A Multidisciplinary Study Of Gender-Based Research Productivity In The World's Best Journals

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ABSTRACT

The past academic gender literature has focused on the underproduction of academic women in research outcomes and related reasons such as prejudice, more frequent career breaks and personality differences between genders. This study examines the top six journals in the world and finds no difference between women and men productivity when the percentage of women participating in the academic work force is factored in. Women have a 30-35% participation rate in academic university positions and represented almost 30% of the authors in the top tiered journals. There are also no significantly statistical differences in Journal Impact Factor ratings between men and women. These findings are consistent across all the major disciplines, science, business and social science. Other trends are noted such as the significantly higher number of authors in science journals and the different trends between US and non-US authors. Science authors' quality (as measured by Journal Impact Factor (JIF of 31.9) is significantly higher than non-science authors (JIF 6.5); thus differences in quality are discipline specific not a gender issue. The implications are that academic women's research contribution matches that of a man's productivity.

SECTION 1: INTRODUCTION AND LITERATURE REVIEW

This study examines publication patterns of female and male researchers for the world's top journals across the key disciplines of science, business and social science using 2005 data. There have been numerous studies looking at various aspects of gender research productivity in academia. These can be broadly categorized into several key issues: women's participation in academia, impediments that hamper academic women research productivity and evaluations of women's research productivity overall.

Women Participation In Academia

Robinson (2006) found that in 2004/2005 the number of women academics in Australia, Canada, New Zealand, UK and UK has increased, however the academic workforce remains dominated by men. The representation of women in academic positions ranges from a low of less than 32% in Canada to over 39% in the US. Women are more likely to be represented at the lower academic ranks and in part-time positions; in most of these countries less than 20% of full professors are women. Women academics remain seriously under-represented and underpaid compared to their male colleagues. However, the Higher Education Funding Council for England (2006) found higher participation rates but disparity across disciplines, ranging from 62% in medicine and 58% in education to lower numbers 49% in languages and 43% for law faculties. Overall, there is clear evidence that there are fewer women in academia then men especially at the higher levels.

Issues That Hamper Academic Women Research Productivity

Scholarly production is typically a significant factor in determining earnings and promotions, and many authors note that women faculty members publish less on average than their male counterparts. Thus gender differences in publication rates explain, at least partially, differences in average earnings and promotion rates between men and women. The Higher Education Research Institute found that, as of 1989, 43% of women in colleges and 20% in universities had never published a single journal article. The same was true of only 23% of men in colleges and 7% in universities. They opine that females may be publishing less because they are not able to establish professional and collegial networks. Some of the gender differences in productivity might also be explained by job selecting and gender sorting by coauthors since men and women tend to collaborate with coauthors of the same sex. Because there are relatively few women in faculties, women are placed at a disadvantage because it is more difficult for them to find collaborations (Bentley, 2003).

Mathews and Andersen (2001) offer broader explanations for gender disparities in academic publishing explanations, females are more likely to work in non-tenure track, part-time or temporary positions, to work at teaching colleges, and to lack access to the institutional support, resources or time needed for publishing, more likely to involve in activities that detract from research, interrupt their careers because of children, women are also more likely to be isolated and excluded from professional networks that define the life of a department. Bentley (2003) finds that women faculties are placed at a particular disadvantage by family responsibilities during child-rearing years negatively affecting career advancement and hence earnings of women faculty.

Bigilhole and White (2003, p.2) bluntly state "At the heart of male cultural hegemony in higher education is the notion of men as knowledge creators and women as reproducers (teachers)". Maske, Durden and Gaynor (2003) posit that women are more involved in service activities at the expense of research. Suitor, Mecom and Feld found that overall men spent about 10% more time on their academic work than did women while women reported spending 22% more time on teaching than did men. Women also stated that they spend 29% more time on household labor than did men. Among all married faculty, men spent 59% more time on their research than did women, while women devoted 43% more time on household labor than did the men. When there were children at home, time spent on household labor reduced women's productivity. The presence of children in home further magnified gender differences in the allocation of work time, men spent greater than two times more hours weekly on research than did women, while women stated they had 55% more hours on household labor than men. Hence, when there were children at home, time spent on household labor reduced women's but not men's scholarly productivity.

