

Gender Disparities in Academic Disciplines: An Attempt to Fill in the Blind Spots of Bibliometrics

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Abstract

This is a study of gender differences in research activity over time and in different disciplines as measured by scientific output in dissertations at two levels in the Russian system: PhD and the more advanced Doctor of Science (DS). Data are derived from more than 250,000 dissertations from 2005-2016, a data source with several advantages compared to WoS or Scopus for the purpose of this study: a) complete data, also for the SSH; b) easy gender disambiguation because Russian patronyms are gendered; c) easier attribution of the work (no need to attribute to the first author in multi-authored publications); d) the indication of career stage by separating between PhD and DS. The results show the expected gender imbalances in the spectrum between Engineering Science (male dominance) and Philology (female dominance). A trend over time towards increasing balance is seen only at the DS level, where the male share is higher than at PhD level in almost all disciplines. The results mainly confirm results from studies in other countries, however, the four advantages listed above make this study an important reference for further studies of gender disparities limited to WoS or Scopus.

Introduction

This article attempts to come closer to understanding the gender inequality in academia present in most countries, and Russia in particular. One of the most widely explored gender gaps is the publication gap; its estimations are often based on WoS and Scopus data (Larivière et al., 2013; Huang et al., 2020). Studies of the Russian academic environment have documented persistent gender gaps in publication productivity. Women publish fewer papers than men, even though they are better represented in many academic fields: it is shown through the analysis of selected Russian academic journals (Krasnyak, 2017), Web of Science data in the Natural Sciences and STEM (Lewison & Markusova, 2011; Paul-Hus et al., 2015), on a broader list of disciplines (Pilkina & Lovakov, 2022). In addition, the proportion of female teachers in higher education in Russia has been consistently high, and over 60% in recent years (UNESCO UIS, 2020; also Fig. S1). However, Russian women are less represented in higher academic positions and academic management (Sterligov, 2017).

This study assesses gender imbalances in Russian academia by analyzing two types of dissertations. We answer the following research questions: (1) What gender imbalances exist in Russian academia? (2) Which research fields are more or less affected by gender imbalances? (3) How does gender imbalance change depending on the type of dissertation and, therefore, the stage of the academic career? (4) What are the dynamics of the gender imbalance in Russia from a dissertation perspective?

Research on gender inequality in science based on bibliometric data from databases such as WoS and Scopus has some limitations that need to be considered. One of the primary limitations is the underrepresentation of Social Sciences and Humanities (SSH) in these databases and a bias that favors Natural Sciences, Engineering, and Biomedical Research. This can lead to a skewed view of the overall picture of gender inequality in science (Mongeon & Paul-Hus, 2016; Martín-Martín et al., 2018).

In this study, we analyze a representative sample of dissertations from all disciplines to reveal the gender structure of Russian academia. This approach enables us to examine the gender

structure in general and estimate disparities in fields that are frequently underrepresented in bibliometric analyses, such as SSH. By doing so, this paper contributes to the literature on gender as a component of academic career analysis in Russia across a comprehensive list of academic fields. Additionally, our findings allow us to view the results of bibliometric studies from a different perspective and complement them to some extent.

The article is organized as follows: the *Data* part describes the origin of the data, the difference between the two types of dissertations existing in Russia, describes the algorithm used to determine gender, scientific fields, and subfields. The *Results* part describes the gender disproportions existing in Russian academia and identifies primarily female, balanced, and primarily male fields. Next, we show how disproportions look at different academic career levels by analyzing PhD and DS dissertations and the trends for all academic fields. *Conclusions* present possible explanations for the gender gaps and discuss what might bring the view through the lens of dissertation production compared to bibliometric studies. Next, we discuss the limitations and future directions of this research.

