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Gender and citation impact in management research

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ABSTRACT

This study investigates the extent to which a gender gap exists in the citation rates of management researchers. Based on a cross-sectional sample of 26,783 publications and 65,436 authorships, we illuminate possible differences in women's and men's average citation impact per paper, adjusting for covariation attributable to geographical setting, institutional reputation, self-citations, collaborative patterns and journal prestige. We find a marginal difference in citation impact in favor of women management scholars. Women are also slightly more likely than men to author articles among the top-10% most cited in their field. Yet given the sensitivity of our results to uncertainties in the data, these variations should not be overgeneralized. In the large picture, differences in citation rates appear to be a negligible factor in the reproduction of gender inequalities in management research.

1. Introduction

Citation indicators have become increasingly influential as proxies for visibility, impact and success in the academy. Citation counts are used in tenure, hiring and funding decisions (Diamond, 1986; Nielsen 2017a; van den Brink, Fruytier, & Thunnissen, 2013; Weingart, 2005) and citations have been shown to heighten academic salary levels (Leahey, 2007). As such, citations can be seen as essential building blocks for success and status in the academy; but they also shape institutional patterns of stratification. Bourdieu (1990, p. 76), for instance, refers to citations as the "most objectified of the indices of symbolic capital", while Baldi (1998, p. 830) describes them as "critical micro-level stratifying mechanisms". Thus, given their potentially profound consequences as sieves for allocating opportunities and rewards, the question of whether a gender gap in citation impact exists in management research deserves careful attention.

Gender inequalities in management research are scarcely documented (Reilly, Jones, Rey, Vasquez, & Krisjanous, 2016), but existing evidence suggests that a disproportionate number of women advance to the upper echelons of the discipline. Consider recent developments in the United States as an example. From 1997 to 2007, women's share of doctoral degrees conferred in Business and Management increased from 31% to 41%, according to the U.S. Department of Education (cf. AACSB, 2010); but men are still dominating the faculty positions. A recent survey of 504 business and management schools in the United States, conducted by the Association to Advance Collegiate Schools of Business (AACSB), estimated that women comprise 21% of full professors, 33% of associate professors, 38% of assistant professors in 2015–2016 (Brown, 2016). As such, the scarcity of female faculty cannot be fully attributed to supply-side factors (i.e. the available pool of women in the education pipeline), meaning that demand-side factors (i.e. the ability of schools to recruit and retain female candidates) may be operating as well. But to what extent may gender differences in citation rates factor into the reproduction of such inequalities?

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In this study we investigate potential gender differences in management scholars' citation impact per paper. Based on a cross-sectional sample of 26,783 publications and 65,436 authorships, we illuminate differences in the average citation rates of women and men, adjusting for covariation attributable to geographical setting, institutional reputation, self-citations, collaborative patterns, the gender composition of author groups and journal prestige. We also examine national differences in women's citation rates relative to men's. To our knowledge, this study represents the hitherto most comprehensive examination of the link between author gender and citation impact in the social sciences.[1]

2. Gendered patterns of citation

The literature addressing gender differences in citation impact is scarce and inconclusive. Results tend to vary depending on research design,[2] scientific discipline (Duch et al., 2012; Gonzalez-Brambila & Veloso, 2007; Larivière, Vignola-Gagné, Villeneuve, Gelinas, & Gingras, 2011; van Arensbergen, van der Weijden, & Van den Besselaar, 2012), geographic location (Elsevier, 2017; Sugimoto et al., 2015) and gender composition in the field (Ferber & Brün, 2011). Some studies find that men are cited more frequently than women (e.g. Aksnes, Rorstad, Piro, & Sivertsen, 2011; Larivière, Ni, Gingras, Cronin, & Sugimoto, 2013). Others find no notable gender difference (e.g. Nielsen, 2016; Slyder et al., 2011; Symonds, Gemmell, Braisher, Gorringe, & Elgar, 2006), while a third group of studies report higher citation rates for women than for men (e.g. Borrego, Barrios, Villarroya, & Ollé, 2010; Long, 1992). In this overview, we focus specific attention on evidence concerning gender and citation rates in the social sciences.

The literature survey was carried out using title-focused searches in Web of Science and JSTOR.[3] We limited our scope to papers published from 2000 through 2016, focusing on gender and citation impact in social science disciplines. We read through 122 titles and abstracts and used snowballing techniques to identify additional sources in the reference lists of relevant articles. We included all studies in English reporting quantitative evidence on the role played by gender in predicting the citation impact of social-science researchers. We identified 17 relevant studies, summarized in Table 1.

Like the broader literature, research concerning gender and citation impact in the social sciences is characterized by mixed results. Six out of 17 articles reviewed for this study report a citation bias in favor of men, three articles find women to be cited more frequently, while seven articles show no notable gender differences. One article reports a citation bias in favor of men in the established generation of social scientists, whereas no difference is reported for the young generation.

A closer look at variations across research areas demonstrate a citation bias in favor of men in the following disciplines: International Relations (Maliniak, Powers, & Walter, 2013; Mitchell, Lange, & Brus, 2013), Information Science (Håkanson, 2005), Linguistics (Leahey, 2007; McElhinny, Hols, Holtzkener, Unger, & Hicks, 2003); Sociology (Leahey, 2007) and Social Psychology (Nosek et al., 2010). No notable gender differences are reported for Management (Judge, Cable, Colbert, & Rynes, 2007; Podsakoff, MacKenzie, Podsakoff, & Bachrach, 2008), Criminal Justice (Stack, 2002) and Peace Research (Østby, Strand, Nordås, & Gleditsch, 2013), while citation biases in favor of women are reported in Construction Research (Powell, Hassan, Dainty, & Carter, 2009) and Political Science (Montpetit, Blais, & Foucault, 2008). Finally, research focusing on Law finds that women either outperform (Merritt, 2000) or are cited at similar rates as men (Ayres & Vars, 2000).

The inconsistencies in the literature refrain us from formulating any prior conjectures concerning the link between author gender and citation impact in management research. Existing studies focusing on management do not to report any notable differences (Judge et al., 2007; Podsakoff et al., 2008); but these studies, like most studies in our review, target articles (or authors) in selected core journals, which complicates generalizability beyond these journals (Ayres & Vars, 2000; Håkanson, 2005; Maliniak et al., 2013; Mitchell et al., 2013; McElhinny et al., 2003; Østby et al., 2013; Powell et al., 2009; Stack, 2002). The remaining studies are based on restricted samples of top-ranked university departments in North America (Nosek et al., 2010), research intensive universities and accredited law schools in the United States (Leahey, 2007; Merritt, 2000), Canadian social scientists (Larivière et al., 2011; Montpetit et al., 2008), grant applicants in the Netherlands (van Arensbergen et al., 2012) and researchers at a Danish University (Nielsen, 2016). These studies have similar limitations with respect to external validity beyond the selected contexts.

Our study offers a more comprehensive analysis of the current gender disparities (or similarities) in citation impact. We use a large-scale global sample of management articles from 185 management journals indexed in Web of Science's Social Citation Index to sketch variations in women's and men's scholarly impact per paper. Our large sample size mitigates the exposure to variance characterizing existing studies with smaller sample sizes, thereby making our results more robust.

3. Data and methods

Basically, citation analysis builds on the assumption that authors primarily cite papers that they consider important to the development of their own work. Following this logic, highly cited papers represent contributions with a greater influence on a given literature than less frequently cited papers (Podsakoff et al., 2008; Ramos-Rodríguez & Ruíz-Navarro,

[1] An article by Podsakoff and colleagues (2008) represents an exception in this regard, but their study devotes very limited attention to gender-related variations.

[2] Selection criteria, sample-sizes and measurement techniques vary considerably in the literature

[3] For specifications on search strings, see Table S1 in the online supplementary material

Table 1
Gender differences in citations, summary of literature survey.

