

Researchers in Sweden: Mobility and gender



STINT

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Summary

Gender equality is very high on the agenda in the Swedish higher education system. In this report, publication data are used to study women's and men's participation in research and their international mobility. As scientific publications typically do not include information about the gender of the authors, gender in research has seldom been studied using publication data. Using the NamSor gender classifier API, which infers gender based on the author's name, Elsevier has managed to assess publication data using a gender lens. The quality of the gender recognition algorithm results differs between countries.

Elsevier has published a series of reports about gender in research. The latest report based on this approach was published in 2020 and did not include data for Sweden. However, STINT was offered access to additional data that include further countries and regions, among them Sweden. The present report makes use of this data to take a gender perspective on Swedish research.

This report is based on publications up to and including 2018 and thus does not include the potential effects of the COVID-19 pandemic. Obviously, the pandemic has had consequences for researcher mobility and probably also for gender equality in research.

Male researchers are more internationally mobile than female researchers, in Sweden as well as in all other 25 countries and regions included in the data. Overall, men publish on average more than women. The gender differences in terms of the average publication count per researcher are accentuated by international mobility. Gender differences in citation impact are small in most countries, including Sweden. In Sweden, when the international mobility dimension is taken into account, the largest difference in citation impact occurs within the group of researchers who produced their first publications in the period 1999–2003 and are sedentary (without any affiliation abroad), with female researchers being cited approximately 10% more frequently than their male colleagues.

In all countries and scientific fields, the share of female authors of publications is higher in the cohort of relatively young researchers. However, there are only more female than male researchers in this cohort in a single country, Argentina. In Sweden, there were 1.7 male researchers for each female researcher in the period 2014–2018, which is a slightly higher ratio than for the EU28. When

dividing the publications into 37 scientific fields, all exhibit a trend towards more female researchers and in 30 of the fields, this results in a trend towards increased gender parity. The average publication count per researcher is higher for men in all scientific fields studied, whereas the field-weighted citation impact shows small and less systematic differences between the genders.

Preface

STINT, the Swedish Foundation for International Collaboration in Research and Higher Education, was set up by the Swedish Government in 1994 with the mission of internationalising Swedish higher education and research. STINT promotes knowledge and competence development in the area of internationalisation and invests in internationalisation projects proposed by researchers, teachers and senior leadership at Swedish universities.

STINT's programmes target to a large extent international mobility. The review criteria are gender neutral and approximately 30% of the proposals and granted projects have female leaders. Gender balance varies depending on the scientific field. All programmes are open to all fields and there is a variation in the mix of fields depending on the home country of the main collaboration partner.

The author of this report is Hans Pohl, Programme Director, STINT. We would like to present our sincere thanks to Elsevier (Bamini Jayabalasingham and Anders Karlsson) and the Swedish Secretariat for Gender Research at the University of Gothenburg (Fredrik Bondestam, Kajsa Widegren and Susanna Young Håkansson), who have read and provided valuable comments on draft versions of the report.

Andreas Göthenberg Executive Director STINT

Stockholm, Sweden, December 2020

Introduction

Gender perspectives are high on the agenda in the Swedish higher education system. In its appropriation directions to the universities, the Swedish government has named equality as the primary goal to pursue and report.¹ Gender equality is often associated with an even representation of women and men in research projects. However, there are also more qualitative aspects behind these figures. One of them is the established norms defining the characteristics of what makes a good researcher, which might be difficult to combine with responsibilities outside work.² Expectations relating to international mobility might be one such example.

STINT's programmes are gender neutral in the review criteria and approximately 30% of the proposals and granted projects have female leaders. Gender balance varies depending on the scientific field. All programmes are open to all fields. The programmes largely target international mobility. In a previous report, a correlation between international mobility and high research performance based on publication indicators has been indicated.³ Moreover, several studies highlight that international co-publications are more frequently cited than other types of publications.⁴

Elsevier has published at least three reports studying research from a gender perspective.⁵ None of these include Sweden. However, STINT has been offered access to additional data linked to the 2020 report, which include Sweden. Focusing on mobility, this report gives some perspectives on female and male researchers and gender representation in publications.