Dasaratha, Raghunandan, Logan and Barkman (1997) outlines the arguments that females will be less productive than male given factors such as acceptance into high quality graduate programs, funding and mentoring in early career stage, collaboration opportunities for research, disproportionate participation in service and teaching activities, time devoted for families and differentials in rewards and opportunities. Ashcroft, Bigger and Coates (1996, p.119) argue that "women are less likely to be part of a system of networking, and are therefore less often sponsored by influential scholars. This in turn reduces their opportunity for networking and experiences of discrimination may affect their career aspirations". Poole et al (1997) noted that across the countries studied there are distinctive patterns of gender related academic work. The pattern recurring in the literature that women appear to be more positively oriented towards teaching and men towards research was sustained. Corley and Gaughan (2005) looking at university research centers note that women spend more time writing grant proposals, but less time working on unfunded research. Female scientists are less satisfied with their jobs and feel less appreciated by their colleagues for their research contributions. Women are less likely to be tenured or full-professors, the result of their younger career age. Alternatively, Robinson (2006) argues that the low level of representation of women in senior academic ranks is largely related to two factors. First, women academics are significantly less likely to have a PhD than men. In addition, the distinctive way women find they must balance work and family plays a critical role. Female academics are far more likely to be working part-time or to have left work because of family responsibilities. Overall, the past literature offers a myriad of conflicting reasons why women may be less research successful than men; some of the impediments are structural and institutional bias whilst others may be linked more to social conditioning and/or differing value systems (Tower and Ridgewell, 2006, Ridgewell and Tower, 2005).

Women Research Productivity In Academia

The past research on women's research productivity in academia has shown mixed findings and conclusions. Kyvik and Teigen (1996) state that during 1989-91 men published 6.9 articles, whilst women published 5.6 articles (20% fewer). Male faculty members under age 40 published twice as many article equivalents than their female counterparts, whereas for faculty over age 40 the difference is small (10-15%). Chen, Gupta and Hoshower (2006) note that there are three factors that had the most impact on explaining the variability in number of journal articles published by tenured faculty are percentage of time spent on research, motivation to contribute to the field, and years in academic, in that order. The greater the percentage of time that tenured faculty members spent on research and the more motivated they were to make a contribution to the field, the more articles them published. No major gender differences are noted. However research productivity decline with the length of time a faculty member stayed in academics.

Reskin (1978) uses longitudinal data to first assesses sex differences in several measures of productivity; pre-doctoral publication (articles published prior to the PhD year), early productivity (articles published in the 3-yr period beginning with the PhD year), and decade productivity (articles published in (9th and 10^{th} post PhD years). Reskin (1978) finds that:

- Men were slightly more productive than women, but the differences were small,
- The greater indeterminacy of women's productivity mirrors the greater unpredictability of their careers, they often held extended post doctoral fellowships, changed job more frequently, and moved up and down in both position and institutional prestige without the usual compensations for such shifts,
- Prestigious post-doctoral fellowship was more important in predicting women's productivity than men's, employment in tenure track university position, citations, career continuity are all related to women's productivity,
- University employment was more important to women's productivity than men's, and
- Women depend more on employment setting, collegial recognition, continued informal support, and professional reward for performance.

Kyvik (1990) notes that productivity differences were the least in natural science (women published 20% fewer articles than men) whilst women in medicine, social science and humanities were 30-35% less productive than men. Academic rank is found to be important in relation to productivity. Professors are more productive than associate professors, and since there are fewer women in senior positions, the difference in productivity between ranks has consequences for average productivity between male and female researchers. Tower, Desai, Carson and Cheng (2006) reach the same conclusions in a more recent large scale study of Australian accounting academics. Interestingly, Kyvik (1990) observed that women publish less than men in the same positions but that they are more productive than men in lower positions. Thus female associate professors publish more than male associate professors, and female associate professors publish more than male assistant professors. There is relation between age and productivity and this connection holds for both men and women. High age is negatively related to productivity for both men and women. Women are more productive in the age group 50-54, while men are more productive in the age group 45-49. Considering all researchers, productivity is highest in the 45-49 age groups. For both men and women, married and divorced persons are more productive than single persons. Women with children are more productive than women without children.

