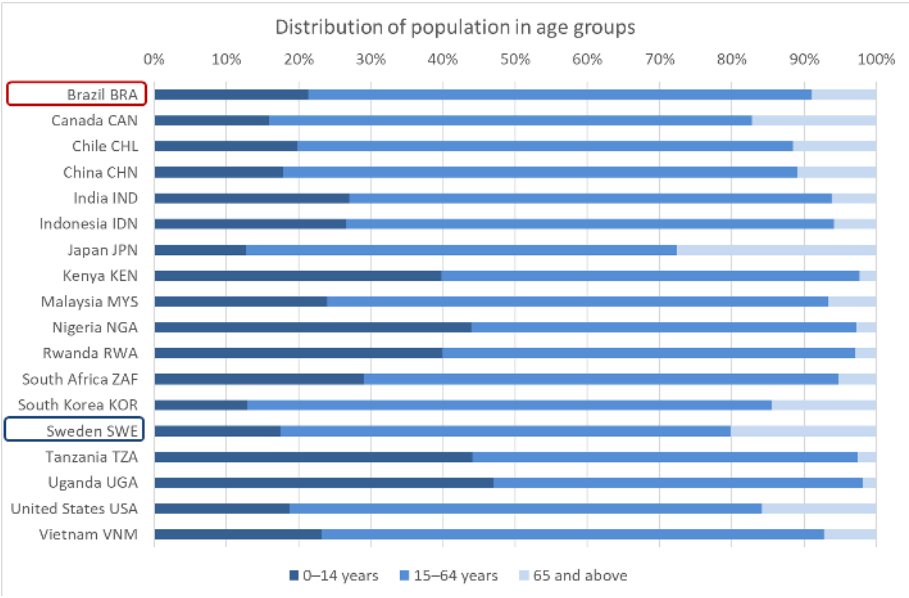
Figure 1: **Total population (logarithmic scale) and population growth**



Historically, immigration has been an important part of population growth. The government encouraged the arrival of Europeans to occupy plots of land and become small farmers. Several waves, also from Japan, followed until the 1930s, and from 1870 to 1930, 2–3 million immigrants settled in Brazil. Since 1930, immigration to Brazil has significantly decreased.

Economic crises in the 1980s and 1990s turned Brazil from a country of immigration into one of emigration as well. On average, about 100,000 Brazilians have left the country annually since 2000 and large Brazilian populations reside in the United States and Europe.

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

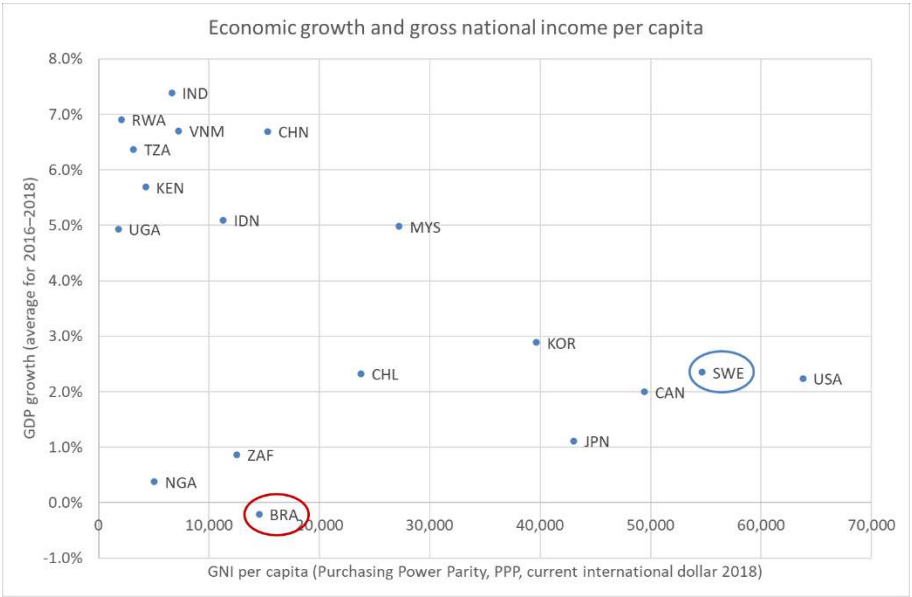


Throughout Brazil's history, population growth has been rapid, and it is still a country of young people. The Brazilian population is also said to be the most racially mixed in the world. Geographically, the population distribution in Brazil is very uneven. The majority of Brazilians live within 300 kilometres of the coast, while the interior is almost empty.

Brazil only became an "ageing" society in 2012, and with a relatively young population and other development priorities, accommodating ageing has not yet become a focus of the Brazilian government. Yet the population share comprised by people aged 65 and older is projected to triple by 2050, driven by improved life expectancy and declining fertility rates.

This growing number of senior citizens may also have an impact on the economic growth and social welfare of Brazil. The social security system in Brazil is already under strong pressure from the increased ratio of dependents to active workers making monthly contributions. People are allowed to retire at young ages, even in their 50s, if they started working young.