This report does not include data on the potential effects of the COVID-19 pandemic. Obviously, the pandemic has had consequences for researcher mobility. Some reports also indicate that the pandemic has had negative consequences for gender equality. A paper focusing on research for example argues that lockdowns have increased the gender gap in the production of scientific publications.⁶

¹See see https://www.esv.se/statsliggaren/regleringsbrev/?rbid=20296

² See https://swafs.se/swafs/gender-equality/

³ See Researcher Mobility in Swedish Higher Education Institutions, STINT and Elsevier 2016, https://www.stint.se/wp-content/

 $uploads/2018/07/Comparative_Researcher_Mobility_at_Swedish_R_16-01_2016.pdf$

⁴ See for example The Royal Society (2011), Knowledge, networks and nations: Global scientific collaboration in the 21st century, RS Policy document 03/11

⁵ See https://www.elsevier.com/research-intelligence/research-initiatives/gender-2015 https://www.elsevier.com/_data/assets/pdf_file/0008/265661/ElsevierGenderReport_final_for-web.pdf https://www.elsevier.com/research-intelligence/resource-library/gender-report-2020

⁶ Cui R. et al (2020) Gender Inequality in Research Productivity During the COVID-19 Pandemic, Harvard Business School, Working Paper 20-129

Previous studies, data and methods

Elsevier's reports are predominantly based on scientific publications in the Scopus database, which is the database with the broadest coverage. Publications do not typically explicitly specify authors' genders. Using advanced algorithms to assess the gender based on authors' names, the NamSor gender classifier API, Elsevier has added a gender layer to the publication data. The quality of the gender recognition algorithm results differs between countries.

The first report, "Mapping gender in the German Research Arena," only covered Germany. Results included that the number and share of female researchers were increasing. Female researchers were less productive, and their publications had a lower citation impact. However, the gender disparities in such performance data were less pronounced among senior researchers.

The second report, "Gender in the Global Research Landscape," covered 12 countries or regions but not Sweden. It highlighted the increasing share of female researchers in all areas; in nine of the countries or regions covered, this share exceeds 40%. The lower publication productivity noted in the previous study is confirmed, but no systematic differences in citation impact were found. Female researchers are slightly under-represented in internationally co-authored publications and slightly over-represented in highly interdisciplinary research.

The most recent report, published in 2020, is entitled "The Researcher Journey Through a Gender Lens." It covers the same 12 countries and regions as the second report and confirms the trend towards a decreasing gender gap in research participation. In general, men publish more, are awarded more grants, and apply for more patents than women. On average, men conduct research over a longer period, which contributes to their higher publication volume and slightly greater citation impact.

Further results from the reports relating to mobility and some other aspects are presented below. STINT has been in contact with Bamini Jayabalasingham, Elsevier, the main author of the 2020 report, and been given access to some datasets including Sweden. She has also reviewed a draft version of this report.

As always, publication data do not tell the whole story and in this case, there is an additional challenge related to the gender recognition algorithm. Another challenge is related to the fact that many publications have both female and male co-authors in different proportions. This may be addressed by taking into account the position of the author (first, last, corresponding author).⁷ Further challenges and solutions using empirical data on Sweden are discussed by Besselaar and Sandström (2017).⁸ Publication traditions vary between scientific fields and even though Scopus is the broadest publication and citation database, it covers only a part of all publications. Still, this study provides a partially new perspective on gender in research and might thus contribute to discussions.

In the Elsevier reports, further perspectives on gender in research are addressed and the methodology and data are described in some detail. Data for instance only include researchers who have publications indexed in Scopus during the specified period, and researchers are only included in the analysis if the gender recognition algorithm gives a high Gender Probability Score. The calculations are based on the "whole count", which means that all publications are counted fully, independent of the number of co-authors. Also, the additional data, which are in part available online,⁹ allow closer studies of specific scientific fields and types of authors. This STINT report should therefore be complemented with the full reports as well as the additional data available online.

