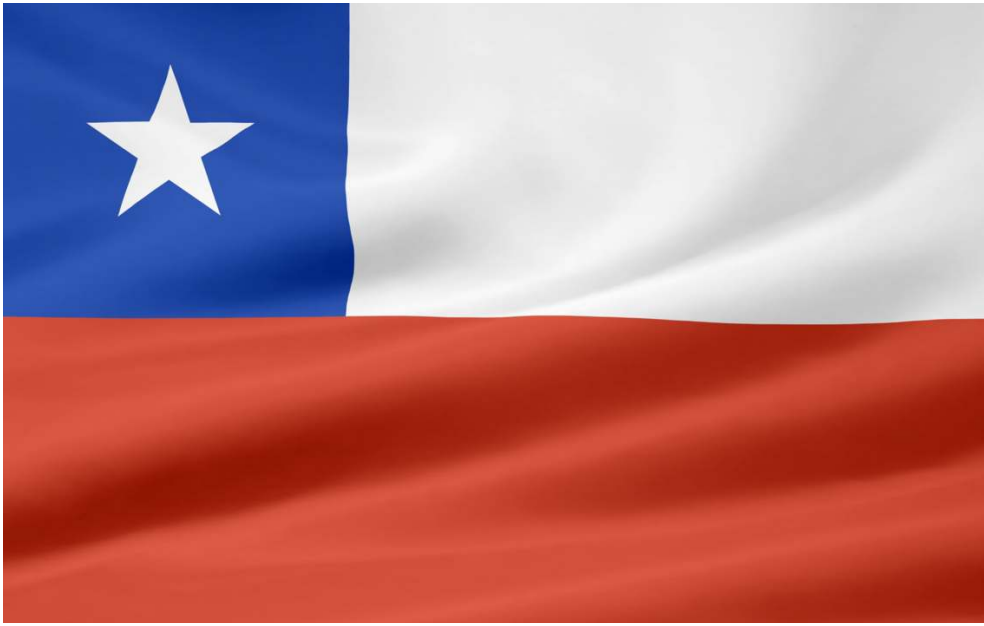

# Country Report – Chile

STINT
Stiftelsen för internationalisering av
högre utbildning och forskning

The Swedish Foundation for International
Cooperation in Research and Higher Education

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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

Chile is a mid-sized country on the South American continent. Despite its authoritarian past, Chile is today a well-functioning democracy.

The country has enjoyed an extended period of steady economic growth and is one of the richest countries in South America. In recent years, economic growth has also been above the OECD average. However, there is a considerable spread in income distribution. The gap between rich and poor is among the widest in the region.

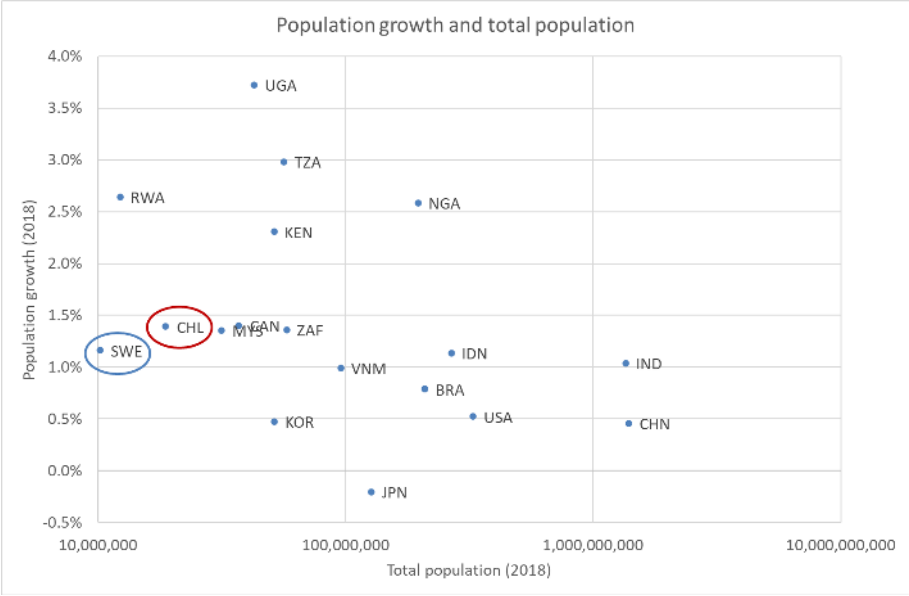
This prosperity has gradually led to greater investment in higher education institutions (HEIs) through the past decade's ambitious higher education reform. The country has some of the best universities and the highest tertiary education enrolment in South America. Most of the growth has come from the private sector. In 2017, 88.5% of the school-aged population at the tertiary level was enrolled in higher education programmes. In 2000, the proportion was only 35%.

State and private investments in research and development (R&D) are however low and constitute less than 0.5% of the gross domestic product (GDP). The main economic sectors include mining, agriculture and services.