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

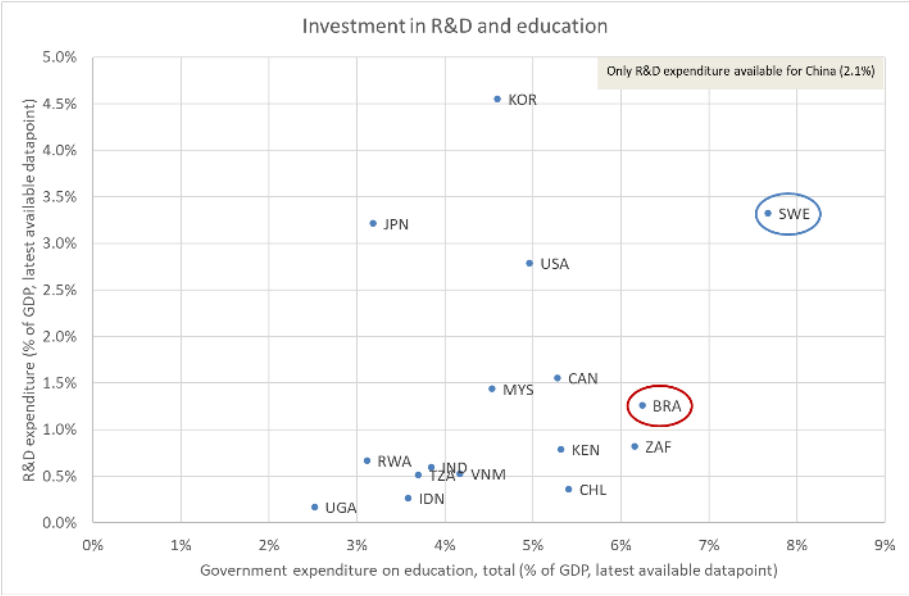


Brazil's economy was the ninth largest in the world by gross domestic product (GDP) and eighth largest by purchasing power parity in 2019. From 2000 to 2012, Brazil was one of the fastest-growing major economies in the world, with an average annual GDP growth rate of over 5%.

However, the country's economic growth decelerated in 2013 and the country entered a recession in 2014. Brazil has suffered low productivity growth over the last two decades due to a cumbersome business environment, distortionary tax system, and a domestic market that is relatively closed to trade and external competition. Income inequality is also a distinct feature of the Brazilian economy.

Brazil further lacks adequate investment in infrastructure, resulting in a deterioration of the infrastructure stock that in turn creates acute bottlenecks for production. Covid-19 hit as Brazil was still recovering from its 2014–16 recession. Economic recovery remained weak since the peak of the recession in 2015–2016, with 1.3% real GDP growth recorded in both 2017 and 2018, and 1.1% in 2019.

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



The Brazilian government's expenditure on education is slightly more than 6% of GDP, which is relatively high internationally. However, expenditure on R&D is less than 1.5% of GDP. Brazilian government expenditure on education, as well as R&D, is higher as a percentage of GDP than that of Chile. 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 Brazil

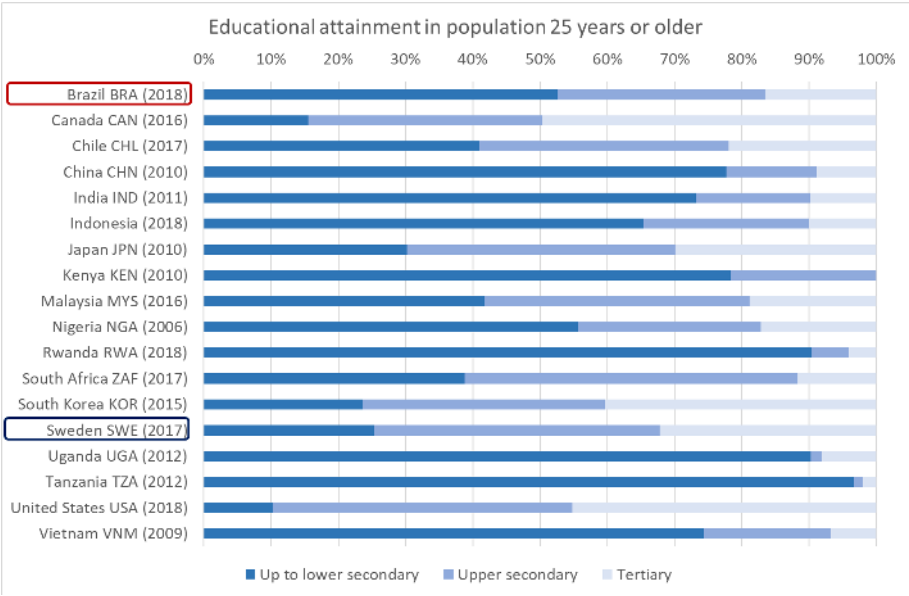
Brazil's higher education system is fairly young. Nonetheless it is one of the stronger systems in the region. Large investments have been made in HEIs and R&D in recent years. In comparison with other countries at similar levels of development, Brazil invests significantly, especially in education.