Long, Allison and McGinnis (1993) investigate two issues. The first issue is why female scientists advance more slowly in rank, and few reach the rank of full professor. The second issue is the degree to which promotion depends on the volume of published work as opposed to the quality of work. They find women have significantly more publications prior to beginning their jobs as assistant professors, which reflects the fact that they started their first jobs 4.6 years after the PhD, on average, compared to 3.2 years for men. Although men and women start out as assistant professors with similar productivity, by the last year in rank (year 6.06 on average for men and year 6.22 for women), men have significantly more publications but not significantly more citations. They conclude that exceptionally productive women have exceptionally high probabilities of promotion, while the majority of women are less likely than comparable men to be promoted to full professor.

Maske, Durden and Gaynor (2003) examined what factors cause disparity between male and female publications. They found 41.3% of the difference between male and female article production is explained by experience, number of courses taught, type of university orientation, and other control factors. They argue that the unexplained difference may be related to discriminatory practices in the publication process. Other contributory factors perhaps women are more involved in service activities at the expense of research. Their statistical regression results showed that females have 12.2 years experience whereas males have 17.2 years experience; the marginal year of experience is associated with an increase of 0.99 papers for males and 0.45 for females. Other significant predictive factors include a negative relationship with time devoted to administration, teaching or working in a teaching-focused institution.

In summary, the past literature has been somewhat mixed in determining to what extent (if any) that women are less productive then men in academic research in both quantity and quality terms. There are structural and institutional biases; women devote more time to family responsibilities, have far more lower level positions and tend to be underrepresented across the board. Past studies have also noted discipline differences in research productivity trends. This study examines these issues by comparatively analyzing the extent of women's research production in the world's top scholarly journals.

SECTION 2: RESEARCH APPROACH AND FINDINGS

Bentley (2003) states that the literature generally acknowledges the shortcomings of available measures of scholarly production. According to Bentley (2003), simple counts of articles and books published were the most frequently used measures of scholarly productivity. This study uses the number of refereed journal articles published as the sample frame; the data source for this research is the top two journals as rated by Thompsons' ISI index in the three overarching broadest academic discipline categories: science, business and social science. Specifically, the first and middle issues of these top journals in 2005 are analyzed; two issues from each of the six journals in total. These top ranked journals are:

- Science discipline: : Science and Cancer Journal for Clinicians
- Business discipline: Academy of Management Review and Quarterly Journal of Economics
- Social Science discipline: Archives of General Psychiatry and Harvard Law Review (Thomson ISI Web of Knowledge, 2006)

Data is gathered from each of the six journals. Information is collected on the number of articles, number of authors, gender of authors, and Journal Impact Factor (JIF) ranking of the journal, These impact factors are derived from 2005/2006 Thompson's ISI Web of Knowledge using their science and social science (which includes business journals) indices. They state the impact factor is calculated by dividing the number of citations in the year by the total number of articles published in the two previous years; the higher the number the more impact the article is perceived to have.

The data in this study reveals the following 2005 publication patterns of these six journals across the three disciplines:

- The total data set from the six journals is 169 refereed articles authored by 679 different academics from all over the world.
- Business: There are 56 business articles, with the number of authors ranging from one to four.
- Social Science: There are 25 social science articles with number of articles ranging from one to sixteen.
- There are a larger number of articles in Science journals (88) and a much wider range of authors (1-50)
- Overall, of the 169 articles: 38% are sole-authored, 20% have two authors, 12% have three authors, 22% between four to ten authors and the remaining 8% have more than ten authors.

Analysis By The 169 Journal Articles

Table 1 highlights the differences in authorship trends across these journals based on the 169 journal articles examined. There are vast differences in the number of articles each of the top six journals publishes in the sample. This ranges from only five articles for two of the non-science journals to a high of 83 for the Science journal in the science discipline. The average number of authors is then calculated for each journal issue and then an Analysis of Variance (ANOVA) is calculated to test for significant statistical differences across the journals (see Table 1).

Table 1: Analysis of Variance (ANOVA) – (Six journals by number of authors)

DV – Number of Authors (Six Journals)	N	Mean	SD	F	Sig
(1) Academy of Management Review	36	1.861	0.961	2.764	**0.020**
(2) Archives of General Psychiatry	20	7.350	3.528		
(3) CA-A Cancer Journal for Clinicians	5	4.200	2.490		
(4) Harvard Law Review	5	1.200	0.447		
(5) Quarterly Journal of Economics	20	2.300	0.801		
(6) Science	83	4.916	8.712		
	169				

Table 1 reveals that General Psychiatry, Science and CA-A Cancer Journal for clinicians have the highest number of authors ranging from 4.2-7.4 whereas the other three journals Harvard Law Review, Academy of Management Review and Quarterly Journal of Economics have far fewer authors averaging between 1.2 to 2.3 authors per paper. The ANOVA (p value 0.20) shows that these are statistically significantly different.