# Population and economic development

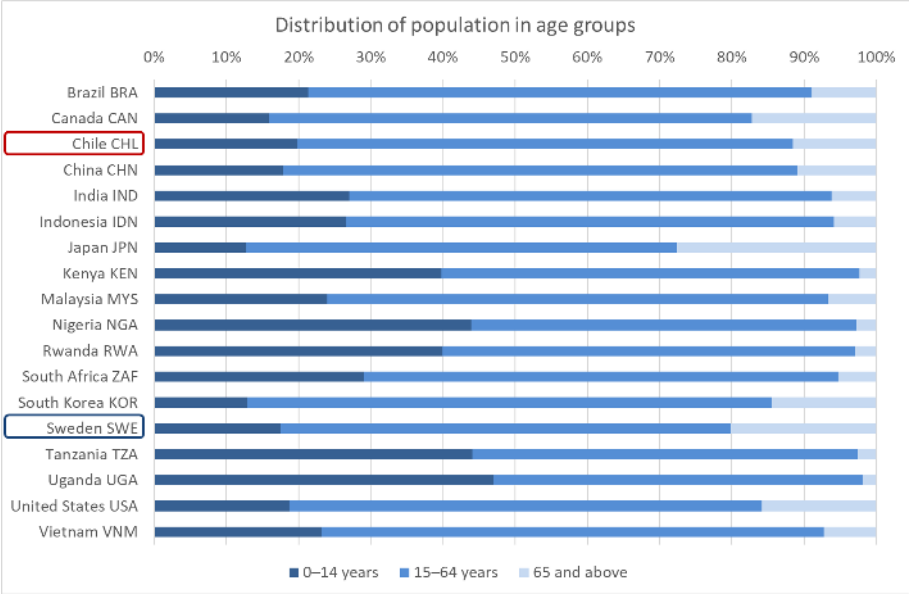
Chile's population is estimated to be 19.1 million people (17.6 million according to the 2017 census), with a slightly higher population growth than that of Sweden. With a low fertility rate of 1.65 million per annum, net migration (about 111,000 per annum before Covid-19) constituted the majority of Chile's population growth.

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




As opposed to the mass migrations from Europe to Argentina and Brazil, most immigrants to Chile come from other American countries. A key historical marker is the bloody 1973 military coup, which installed Augusto Pinochet as dictator. Pinochet remained in power until the republic was returned to democratic rule in 1990. Nevertheless, Chile's relatively stable political situation, in the Latin American context, has been posed as a main reason for inter-American immigration, as has the country's significant economic growth in recent decades.

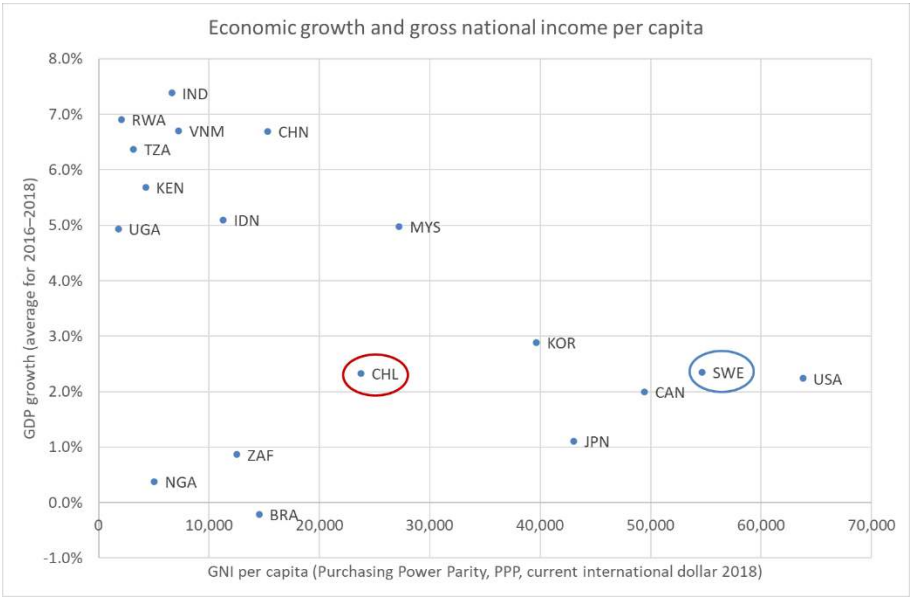
Figure 2: **The percentage of the population in each age group**




Chile is in the advanced stages of demographic transition and is becoming an ageing society. Chile is one of the most prosperous nations in Latin America, and it also has one of the largest proportions of older adults in that region.

This transition presents Chile with dual and possibly competing challenges: providing resources in the form of education, and addressing the emerging health and social service needs of its growing elderly population. Chile is the OECD member with the biggest income inequality between the rich and the poor, with overrepresentation of the poor among the elderly. The proportion of older people who live alone is increasing significantly, as in many advanced nations, which reduces access to caregiving and favours isolation.