Author(s)	Field/Discipline	Country	N	Period	Data/Design	Result
Ayres & Vars (2000)	Law	International	979 articles	1980–1995	Gender comparison of articles published in three top law journals	Adjusting for variations across subject areas in a log-linear regression, articles authored by women are found to be cited far more often (165% more for minority women and 57% more for white women) than articles by white men (White ♀: β:0.467; Z:0.2074; p < 0.05)/Minority ♀: β:1.640; Z:0.2546; p < 0.05).
Håkanson (2005)	Librarian and **I**nformation science	International	1739 articles	1980–2000	Gender comparison of articles published in core journals	Articles authored by women are found to be cited less than articles authored by men, though differences decrease over time. The study is descriptive and does not specify the effect sizes.
Judge et al. (2007)	Management research	International	614 articles	1990–1994	Gender comparison of articles published in 21 top-tier management journals	In a structural equation model accounting for a broad range of journal and article characteristics including content specific variables, gender has no noteworthy effect on citation impact (♂ Path coefficient: −0.03; p > 0.05).
Larivière et al. (2011)	Social science and **H**umanities	Canada	Not specified	2000–2008	Gender comparison of articles in WoS published by professors in Quebec	Women's field-normalized citation rates per paper are similar to men's (♂ mean: 1.11/♀ mean: 1.13).
Leahey (2007)	Sociology and **L**inguistics	International	418 authors	Unspecified	Gender comparison of articles and books in sociology and linguistics	Women's cumulative citation rates are shown to be considerably lower than men's and the gender gap increases over time (♂ Mean: 202.7; SD: 412.6; Median: 54/♀ Mean: 85.4; Median: 23; SD: 175.7).
Maliniak et al. (2013)	International **R**elations	International	2541 articles	1980–2006	Gender comparison of articles in core journals	Using negative binomial regression models with multiple covariates, articles by all-female author groups are found to be cited 20% less than all-male author groups (β:−0.149; p < 0.10; SE: 0.089).
McElhinny et al. (2003)	Sociolinguistics	International	4576 authors	1965–2000	Gender comparison of articles in five core journals	35.1% of women's citations go to other women. 21.5% of men's citations go to women. The study is descriptive and does not enable computations of effect sizes.
Merritt (2000)	Law	United States	815 researchers	1986–1998	Gender comparison of citation-performance among tenure-track researchers at **L**aw **S**chools	In an OLS regression for log of citations accounting for a broad range of author characteristics, including scholarly output, women are cited at similar frequencies as their men colleagues (white ♀: non-standardized coefficient: −0.016; p > 0.10; ♀ of color: non-standardized coefficient: −0.175; p > 0.10).

Table 1 (*Continued*)

Author(s)	Field/Discipline	Country	N	Period	Data/Design	Result
Mitchell et al. (2013)	International Relations	International	57 articles, 3414 references	2005	Citing-cited analysis of articles in two core journals	A multivariate analysis demonstrates that men cite publications by women at disproportionate rates (β:−1.303; p < 0.05; SE: 0.115).
Montpetit et al. (2008)	Political Science	Canada	758 researchers, 1764 articles	1985–2005	Gender comparison of political science articles in WoS	In an OLS-regression accounting for variation attributable to journal impact and other factors women have slightly higher citation rates than men (regression coefficient: 1.097; SD:0.376; p < 0.001).
Nielsen, 2016	Social science and humanities	Denmark	282 scholars in social science and humanities	2009	Gender comparison of articles in WoS published by researchers at a Danish University	Women's field-normalized citations rates per paper are similar to men's (♂ median: .93/♀, median: .94; P(*U*-test): 0.639; *r*:−0.03).
Nosek et al. (2010)	Social Psychology	United States and Canada	611 researchers	Unspecified	Gender comparison of articles published by North American researchers	In a multivariate regression, adjusting for career stage, men (*M*: 0.10, *SD:* 0.97) are slightly more cited than women (*M*: −0.14, *SD:* 0.95) (F (1, 588): 7.59; p < 0.0001).
	Peace Research (International Relations)	International	965 researchers, 1,032 articles	1983–2008	Gender comparison of articles published in Journal of Peace Research	In a negative binomial regression adjusting for collaboration, reviewer characteristics and paper characteristics, no significant difference is found between women's and men's scholarly impact per paper (♀: Incidence ratio rate: 0.951; SE: .092; p > 0.01).
Podsakoff et al. (2008)	Management Research	International	+25,000 authors from top universities	1981–2004	Gender comparison of articles in 30 core journals	In a structural equation model adjusting for variations attributable to publication rates and editorial board memberships, gender is found to br a trivial predictor of citation rates.
Powell et al. (2009)	Construction Research	International	464 articles	2003	Gender comparison of articles in 20 core journals	71% of articles authored by women were cited, 63% of articles authored by men were cited. The study is descriptive and does not provide specifications on effect sizes.
Stack (2002)	Criminal Justice	International	2125 articles	1964–1996	Gender comparison of articles in four core journals	In a OLS-regression for log of citations accounting for rank, field of terminal degree, years since terminal degree, and institution, women and men are found to be cited at similar rates (♂: β:−0.129; p > 0.05).
van Arensbergen et al. (2012)	Social sciences	Netherlands	852	2003–2005	Gender comparison of the citation performance of young and established grant applicants for two Dutch funding schemes	Men's cumulative citation rates are higher than women's in the established generation but not in the younger generation(based on cumulative citations accrued 3 years prior to grant application) (established generation: ♂ mean: 25.9, median: 3/♀ mean: 19.5 median: 1, P(*U* test):0.034; young generation: ♂ mean: 8.4, median: 1/♀ mean: 10.5, median: 0, P(*U* test): 0.522). Men and women are represented at similar proportions among the top 10% most cited (established generation: ♂ 11.2%/♀ 9.4%; young generation: ♂ 9.2%/♀ 11.3%).

2004). Critics have problematized this assumption, arguing that it is impossible to accurately distinguish the motive for a given citation (Brooks, 1986; MacRoberts & MacRoberts, 1988; Vinkler, 1998). Citations, it is claimed, can take on negative, positive, perfunctory or even strategic (flattering) forms. Numerous empirical studies challenge this critique by illustrating that citations, when studied at aggregate levels, represent a reliable proxy for international impact (Bornmann & Daniel, 2008; Catalini, Lacetera, & Oettl, 2015; Van Raan, 2005a, 2005b). Irrespective of their methodological shortcomings, citations are frequently employed as proxies for visibility and impact in evaluative assessments of individual performance. Hence, while we refrain from taking a stance in the ongoing debate on whether citations represent a proper indicator of scholarly influence, we acknowledge their widespread use as evaluative tools for allocating opportunities and rewards in the academy. And this makes them interesting in a gender-equality perspective.

The data used in this analysis was retrieved from Web of Science's Social Science Citation Index (core collection). It includes all regular articles written in English, indexed under the subject category *management*. According to Clarivate Analytics (2017), the management category "covers resources on management science, organization studies, strategic planning and decision-making methods, leadership studies, and total quality management."

Consistent full first-name author information is available in WoS from 2007 and onwards, and this information was needed for purposes of gender disambiguation. Thus, we limited our sample to studies published between 2007 and 2013, resulting in 46,549 papers from 185 journals. Fig. S1 in the online supplementary material specifies the data-exclusion steps, including the gender-disambiguation process, leading to the final sample of 26,783 papers (58% of the full population) and 65,436 authorships (♂ 46,262, 70.7%; ♀ 19,174, 29.3%). A noteworthy limitation of our sample concerns the fragmented coverage of anthology articles, conference proceedings and monographs in Web of Science. However, compared to other disciplines in the social sciences and humanities, this bias may be less prevalent in management research, where international academic journals have become the primary outlet for scholarly dissemination (Baruch, 2001).

3.1. Gender disambiguation

For purposes of gender disambiguation, we used the name-to-gender assignment algorithm Gender API (2016). Gender API uses information on first names and country affiliations to predict the gender of any given author in the dataset. Accounting for country is important, since the gender connotations of some first names tend to vary across nations. Gender API provides a probability estimate for each name and country pair in the dataset ranging from 50 to 100, with higher values indicating a higher level of certainty in the algorithm's gender prediction. We used these estimates to compute the dichotomous variable *Woman*. Specifically, we excluded all authorships with Gender API probability estimates lower than 0.90 from our dataset. A validation study was carried out to test for potential sampling bias resulting from this data exclusion, and to verify the general accuracy of the name-to-gender assignment algorithm. The results of both validation steps corroborate the accuracy of our analysis (for further specifications, see online Supplementary material).

