Journal of Informetrics 9 (2015) 1007–1017

Contents lists available at ScienceDirect

Journal of Informetrics

journal homepage: www.elsevier.com/locate/joi

Gender differences in scientific performance: A bibliometric matching analysis of Danish health sciences Graduates☆

Tove Faber Frandsen[a,*], Rasmus Højbjerg Jacobsen[b], Johan A. Wallin[c], Kim Brixen[a], Jakob Ousager[c]

[a] Odense University Hospital, Sdr. Boulevard 29, DK-5000 Odense, Denmark
[b] KORA, Danish Institute for Local and Regional Government Research, Copenhagen, Denmark
[c] University of Southern Denmark, Odense, Denmark

ARTICLE INFO

Article history:
Received 1 May 2015
Received in revised form
24 September 2015
Accepted 24 September 2015
Available online 19 November 2015

Keywords:
Scientific productivity
Impact
Gender differences
Gender gap

ABSTRACT

The aim of this study is to compare PhD students' performance with respect to gender using a number of matching methods. The data consists of fine-grained information about PhD-students at the Institute of Clinical Research at the University of Southern Denmark. Men and women are matched controlling for sub-disciplinary affiliation, education, year of enrolment and age. Publications and citations are identified in Web of Science.

Our study shows that the average total number of publication is slightly higher for men than for women. Excluding the "other" group of publications from the analyses reveals that there is a negligible difference between men and women in terms of published articles. A substantial proportion of women is on maternity leave during the time period analysed and thus we would expect their productivity to be considerably lower. Similarly, we have found very little difference between the citation impact of men and women.

We find matching methods to be a promising set of methods for evaluating productivity and impact of individuals from various sub-fields, universities and time periods as we are able to discard some of the underlying factors determining the results of analyses of gender differences in productivity and citation impact.

1. Introduction

Students' decision to enter into research is influenced by many factors such as future career opportunities, chances of academic success and also considerations towards family issues. Graduate students' productivity may be influenced by family obligations such as children, partner, parents etc. According to Kelchtermans and Veugelers (2013) general factors determining the productivity of a researcher are talent, luck, effort and cumulative effect (a.k.a. the Matthew effect). For women, the choice of having children and to and take maternity leave will – all other things equal – make it more difficult to offer the extra effort that may be demanded in a competitive academic environment. Difference in the level of scientific productivity between men and women remains a research issue that has been explored bibliometrically in more than three decades (Mairesse & Pezzoni, 2013) and more studies are frequently called for (Fox & Stephan, 2001; Mairesse &

☆ The authors would like to thank Thomas Aagaard for assistance with data collection and are grateful for valuable comments and suggestions from the referees.

* Corresponding author.
E-mail address: t.faber@videncentret.sdu.dk (T.F. Frandsen).

http://dx.doi.org/10.1016/j.joi.2015.09.006
1751-1577/

Pezzoni, 2013). Mairesse and Pezzoni have provided an overview of existing models for explaining the potentially lower productivity of women (family engagements, marital status and policies in favour of women, institutional specificities, discipline specificities, etc.). Hunter and Leahey (2010) analyse the effect of children on the entire careers of academics which is different for men and women. Fridner et al. (2015) investigate age, academic position, collaboration with former supervisor, control at work and exhaustion as predictors of productivity and finds different patterns for men compared to women. Cole and Zuckerman (1984) coined it the "productivity puzzle" while others prefer the term "productivity gap" (Abramo, Cicero, & D'Angelo, 2015).

Differentiating between academic fields on a relatively general level of e.g. social sciences, physical science etc. Duch et al. (2012) find differences in some but not all fields and find that the lower publication rates of female faculty members are correlated with the amount of research resources typically needed in the discipline. Only a few studies have taken the potential field or discipline differences in to account using a more fine-grained division between these. Some studies find no difference when controlling for academic rank (Paik et al., 2014; Tomei et al., 2014) whereas Tomei et al. do find a statistical significant difference in productivity (Paik et al., 2014). Findings by Abramo et al. (2015) suggest that even within the same discipline there are different tendencies and consequently, analyses may be more appropriately done on the level of sub-disciplines.