Data

The data for this research are taken from the *Russian Book Chamber* website (the national bibliographic agency that carried out bibliographic and statistical records of publications issued in Russia). Information is available on the website about the field of research, the place of defense, the date of defense, and the type of thesis. We got 266,037 PhD and DS dissertations in 18 academic fields from 2005 to 2016. Before 2016, posting on the Book Chamber website was a prerequisite term. In this way, we see all the people in all fields who became PhD or DS from 2005 to 2016. We needed to get the fullest possible sample because we wanted to show a structure of all scientific fields, even detect those that often droop from bibliometric analysis due to the specifics of their publication practices in international journals. Table 1 shows that the most number of dissertations in Russia is in three fields: Technical Sciences (16.5%), Economics (15.5%), and Medical Sciences (14.9%). The least number of dissertations is in Art Studies (0.8%), Culturology (0.9%), and Political Science (1.5%).

Table 1. Research fields with counts of dissertations in 2005-2016.

| <i>Field</i> | <i>Number of diss.</i> | <i>Share of total</i> | <i>Field</i> | <i>Number of diss.</i> | <i>Share of total</i> |
|---------------------|------------------------|-----------------------|----------------------|------------------------|-----------------------|
| 1 Technical science | 43 794 | 16.5% | 10 Earth Sciences | 8543 | 3.2% |
| 2 Economics | 41 020 | 15.5% | 11 History | 8520 | 3.2% |
| 3 Medical Sciences | 39 479 | 14.9% | 12 Chemistry | 7957 | 3.0% |
| 4 Education | 20 170 | 7.6% | 13 Psychology | 5819 | 2.2% |
| 5 Biology | 16 727 | 6.3% | 14 Philosophy | 5464 | 2.1% |
| 6 Law | 15 610 | 5.9% | 15 Sociology | 4360 | 1.6% |
| 7 Philology | 14 653 | 5.5% | 16 Political Science | 4049 | 1.5% |
| 8 Physics & Math. | 14 586 | 5.5% | 17 Culturology | 2477 | 0.9% |
| 9 Agriculture | 9724 | 3.7% | 18 Art Studies | 2183 | 0.8% |

In Russian academia, there are two types of dissertations: PhD and Doctor of Science (DS). The DS dissertation has a higher status and is defended after the PhD, allowing a person to move up the academic ladder. It is also a formal requirement for obtaining a position as a professor or a high administrative position in academia (Huisman, Smolentseva & Froumin, 2018).

Gender-specific suffixes of patronymic (part of the author's full name) provided gender assignment. Patronymics with the suffix 'na' were associated with the female gender, 'ch' with the male gender (see Table S1). Patronymic names provide very high results but are usually absent in international bibliometric data. In our data, patronymic is present for 97.6% of the authors. Thus we made female/male gender assignments for 258,826 dissertation authors.

The definition of academic fields and subfields was based on the standard Russian classification—*High Certification Committee Codification*. Over ten years, there have been changes in the codification. For example, in 2006, Geological Sciences was a separate field; in 2016, it was a subfield of Earth Sciences. We carried out data unification based on the 2016 codification.

Results

Female and male authors

To assess the gender situation in Russian academia, we assessed the relative contributions of men and women in all PhDs and DSs defended in Russia from 2005-2016. The analysis demonstrates a relative gender balance among PhD authors (even a shift in favor of women) and a gender disproportion among DS authors (Table 2).

Women are the relative majority in the context of PhD authors in Russia in general. Among the 227,730 authors, 120,286 are women (52.8%), and 107,444 are men (47.2%). This suggests that women are as widely represented as men in PhD authors in Russia.

The gender disparity is more explicit among the 31,096 DSs authors. The share of male authors is 58.6%, and the share of female authors is 41.4%. Various reasons can explain this trend: women may not reach the DS stage because of barriers within academia (from direct discrimination in hiring and promotion to the unequal impact of parenthood on women and men).

Table 2. Share of female and male authors of PhDs and DSs.

| <i>Dissertation type</i> | <i>Female (%)</i> | <i>Male (%)</i> | <i>Total</i> |
|--------------------------|-------------------|-----------------|--------------|
| PhD | 120 286 (52.8%) | 107 444 (47.2%) | 227 730 |
| DS | 12 876 (41.4%) | 18 220 (58.6%) | 31 096 |

Share of female and male authors by research fields

Figure 1 shows the share of male and female authors in all research fields. The share of female authors of PhDs ranges from 27% to 87%. This proportion decreases for female DSs authors, ranging from 13% to 77%. In Physics & Math, we have 5.5% of all dissertations (eighth position in Table 1), and this field shows the highest gender disbalance in the male

predominance direction. Philology has the highest predominance of women (also holds 5.5% of all dissertations, Table 1).