Today there are over 2,600 universities and a high number of colleges in the country, and the system caters to over 8 million students. Universities are funded by federal and state sources, while private universities rely heavily on tuition-paying students.

The University of São Paulo (USP) has the highest world ranking of Brazilian HEIs. The Academic Ranking of World Universities (ARWU) ranked USP in the 101–150 range. Other prominent universities include the University of Campinas, the Federal University of Rio de Janeiro, São Paulo State University, the Federal University of Minas Gerais, and the Federal University of Rio Grande do Sul. These are all ranked among the top 500 in the world by ARWU.

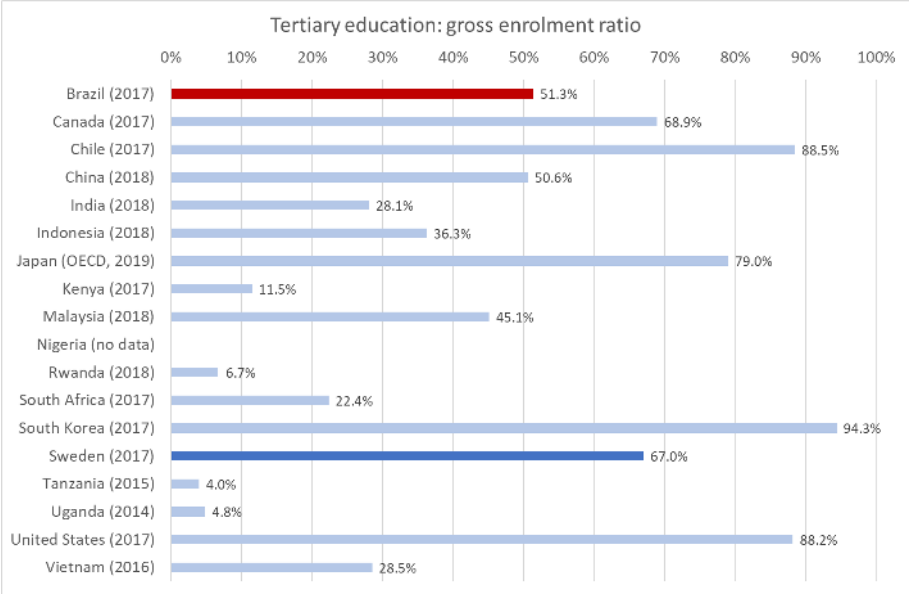
Educational attainment and student mobility

Figure 5: **Educational attainment**



In Brazil, about 30% of the population (25 years or older) had attained upper secondary education in 2018. Less than 20% had attained tertiary education. These numbers are lower than for Chile (see Figure 5). By comparison, in Sweden about 40% of the population had attained upper secondary and more than 30% tertiary education.

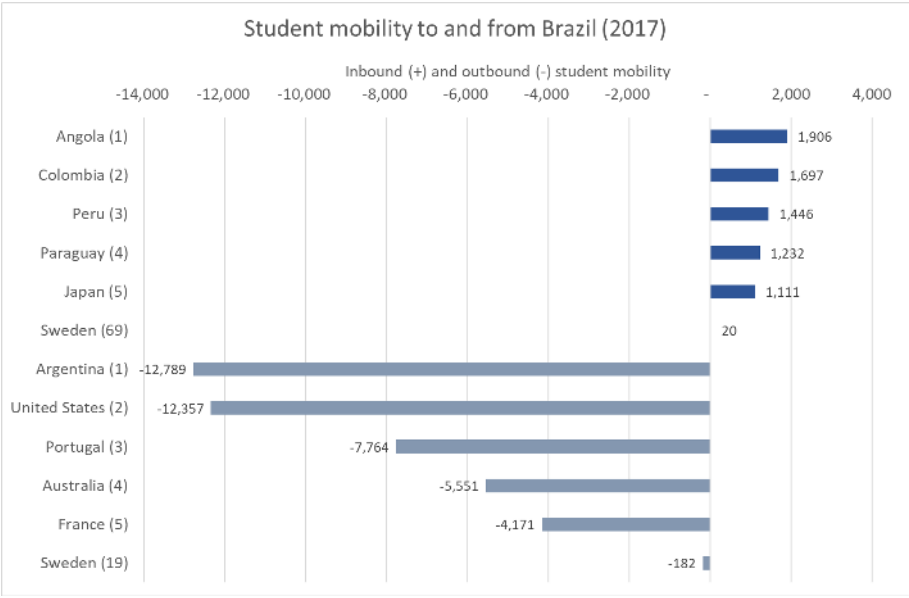
Figure 6: **Gross enrolment ratio for tertiary education**



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 Brazil, the GER for tertiary education is 51.3%, which is significantly lower than that of Chile at 88.5%. The corresponding GER for Sweden is 67%.

