

Country Report – South Korea



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

A specific 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 progress of South Korea from the ashes of the Korean War 1950-1953 has served, and continues to serve, as a role-model for many developing economies. Part of the success should be attributed to continuous investments in its national innovation system with a sharp focus on research during transition from dictatorship to democracy and subsequent development. The adopted policies resulted in real gross domestic product growth averaging 7.3% annually between 1960 and 2019.

South Korea now has one of the highest-educated labor forces among OECD countries and, together with Israel, the highest share of GDP spending on R&D in the world. A large proportion of R&D funding, including for basic science, stems from private enterprises.

The high R&D intensity has helped South Korea become a global leader in several technology fields including ICT, with an innovation system that is characterized by top-down direction from government in close collaboration with large companies and the academic community.

The country's industry structure, with value-creation to a large extent concentrated to a handful of large conglomerates known as chaebols, is however also flagged as a potential weak point, with a relatively weak smalland medium-sized company sector and relatively small service industry. The five largest conglomerates (Samsung, SK, Hyundai, LG, and Lotte) made up half of the South Korean stock index in 2018.

South Korea faces numerous threats in the mid-term, notably increased competition from China and other newly industrializing economies; among the lowest fertility rate in the OECD with a quickly ageing society; and a continuing high dependency on imports of natural resources.

Population and economic development

The population of South Korea is 51,3 million that is to a large extent concentrated to the greater Seoul area which includes Seoul, Gyeonggi Province, and Incheon. People living in the capital and its surrounding areas exceeds 50% of the country's total population.



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

The process of population stabilization began in the early 1960s. Responding to the high population pressure coupled with extreme poverty, the government became more involved in family planning. Fertility began to decline rapidly in the mid 1960s and reached population replacement level in the mid 1980s. South Korea now has the lowest fertility rate in the world, women have an average of just 1.1 children each. In other words, women aren't having enough children in South Korea to maintain its population without migration. However, immigration to South Korea is also low due to restrictive immigration policies resulting from strong opposition to immigrants from the general public. In recent years the influx of immigrants into South Korea has even so been on the rise, with foreign residents accounting for 4.9% of the total population in 2019.



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

South Korea is one of the world's fastest-aging societies. The country is expected to become a "super-aged society" with over 20% of its population aged 65 years and older in 2026.

The South Korean government has done relatively little in fostering a secure social safety for its senior citizens. South Korea has the highest recorded elderly poverty rate among OECD member states. Poverty is seen as one of the main reasons that South Korea's elderly suicide rate has remained highest among OECD members.

As a dramatic change in demography is expected in the coming decade, how to minimise the potential impact from an ageing society will have to take top policy priority. The increased life expectancy has led to calls for increasing the legal age limit for various welfare programs for the elderly from 65 to 70 or even higher.



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

The economic progress of South Korea over the last three generations has been nothing less than an economic miracle of rapid industrialisation. Today South Korea has the fourth largest economy in Asia after China, Japan, and India. Post-war policies resulted in real GDP growth averaging 7.3% annually between 1960 and 2019. This strong performance was fueled by annual export growth of 16.0% on average from 1961–2019. South Korea's gross national income per capita increased rapidly from US\$67 in the early 1950s to US\$40,000 (Purchase Power Parity) in 2018. The economy is dominated by family-owned conglomerates, such as Samsung, called chaebols. Having almost no natural resources and a high population density, South Korea early on adapted an export-oriented economic strategy to fuel its economy, and in 2019, South Korea was the eighth largest exporter and eighth largest importer in the world.

Demographic changes is now seen as a key factor explaining why South Korea's economic growth rate has fallen since 2010. With the working age population and the young population continuing to decrease, a rapid decline in labor input is predicted to affect South Korea's potential economic growth rate.



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

The South Korean government expenditure on education is around 4.5% of GDP. However, the expenditure on research and development (R&D) is very high in comparison, about 4.5% of GDP. South Korean R&D expenditure in terms of percent of GDP is much higher than that of Japan and China. Swedish expenditure is more than 7% of GDP for education and more than 3% of GDP for R&D, see Fig. 4.

Higher education institutions in South Korea

The number of universities in South Korea increased significantly until 2000 to over 200 but has since gradually declined. Decline in numbers is largely related to the government's policy of university restructuring due to a decrease in the school-age population.

Higher education institutions in South Korea are distinctly divided into public and private institutions. Public institutions include national universities and public universities that carry out various governmentsupported projects. For private universities, university administration is perceived as more flexible, and the institution is sometimes is operated and financed closely together with private companies.

SKY is an acronym used in South Korea to refer to the three most prestigious universities in South Korea: Seoul National University, Korea University, and Yonsei University. Entry to any of these, or other top universities sets the career path for a young person perhaps more than in any other country. Competition over admission into top universities is consequently extremely fierce, and the whole national university enrollment system can been described as both very stressful and brutally competitive. The country's students devote more time to studying than children in any other OECD country, while parents spend large parts of their income on private tutoring in what has been dubbed an "educational arms race".