⁷ cf. The end of gender disparities in science? If only it were true... Vincent Larivière, Cassidy Sugimoto (2017, see https://www.cwts.nl/ blog?article=n-q2z294

⁸ cf. Besselaar P and Sandström U (2017) Vicious circles of gender bias, lower positions, and lower performance: Gender differences in scholarly productivity and impact, PLoS ONE, ISSN 1932-6203, E-ISSN 1932-6203, Vol.

 $^{^{9}\} https://public.tableau.com/profile/bamini.jayabalasingham \#l/vizhome/Authorgenderstatistics/Genderdashboard?publish=yes_{1}\ https://public.tableau.com/profile/bamini.jayabalasingham \#l/vizhome/Authorgenderstatistics/Genderdashboard?publish=yes_{2}\ https://public.tableau.com/profile/bam$

https://public.tableau.com/profile/bamini.jayabalasingham#!/vizhome/Authorgenderstatisticscountrydeepdive/Genderdashboard

Mobility and gender

In this study, researchers are considered internationally mobile if they have published with affiliations outside their country of origin. In this analysis, the country of origin is assumed based on the author's first publication. It should be noted that collaboration indicated by international co-authorship of publications is something else. Authoring such publications is possible without changing affiliations.

In the following figures, two cohorts of researchers are compared: those who first published in the period 1999–2003 (giving an indication of the trends for a senior cohort of authors) and those who first published in 2009–2013 (giving an indication of the trends for a junior cohort of authors). Publications up to and including 2018 are used to determine international mobility. It is thus natural that the 1999–2003 cohort has higher shares of mobile researchers as it has had a longer period during which to complete a potential stay abroad.

With no exceptions, the men in the 1999–2003 cohort (i.e. the more senior male authors) are the most mobile and the women in the 2009–2013 cohort (i.e. the more junior female authors) are the least mobile, see Figure 1. In Sweden, both male cohorts are more mobile than the female cohorts.¹⁰



Mobile male and female researchers, two cohorts

Figure 1: Share of mobile researchers in four cohorts

¹⁰ A list of country abbreviations is provided in the appendix.

The EU28 values are lower than almost all individual countries in the EU28, as international mobility in this case means mobility outside the EU28. This high-lights one aspect that is important in all studies of international mobility and collaborations, namely that the size of the country often correlates negatively with the mobility of its researchers.

If the ratios between the percentages of male and female researchers in each cohort are calculated, the result indicates the relative mobility between women and men in each cohort, see Figure 2. For all countries and regions, the ratio of men to women among internationally mobile authors is larger than one, which means that, in all countries and regions, male researchers are more mobile in both cohorts. Sweden exhibits a rather high ratio, and it is higher for the cohort which first published in the period 2009–2013. This indicates a larger difference in international mobility between women and men among younger researchers which could also be interpreted as a trend departing from gender parity. However, this could also indicate that female researchers in Sweden are internationally mobile later in their academic careers.



Ratio of male to female mobile researchers, two cohorts

Figure 2: Ratio of male to female internationally mobile researchers

In Figure 3, the internationally mobile and sedentary researchers are compared for both cohorts, based on data for the period 2014 - 2018. For all four groups, the ratios of average number of publications made by men to women are indicated. In all cases except one (the Netherlands, sedentary researchers 1999 – 2003), men publish more than women. Also, with few exceptions, the gender difference is more pronounced for internationally mobile researchers. EU28 includes a broad dataset and there appears to be a negligible difference in the average number of publications between the age groups.



Figure 3: Ratio of average publication numbers by men to women

A similar comparison for the field-weighted citation impact shows that the gender differences are small.¹¹ In Figure 4, a value of 1.00 indicates no gender difference and a value below one that women have a higher citation impact. EU28 shows that women have a slightly higher citation impact than men with the largest difference in the group internationally mobile 1999 – 2003. In Sweden, sedentary women in the 1999 – 2003 cohort enjoy the largest relative positive citation im-

¹¹ 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. The global average is 1.00. For more details, see https://www.elsevier.com/research-intelligence/resource-library/research-metrics-guidebook

pact versus men. The outlier in Figure 3 (the Netherlands, sedentary researchers 1999 - 2003) is an outlier also here, with men being clearly more cited than women. Obviously, this group represents quality rather than quantity.