Further analysis is then conducted to determine whether there are discipline differences in terms of the average number of authors per paper (see Table 2).

Table 2: Descriptive statistics – ANOVA (Three Discipline Categories by Number of Authors)

DV – Number of Authors (Three Broad Disciplines)	N	# Author			
		Mean	SD	F	Sig
Social Science	25	6.120	4.024	4.935	**0.008**
Science	88	4.875	8.477		
Business	56	2.018	0.924		
	169				

Table 2 highlights the clear significant differences between the number of Social Science (6.1), Science (4.9) and Business (2.0) authors (highly significant ANOVA p-value .008).

The academic women's publication percentages varied for each journal within each of the three major disciplines (business 18-30%; social science 20-43% and science 18-56%). The data set has 96 articles which are solely published by men, only 19 articles published by all women and 55 had at least one author from each gender. Table 3 examines these authorship trends in relation to the quality of the journal as measured by the Journal Impact Factor (JIF). The data clearly reveals that journals with women authors are at least as good as their male counterparts.

Table 3: Descriptive statistics – ANOVA (Gender Publication Trends per Article by Journal Impact Factor (JIF))

DV – 5	N	Journal Impact Factor (JIF)			
		Mean	SD	F	Sig
(1) All male	95	20.389	13.070	0.422	0.656
(2) At least one male & female	55	18.458	12.946		
(3) All female	19	20.814	16.164		
	169				

Table 3 shows that the JIF impact factors between these groups are very similar. Interesting all women-authored papers have the highest JIF factor (20.8) of all the gender categories. However, there are no statistically significant differences (ANOVA p-value .650) between the groups. This evidence is analogous to the Rothausen-Vange et al (2005) data showing no relationship between sex and publication productivity of American assistant professors and Dasaratha et al (1997) finding that there are no significant differences in publication productivity for the top five journals in accounting between females and males.

Xie and Shauman (1998) suggest that the notion of sex differences in research productivity may be misleading for three reasons. First, when properly defined, the magnitude of raw sex differences in research productivity is smaller than previously claimed. Second, to the extent that sex differences can be explained by personal characteristics, employment positions and access to resources, sex differences have structural causes that can be further investigated. Third, sex differences in research productivity have declined in response to the secular improvement of woman's role in disciplines such as science. Xie and Shauman argue that men generally have positions superior to those of women, although structural differences by gender have appreciably declined overtime. They argue that once sex differences in such positions and resources are taken into account, net differences between men and women in research productivity are nil or negligible.

Tables 4a and b reveal that the difference in quality publications (as measured by JIF) is not gender-based, rather it is purely discipline based. Science journal have fundamentally higher JIF scores (32,0) than do Social Science (11.3), with Business journal JIF scores (4.4) lagging far lower (T-tests and ANOVA p-value .000).

Table 4a: T Test (Science and Non-Science Categories by Journal Impact Factor (JIF)

DV – 1b	N	Journal Impact Factor (JIF)			
		Mean	SD	t-value	Sig
Science	88	31.999	4.393	-41.646	**0.000**
Non-science	81	6.564	3.529		
	169				

Table 4b: ANOVA (Social Science, Science & Business Categories by Journal Impact Factor (JIF)

DV – 1c	N	Journal Impact Factor (JIF)			
		Mean	SD	F	Sig
Social Science	25	11.321	2.697	1256.322	**0.000**
Science	88	31.999	4.393		
Business	56	4.440	0.252		
	169				

Further, more detailed statistical analysis reveals some interesting findings about academic women's research productivity. Table 5 shows the ANOVA results (p=.007) that there is a statistical significant difference in women's publication percentages between the six top ranked journals in the sample. Further multiple regression

analysis (not shown for brevity) confirms there is a significant difference between publication rates between the top six journals, but there is no different in the JIF score, number of authors or country between the genders.