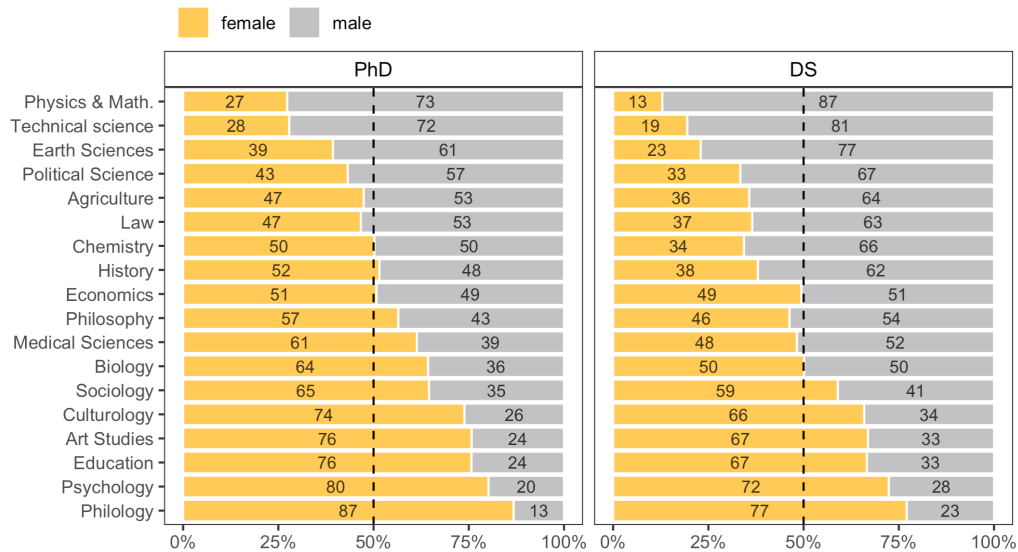


Figure. 1 Share of female and male authors in 18 research fields.

The size of the gap in the share of women defending PhDs and DSs varies considerably across fields. As expected, women are less represented in STEM fields. Physics & Math, Technical and Earth Sciences confirm the significant disparity in the context of PhD production between men and women in these traditionally primarily male disciplines. Regarding PhDs and DSs, the lowest proportion of women is found in Physics & Math (17% in PhD and 13% in DS). In contrast, men are underrepresented in Philology (13% in PhD and 23% in DS). Female and male PhD authorship is about equal in Agricultural Sciences, Law, Chemistry, History, and Economics and maintains a 47%-51% share. However, regarding DS authors, the gender-balanced fields that were more skewed toward women at the PhD level became completely different, namely Medical Sciences and Biology (48%-50% female authorship rate). Gender-balanced fields at the PhD level shifted to more masculine fields at the DS level. The only exception is Economics, which is gender-balanced at PhD and DS levels.

Fig 2 also compares the percentage presence of women among PhDs and DSs authors. For each field, it is shown that female authors are worse represented than PhDs authors, even in the primarily female fields. The difference ranges from 1.3 pp in Economics, 5.6 pp in Sociology, 7.8 pp in Psychology to 16.3 pp in Earth Sciences, 15.9 pp in Chemistry, and 14.4 pp in Physics & Math. This tendency may be related to women's lower rate of advancement or their higher rate of "leaking" out of academia (Sheltzer & Smith, 2014). Even in predominantly female fields, the share of women who reach the DS level is lower.