For each article in the dataset we also computed the weighted indicator *fw* to specify the general participation of women authors in the byline of a given article. We employed this indicator as a covariate to account for the effects of women's general representation in the author group in predicting a given author's citation rates. *fw* values range from 0 to 1, with values closer to 1 indicating a higher proportion of women in the author group. This indicator is calculated based on gender API estimates for all authors contributing to a given study, including authors with probability estimates below 0.90.

3.2. Citation impact per paper

In this study, we use two indicators of citation impact per paper developed at the Centre for Science and Technology Studies, Leiden University: PP top-10% and field normalized citation scores (henceforth NCS).[4] PP top-10% indicates the share of publications that "compared with other publications in the same field in the same year, belong to the top 10% most frequently cited" (CWTS website, 2017). NCS takes the annual number of citations accrued by a paper and divides it with the average number of citations received by all papers of the same type, in the same subject area, for the same year (Waltman, van Eck, van Leeuwen, Visser, & van Raan, 2011).[5] Both indicators exclude self-citations and enable a comparison of citation impact per paper across subfields and time periods.

3.3. Covariates

The prestige of a given author's institutional affiliation have been shown to matter for citation rates (Hunter & Leahey, 2010; Judge et al., 2007; Stremersch, Verniers, & Verhoef, 2007). We constructed two binary variables to capture institutional prestige.[6] *University prestige* measures whether a given author is affiliated with one or more of the top-100 universities in

[4] All bibliometric indices (NCS, PP top-10%, NJS, self-citation rates, institutional collaboration and international collaboration) were generously provided by CWTS.

[5] The NCS indicator is typically applied to calculate Mean Normalized Citation Scores (MNCS), i.e. the average NCS for a set of papers published by a given research unit or institution.

[6] Authorships with multiple institutional affiliations are enlisted once for every affiliation, in the dataset used for regression analysis. Observations are weighted using the following approach: authorships with one affiliation are assigned a weighted value of 1 per observation; authorships with two

the world, according to the Shanghai Ranking from 2008 (institutions below top-100 = 0, institutions in top 100 = 1). *Business prestige* measures whether a given author is affiliated with one or more of the top-50 institutions in the QS World University Ranking's subject based hierarchy of Business and Management Studies from 2016 (institutions below top-50 = 0, institutions in top-50 = 1).[7]

Citation rates have also been shown to vary across geographical settings (Smith, Weinberger, Bruna, & Allesina, 2014). To control for this factor, we computed 10 categorical variables based on geographical groupings (for specifications on the countries included in each grouping, see Table S2 in the online Supplementary material).

Another factor known to positively correlate with a paper's citation impact is international collaboration (Bornmann, 2017; Katz & Hicks, 1997; Narin & Whitlow, 1991; Smith et al., 2014). We used the binary variable *International collaboration* to account for this factor. This variable specifies whether a given paper involves collaboration between authors from two or more institutions in different countries (no collaboration = 0, collaboration = 1).

Collaborations involving multiple institutions have also been shown to accrue more citations than single-institution papers (Bornmann, 2017; Katz & Hicks, 1997; Narin, Stevens, & Whitlow, 1991). We used the binary variable *Institutional collaboration* to account for this factor. The variable specifies whether a given paper involves collaboration between authors from different institutions in the same country (no collaboration = 0, collaboration = 1)

We also accounted for potential variations attributable to journal prestige (Bergh & Perry, 2006; Judge et al., 2007; Leimu & Koricheva, 2005; Peters & van Raan, 1994). Specifically, we used a measure denoted *Normalized Journal Score* (henceforth NJS). This indicator takes the average number of citations received by all publications in a given journal, adjusting for publication year, publication type, and field (Waltman et al., 2012).[8] NJS shares similarities with Clarivate Analytics' Journal Impact Factor (JIF), but has the advantage that it corrects for field-specific citation characteristics.

Finally, self-citations may positively impact the visibility of a paper ultimately leading to more citations from others (Fowler & Aksnes, 2007; Stremersch et al., 2007). We included the continuous variable *Self-citations* to rule out the potential "cumulative advantages" associated with this form of visibility.

3.4. Statistical models

To investigate differences in women's and men's probability of having a paper among the top-10% most cited in their field, we used simple logistic regression analysis. In examining the relationship between authorship gender and normalized citation scores, we used generalized linear models (henceforth GLMs), which are useful in accommodating a variety of non-linear response distributions (see McCullagh & Nelder, 1989). Due to overdispersion, the negative binomial distribution with log-link function has been argued to be the best fitting model for citation data (Bornmann & Daniel, 2008; Mingers & Xu, 2010). All GLMs were calculated with robust standard errors. Table 2 provides summary statistics for the predictors and outcome variables in the regression analyses. In the GLMs, the outcome variable NCS has been transformed to integer values (*NCS-integer*) to fit the negative binomial distribution and log-link function in SPSS. Specifically, we have multiplied each NCS-score by 1000 and rounded to nearest integer. To check for multi-collinearity, we examined the Variance Inflation Factors (VIF) in all models, using VIF >5 as cut-off value (Berk, 2003; Liao & Yen 2012). All predictors and covariates had VIF values below this threshold

4. Results

The analysis is divided into three parts. First we use descriptive statistics to sketch general variations in women's and men's scholarly impact and collaboration patterns. Second, we employ regression analyses to examine the effect of gender on citation rates per paper. Third, we examine national variations in women's and men's scholarly impact, by comparing estimates for our key predictor (*Woman*) in 20 country-specific regression models.

4.1. Descriptive overview

Fig. 1 visualizes gender differences (or similarities) in NCS, PP top-10%, NJS, self-citation rates, and collaboration patterns in the full author sample based on boxplots and bar charts (for numerical specifications, see Tables A1 and A2 in the Appendix A). Country-specific data for NCS, PP top-10%, NJS, self-citation rates and collaboration patterns are reported in Tables S3–S7 in the online Supplementary material.

affiliations are assigned a weighted value of 1/2 per observation; authorships with three affiliations are assigned a weighted value of 1/3 per observation etc. A few authorships have first names with varying gender connotations across two countries, and have institutional affiliations in both countries. This leads to a small discrepancy between the gender compositions reported in the descriptive analysis (Tables A1 and A2: ♀ 19,174 vs. ♂ 46,262) (multiple affiliations not included) and in the regression models (Table ♀ 19,182 vs. ♂ 46,254) (multiple affiliations included).

[7] Initially, we ran the regression models with continuous variables for university and business rank. This approach proved less useful in predicting citation impact than the binary variables.

[8] The NJS indicator is typically used to compute Mean Normalized Journal Scores (MNJS), i.e. the average NJS for a set of papers published by a given research unit or institution.

Table 2
Dependent and independent variables in the regression models for first-authors and full-population sample.

Variable	Type	Minimum	Maximum	First Author Mean	Std. Dev.	Full sample Mean	Std. Dev.
Woman	Categorical	0	1	0.308	0.462	0.293	0.455
fw	Continuous	0	1	0.305	0.298	0.306	0.298
Context							
Univ. Prestige	Categorical	0	1	0.174	0.379	0.179	0.383
Business Prestige	Categorical	0	1	0.228	0.419	0.228	0.419
Arab States	Categorical	0	1	0.050	0.218	0.048	0.214
East Asia	Categorical	0	1	0.044	0.206	0.043	0.203
Common Wealth St.	Categorical	0	1	0.001	0.028	0.001	0.030
Latin America	Categorical	0	1	0.016	0.125	0.018	0.133
North America	Categorical	0	1	0.361	0.480	0.370	0.483
SW Asia	Categorical	0	1	0.019	0.157	0.021	0.142
SCE Europe	Categorical	0	1	0.025	0.157	0.026	0.159
Sub-Saharan Africa	Categorical	0	1	0.107	0.103	0.009	0.096
Western Europe	Categorical	0	1	0.447	0.497	0.437	0.496
Oceania	Categorical	0	1	0.061	0.239	0.060	0.237
Publication behavior							
NJS	Continuous	0.020	6.149	1.224	0.951	1.236	0.964
Self-citations	Continuous	0	45.0	1.149	2.112	1.231	2.255
Collaboration	Categorical	0	1	0.677	0.468	0.725	0.447
International Collaboration	Categorical	0	1	0.323	0.469	0.355	0.479
Dependent variables							
NCS (Integer)	Continuous	0	5092	120.722	179.012	122.755	179.914
PP top-10%	Categorical	0	1	0.110	0.313	0.113	0.316