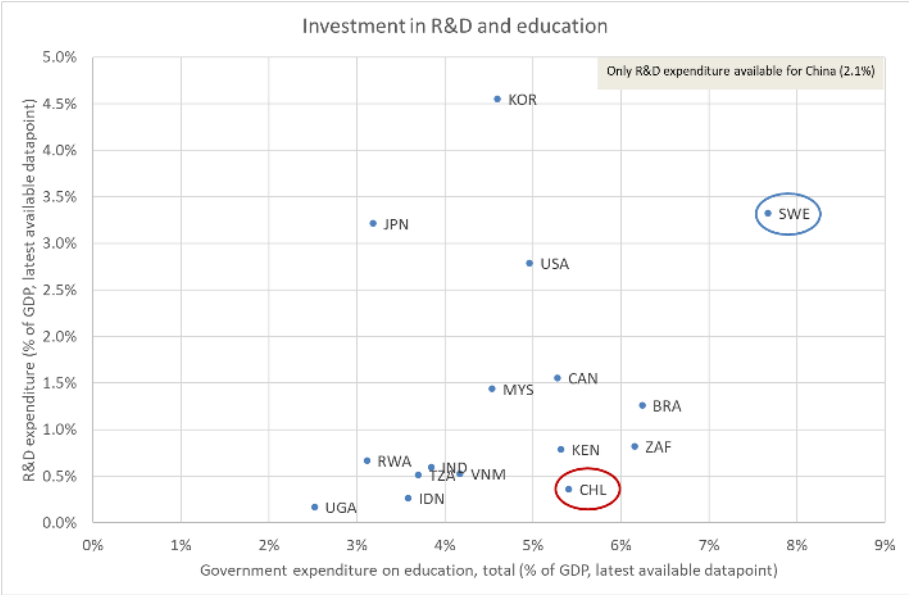
Figure 3: **Gross national income (GNI) and gross domestic product (GDP) growth**




Chile has been growing in a sustained and relatively stable manner since the 1990s, thanks to effective macroeconomic management and its open economy. The implementation of open trade and investment policies has been central to Chile's positive growth performance. Its strong economic foundations made Chile the country with the highest nominal GDP per capita in Latin America in 2006. Chile has been one of Latin America's fastest-growing economies in recent decades.

Growth in real GDP averaged 8% from 1991 to 1997 but fell to half that level in 1998 because of tight monetary policies (implemented to keep the current account deficit in check) and lower exports due to the Asian financial crisis. Chile's economy has since recovered and has seen fluctuating growth rates of between 1 and 6% over the past decade.

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




The Chilean government's expenditure on education is slightly more than 5% of GDP. Expenditure on R&D is less than 0.5% of GDP, which is low internationally. Chilean government spending on education, as well as R&D, is lower than that of Brazil in terms of a percentage 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).

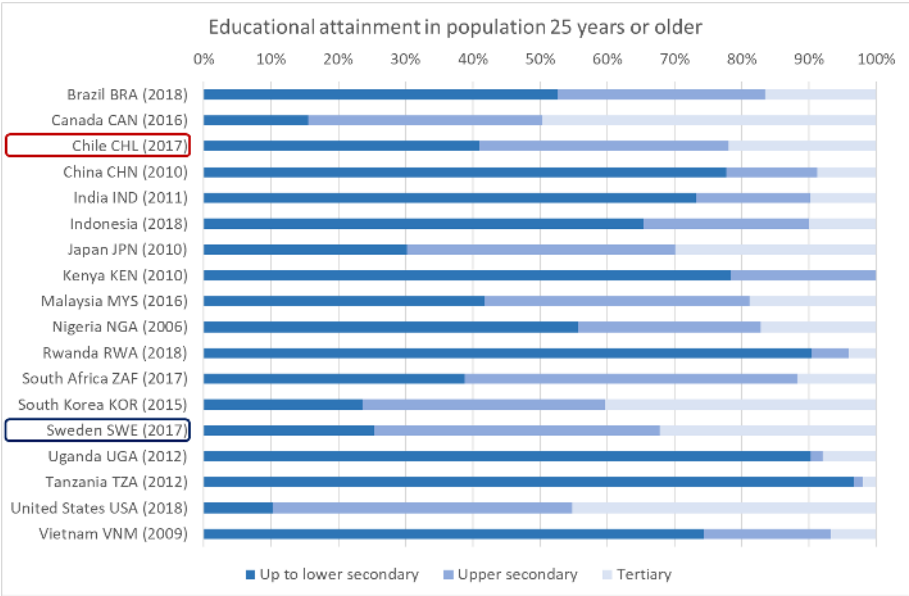
# Higher education institutions in Chile

Chile has enjoyed consistent economic growth since democratisation. This prosperity has gradually led to greater investment in HEIs through the past decade's ambitious higher education reform. The country has some of the best universities and the highest tertiary education enrolment in South America. Most of the growth has come from the private sector.

Chile has 61 universities, whereof 46 are accredited. These accredited universities account for a large majority of university enrolments. The major universities can be found in the capital Santiago, including the country's two top universities: the University of Chile and the Pontifical Catholic University of Chile. These two universities were ranked 401–500 and 501–600, respectively, by the Academic Ranking of World Universities in 2020.

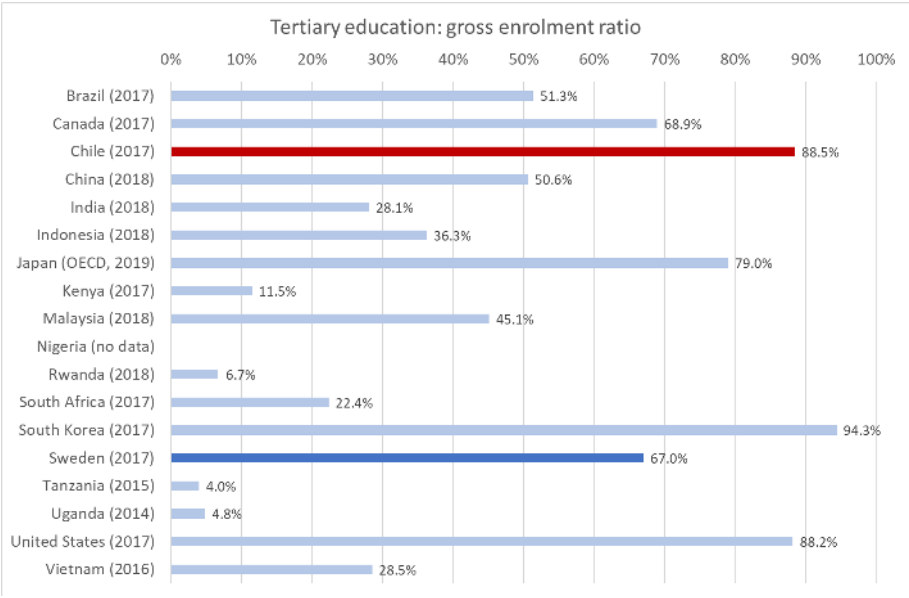
# Educational attainment and student mobility