According to the QS World University ranking methodology from 2020, South Korea's highest ranked university are:

- 1. Seoul National University (World Rank 37)
- 2. Korea Advanced Institute of Science and Technology (World Rank 41)
- 3. Korea University (World Rank 83)
- 4. Pohang University of Science and Technology (World Rank 87)
- 5. Sungkyunkwan University (World Rank 95).

Educational attainment and student mobility

There is no recent data on educational attainment for the population in South Korea. About 40% of the population (25 years or older) had attained tertiary education in 2015.



Figure 5: Educational attainment

Upper secondary education was attained by about 35%, see Fig. 5. In comparison, in Japan about 30% of the population had attained tertiary education in 2010 and in Sweden slightly more than 30% in 2017.



Figure 6: Gross enrolment ratio to tertiary education

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

In South Korea, the GER for tertiary education is 94%, which is very high in comparison to other countries, reflecting the strong focus on education in the South Korean society, especially higher education. Corresponding GER for Sweden is 67%.



Figure 7: Inbound and outbound students, origins and destinations

Inbound students to South Korea in 2017 comprised mainly of students from China, with smaller groups of students from Vietnam, Mongolia, Uzbekistan, and Japan. Swedish students make up a modest group, only 23 students from Sweden went to study in South Korea the same year. The number of South Korean students going to study in Sweden were 72. The most popular study destinations for students from South Korea were the United States and Japan.



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

Fig. 8 illustrates the inbound and outbound students from and to Sweden. The data from the Swedish side shows the number of outgoing exchange students being relatively constant for the past few years, with roughly 250 students doing a study exchange in South Korea per year. South Korea is a relatively popular exchange study destination in Asia for students from Sweden. The balance in exchange students between the two countries has been symmetrical in the last years. Sweden is however not a popular study destination for South Korean students, although the group is highly internationally mobile, as was seen in Fig. 7.



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

Fig. 9 illustrates the inbound students from South Korea to specific Swedish higher education institutions. The largest number of students go to Uppsala University and Lund University. The outbound students, who comprise of exchange students, come from a heterogenous group of higher education institutions, including larger comprehensive universities such as Uppsala University, Linköping University, and Lund University, technical and smaller universities. Linneus University has a relatively large number of outbound students.

Research and collaboration with Sweden

South Korea is considered an advanced science nation. The country invests almost 5% of its GDP on R&D. South Korea's scientific production makes up 2.74% of the world total. In terms of annual growth of publications (2015-2019) there is a minor growth (roughly 2% per annum). The FWCI is moderate at 1.05, which is on par with the world average. South Korea underperforms with regards to international collaboration. The country's share of international co-publications, as measured by the FWIS, 0.69% between 2015-2019.

Based on pub	lications 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 accorp. co-publ.	Collabo- ration 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

Table 1: Selected publication indicators

See appendix for detailed explanations 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 South Korea are dominated by cooperations with more than 10 co-authors, as indicated in Fig. 10. During the last 10 years there has been a drastic increase in the number of copublications between Sweden and South Korea, especially so for cooperations with more than 10 co-authors. Both Sweden and South Korea benefit when researchers work together, co-publications (100 co-authors or less) have significantly higher FWCI than what it is for each country as can be seen in Fig. 11.

In 2012, STINT together with the Royal Academy of Engineering Sciences (IVA) arranged a university presidents' delegation to South Korea in

cooperation with the South Korean National Research Foundation (NRF) with the aim to promote academic cooperation between the countries.



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

The scientific profiles in Figure 12 shows the distribution over scientific disciplines of the research collaboration between Sweden and South Korea as well as the individual such for Sweden and South Korea. For example, approximately 28% of the publications with South Korean participation are in the engineering and technology discipline. In Sweden, the share is clearly lower at 16%. If all scientific disciplines collaborated internationally to the same extent, the shares of co-publications involving both countries would typically be between the national shares, as it is in engineering and technology, medicine, and social sciences. Natural sciences are slightly overrepresented in the scientific collaboration between Sweden and South Korea.

Overall, the collaboration follows the profile of both countries quite closely. The dominance in South Korea of natural sciences, and engineering and technology is in line with the profile of most Asian countries. Figure 13: Word cloud based on co-publications with ≤100 co-authors (2015–2019)



A A A relevance of keyphrase | declining A A A growing (2015-2019)

The word cloud in Fig. 13 is produced using Elsevier's Fingerprint Engine. It shows the most prominent key phrases based on the titles, abstracts, and keywords in the co-publications with Swedish and South Korean co-authors. Green and large texts signal highly relevant and growing key phrases.