At the global level, women and men are cited (NCS) at similar rates (♀: mn = 1.234/mdn = 0.714 vs. ♂: mn = 1.231/mdn = 0.683) and have close to equal proportions of papers among the top-10% most cited (PP top-10%) (♀: 11.1% vs. ♂: 11.4%). Women's and men's confidence intervals overlap for both indicators (see Tables A1 and A2), and Fig. 1 demonstrates close to identical distributions. Slightly larger variations are detected for NJS (♀: mn = 1.204/mdn = 1.014 vs ♂: mn = 1.250/mdn = 1.042), self-citation rates (♀: mn = 1.112/mdn = 0.598 vs. ♂: mn = 1.281/mdn = 0.663),[9] international collaboration (♀: 31.2% vs. ♂: 37.3%) and cross-institutional collaboration (♀: 69.7% vs. ♂: 73.6%). Yet, as displayed in Fig. 1, the differences in male and female authors' distributions on these indicators are also marginal, despite non-overlapping confidence intervals (see Tables A1 and A2).

4.2. Regression analyses

Table 3 reports odds ratios, confidence intervals and standard errors for the GLMs predicting field-normalized citation rates (*NCS-integer*). Model 1 focuses on first authors and Model 2 covers all authors in the sample. As demonstrated in Models 1 and 2, women are marginally more likely to be cited than men. Odds ratios for the main predictor (*Woman*) are 1.064 (CI: 1.034–1.096) for first authors and 1.071 (CI: 1.052–1.090) for the full author sample.[10] Table 4 presents odds ratios, confidence intervals and standard errors for the logistic regression analyses predicting a paper's probability of being among the top-10% most cited in its field (PP top-10%). Model 3 focuses on first authors, while Model 4 includes all authors in the sample. Women also score marginally higher than men on this indicator. Odds ratios for the main predictor (*Woman*) are 1.143 (CI: 1.033–1.264) for first authors and 1.164 (CI: 1.094–1.238) for the full author sample.[11]

Selected control variables also deserve attention. First, the covariate adjusting for the general proportion of women per author group (*fw*) is a trivial predictor in all four models with odds-ratio values close to 1 and confidence intervals spanning the line of no difference (i.e. Odds ratio: 1). Author groups consisting predominantly of women are in other words not less likely to be cited in management research. In contrast, author affiliation with a North American or Western European institution, affiliation with a prestigious research institution in business and management, high self-citation frequencies,

[9] Men's slightly higher self-citation rates may be explained by variations in scholarly output. As illustrated in numerous studies, women are publishing articles at lower rates than men in the social sciences, hence having less publications to self-cite (see e.g. Leahey, 2007). The gendered age structure of the academy, with a severe overrepresentation of men in the older generation may also play a role, since more senior researchers typically have a larger catalogue of past publications to self-cite.

[10] For purposes of transparency and robustness, we ran two complementary GLMs using regular citations (i.e. non normalized citations per paper) as the outcome variable and including the same covariates as in Model 1 and 2. Results for these models are reported in Table S8 in the online supplementary material. Odds ratios for the main predictor (*Woman*) are 1.103 (CI: 1.016–1.198) for first authors and 1.082 (CI: 1.029–1.139) for the full author sample.

[11] A reviewer requested that we ran four additional regression models excluding the following variables: *Univ. Prestige*, *Business Prestige*, *Arab St./East Asia*, *Common Wealth States.*, *Latin America*, *North America*, *SW Asia*, *SCE Europe*, *Sub-Saharan Africa*, *Western Europe*. Results for the reduced models are reported in Table S9 and S10 in the online supplementary material. Odds ratios for the main predictor (*Woman*) in the GLMs predicting NCS-integer are 1.057 (CI: 1.021–1.094) for first authors and 1.056 (CI: 1.033–1.080) for the full author sample. Odds ratios for the main predictor (*Woman*) in the logistic regressions predicting PP top-10% are 1.066 (CI: .973–1.169) for first authors and 1.078 (CI: 1.019–1.141) for the full author sample.

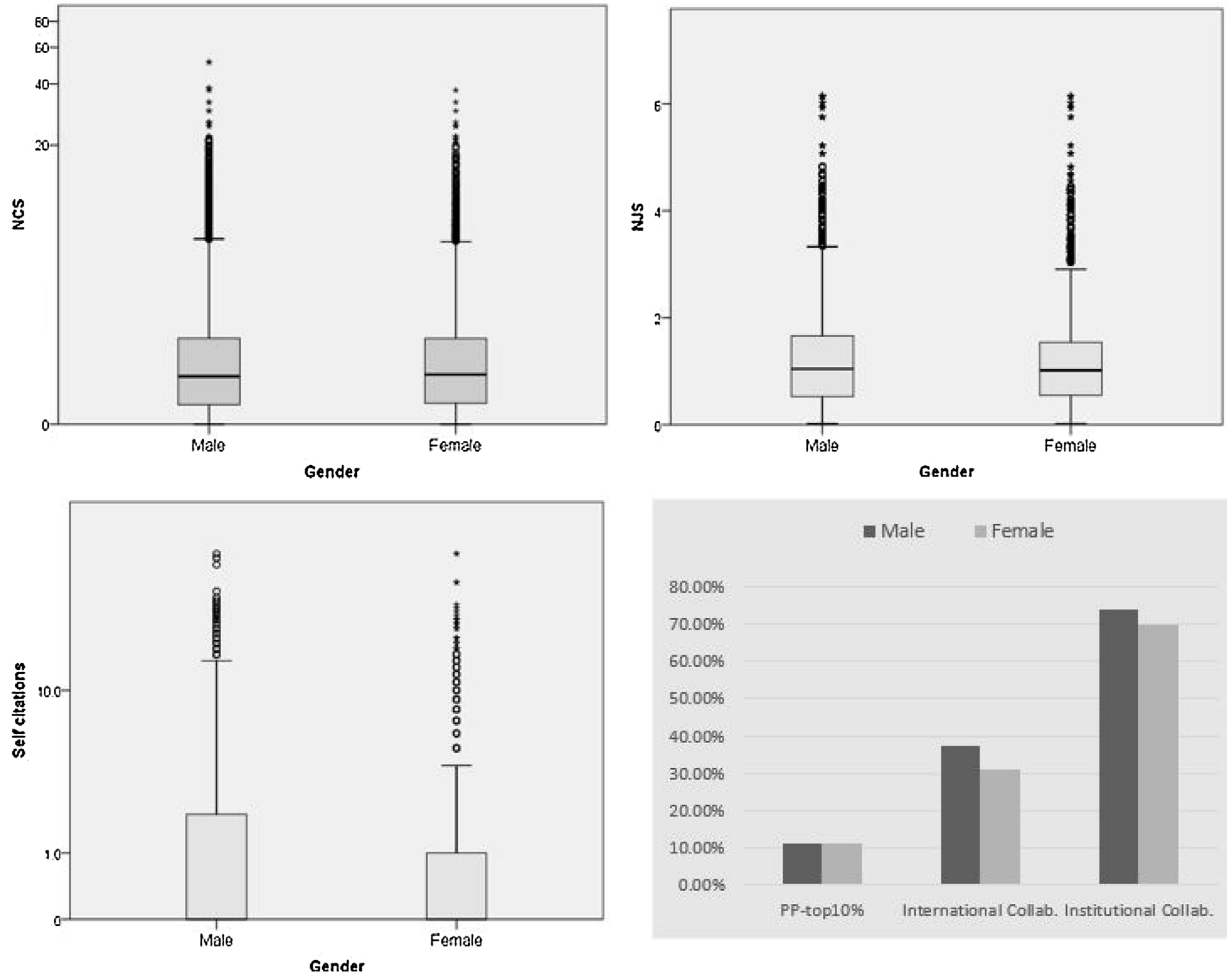

Fig. 1. Gender differentiated box plots and bar charts specifying indicator performance.
Note: Gender differentiated boxplots for NCS, NJS and self-citations. Bar charts for PP top-10%, International collaboration and Institutional collaboration. In the boxplots NCS and self-citations are shown on a log-scale to enable inclusion of outliers.

journal prestige, and author collaboration across national borders are all notable positive predictors of NCS and PP top-10%. Indeed, the odds ratios for these covariates in most cases far exceed the marginal effects attributable to gender.