Figure 5: **Educational attainment**




In Chile, more than 30% of the population (25 years or older) had attained upper secondary education in 2017. More than 20% had attained tertiary education. These numbers are higher than for Brazil (see Figure 5). By comparison, in Sweden about 40% of the population had attained upper secondary and more than 30% tertiary education.

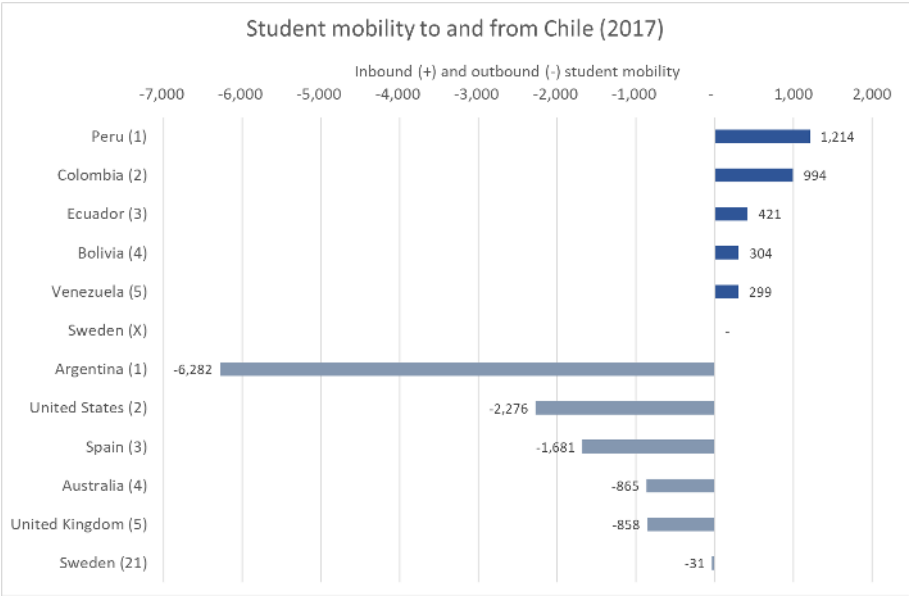
Figure 6: **Gross enrolment ratio for tertiary education**




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 Chile, the GER for tertiary education is very high at 88.5%, which is similar to that of the United States at 88.2%. The corresponding GER for Sweden is 67%.

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




In 2017, incoming students to Chile mainly comprised students from other South American countries (see Figure 7). Swedish students constitute a relatively modest group. Thirty-one Chilean students left to study in Sweden. The most popular study destinations for Chilean students were Argentina and the United States.

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

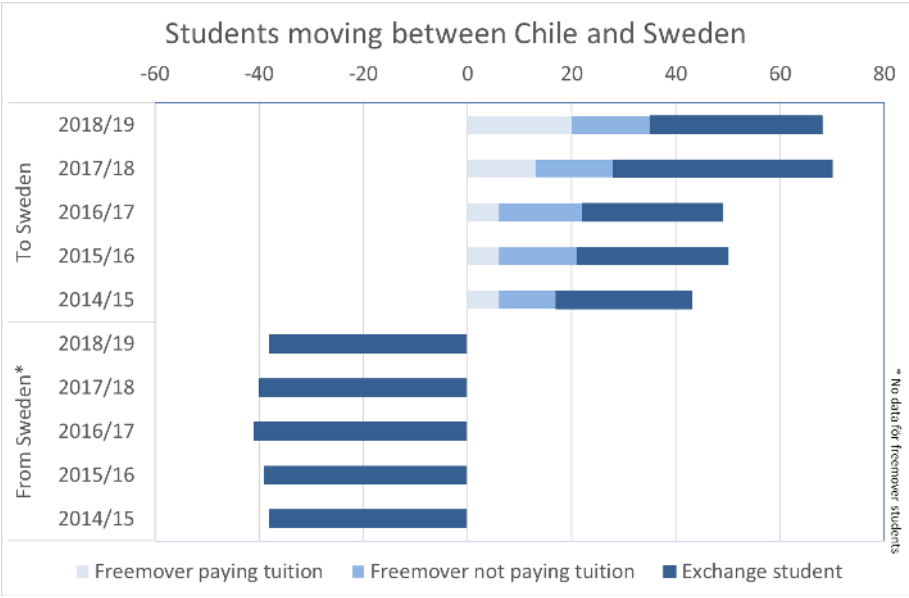
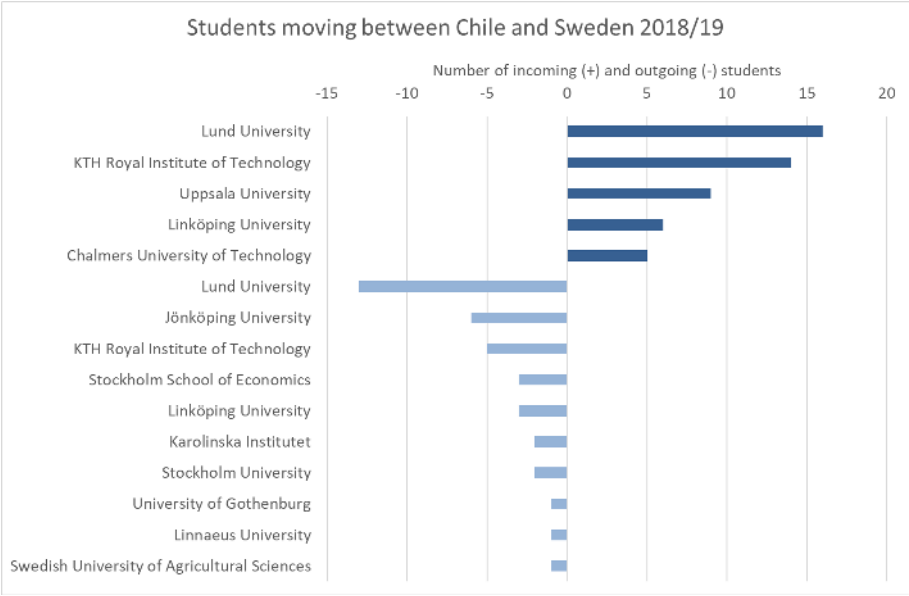