Denmark is another interesting example. In one group, sedentary researchers 1999-2003, women enjoy a clearly higher citation impact than men. At the same time, there is almost gender parity in the average number of publications by men and women in this group (see Figure 3).



Figure 4: Citation impact: men to women ratio

Women's participation in research: development over time

In all countries analysed, the share of women doing research has increased over time. However, there are only more female than male researchers in one country, Argentina. In Figure 5, two partly overlapping groups of researchers are compared: those who were active in the period 1999–2003, and those who were active in 2014–2018. Sweden has a slightly lower share of female researchers than the EU28 in both periods but a higher share than its neighbouring countries.

Statistics on active authors during two periods



Figure 5: Ratio of women to men in two periods

It should be noted that a higher share of women in the latter period does not automatically lead to an improved gender balance. The Elsevier (2020) report shows that women tend to drop out from research to a higher extent than men. This might lead to future senior cohorts of researchers being dominated to the same extent as today by men. An illustration of differences across generations is provided in Figure 6. Here four cohorts are created based on when the researchers had their first publication. Only currently active authors were included, which in this case means that they must have published at least twice during the period 2014–2018, unless the author is in the most recent cohort. The cohort 2003 or prior (cohort A) is therefore the smallest and cohort D the largest.¹²



Figure 6: Ratio of women to men in four cohorts of researchers

Figure 6 shows that the gender ratio is most equal in the youngest cohort in almost all countries. Sweden exhibits a considerable change between cohorts A and B, and somewhat smaller changes thereafter. It should be noted that, if all researchers remain active for an equal period and cease doing research at the same rate, gender parity will never be achieved as long as new cohorts are male dominated, which is the case for all except three countries in Figure 6.

¹² Given the substantial differences between cohorts, in several aspects, the distribution of researchers across cohorts might be one of the factors explaining countries' profiles. For example, if a country is dominated by younger researchers and the gender differences are limited in that cohort, this impacts the overall result. The number of publications per researcher depends on the scientific discipline and other factors. In Figure 7, the average publication count of women is compared to that of men. A value below one means that the average publication count is lower for women than for men. This is clearly the case in all countries included. In Sweden, female researchers' average publication count is approximately 62% of that of male researchers.

The FWCI is also presented in Figure 7, expressed as a ratio between female and male researchers. Almost all countries show a ratio relatively close to one, with the largest difference in citation impact occurring in Poland, at 91%. As Poland has seen a rapid increase in its share of female researchers, see Figure 6, their relatively young age might partially explain the difference in citation impact. Sweden has a ratio of 97%, which means that male researchers on average have a slightly higher citation impact than their female counterparts.



Figure 7: Ratio of women to men in two indicators: publication count and average field-weighted citation impact

To study differences between cohorts in the average publication count, the oldest and youngest cohorts are compared in Figure 8. It should be noted that the scales are different, thus masking that almost all countries show a more equal average publication count for cohort D. In Sweden, the ratio of the average publication count by women compared to that of men for the oldest cohort (A) is 0.68, whereas the same ratio for the youngest cohort (D) is 0.86. However, all countries exhibit lower average publication counts for female researchers than for their male colleagues in all cohorts.

In short, Figure 8 shows that female researchers who have been active since 2003 or earlier exhibit a clearly lower average publication count compared to that of men in the same cohort and to that of female researchers who started publishing in the period 2014–2018. Apparently, publication volumes differ less between women and men among younger researchers.



Figure 8: Ratio of average publication count of women compared to that of men, two cohorts

A similar comparison of the field-weighted citation impact is made in Figure 9. Here, the relative citation impact for female researchers is higher in the "old" cohort (A) compared to the "young" one (D). In Sweden, the difference between the cohorts is small with 1.00 for cohort A and 0.975 for cohort D. For Switzerland (CHE), female researchers in cohort A are more cited than men, whereas men are slightly more cited in the cohort D. But overall, the differences between the genders are small.