To examine whether the odds-ratio estimates for our covariates differ by gender, we also computed separate regression models for women and men (see Tables A3–A6 in the Appendix A). These models indicate close to similar effect estimates for most covariates, but a few factors in the logistic regressions predicting PP top-10% merit closer attention. As displayed in Tables A5 and A6, men are benefitting slightly more than women from being affiliated with a prestigious business school, and this holds true for both first authors (♂ Odds ratio: 1.415, CI: 1.238–1.618 vs. ♀ Odds ratio: 1.122, CI: 0.895–1.406) and in the full author sample (♂ Odds ratio: 1.358, CI: 1.251–1.474 vs. ♀ Odds ratio: 1.206, CI: 1.049–1.387). In contrast women in the full author sample are benefiting more than men from affiliations with institutions in North America (♂ Odds ratio: 1.618, CI: 1.346–1.946 vs. ♀ Odds ratio: 1.940, CI: 1.519–2.477). Finally, the citation advantage of publishing papers in prestigious management journals is higher for women than men in both the first author sample (♂ Odds ratio: 2.450, CI: 2.329–2.577 vs. ♀ Odds ratio: 3.034, CI: 2.780–3.311) and the full author sample (♂ Odds ratio: 2.484, CI: 2.409–2.562 vs. ♀ Odds ratio: 2.788, CI: 2.647–2.936).

Fig. 2 displays odds ratios and confidence intervals for the main predictor (*Woman*) in the 20 country-specific GLMs predicting NCS-*integer*. All twenty models adjust for covariation attributable to institutional prestige (*University and Business Prestige*), collaboration (*International and Institutional collaboration*), normalized journal scores (*NJS*), self-citations and share of women in the author group (*fw*). Model specifications and estimates for the main predictor (*Woman*) for each model are reported in Table A7 (full model specifications are provided in the online supplementary material, Tables S11–S30). As illustrated in Fig. 2, a marginal citation bias in favor of women exists in the United Kingdom (Odds ratio: 1.067, CI: 1.013–1.123), Australia (Odds ratio: 1.080, CI: 1.008–1.157), the United States (Odds ratio: 1.096, CI: 1.063–1.131), Netherlands (Odds ratio: 1.105, CI:1.022–1.194), Canada (Odds ratio: 1.194, CI: 1.107–1.288) and Denmark (Odds ratio: 1.209, CI: 1.018–1.435).

Table 3
Generalized Linear Model Predicting NCS-*integer*.

	MODEL 1 (FIRST AUTHORS)			MODEL 2 (FULL SAMPLE)		
	Odds ratio	CI (95%)	S.E.	Odds ratio	CI (95%)	S.E.
Intercept	29.172	27.481–30.966	0.031	29.148	28.055–30.283	0.020
Woman	1.064	1.034–1.096	0.015	1.071	1.052–1.090	0.009
Univ. Prestige	1.025	0.983–1.069	0.021	1.013	0.988–1.038	0.127
Business prestige	1.140	1.100–1.182	0.018	1.127	1.103–1.152	0.011
Arab States	0.951	0.779–1.160	0.104	1.033	0.915–1.166	0.062
East Asia	1.055	0.973–1.143	0.041	1.058	1.005–1.114	0.026
Common Wealth St.	0.847	0.585–1.227	0.189	0.795	0.602–1.050	0.142
Latin America	0.752	0.657–0.861	0.069	0.819	0.754–0.890	0.042
North America	1.174	1.109–1.243	0.029	1.205	1.163–1.249	0.018
SW Asia	0.670	0.589–0.762	0.066	0.692	0.638–0.752	0.042
SCE Europe	0.931	0.821–1.054	0.064	0.917	0.851–0.987	0.038
Sub-Saharan Africa	0.485	0.397–0.592	0.102	0.524	0.465–0.591	0.061
Western Europe	1.179	1.118–1.243	0.027	1.214	1.174–1.256	0.017
NJS	1.910	1.875–1.944	0.009	1.888	1.868–1.909	0.006
Self-citations	1.127	1.118–1.135	0.004	1.123	1.118–1.128	0.002
Institutional Collaboration	1.016	0.981–1.053	0.018	1.024	1.00–1.047	0.012
fw	1.039	0.993–1.087	0.023	1.011	0.984–1.040	0.014
International Collaboration	1.106	1.070–1.143	0.017	1.093	1.072–1.115	0.010
Goodness of fit						
Deviance Value/DF	1.223			1.223		
χ^2 Value/DF	0.801			0.784		
Log Likelihood	−140826.925			−367649.298		
Omnibus test						
Log-likelihood χ^2	7769.404	(P < 0.001)		20352.851	(P < 0.001)	
DF	17			17		
N	24,985			65,436		

Note: Calculated with robust standard errors. Oceania is the reference group for the geographical variables.

Table 4
Logistic regression model predicting PP top-10%.

	MODEL 3 (FIRST AUTHORS)			MODEL 4 (FULL SAMPLE)		
	Odds ratio	CI (95%)	S.E.	Odds ratio	CI (95%)	S.E.
Woman	1.143	1.033–1.264	0.051	1.164	1.094–1.238	0.032
Univ. Prestige	1.106	0.972–1.259	0.066	1.073	0.992–1.161	0.040
Business prestige	1.324	1.180–1.485	0.059	1.318	1.228–1.414	0.036
Arab States	0.905	0.352–2.325	0.481	1.060	0.612–1.836	0.280
East Asia	1.546	1.138–2.101	0.156	1.373	1.133–1.664	0.098
Common Wealth St.	0.631	0.037–10.805	1.449	0.503	0.094–2.697	0.857
Latin America	0.959	0.513–1.794	0.319	0.901	0.627–1.293	0.184
North America	1.672	1.315–2.126	0.123	1.691	1.460–1.958	0.075
SW Asia	0.426	0.185–0.981	0.426	0.785	0.528–1.168	0.203
SCE Europe	1.239	0.765–2.008	0.246	1.051	0.778–1.421	0.154
Sub-Saharan Africa	0.412	0.115–1.481	0.653	0.367	0.155–0.867	0.439
Western Europe	1.587	1.254–2.009	0.120	1.584	1.371–1.829	0.074
NJS	2.596	2.485–2.712	0.022	2.562	2.495–2.630	0.013
Self-citations	1.286	1.263–1.310	0.009	1.275	1.262–1.288	0.005
Institutional Collaboration	1.010	0.893–1.143	0.063	1.010	0.934–1.093	0.040
fw	1.067	0.915–1.245	0.079	0.999	0.908–1.098	0.048
International Collaboration	1.344	1.202–1.503	0.057	1.276	1.193–1.363	0.034
MODEL SUMMARY						
−2 Log Likelihood	12918.481				34390.211	
Cox & Snell R^2	0.162				0.164	
Nagelkerke R^2	0.323				0.325	
N	24,985				65,436	

Note: Oceania is the reference group for the geographical variables.

Yet, the confidence intervals are in most cases wide with lower bounds extremely close to 1. The confidence intervals for the remaining countries span the line of no difference, indicating statistically insignificant gender differences.