Figure 8 illustrates the inbound and outbound students to and from Sweden. Chile is a not a common study destination for Swedish students. Swedish data show that the number of outgoing exchange students remained constant in recent years, with roughly 40 students doing a study exchange in Chile. The exchange between the two countries is fairly symmetrical with regards to student numbers. A smaller number of Chilean students have also gone to Sweden for degree-awarding education. This group has slightly increased in recent years.

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 and outbound students to and from Chile of all Swedish HEIs. Overall, the comprehensive universities in Sweden have larger exchange programmes.

# Research and collaboration with Sweden

Chile has moderate to advanced science and technology capacity. The share of the country's scientific production in the world is high relative to the size of its economy and population. Measured by citation impact, the quality of Chile's research output is slightly above world average. The field-weighted citation impact (FWCI) was 1.22 between 2015 and 2019, while the corresponding number for Sweden was 1.68. With regards to international collaboration, Chile has a relatively open 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 FWCI | Share of int'l co-publ FWIS | Share of ac.-corp. co-publ. % | Collaboration intensity with Sweden $NCII_{100}$ |
| 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**

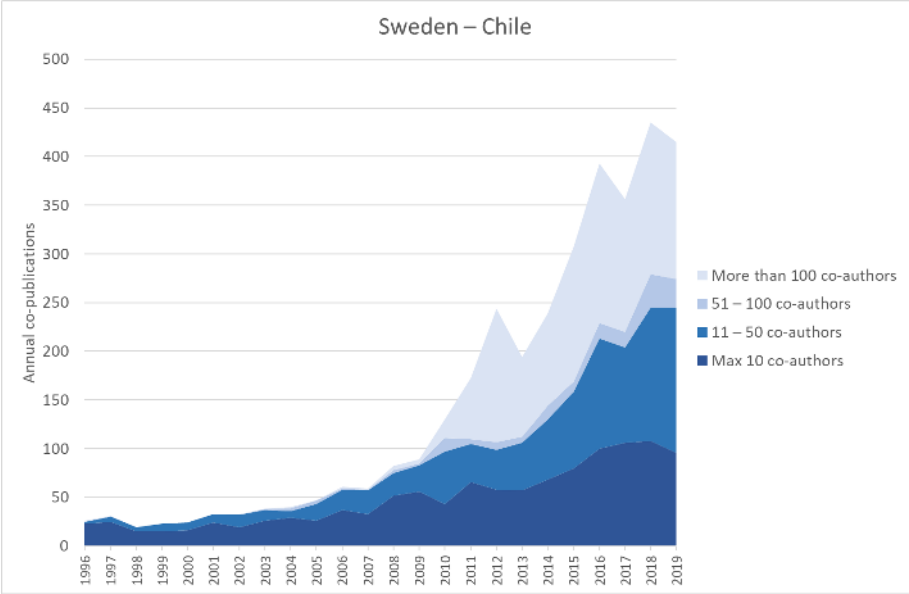
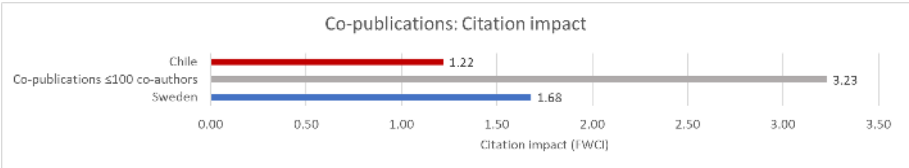
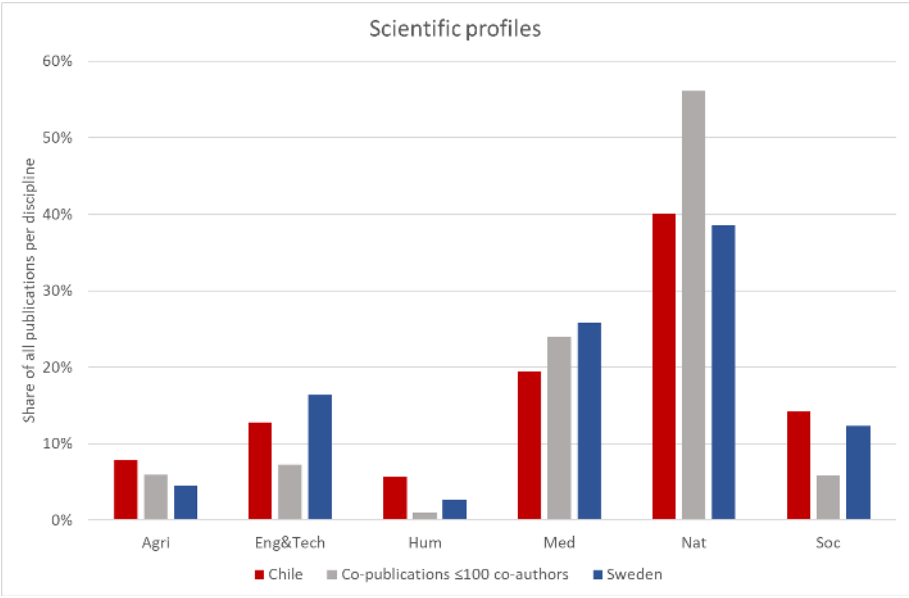