Table 5: Academic Women-Percentage of publications in top six journals

DV – 1a	N	% Female			
		Mean	SD	F	Sig
Academy of Management Review	36	0.301	0.394	3.288	**0.007**
Archives of General Psychiatry	20	0.430	0.303		
CA-A Cancer Journal for Clinicians	5	0.555	0.436		
Harvard Law Review	5	0.200	0.447		
Quarterly Journal of Economics	20	0.175	0.232		
Science	83	0.176	0.311		
	169				

Additional analysis (not shown for brevity) finds there are statistical differences (ANOVA, p-value .050) in trends between the three major categories (science, business and social science) with science having only 20% women publishing, business 26% and social science 38%. The Tukey HSD test (again not shown for brevity) further highlights the key difference rests between social science and science journals.

The story remains when the 88 science articles are compared to the 81 non-science articles (business and social science). Women authors represented only 20% of the top two science journals but 30% of the top four non-science journals. However women had significantly higher JIF factors in science as these journals have higher scores (see Table 6).

Table 6: Multivariate Regression (Science and Non-Science by Percentage of Female authors)

	t-stat	Sig.
(Constant)	2.434	0.016
Journal Category (Science vs Non-Science)	-3.455	**0.001**
Journal Impact Factor	2.967	**0.003**
# of Author	1.168	0.244
Country	-0.143	0.887
Model Summary		
F-statistic	3.868	0.005
R-Square	0.086	
Adjusted R-Squared	0.064	
Sample Size	169	

Analysis By The 681 Authors

Additional insights are offered when the focus shifts to all 681 authors instead of the 169 journal articles in terms of quantity, quality in a gender comparative sense. There are 488 male authors and 193 female authors in the sample data. This male/female percentage difference 71.7% versus 28.3% is more extreme than the gender participation differences as academic staff (30-35% female) noted in the past literature. However, the data shows that the quality of the journals, as measure by journal impact factor (JIF), is virtually the same for men (23.2) and women (22.8). An important conclusion is that whilst women publish less than men in these top journals, the quality of their work are the same as the men's quality. Again, differences in quality are discipline specific not a gender issue.

A logistic regression (Table 7) using a dichotomous dependent variable (female or male) is run to test for gender differences (what factors predict female authorship).

Table 7: Logistic regression (Male versus Female with Four Predictor Variables

	Sig.
(Constant)	0.002
Journal Type (6 Categories)	**0.019**
Journal Impact Factor	0.755
# of Author	**0.008**
Country	**0.033**
Model Summary	
Overall Percentage	71.66
Cox & Snell R-Square	0.033
Nagelkerke R-Square	0.048
Sample Size	681

Table 7 shows that journal type, number of authors and country of author are significantly different between genders. However, Journal Impact Factor does not differ. There are 368 US authors and 313 non-US authors. Chi-squared analysis reveals that there are a significantly (p=.000) higher percentage of female US authors (32.1%) than non-US authors (24.0%). Whereas an ANOVA reveals there are no JIF differences (p values > .9) between genders in either geographic grouping.

SECTION 3: IMPLICATIONS AND CONCLUSIONS

Vasil (1996) investigates the contribution of self-efficacy beliefs in explaining gender differences of research productivity finding that male academics reported significantly stronger self-efficacy beliefs for social process skills than their female counterparts. Males have greater confidence in tasks such as chairing academic meetings, developing strategies to promote oneself, getting work recognized, negotiating/applying for promotion, and evaluating a colleague for promotion. Gender did not explain any unique variance in self-efficacy beliefs. Increases in academic rank meant significantly higher self-efficacy scores on average. Male academics reported greater productivity than females. Low level of productivity would, according to self-efficacy theory, further diminish perceptions of self-efficacy.

Past studies have documented lower productivity of women in academic research publication performance as compared to their male colleagues. Many reasons are then advanced to explain this perceived lack of successful outcomes. These explanatory factors include a woman's family expectations and burden, lesser time in the work force, differing priorities and male bias. This study fundamentally questions whether there actual is female under production in the research arena.

A gender examination is conducted of the top six journals in the world. The findings show no difference between women and men productivity when the percentage of women participating in the academic work force is factored in. Women have a 30-40% participation rate in academic university positions and represent virtually the same percentage of the authors in these highest ranked journals. Importantly, there are no significantly statistical differences in Journal Impact Factor ratings between men and women in the world's top journals. These findings are consistent across all the key journals in al major disciplines, science, business and social science. Other trends are noted such as the significantly higher number of authors in social science and science journals and the far higher JIF ratings for journals in the sciences and social sciences as compared to business. The key implication to these findings is that academic women's research productivity matches that of men. There are stark discipline differences in how publications occur, but no discernable gender differences across the disciplines.

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