If Figure 8 and Figure 9 are compared, it indicates that female researchers in cohort A on average publish less than men but receive approximately the same citation impact. The citation impact calculation is independent of the number of publications per person as it is calculated per publication.



Figure 9: Ratio of average citation impact of women compared to that of men, two cohorts

Gender representation in different scientific fields

As mentioned above, the gender balances of different scientific fields differ. In this section, the participation in different fields is presented only for the EU28 and Sweden. The data for other countries or regions can be studied online.

In Figure 10, the ratio of women to men in Sweden is presented for two groups of researchers. All fields exhibit a change towards more women participating in research in the period 2014–2018. In most cases, this leads to greater gender balance. A ratio of 0.2 indicates one woman per five men, while a ratio of 2 indicates two women per man. Although the nominal difference between 1.0 (indicating gender parity) and 0.2 is smaller than that between 1.0 and 2, it thus signifies greater imbalance.



Figure 10: Ratio of women to men in different scientific fields, Sweden

The corresponding data for the EU28 are presented in Figure 11. In the EU28, the share of publications with female authors is also increasing in all fields. There are more publications by women than men in seven fields in Sweden and in eleven in the EU28. All seven fields dominated by women in Sweden are also dominated by women in the EU28. In both Sweden and the EU28, mathematics is the field with the lowest average number of publications by female authors relative to that by male authors. In Sweden, the field of "fertility & birth" has the highest share of female authors, whereas nursing has the highest share in the EU28.



Statistics on active authors during two periods

Figure 11: Ratio of women to men in different scientific fields, EU28

Above, it was noted that men on average tend to produce higher volumes of publications than women. In Figure 12, the ratio of the average publication count of women compared to that of men is displayed for each scientific discipline. Data for Sweden are compared to data for the EU28. Figure 12 shows that women on average produce fewer publications than men in all scientific fields. In both Sweden and the EU28, decision sciences are the closest to achieving gender parity with a ratio of approximately 0.91 (Sweden) and 0.84 (EU28). This means that on average, men produce approximately 10% more publications than women in decision sciences. Dentistry is the discipline with the largest difference in average publication count between the genders in Sweden, with men producing almost twice as many publications than women. In the EU28, the area of "cardiology & pulmonology" exhibits the lowest ratio. Overall, the patterns in Sweden and the EU28 are similar.



Figure 12: Ratio of average publication count of women to that of men, Sweden and the EU28

Finally, in Figure 13, the average FWCI ratio of women compared to that of men is indicated for each field in Sweden and the EU28. First, it should be noted that the scales are different for Sweden and the EU28, as Sweden's ratio has somewhat larger

variations. This is not surprising, given the lower total numbers of publications. In Sweden, nine of 37 fields exhibit a ratio above one, which means that the publications by female authors are cited more frequently. The corresponding number for the EU28 is six.

There appears to be no direct correlation between gender dominance in a discipline and higher citation impact. The discipline with the highest share of publications by female authors in Sweden, fertility and birth, shows a ratio of 0.91, which means that men have a slightly higher citation impact than women. Most fields with a ratio above one are clearly dominated by men. Paediatrics is one exception in both Sweden and the EU28, being dominated by women while women also enjoy a higher citation impact.



Figure 13: Ratio of average field-weighted citation impact of women to that of men, Sweden and the EU28

Discussion

This study originates in being granted access to data covering Sweden, following a discussion of the results in Elsevier's 2020 report on gender in research. The purpose of this report is to make some of the data available and to provide commentary on the results presented in the figures. It should be noted that using publication data to take a gender perspective on research (output) is more complicated than it may at first appear.

Swedish researchers are more mobile than researchers in Finland and Norway but slightly less mobile than their Danish counterparts. Interestingly, researchers in France and the United Kingdom are more mobile than Swedish researchers. Otherwise, international mobility is often linked to the size of the country; a small country tends to have higher international mobility than a large one. The gender gap in mobility is relatively large in Sweden; whereas approximately 32% of male researchers in the older cohort have international experience (having published with a non-Swedish affiliation), the corresponding figure for the female cohort is 23%. A similar difference in percentile units also applies to the younger cohort, which in relative terms is even larger than that of the older cohort.