Figure 11: **Field-weighted citation impact for each country and their co-publications with ≤100 co-authors (2015–2019)**




Co-publications between Sweden and Chile are dominated by cooperations with more than ten 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 Chile, especially regarding large cooperations with more than 100 co-authors. Both Sweden and Chile 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 Chile are compared with the overall profiles of these countries in various fields. For example, approximately 20% of the publications with Chilean participation are within medicine, whereas the share of such publications in Sweden is 25%. The share of co-publications in medicine involving both countries lies between these. 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.

The natural sciences are clearly overrepresented in Swedish–Chilean collaborations, at the expense of engineering & technology, the humanities, and the social sciences. The humanities and social sciences are almost always underrepresented in these scientific profiles, due to the lower share of international co-publications. This argument also applies in the reverse: these fields have a low share of international co-publications as they are underrepresented in international collaborations.

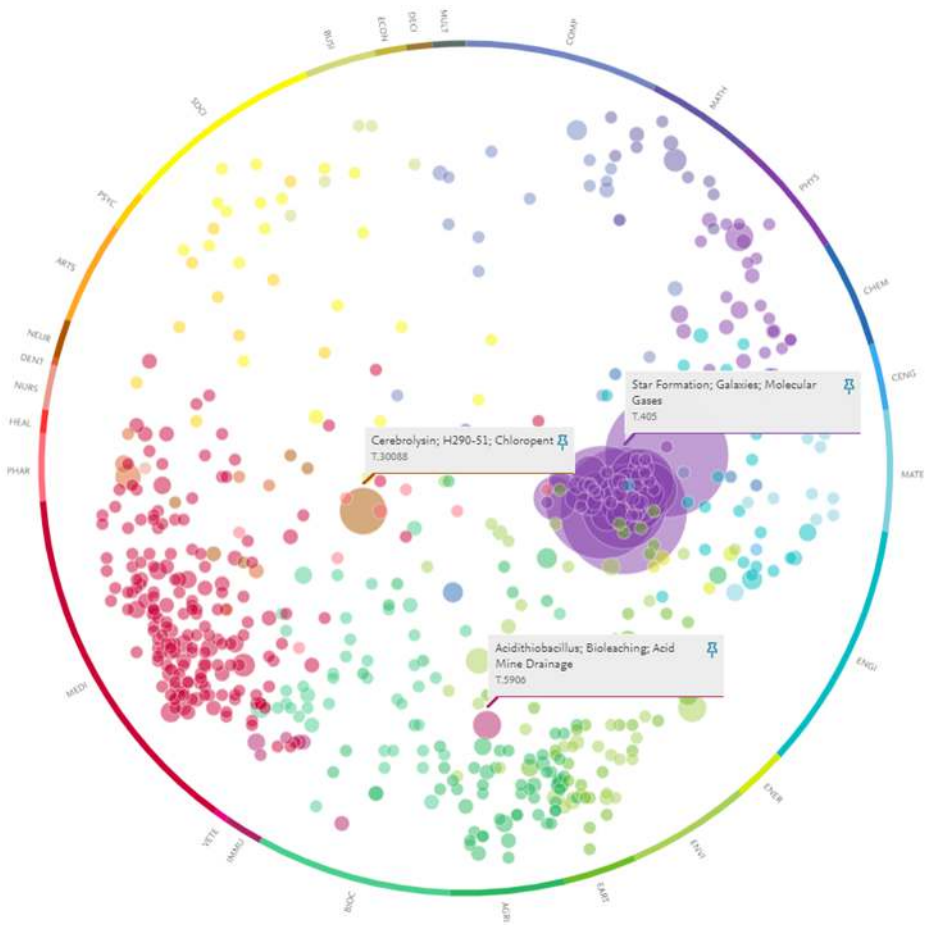
Figure 13: **Word cloud based on co-publications with ≤100 co-authors (2015–2019)**


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 Chilean 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 Chile, most keyphrases are green.