Fig. 3 and Table A8 present the outcomes for the main predictor (*Woman*) in the 20 country-specific logistic regressions predicting PP top-10%. We included the same covariates as in the country-specific GLMs (full model specifications are available in the supplementary online material, Tables S31–S50). Only two countries, Canada (Odds ratio: 1.417, CI: 1.083–1.853) and the United States (Odds ratio: 1.306, CI: 1.189–1.435) are characterized by "notable" gender differences in these models. While the confidence intervals are wide, the odd-ratio estimates point to notable differences in favor of women in both

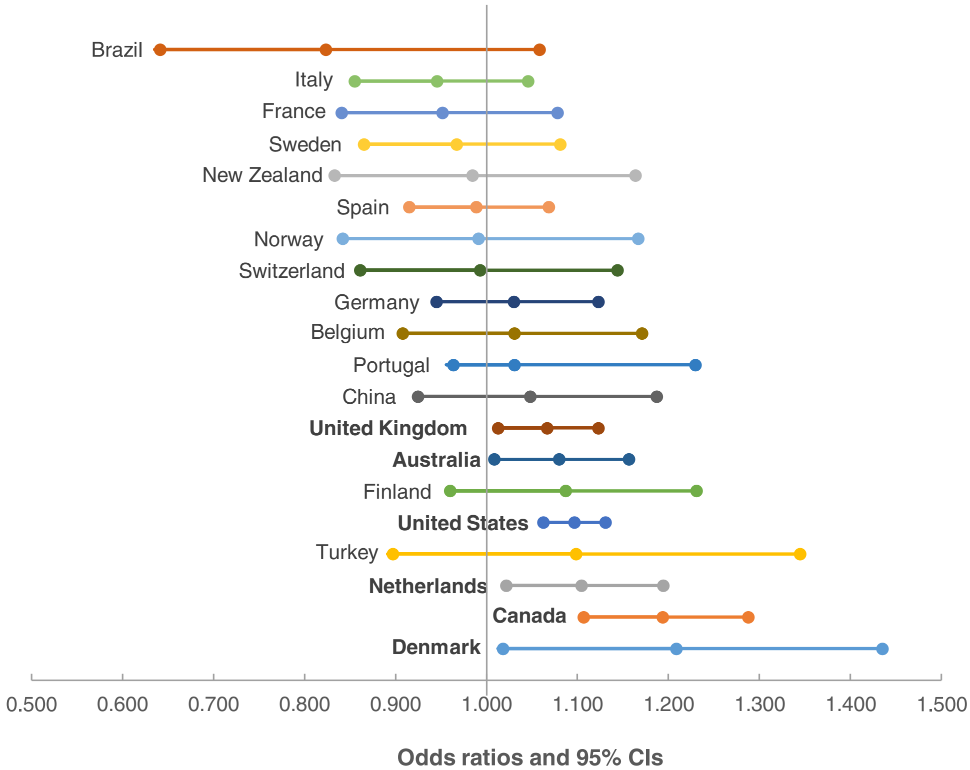

Fig. 2. Country specific odds ratios and confidence intervals for the main predictor (Woman) in the Generalized Linear Models predicting NCS-integer (full author sample).
Note: Countries are listed from smallest to highest odds ratios.

countries. Indeed, these are the largest gender differences identified in this study. For the remaining countries, the wide confidence intervals overlap the point of no difference, implying statistically insignificant variation.

5. Concluding discussion

Understanding the mechanisms reproducing inequalities in academia is an important premise for creating more inclusive and diverse research organizations. This study adds to the debate on gender inequalities in management research by investigating the extent to which a gender gap exists in the citation rates of management scholars. Based on a global sample of 26,783 publications and 65,436 authorships, we compared women's and men's citation impact per paper (NCS-*integer*) and relative shares of papers among the top-10% most cited (PP top-10%). A descriptive comparison showed no gender with respect to these indicators; but men were found to cite their own work at higher rates, collaborate more frequently with authors from other institutions and countries and publish in journals with higher average impact. The gender differences were, however, marginal and may be attributable to minor uncertainties in the data. By minor uncertainties, we refer to database-related errors in the cited references (e.g. spelling mistakes in author names and errors in institutional affiliations in Web of Science) and inherent problems associated with a non-random sample of "found data" like ours. As discussed earlier, 42% of the original dataset was excluded from the analysis due to lack of full first-name author information and gender ambiguous first names. This inevitably leads to some level of uncertainty in the data, implying that low-effect gender differences should be interpreted with caution.

To estimate the effect of authorship gender on citation impact per paper, we ran a number of regression models adjusting for variation attributable to institutional prestige, geographical setting, journal prestige, self-citations, the gender composition of the author group, and institutional and international collaboration. Using generalized linear models, we found marginal gender differences in field-normalized citation scores (NCS-*integer*) in favor of women. Further, logistic regression analyses showed that women were marginally more likely than men to publish papers among the top-10% most cited in their field. Yet, given the sensitivity of the results to small uncertainties in the data, these variations should not be overgeneralized. In the large picture, differences in citation-rates appear to be a negligible factor in the reproduction of gender inequalities in management research. In fact, the variance attributable to gender is extremely small compared to the effects of other author- and paper-related attributes such as country affiliation, institutional affiliation, self-citations and journal prestige.

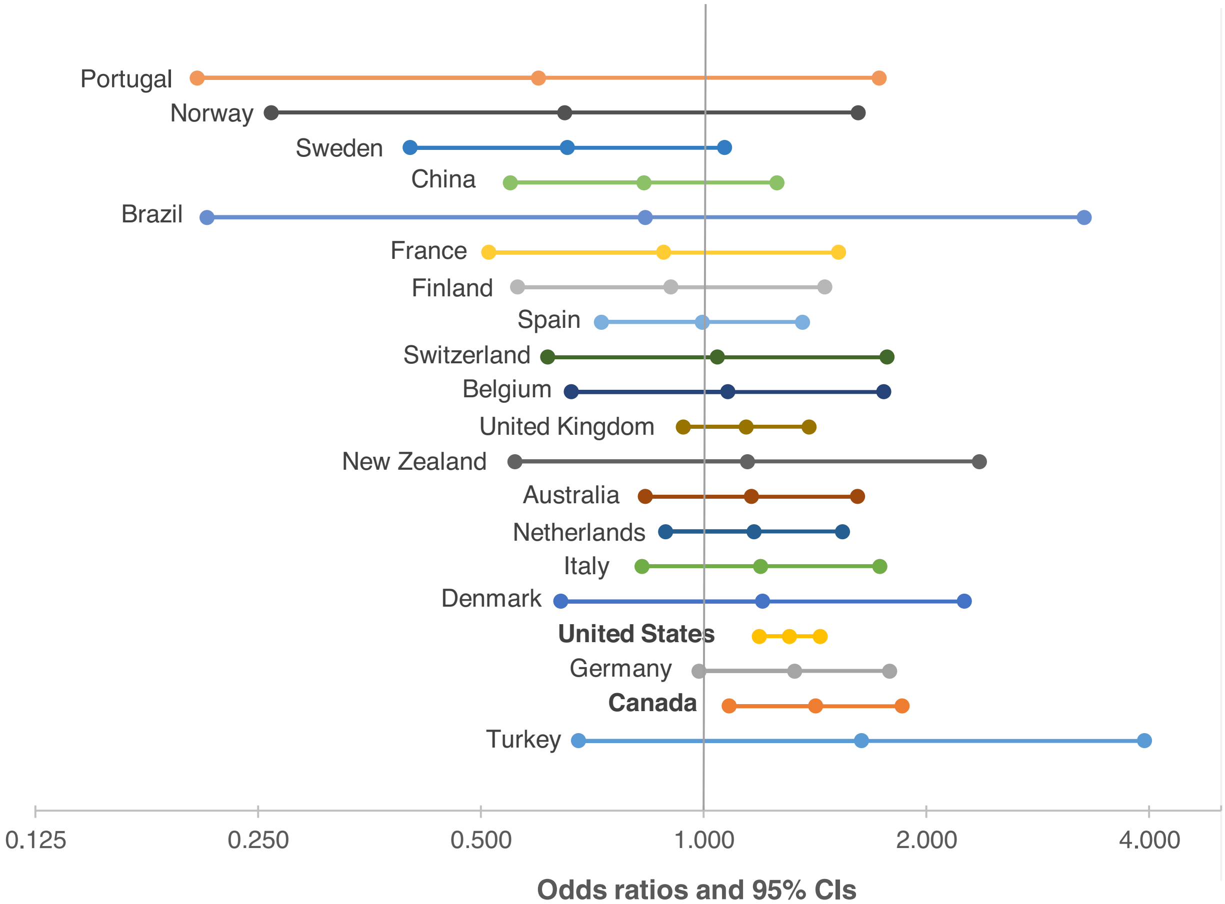

Fig. 3. Country specific odds ratios and confidence intervals for the main predictor (Woman) in the logistic regressions predicting PP top-10% (full author sample).
Note: Countries are listed from smallest to highest odds ratios. Values are on a logarithmic scale.