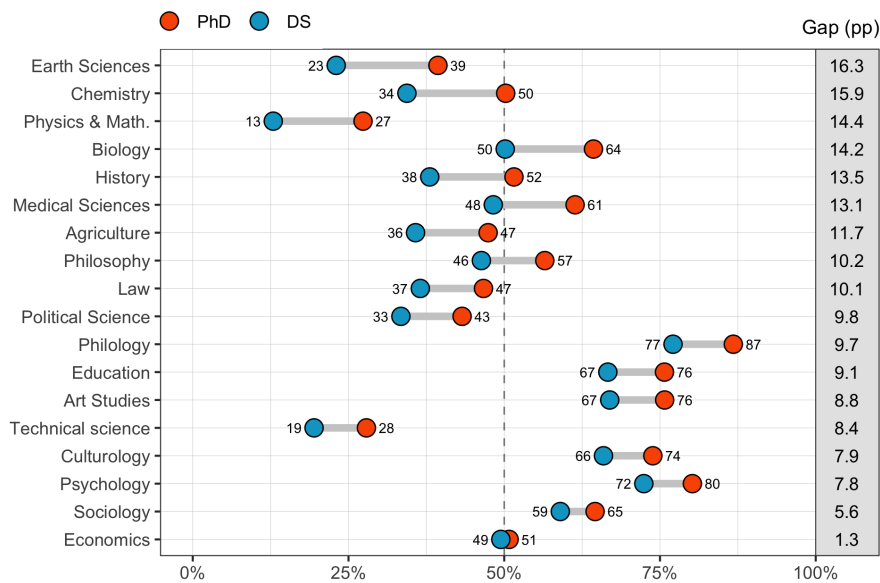


Figure. 2 Gap between the share of female authors on PhD and DS levels.

Thus, we can record the significance of two dimensions of gender inequality—the different representation of women and men by field and the “promotion” up the track in the form of DS defense. This tendency may confirm previous research that while dominant in the early stages of their academic careers, women in Russia become significantly less represented in the later stages (Sterligov, 2017).

Ten-year dynamics by field and dissertation types

Fig 3 shows the dynamics of the share of women as PhD and DS dissertation authors from 2005-2016. The graphs are arranged from the primarily feminine fields (Philology, Psychology) to the primarily masculine (Technical Sciences, Physics & Math). For PhD dissertations, we see weak dynamics in most fields—the proportion of women almost always remains consistently high in women's fields and consistently low in men's fields. We do not see a trend toward the balance—the feminization of male fields and the masculinization of female fields. From 2005-2016, for example, the proportion of women among Education PhD authors did not change and was 75% ($\pm 1\%$) each year. The same immutability is also observed in the primarily male Technical Sciences (each year around 27-28%). The exception is Agriculture, which steadily increased from 45% in 2005 to 53% in 2016. Political Science also shows an increasing trend but with less confidence (see Figure S2).

We see very different trends in the proportion of female DS authors. There is feminization in many fields, and examples can be found in both primarily female and primarily male fields. In Education, the share of female authors of DSs by the end of the period equaled the share of female authors of PhDs (75% female for both types of dissertations). Similarly, the gap in the share of female authors of PhDs and DSs disappeared for Psychology (both types of dissertations by the end of the period converged at about 78%), Philosophy (59%), Economics (54%), and even Engineering (28%) (see Fig S3).