It is worth noting that the study by Khan et al. (2014) as it seems to indicate that there are significant differences across departments or programs within the same field. They found mean *h*-index values ranging from app. 5 to app. 30. Consequently, one should be careful when aggregating data from various universities, a point also noted by others (Mairesse & Pezzoni, 2013).

The existing studies of the gender productivity and impact puzzle typically include a much greater cohort of men than women (in a recent study the women only make up as little as 21 percent of the included faculty members, Duch et al., 2012). The over-representation of male academics is well known (see e.g. Sugimoto, Lariviere, Ni, Gingras, & Cronin, 2013), and data on the staff of national research systems indeed confirm that there is a significant deficit in the presence of women. The share of women ranges from 14 percent to 45 percent with a median value in 2011 of 33 percent (OECD, 2015). However, the share of women is not distributed equally across the data set. Compared with men, women tend to be younger and of lower academic rank. Moreover, some disciplines have very few female researchers whereas women dominate others.

The so-called leaking pipeline can be illustrated by depicting the obvious differences in the presence of women on bachelor, master, doctoral and faculty level (Duch et al., 2012). This will inevitably skew the dataset and possibly bias the analyses if not taken in to account. We therefore suggest the use of matching methods.

In this study, the aim is to analyse PhD students' performance with respect to gender. Outcomes are publications and citations. We control for a number of factors considered important for productivity including the department (i.e. academic subfield) where the students were enrolled and use an exact matching method to construct comparable groups of men and women.

This paper uses a unique data set of health science PhD students within the clinical specialties from the University of Southern Denmark (formerly known as Odense University).

2. Overview of related literature

A number of studies have provided evidence of a gender gap documenting women researchers to be less productive than men. Most studies use samples restricted to one discipline and in some cases from one country e.g., Spanish psychologists (Barrios, Villarroya, & Borrego, 2013), Swedish physicians (Fridner et al., 2015), library and information scientist (Penas & Willett, 2006), German cardiologists (Bohm, Papoutsis, Gottwik, & Ukena, 2015), social psychologists (Cikara, Rudman, & Fiske, 2012), and German medical researchers (Kretschmer, Pudovkin, & Stegmann, 2012).

Other studies confirming the gender gap in productivity cover several disciplines. Baccini, Barabesi, Cioni, and Pisani (2014)study Italian researchers from various disciplines and find that women are less productive than men. Another Italian studies confirm their findings (Abramo, D'Angelo, & Caprasecca, 2009). Studies on Spanish data (Mauleon, Bordons, & Oppenheim, 2008) as well as Croatioan (Prpic, 2002) and American data (Xie & Shauman, 1998) are also available. Stack finds great differences in gender effect between different fields using data from the National Research Council (Stack, 2004). Canadian data supports their findings (Lariviere, Vignola-Gagne, Villeneuve, Gelinas, & Gingras, 2011).

A number of studies provide further insight into the existence of a gender gap in productivity and does not confirm the existence without reservations. Mairesse and Pezzoni (2013) study French physicists and find a substantial lower production by women, however, having controlled for a number of variables (e.g. non-equal chances of promotion and non-publishing spells) the differences disappear. Their findings are to a certain degree supported by a study of two disciplines (Bordons, Morillo, Fernandez, & Gomez, 2003) and nano science (Sotudeh & Khoshian, 2014). Eloy et al. (2013a) find that the productivity of women in Otolaryngology equals or surpasses that of men later in their careers. The differences between subfields are confirmed in a large study of various medical disciplines (Eloy et al., 2013b). A large-scale study confirms that the differences in publication rate and impact are discipline-specific (Duch et al., 2012). van Arensbergen, van der Weijden, and van den Besselaar (2012) stress the importance of keeping the skewed publication data in mind as few highly productive authors can skew the data set. Some studies find the gap to be decreasing over time (Abramo et al., 2009; Mauleon et al., 2008; van Arensbergen et al., 2012; Xie & Shauman, 1998). The large-scale analysis by West, Jacquet, King, Correll, and Bergstrom