Regression-based comparisons of gender differences for the twenty countries with the largest scholarly output in management research revealed marginal citation biases (NCS-*integer*) in favor of women in Australia, Canada, Denmark, the Netherlands, the United Kingdom and the United States. However, the odds ratio-based confidence intervals were large and in most cases had lower bounds close to 1. Slightly larger gender differences, in favor of women, were reported for PP top-10% in Canada and the United States. In fact, these differences were the largest identified in the study.

Against this backdrop, it seems reasonable to conclude that differences in citation rates play a marginal role in explaining gender inequalities in management research. Yet, gender disparities persist at the upper echelons of business and management schools (Brown, 2016), and our findings demonstrate that women's share of authorships is considerably lower than men's (♂ 70.7% vs. ♀ 29.3%).

In explaining such inequalities, scholars have pointed to bias in academic selection and promotion processes (Treviño, Gomez-Mejia, Balkin, & Mixon, 2015), chilly work climates and subtle discrimination forms that disadvantage women (Kjeldal, Rindfleish, & Sheridan, 2005; Lanier, Tanner, & Guidry, 2009). Bibliometric research focusing on the social sciences also find that women on average publish fewer papers than men, with potential implications for scholarly advancement (see e.g. Leahey, 2006, 2007; Nielsen, 2017b). Sociologists and economists offer a variety of explanations to this performance gap. Some have argued that child-bearing is lowering women's publication rates during the early-career stages (Kyvik & Teigen, 1996; Mairesse & Pezzoni, 2015); others relate the productivity gap to differences in women's and men's access to funding (Xie & Shauman, 1998), level of disciplinary specialization (Leahey 2006) and available time for research and other activities (Taylor, Fender, & Burke, 2006). Whether these findings also apply to researchers in management remain an open question and more systematic research is needed to fully disentangle the persistent gender inequalities in this area.

Author contributions

Mathias Wullum Nielsen: Conceived and designed the analysis; collected the data; performed the analysis; wrote the paper.

Appendix A.

Table A1
Gender differences in NCS, NJS and self-citations.

	Women					Men				
	Mean	N	Median	Mean CI (95%)	Median CI (95%)	Mean	N	Median	Mean CI (95%)	Median CI (95%)
NCS	1.234	19,174	0.714	1.211–1.261	0.685–0.738	1.231	46,262	0.683	1.215–1.249	0.699–0.704
NJS	1.204	19,174	1.014	1.191–1.217	1.012–1.019	1.250	46,262	1.042	1.240–1.259	1.030–1.043
Self-citations	1.112	19,174	0.598	1.080–1.141	0.585–0.611	1.281	46,262	0.663	1.260–1.301	0.654–0.671

Note: 95% confidence intervals are based on 1000 bootstrap samples.

Table A2
Gender differences in PP top-10%, international collaboration and institutional collaboration.

	WOMEN			MEN		
	Share	N	Share CI (95%)	Share	N	Share CI (95%)
PP top 10%	11.1%	19,174	10.7%–11.6%	11.4%	46,262	11.1%–11.7%
International Collaboration	31.2%	19,174	30.5%–31.8%	37.3%	46,262	36.8%–37.7%
Institutional Collaboration	69.7%	19,174	69.0%–70.4%	73.6%	46,262	73.2%–74.0%

Note: 95% confidence intervals are based on 1000 bootstrap samples.

Table A3
Generalized Linear Model Predicting NCS-*integer,* differentiated by gender (first authors).

	MODEL 5 (MEN)			MODEL 6 (Women)		
	Odds ratio	CI (95%)	S.E.	Odds ratio	CI (95%)	S.E.
Intercept	28.620	26.584–30.812	0.038	31.756	28.886–34.912	0.048
Univ. Prestige	1.042	0.990–1.097	0.026	0.989	0.921–1.062	0.036
Business prestige	1.147	1.098–1.198	0.022	1.122	1.054–1.194	0.032
Arab States	0.969	0.771–1.219	0.117	0.934	0.637–1.370	0.196
East Asia	1.095	0.995–1.205	0.049	0.965	0.826–1.127	0.079
Common Wealth St.	0.663	0.418–1.052	0.235	1.192	0.709–2.004	0.265
Latin America	0.789	0.679–0.917	0.077	0.659	0.481–0.904	0.161
North America	1.191	1.108–1.280	0.037	1.151	1.051–1.261	0.047
SW Asia	0.671	0.578–0.779	0.076	0.702	0.541–0.912	0.133
SCE Europe	0.987	0.832–1.172	0.088	0.845	0.715–0.999	0.085
Sub-Saharan Africa	0.487	0.381–0.623	0.126	0.488	0.350–0.683	0.171
Western Europe	1.210	1.131–1.295	0.035	1.128	1.035–1.230	0.044
NJS	1.890	1.850–1.931	0.011	1.960	1.896–2.026	0.017
Self-citations	1.126	1.117–1.136	0.004	1.129	1.113–1.145	0.007
Institutional Collaboration	1.020	0.975–1.066	0.023	1.010	0.954–1.069	0.029
fw	1.034	0.978–1.093	0.028	1.053	0.973–1.139	0.040
International Collaboration	1.125	1.081–1.171	0.021	1.056	0.997–1.119	0.029
Goodness of fit						
Deviance Value/DF	1.223				1.226	
χ^2 Value/DF	0.841				0.708	
Log Likelihood	−97701.432				−43118.755	
Omnibus test						
Log-likelihood χ^2	5539.493	(P < 0.001)			2238.514	(P < 0.001)
DF	16				16	
N	17,277				7,708	

Note: Calculated with robust standard errors. Oceania is the reference group for the geographical variables.

Table A4
Generalized Linear Model Predicting NCS-*integer*, differentiated by gender (full sample).

	MODEL 7 (MEN)			MODEL 8 (WOMEN)		
	Odds ratio	CI (95%)	S.E.	Odds ratio	CI (95%)	S.E.
Intercept	29.203	27.860–30.609	0.024	30.896	29.047–32.862	0.032
Univ. Prestige	1.034	1.004–1.066	0.015	0.966	0.924–1.010	0.023
Business prestige	1.126	1.097–1.156	0.013	1.124	1.081–1.169	0.020
Arab states	1.054	0.916–1.212	0.072	0.956	0.765–1.193	0.113
East Asia	1.058	0.996–1.124	0.031	1.076	0.970–1.193	0.053
Common Wealth St.	0.642	0.465–0.888	0.165	1.032	0.670–1.589	0.220
Latin America	0.846	0.768–0.931	0.049	0.744	0.632–0.874	0.083
North America	1.193	1.141–1.248	0.0230	1.233	1.164–1.307	0.030
SW Asia	0.683	0.622–0.750	0.0480	0.744	0.625–0.886	0.089
SCE Europe	0.941	0.853–1.037	0.050	0.879	0.787–0.981	0.056
Sub-Saharan Africa	0.525	0.455–0.605	0.073	0.526	0.422–0.655	0.112
Western Europe	1.231	1.179–1.284	0.022	1.178	1.115–1.245	0.028
NJS	1.872	1.848–1.897	0.007	1.932	1.893–1.973	0.011
Self-citations	1.122	1.117–1.128	0.003	1.125	1.116–1.135	0.004
Institutional Collaboration	1.025	0.996–1.053	0.014	1.021	0.983–1.060	0.019
fw	1.006	0.973–1.041	0.017	1.022	0.972–1.074	00.026
International Collaboration	1.103	1.078–1.030	0.012	1.068	1.030–1.107	0.018
Goodness of fit						
Deviance Value/DF	1.223			1.224		
χ^2 Value/DF	0.808			0.723		
Log Likelihood	−260478.260			−107156.510		
Omnibus test						
Log-likelihood χ^2	14600.355		($P < 0.001$)	5781.320	($P < 0.001$)	
DF	16			16		
N	46,254			19,182		

Note: Calculated with robust standard errors. Oceania is the reference group for the geographical variables.

Table A5
Logistic regression model predicting PP top-10%, differentiated by gender (first authors).