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



In 2017, incoming students to Brazil mainly comprised students from Angola, neighbouring countries in South America, and Japan (see Figure 7). Swedish students constitute a relatively modest group; only 20 students from Sweden went to study in Brazil the same year. The number of Brazilian students coming to Sweden was 182. The most popular study destinations for Brazilian students were Argentina and the United States.

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

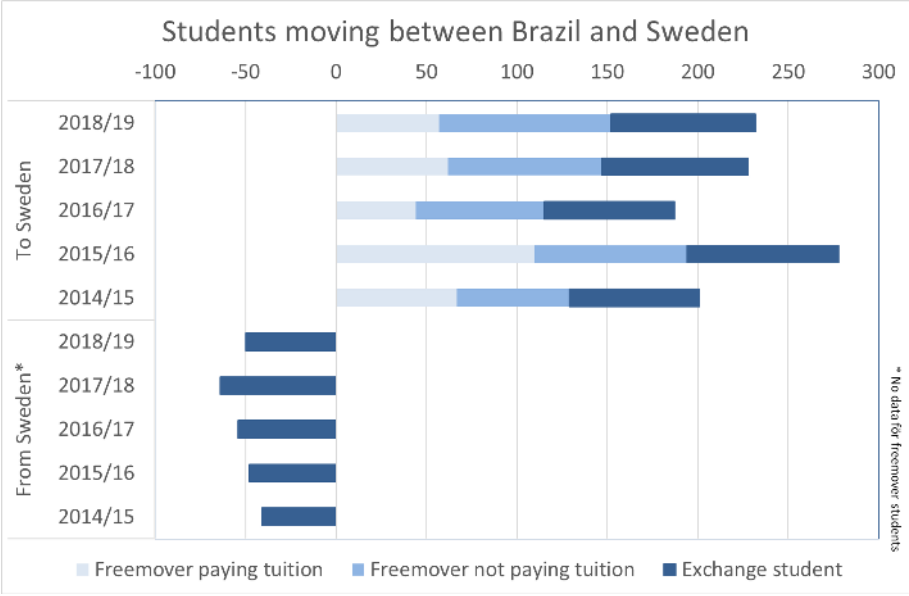
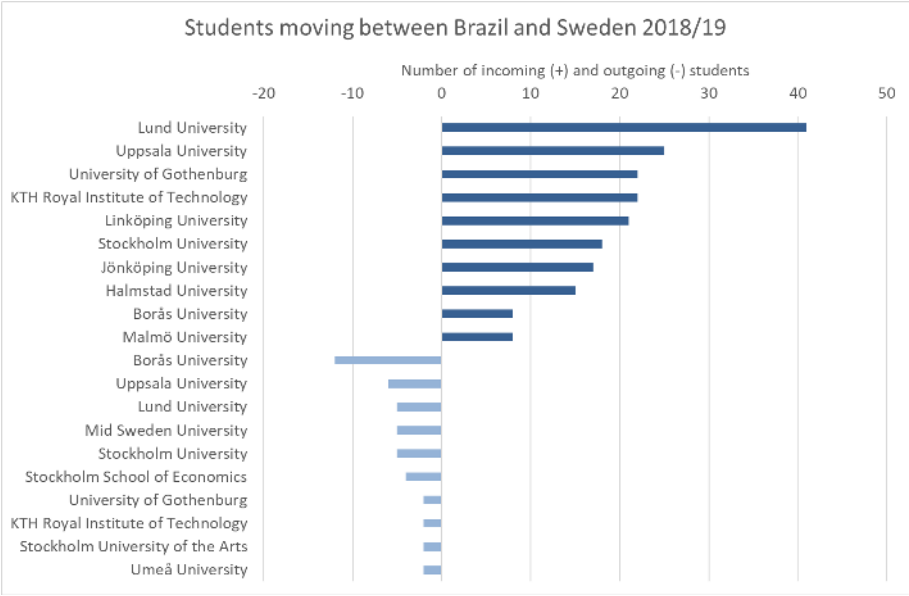


Figure 8 illustrates the inbound and outbound students to and from Sweden. Brazil is not a common study destination for Swedish students. Swedish data show that the number of outgoing exchange students has remained constant in recent years, with roughly 50 students doing a study exchange in Brazil. The exchange between the two countries is asymmetrical, with more students coming from Brazil to Sweden than vice versa.

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



In Figure 9, the exchange pattern for specific HEIs is illustrated. Lund University has by far the highest number of inbound Brazilian students of all Swedish HEIs. The University of Borås has the highest number of outgoing students to Brazil. Typically the comprehensive universities in Sweden have larger exchange programmes.

Research and collaboration with Sweden

Brazil has moderate science and technology capacity in an international comparison. The global share of the country's scientific production is smaller that would be expected relative to the size of its economy and population. However, Brazil has shown significant growth in publication volumes in recent years. Measured by citation impact, the quality of Brazil's research output is slightly below the world average. The field-weighted citation impact (FWCI) was 0.90 between 2015 and 2019. With regards to international collaboration, Brazil has a relatively closed science system.