Keyphrases pertaining to astronomy dominate heavily among the growing as well as declining words. Only a few other keyphrases are represented, and they mainly pertain to medicine.

Of the Swedish universities, Stockholm University appears to be very active in research pertaining to galaxies, stars and planets. As can be seen below, Stockholm University has the highest number of co-publications with Chilean institutions of all Swedish HEIs.

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




Publications involving Swedish and Chilean researchers cover almost all scientific fields (see Figure 14). One area clearly dominates, with many large overlapping bubbles, most of which pertain to astronomy. Their size indicates that a high number of all the included co-publications are on these topics. Otherwise, the bubble density is somewhat higher than average in medicine.

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 Chile (≤100 co-authors) | Share of all publications at the Swedish institution | FWCI |
|---|---|---|---|
| Royal Swedish Academy of Sciences | 9 | 2.23% | 4.55 |
| Stockholm University | 250 | 1.38% | 2.30 |
| NORDITA | 12 | 1.31% | 1.98 |
| Sandvik AB | 5 | 1.27% | 0.53 |
| Swedish Museum of Natural History | 16 | 1.20% | 2.17 |
| University of Skövde | 12 | 1.01% | 1.45 |
| Chalmers University of Technology | 137 | 0.93% | 1.41 |
| Uppsala University | 174 | 0.59% | 3.19 |
| Luleå University of Technology | 32 | 0.58% | 1.79 |
| Linnaeus University | 20 | 0.57% | 1.08 |
| Lund University | 172 | 0.54% | 3.22 |
| Swedish University of Agricultural Scienc | 49 | 0.54% | 3.84 |
| University of Gothenburg | 121 | 0.53% | 7.65 |
| KTH Royal Institute of Technology | 110 | 0.50% | 1.63 |
| Karolinska Institutet | 165 | 0.46% | 5.46 |
| Umeå University | 48 | 0.40% | 6.46 |
| Linköping University | 52 | 0.37% | 3.12 |
| Vattenfall | 1 | 0.32% | 0.39 |
| SP Technical Research Institute of Swec | 2 | 0.30% | 0.37 |
| Stockholm Environment Institute | 2 | 0.30% | 0.86 |

Table 2 ranks Swedish HEIs and research institutes based on their co-publications with Chile (with up to 100 co-authors) as a share of their total publication output. While the co-publication share with Chile is larger than Chile's share of the global publication output for the majority of listed institutions, the overall number of publications is small. Because the total number of publications is typically very low, conclusions should be drawn cautiously. Nevertheless, the listed Swedish institutions with co-publication shares larger than Chile's global publication share represent a broad spectrum of large and small HEIs as well as specialised research institutes.

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

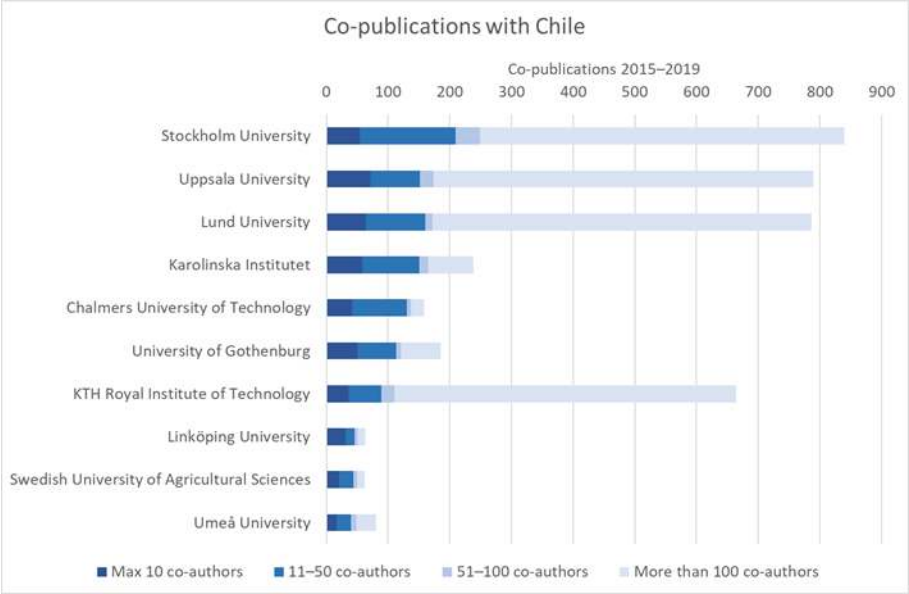



Figure 15 lists the ten Swedish universities with the most co-publications with Chile, ranked according to the number of co-publications with up to 100 co-authors. These are the same as the top ten Swedish universities by overall publication volume, yet ranked differently. Karolinska Institute, for example, is ranked lower than in the overall ranking, which is consistent with the fact that the share of Swedish–Chilean research collaboration in medicine is lower than its overall share in Sweden, as can be seen in Figure 12. Chile is a global centre for astronomical research and a large part of the research collaborations between Chile and Sweden indeed centres on the fields of astronomy as well as earth and planetary sciences. This is also reflected in Figure 12, where the share of co-publications in the natural sciences far exceeds the national shares in the same field in either country, and in the word cloud of Figure 13. The largest shares of co-publications with Chile are in these subject areas for many of the Swedish institutions topping the list in Figure 15.