The gender difference in average publication count is larger among internationally mobile researchers, with men publishing more, especially in the older cohort. However, international mobility does not affect citation impact differently for the genders. In the older group of sedentary researchers, women tend to have a higher citation impact than men, although not systematically so. The expectations that male researchers need to spend some time abroad, an international postdoc for example, are presumably higher than for women. Men are also more active in scientific fields with substantial international collaboration. This leads to a larger difference between those men who do go abroad and those who stay in Sweden, compared to their female counterparts.

When comparing still-active cohorts producing their first publications in different periods, the share of female researchers is the highest in the most recent cohort. Sweden, with shares of female researchers between 0.33 (cohort 2003 or prior) and 0.72 (cohort 2014–2018), is similar to the EU28, but has slightly lower proportions of women. In addition to dropout rate, mentioned above, many factors influence these figures, including international recruitment and the dominant scientific fields in each country.

The difference between the average publication counts of male and female researchers is much larger for the oldest cohort than for the youngest. Men publish more. This may partially be explained by the fact that men in the older cohort are to a greater extent leaders of research groups and traditionally the most senior researcher is included as an author in the other researchers' publications. Those who supervise several doctoral students or other younger researchers will rapidly add more publications to their names. In the youngest cohort, this potential difference in position has not yet materialised. This explanation resonates with the low difference in citation impact: a higher hierarchical position does not automatically result in higher citation numbers. Another explanation could be linked to the rather different publication traditions of scientific fields. In Sweden, the share of female researchers in the arts and humanities is slightly higher than the national average. In these fields, articles and conference papers are not as common and publishing books is often the norm.

The comparison between scientific fields shows that gender-related differences in citation impact appear to benefit the minority gender. In most fields dominated by female researchers, men enjoy slightly higher citation impact, and vice versa. This is in line with the findings by Besselaar and Sandström (2017). Overall, the differences are small and although most of the limited selection of reports and articles referenced in this report tend to argue that men enjoy a slightly higher citation impact than women, some articles argue the opposite.¹³ These conflicting messages can to some extent be explained by the choice of data; Besselaar and Sandström (2017) used data for Sweden, whereas the Thelwall (2020) study uses data for English-speaking countries. As highlighted in Figure 9, the United Kingdom (GBR) is among the countries with the highest relative FWCI for female researchers.

¹³ Thelwall, M. (2020) Female citation impact superiority 1996–2018 in six out of seven English-speaking nations, Journal of the Association for Information Science and Technology, 2020;71:979–990.

Conclusions

Based on data and results delivered by Elsevier, this report gives some perspectives on gender equality in research, with a focus on Sweden and international mobility. The basis for the study is Scopus publications. To add a gender layer on the data, the NamSor gender classifier API was used, which infers gender based on the author's name.

The share of female researchers in Sweden is on average slightly lower than that in the EU28. There are considerable differences between scientific fields – from one female per five male researchers (mathematics) to two male per five female researchers (fertility and birth). The trend seems to be towards gender parity, but caution is advised as there are factors such as dropout rate that might gradually change the gender balance in research over time.

International mobility leading to publications with a foreign affiliation is clearly more common among male researchers, in Sweden and in other countries. Male researchers exhibit a higher average publication count, and this difference is accentuated among researchers with international experience. Yet there is no such difference in the citation impact.

Appendix – country codes

ARG	Argentina
AUS	Australia
AUT	Austria
BEL	Belgium
BRA	Brazil
CAN	Canada
CHE	Switzerland
CZE	Czechoslovakia
DEU	Germany
DNK	Denmark
ESP	Spain
EU28	28 EU countries
FIN	Finland
FRA	France
GBR	Great Britain
GRC	Greece
ITA	Italy
JPN	Japan
MEX	Mexico
NLD	Netherlands
NOR	Norway
POL	Poland
PRT	Portugal
SWE	Sweden
TUR	Turkey
USA	United States of America

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. For example, STINT 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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