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**

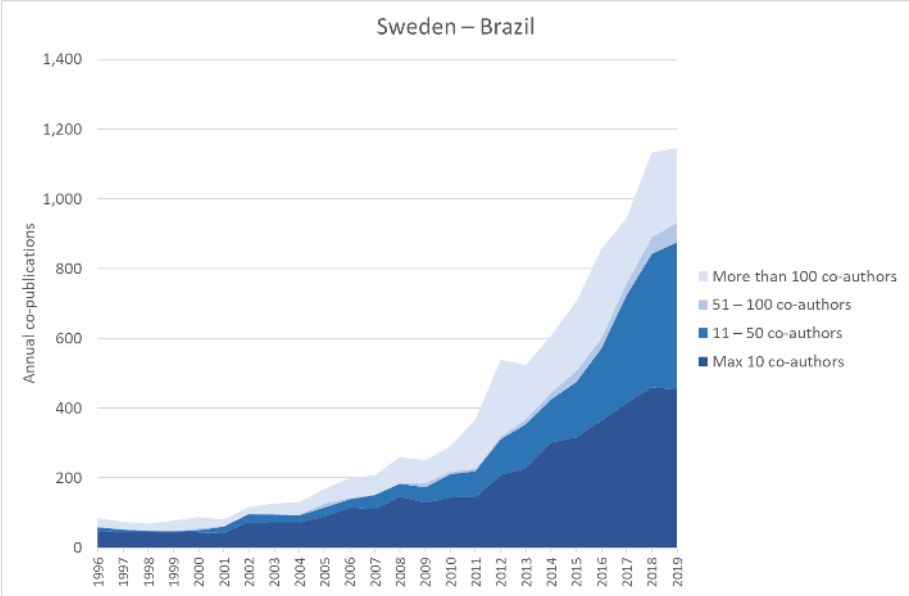
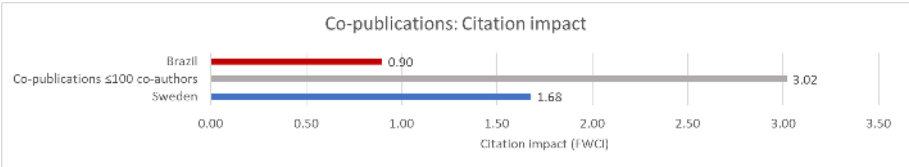
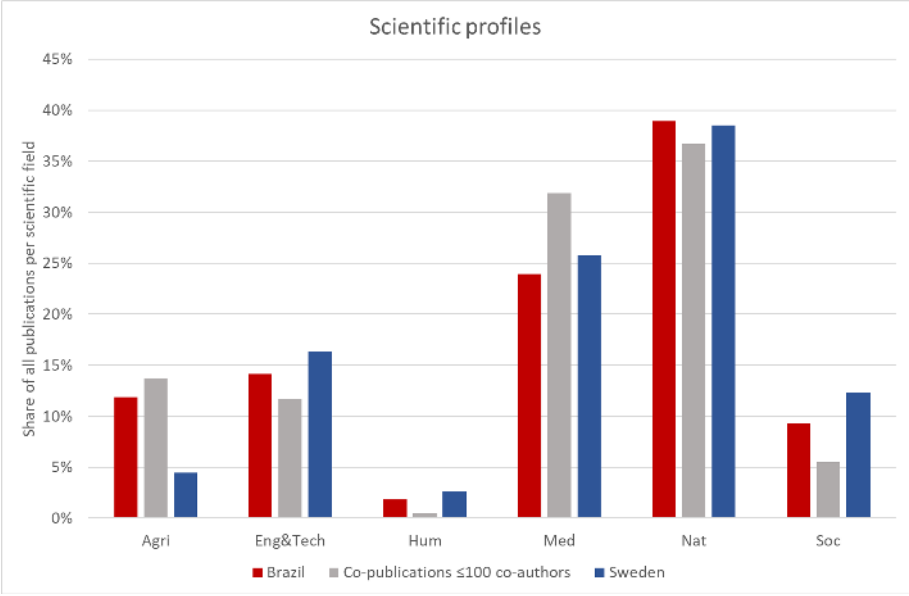


Figure 11: **Field-weighted citation impact for each country and their co-publications with ≤100 co-authors (2015–2019)**



Co-publications between Sweden and Brazil are dominated by cooperations with up to 50 co-authors, as indicated in Figure 10. During the last decade there has been a drastic increase in the number of co-publications between Sweden and Brazil, especially regarding medium-sized cooperations with 11–50 co-authors. Both Sweden and Brazil 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.