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

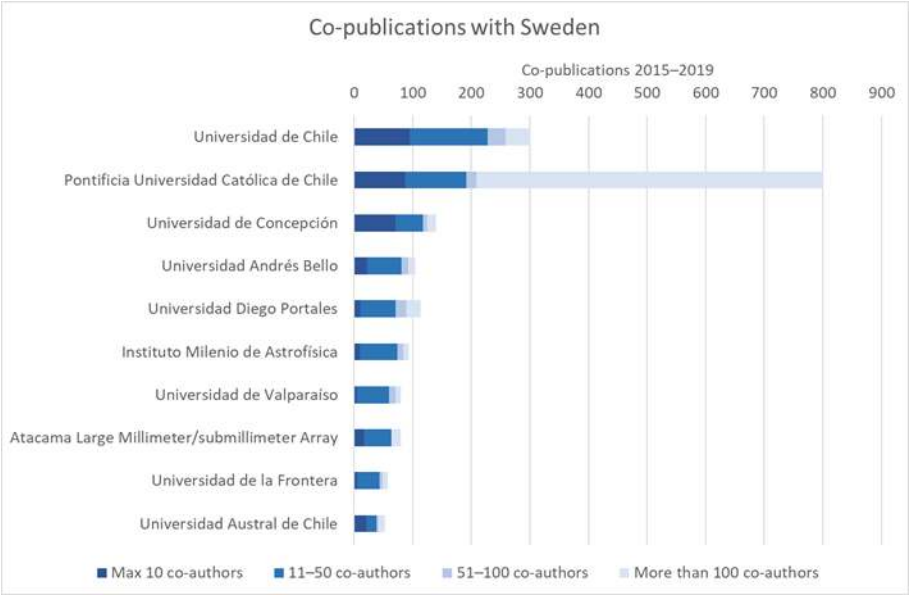



Figure 16 lists the ten Chilean universities with the highest numbers of co-publications with Sweden, ranked according to the number of co-publications with up to 100 co-authors. The list differs to a certain degree from the list of top ten Chilean institutions ranked by overall publication volume, only six of which are among the top ten co-publishers with Sweden. The ranking also underscores the importance of astronomy and planetary science in Swedish–Chilean research collaborations, with Instituto Milenio de Astrofísica and the Atacama Large Millimeter Array among the top ten collaborating institutions. Instituto Milenio de Astrofísica, it should be noted, is a joint venture involving seven Chilean universities,[1] five of which are themselves included in the list of the ten Chilean universities with the highest numbers of co-publications with Sweden.

[1] Universidad de Chile, Pontificia Universidad Católica de Chile, Universidad de Valparaíso, Universidad de Concepción, Universidad Andrés Bello, Universidad Metropolitana de Ciencias de la Educación, and Universidad Diego Portales.

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 | Universidad de Chile | Pontificia Universidad Católica de Chile | Universidad de Concepción | Universidad Andrés Bello | Universidad Diego Portales | Instituto Milenio de Astrofísica | Universidad de Valparaíso | Atacama Large Millimeter/submillimeter Array | Universidad de la Frontera | Universidad Austral de Chile | With Chile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Stockholm University | 77 | 55 | 14 | 30 | 47 | 46 | 23 | 11 | - | 3 | 249 |
| Uppsala University | 19 | 36 | 20 | 30 | 20 | 17 | 16 | 6 | 6 | 6 | 174 |
| Lund University | 24 | 35 | 41 | 31 | 18 | 26 | 23 | - | 2 | 5 | 172 |
| Karolinska Institutet | 48 | 32 | 1 | 2 | 8 | - | 12 | - | 11 | 1 | 165 |
| Chalmers University of Technology | 17 | 14 | 13 | - | 10 | 2 | 8 | 58 | - | - | 137 |
| University of Gothenburg | 22 | 18 | 10 | 7 | - | - | 8 | 1 | 26 | 11 | 121 |
| KTH Royal Institute of Technology | 31 | 11 | 6 | 8 | 33 | 10 | 18 | 7 | 1 | - | 110 |
| Linköping University | 17 | 8 | 3 | - | - | 2 | - | - | 3 | 2 | 50 |
| Swedish University of Agricultural Sciences | 13 | 3 | 8 | 5 | - | - | - | - | 1 | 11 | 49 |
| Umeå University | 13 | 7 | 9 | 2 | - | - | 1 | - | 3 | 5 | 48 |
| With Sweden | 258 | 209 | 125 | 92 | 89 | 84 | 71 | 64 | 48 | 41 | 1,167 |

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 Chile and thus gives an indication of the distribution of collaborations between Swedish and Chilean HEIs and research institutes. The blue/green bars represent the ratio of the number of co-publications between two HEIs/research institutes to the total number of co-publications (for the Swedish institution). We can see that the top three collaborating Chilean universities, Universidad de Chile, Pontificia Universidad Católica de Chile and Universidad de Concepción, contributed to about 50% of all Swedish–Chilean co-publications. Most of the top ten Swedish HEIs collaborating with Chile do so mainly with only a handful of Chilean universities, and a high percentage of their total co-publications are with the top ten Chilean collaborating universities. It thus suffices to say that Swedish–Chilean research collaboration is rather concentrated to a small number of institutions on both sides.

# 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, 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.

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- Enhance the quality of research and higher education
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