	MODEL 9 (MEN)			MODEL 10 (WOMEN)		
	Odds ratio	CI (95%)	S.E.	Odds ratio	CI (95%)	S.E.
Univ. Prestige	1.056	0.906–1.230	0.078	1.236	0.968–1.579	0.125
Business prestige	1.415	1.238–1.618	0.068	1.122	0.895–1.406	0.115
Arab States	1.258	0.481–3.293	0.230			
East Asia	1.709	1.186–2.462	0.186	1.143	0.603–2.165	0.326
Common Wealth St.	1.085	0.060–19.583	1.476			
Latin America	0.899	0.423–1.912	0.385	1.184	0.377–3.716	0.584
North America	1.699	1.253–2.303	0.155	1.782	1.202–2.642	0.201
SW Asia	0.421	0.164–1.082	0.481	0.472	0.071–3.152	0.968
SCE Europe	1.225	0.664–2.261	0.312	1.417	0.648–3.100	0.399
Sub-Saharan Africa	0.583	0.159–2.143	0.664			
Western Europe	1.653	1.225–2.229	0.153	1.611	1.099–2.361	0.195
NJS	2.450	2.329–2.577	0.026	3.034	2.780–3.311	0.045
Self-citations	1.280	1.254–1.306	0.010	1.313	1.263–1.365	0.020
Institutional Collaboration	1.001	0.862–1.162	0.076	1.026	0.822–1.279	0.113
fw	1.076	0.896–1.292	0.093	1.051	0.788–1.400	0.147
International Collaboration	1.379	1.208–1.573	0.067	1.250	1.011–1.546	0.108
Model Summary						
−2 Log Likelihood	9168.312				3718.505	
Cox & Snell R^2	0.159				0.172	
Nagelkerke R^2	0.314				0.351	
N	17,277				7708	

Note: Oceania is the reference group for the geographical variables. Arab states, Common Wealth st. and Sub-Saharan Africa are not included in Model 10 due to missing values.

Table A6
Logistic regression model predicting PP top-10%, differentiated by gender (full sample).

	MODEL 11 (MEN)			MODEL 12 (WOMEN)		
	Odds ratio	CI (95%)	S.E.	Odds ratio	CI (95%)	S.E.
Univ. Prestige	1.088	0.992–1.193	0.047	1.048	0.900–1.220	0.078
Business prestige	1.358	1.251–1.474	0.042	1.206	1.049–1.387	0.071
Arab States	1.294	0.723–2.315	0.297	0.296	0.040–2.203	1.024
East Asia	1.450	1.156–1.819	0.116	1.093	0.736–1.623	0.202
Common Wealth St.	0.213	0.012–3.704	1.458	1.471	0.194–11.163	1.034
Latin America	0.912	0.596–1.394	0.217	0.884	0.440–1.777	0.356
North America	1.618	1.346–1.946	0.094	1.940	1.519–2.477	0.125
SW Asia	0.816	0.527–1.263	0.223	0.637	0.229–1.771	0.522
SCE Europe	1.015	0.686–1.502	0.200	1.165	0.723–1.877	0.243
Sub-Saharan Africa	0.509	0.213–1.217	0.445			
Western Europe	1.589	1.327–1.903	0.092	1.628	1.280–2.070	0.123
NJS	2.484	2.409–2.562	0.016	2.788	2.647–2.936	0.026
Self-citations	1.267	1.252–1.283	0.006	1.301	1.273–1.329	0.011
Institutional Collaboration	1.014	0.921–1.115	0.049	0.998	0.866–1.149	0.072
fw	0.989	0.884–1.107	0.057	1.017	0.852–1.215	0.090
International Collaboration	1.291	1.194–1.397	0.040	1.229	1.082–1.395	0.065
Model Summary						
−2 Log Likelihood		24598.074			9752.406	
Cox & Snell R^2		0.161			0.173	
Nagelkerke R^2		0.318			0.334	
N		46,254			19,182	

Note: Oceania is the reference group for the geographical variables. Sub-Saharan Africa is not included in Model 12 due to missing values.

Table A7
Odds ratios, confidence intervals and SEs for the 20 country-specific GLMs (NCS-*integer*).

Country	N	Odds ratio	CI (95%)	S.E.	Deviance Value/DF	χ^2 Value/DF	Log likelihood
Brazil	617	0.824	0.641–1.058	0.128	1.119	0.547	−2734.117
Italy	1948	0.946	0.855–1.046	0.051	1.228	0.707	−10926.611
France	1309	0.952	0.841–1.078	0.063	1.224	0.633	−7448.101
Sweden	1422	0.967	0.866–1.081	0.057	1.232	0.704	−7975.107
NZ	605	0.985	0.844–1.164	0.085	1.236	0.850	−3309.718
Spain	3375	0.989	0.916–1.069	0.040	1.215	0.634	−17751.882
Norway	759	0.991	0.842–1.167	0.083	1.241	0.651	−4368.540
Switzerland	903	0.993	0.862–1.144	0.072	1.237	0.716	−5290.293
Germany	2940	1.030	0.945–1.123	0.044	1.227	0.754	−16684.307
Portugal	593	1.031	0.864–1.230	0.090	1.237	0.656	−3224.853
Belgium	993	1.031	0.908–1.171	0.065	1.235	0.620	−5959.590
China	1410	1.048	0.925–1.187	0.064	1.232	0.781	−8224.895
U.K.	7053	1.067	1.013–1.123	0.026	1.223	0.764	−40339.925
Australia	3315	1.080	1.008–1.157	0.035	1.226	0.691	−18008.015
Finland	1210	1.087	0.960–1.231	0.063	1.233	0.755	−6754.515
U.S.	21,311	1.096	1.063–1.131	0.016	1.220	0.908	−124440.771
Turkey	733	1.099	0.898–1.345	0.103	1.202	0.961	−3426.358
Netherlands	3058	1.105	1.022–1.194	0.040	1.218	0.855	−18237.797
Canada	2928	1.194	1.107–1.288	0.039	1.222	0.832	−17133.730
Denmark	755	1.209	1.018–1.435	0.088	1.233	0.870	−4445.690

Note: Countries are listed from smallest to highest odds ratios. N specifies the number of authorships per country.

Table A8
Odds ratios, confidence intervals and SEs for the 20 country specific-regressions (PP Top-10%).

Country	N	Odds ratio	CI (95%)	S.E.	Cox & Snell R^2	Nagel-kerke R^2	−2 log likelihood
Portugal	593	0.597	0.207–1.726	0.541	0.059	0.220	148.817
Norway	759	0.649	0.260–1.617	0.466	0.174	0.406	279.038
Sweden	1422	0.654	0.401–1.066	0.250	0.104	0.238	656.873
China	1410	0.829	0.548–1.255	0.221	0.175	0.306	920.598
Brazil	617	0.834	0.213–3.268	0.697	0.093	0.457	80.586
France	1309	0.882	0.512–1.520	0.278	0.104	0.244	578.571
Finland	1210	0.903	0.560–1.457	0.244	0.140	0.311	541.462
Spain	3375	0.994	0.727–1.361	0.160	0.099	0.248	1365.969

Table A8 (*Continued*)

Country	N	Odds ratio	CI (95%)	S.E.	Cox & Snell R^2	Nagel-kerke R^2	−2 log likelihood
Switzerland	903	1.044	0.616–1.768	0.269	0.191	0.342	547.085
Belgium	993	1.077	0.662–1.750	0.248	0.148	0.286	562.959
UK	7053	1.141	0.937–1.388	0.100	0.146	0.301	3587.379
NZ	605	1.145	0.556–2.358	0.369	0.098	0.245	244.726
Australia	3315	1.160	0.834–1.613	0.168	0.126	0.325	1171.377
Netherlands	3058	1.170	0.889–1.540	0.140	0.172	0.326	1718.945
Italy	1948	1.194	0.824–1.730	0.189	0.133	0.276	1003.227
Denmark	755	1.200	0.640–2.249	0.321	0.204	0.394	378.889
US	21,311	1.306	1.189–1.435	0.048	0.195	0.334	14134.480
Germany	2940	1.326	0.985–1.784	0.496	0.152	0.251	1620.022
Canada	2928	1.417	1.083–1.853	0.137	0.215	0.383	1703.184
Turkey	733	1.633	0.676–3.941	0.450	0.058	0.232	167.495

Note: Countries are listed from smallest to highest odds ratios. N specifies the number of authorships per country.

Appendix B. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.joi.2017.09.005.

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