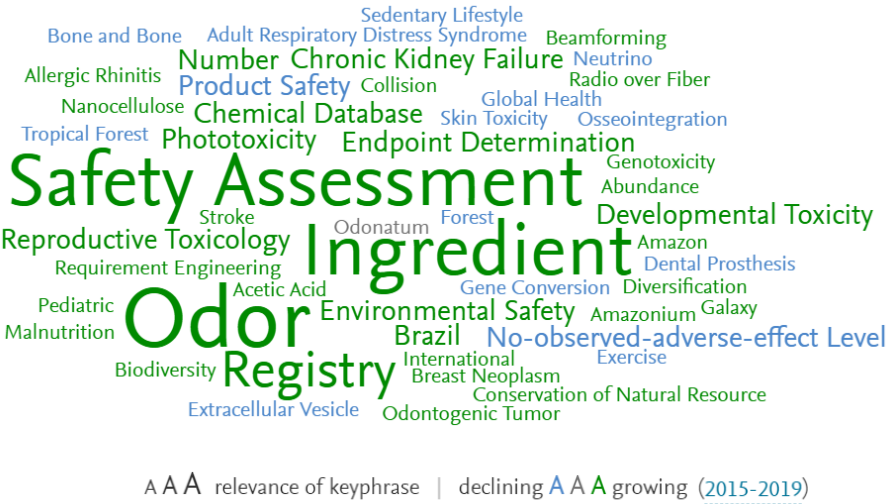
Figure 12: **Distribution of publications per scientific field (2015–2019)**



In Figure 12, the scientific profiles of research collaborations between Sweden and Brazil are compared with the overall profiles of these countries in various fields. For example, approximately 12% of the publications with Brazilian participation are within the agricultural sciences. In Sweden, the corresponding share is slightly below 5%. 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. However, collaborations between Sweden and Brazil do not follow this rule of thumb, as the agricultural sciences and medicine are overrepresented, and the other scientific fields have slightly higher shares than expected.

The HEIs with high numbers of Sweden–Brazil co-publications are listed below. Given the profile of these co-publications, institutions encompassing medicine as well as agricultural sciences (e.g. the Swedish University of Agricultural Sciences) are involved, as may be expected.

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

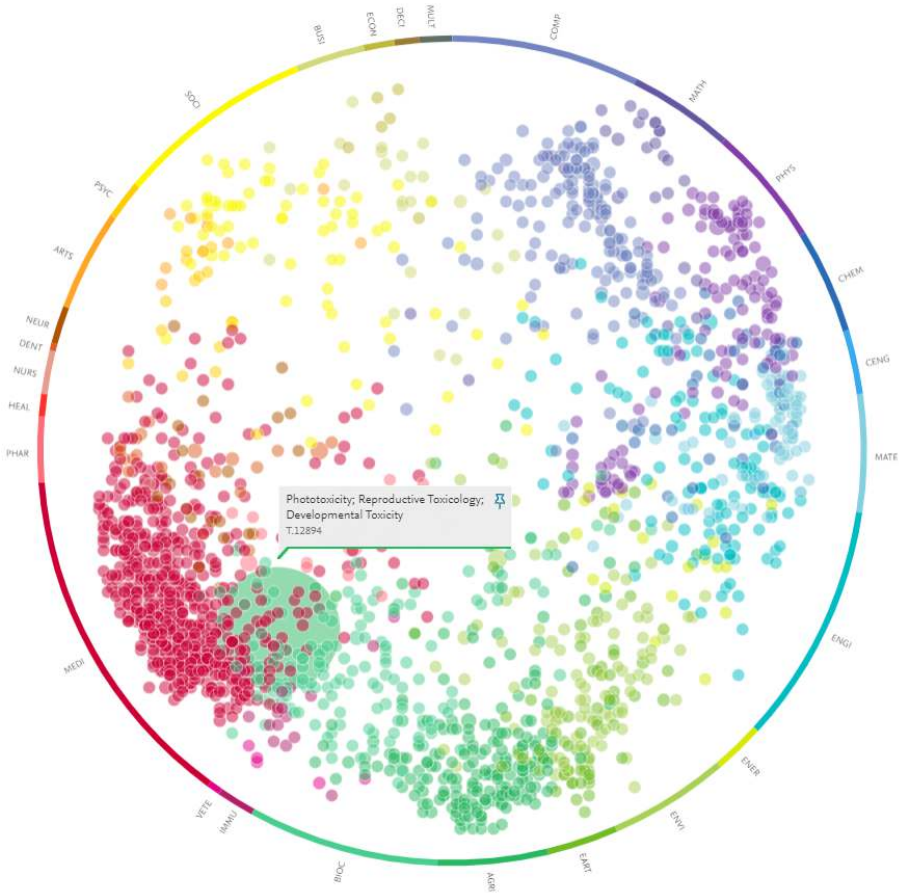


The word cloud in Figure 13 was produced using Elsevier's Fingerprint Engine. It shows the most prominent keyphrases occurring in publications with co-authors affiliated to Swedish and Brazilian institutions, based on their titles, abstracts and keywords. Large, green words signal highly relevant and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

Several keyphrases appear to pertain to medicine, even though some of the largest are very general and could pertain to virtually any scientific discipline.

Some keyphrases, such as 'biodiversity', 'environmental safety' and 'conservation of natural resource', clearly pertain to environmental research. 'Brazil' is among the keyphrases whereas 'Sweden' is not. One interpretation is that the research done in collaboration between the countries has a stronger focus on the Brazilian context.