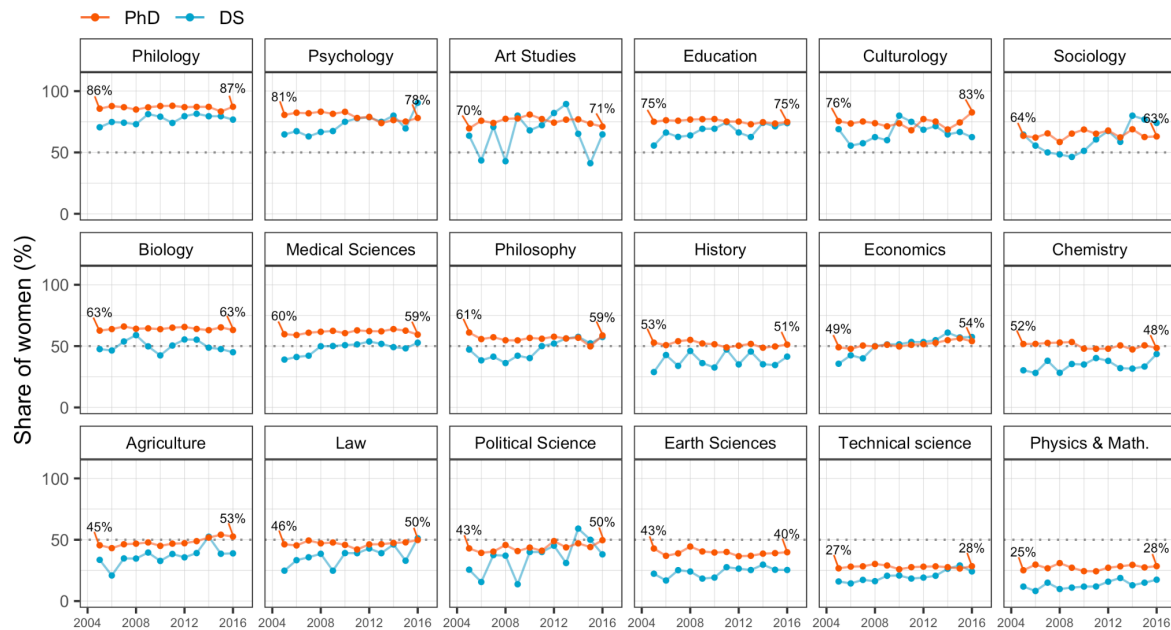


Figure. 3 Share of female authors of PhDs and DSs in 2005-2016.

Conclusions

An analysis of women's presence from 2005-2016 showed that gender disparities persist in the Russian academic environment regarding PhD and DS dissertation defense rates. Women are underrepresented in some academic fields but not in academia in general. Regarding fields that are more or less prone to the gender gap, our analysis divides disciplines into three groups: (1) primarily male (Physics & Math, Technical Sciences, Earth Sciences); (2) prone to equality (Economics); (3) primarily female (Philology, Psychology, Education, Art Studies, Cultural Studies). Our results also show that overall, across all fields of study, the average proportion of female DS authors is lower than that of female PhD authors (Fig 2). For PhD dissertations, we see weak dynamics across most fields—the proportion of women almost always remains consistently high in women's fields and consistently low in men's fields. We do not see a trend to balance—the feminization of male fields and the masculinization of female fields (Fig 3). We see a different tendency for the proportion of female DS authors. There is the feminization of many fields, and examples can be found in both predominantly female and predominantly male areas. In other words, we see that the share of women among DS authors is getting closer to the share of women among PhD authors. However, the share of women among PhD authors does not show any significant dynamics for 2005-2016.

Considering the gender structure of Russian science through the prism of dissertations allows us to overcome the limitations of research based on bibliometric data in a certain way. The analysis of WoS/Scopus publications does not include all publications, and only the part of Russian publications that have been published in international journals and are visible to the global academic community. Table 1 shows that the largest number of dissertations in Russia is in three fields—Technical Sciences (16.5%), Economics (15.5%), and Medical Sciences (14.9%). Bibliometric studies show that Russian science has a predominance of Physics and Chemistry. For example, Pilkina & Lovakov (2022) shows that Physics has 23.2% of all articles that Russian authors wrote in 2017-2019 (at least one Russian-affiliated author, WoS database). Chemistry is in second place (20.7%), and Economics in the structure of Russian science through the prism of WoS publications is less than 1%.

This study also has certain limitations: the defense of a PhD dissertation does not assume that a person necessarily stays as part of academia. Depending on the field of science, a person who received a PhD is more or less likely to be part of the academic community. That said, the defense of the DS is likely to confidently tell us that the person is affiliated with an academic track.

Continuing this study, we plan to examine how defenses are distributed across organizations. Although state agencies set formal requirements for dissertations in 2005-2016, grouping into more and less prestigious organizations will help reveal additional tendencies in gender imbalance in academia. In addition, a further subdivision into subfields could be introduced to show that the academic fields are not homogeneous by their subfields (Fig S4).

Acknowledgments

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Additional information

Online Supplementary materials are available at <https://hellche.github.io/issi2023/>.

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