The largest key phrase 'Systemic Lupus Erythematosus' in related to medicine as well as some other blue key phrases. Material sciences, engineering and information technology are also significant and growing in the collaboration. Figure 14: Wheel of science based on co-publications with ≤100 co-authors (2015–2019)



Publications involving Swedish and South Korean researchers are predominantly found in medicine (red) and physics (purple), as seen Fig. 14. There is also a group of green dots relating to environmental and earth sciences. The largest circle relates to 'Exosomes, Extracellular vesicles', which is a topic combining medical and biological aspects. The size relates to the topic's share of all included co-publications.

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

	Co- publications with South Korea (≤100	Share of all publications at the Swedish	
Institution	co-authors)	institution	FWCI
Royal Swedish Academy of Sciences	5	1.2%	0.68
KTH Royal Institute of Technology	251	1.1%	1.78
SP Technical Research Institute of Sw	7	1.0%	1.42
Sandvik AB	4	1.0%	2.24
Jönköping University	20	1.0%	0.62
Karolinska Institutet	323	0.9%	5.56
Stockholm University	161	0.9%	2.63
Uppsala University	253	0.9%	2.84
Linköping University	121	0.9%	2.50
Swedish Meteorological and Hydrologi	5	0.8%	5.07
Mid Sweden University	15	0.8%	2.23
Lund University	247	0.8%	3.90
Dalarna University	8	0.8%	2.89
Chalmers University of Technology	113	0.8%	2.06
NORDITA	7	0.8%	2.75
University of Gothenburg	171	0.8%	3.93
Ericsson AB	15	0.7%	2.30
Blekinge Institute of Technology	8	0.6%	7.23
Swedish Museum of Natural History	8	0.6%	2.28
Luleå University of Technology	33	0.6%	3.16

Table 2 lists the HEIs and research institutes in Sweden that have the largest number of co-publications (with less than 100 co-authors) with South Korea as a share of their total publication output. All Swedish institutions in the list have a co-publication share significantly below South Korea's global publication share (2.74%), which explains South Korea's very low collaboration intensity with Sweden of 36% (Table 1).



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

Fig. 15 lists the ten Swedish universities with the highest numbers of copublications with South Korea, ranked according to the number of copublications with less than 100 co-authors. These are more or less the same as the top ten Swedish universities by publication volume overall, with only one significant difference: KTH Royal Institute in 2nd place for copublications with South Korea while in 5th place overall, which reflects the fact that natural sciences are over-represented in South Korean-Swedish scientific collaborations compared to the overall numbers (as seen Fig. 12).



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

Fig. 16 lists the ten South Korean institutions with the highest numbers of co-publications with Sweden, ranked according to the number of co-publications with less than 100 co-authors. Eight of universities in the top ten in the list are also the largest universities in South Korea by publication volume, the exceptions being Pohang University of Science and Technology and the Institute of Basic Science, both of which have a strong focus on the natural sciences and engineering. Taken together with the fact that Korea Advanced Institute of Science and Technology (KAIST) is placed higher in the ranking of co-publications with Sweden than in the ranking of South Korean universities by publication volume overall, this further explains why natural sciences are over-represented in South Korean-Swedish scientific collaborations (as seen Fig. 12). With some exceptions, the South Korean universities and research institutions that are the largest collaborators with Sweden are overall also those with the highest rankings the largest world university rankings.

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



The co-publication matrix in Table 3 shows the co-publications (with less than 100 authors) between the top ten collaborating institutions in Sweden and South Korea and thus gives an indication of the distribution of the collaborations between Swedish and South Korean HEIs and research institutes. The blue/green bars in the squares visualizes the ratio of the number of co-publications between two HEIs/research institutes to the total number of co-publications (for the Swedish institution). Seoul National University clearly dominates South Korean-Swedish scientific collaboration, accounting for 18% of the total amount of co-publications, though overall the scientific collaboration between the countries is fairly broadly distributed. The top 10 HEIs and research institutes on both sides listed in Table 3 contributes to about 60% of the total co-publication volume between the countries. In terms of concentrated collaborations, Karolinska Institute and Umeå University, stand out by having 30% and 39%, respectively, of their total South Korean publication volume with Seoul National University.

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 <u>https://databank.worldbank.org/home.aspx</u>
- Research: Publication data from Scopus, the broadest available publication database, see <u>https://www.elsevier.com/solutions/scopus?dgcid=RN_AGCM_Sourced_300005030</u>

Methods

According to the UNESCO Institute for Statistics (UIS), 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 **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 pub-

lications 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 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 Academiccorporate 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 copublications, 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 Distribution of publications per scientific discipline (2015–2019). The scientific profile is calculated using the OECD categorisation of publications in six scientific disciplines: agricultural sciences, engineering and technology, humanities, medical sciences, natural sciences, and social sciences. For each discipline, the share of publications is calculated using the number of publications within the discipline and the total number of publications in the dataset.

The **word cloud** is a feature in SciVal, which uses the Elsevier Fingerprint Engine to extract distinctive keyphrases within the publication set. For more

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

information, see <u>https://www.elsevier.com/solutions/elsevier-fingerprint-engine</u>

The **wheel of science** 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 of science. 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

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