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



Publications involving Swedish and Brazilian researchers cover almost all scientific fields (see Figure 14). The bubbles in the centre of the circle indicate the presence of some multidisciplinary collaborations. The slight dominance of red bubbles confirms the high number of co-publications within medicine. Interestingly, there are also several green-red bubbles, indicating biomedical topics. The largest bubble represents toxicology and is positioned in this area. Its size indicates that a high number of all the included co-publications are on this topic.

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 Brazil (≤100 co-authors)	Share of all publications at the Swedish institution	FWCI
Stockholm Environment Institute	45	6.68%	4.18
Ericsson AB	110	5.31%	0.78
Blekinge Institute of Technology	62	4.94%	1.58
Halmstad University	40	3.76%	1.02
Malmö University	78	3.39%	1.69
RISE ICT	33	3.24%	1.09
IVL Swedish Environmental Research Institute	11	2.79%	5.01
Swedish Museum of Natural History	36	2.70%	2.02
Lund University	840	2.66%	1.88
Swedish University of Agricultural Sciences	199	2.19%	3.52
University West	15	1.74%	0.96
University of Skövde	20	1.68%	1.98
Karolinska Institutet	601	1.67%	4.20
University of Gothenburg	352	1.55%	5.72
Sandvik AB	6	1.53%	0.87
Uppsala University	429	1.45%	4.45
Linnaeus University	49	1.38%	2.01
NORDITA	12	1.31%	1.87
Linköping University	181	1.27%	3.03
Stockholm University	227	1.26%	2.75

Table 2 ranks Swedish HEIs and research institutes based on their co-publications with Brazil (with up to 100 co-authors) as a share of their total publication output. While larger and research-intensive HEIs dominate collaborations with Brazil (see Figure 15), such co-publications constitute a fairly modest share of their total output. Of these, only Lund University has a share of co-publications with Brazil that is commensurate with Brazil's share of the global research output. A few of the smaller Swedish universities have a co-publication ratio significantly higher than that of Brazil's share of the global research output. However, because of low overall co-publication numbers, a few publications can make a significant impact on the co-publication ratio. Stockholm Environment Institute's collaboration with Brazil stands out with a high co-publication rate that also has a high FWCI. Ericsson AB also has a significant proportion of co-publications with Brazil, which can partially be attributed to Ericsson's local R&D lab in Brazil (its only such facility in Latin America).

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

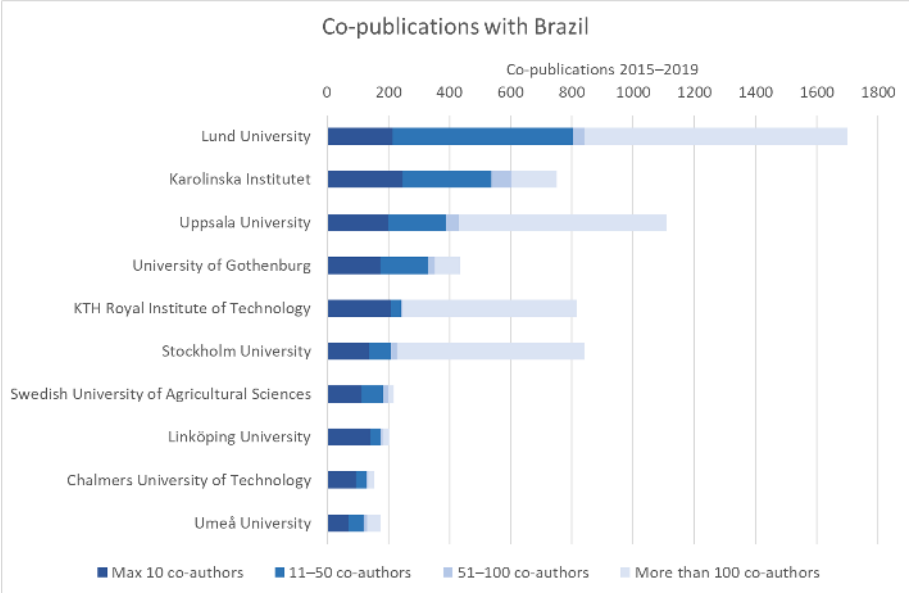


Figure 15 lists the ten Swedish universities with the most co-publications with Brazil, ranked according to the number of co-publications with up to 100 co-authors. This ranking closely follows the ranking of the total number of publications by Swedish universities, the main difference being that the Swedish University of Agricultural Sciences is clearly ranked higher regarding co-publications with Brazil. For Lund University, Uppsala University, Stockholm University and KTH Royal Institute of Technology, a large share of their co-publications with Brazil are in the fields of astronomy and particle physics, which explains why their highest numbers of co-publications are those with more than 100 authors, something which is common in these fields.

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

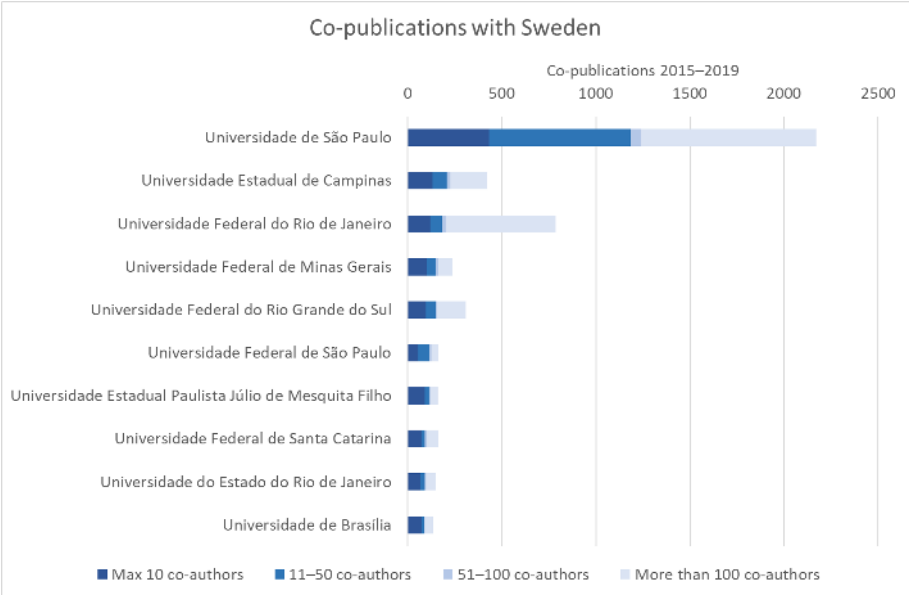


Figure 16 lists the ten Brazilian universities with the highest numbers of co-publications with Sweden, ranked according to the number of co-publications with up to 100 co-authors. Universidade de São Paulo (USP) clearly dominates research collaborations between Brazil and Sweden, alone almost producing more co-publications than all the rest of the Brazilian universities in the list together. This is not surprising, as USP is the largest public university in Brazil with a research output almost three times that of Universidade Estadual Paulista "Júlio de Mesquita Filho" (São Paulo State University, UNESP), the second largest Brazilian university by research output. USP is also the highest-ranking university in Brazil internationally, as well as one of the highest ranked universities in Latin America. The order in Figure 16 on the whole follows the ranking of the largest research universities in Brazil by publication volume. Notable exceptions are UNESP, which ranks lower for Swedish co-publications than its total research output rank, and Universidade do Estado do Rio de Janeiro, which ranks higher for Swedish co-publications than its total research output rank.

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	Universidade de São Paulo	Universidade Estadual de Campinas	Universidade Federal do Rio de Janeiro	Universidade Federal de Minas Gerais	Universidade Federal do Rio Grande do Sul	Universidade Federal de São Paulo	Universidade Estadual Paulista Júlio de Mesquita Filho	Universidade Federal de Santa Catarina	Universidade do Estado do Rio de Janeiro	Universidade de Brasília	With Brazil
Lund University	553	39	35	13	16	21	8	10	6	10	840
Karolinska Institutet	161	45	24	56	54	52	9	16	34	13	601
Uppsala University	120	18	34	17	16	14	21	3	3	3	429
University of Gothenburg	105	28	17	8	15	21	15	4	8	8	352
KTH Royal Institute of Technology	47	25	28	10	8	2	4	10	8	4	248
Stockholm University	54	15	32	12	11	10	10	8	4	2	227
Swedish University of Agricultural Sciences	48	11	9	7	9	-	22	9	2	7	199
Linköping University	28	6	23	2	10	7	1	8	8	23	181
Chalmers University of Technology	39	8	7	7	2	1	7	3	2	7	135
Umeå University	50	8	7	2	6	8	7	3	4	-	130
With Sweden	1,243	226	201	162	156	125	118	103	97	92	3,683

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 Brazil and thus gives an indication of the distribution of collaborations between Swedish and Brazilian 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). Again, we can see how strongly USP dominates research collaborations between Brazil and Sweden; USP contributed to a full 34% of all Swedish–Brazilian co-publications. Only KTH Royal Institute of Technology, the Swedish University of Agricultural Sciences and Linköping University have co-publication ratios above 10% with universities other than USP. Lund University especially stands out with a very small spread in its collaboration with Brazil as its co-publication share with the top ten collaborating Brazilian HEIs amounts to 85% of the total volume, while at the same time a full 66% of these comprise co-publications with USP.

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: UNESCO, 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, the 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.[2] 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.[3]

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

[2] 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.

[3] 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.

STINT
Stiftelsen för internationalisering av högre utbildning och forskning
The Swedish Foundation for International Cooperation in Research and Higher Education

Wallingatan 2, SE-111 60 Stockholm, Sweden
Telephone +46 8 671 19 90. Fax +46 8 671 19 99
info@stint.se, www.stint.se