ACADEMIC SENIORITY AND RESEARCH PRODUCTIVITY: EXPLORING GENDER AS A MODERATOR

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Abstract: *The important components of the academic advancement process are different dimensions of research productivity. Despite the fact that female academics do advance, they do not advance as quickly and with as much ease as male academics. Several metrics have been used, namely "Total Number of Publications," "Total Number of Citations," the "H-index," "Research Funds Granted," and other similar ones. The current study thus uses the "H-index," "Citation Score," and "Research Funds Granted" to evaluate the research productivity level. Although there has been done much regarding assuring gender equality standards, female academics still face barriers in the promotion. The study, therefore, identifies gender differences and further examines the correlations of gender and academic position and research productivity, ascertaining the gender moderator effect. Thus, an independent t-test and a two-way ANOVA were conducted. The data were collected from the Sicris database and sorted according to gender and academic seniority for natural and social academic fields. The results did not show any statistically significant gender differences except for the "Research Funds Granted," which was statistically significantly higher for social science male academics compared to their female colleagues. When examining research productivity on both variables separately and controlling for academic seniority, statistically significant gender differences in the "Citation Score" were found within the natural science field. Research productivity differences narrow in the later stages of the academic career. However, a statistically significant moderator effect of the "Citation Score" and "H-index" was identified within the social science field. The research results thus indicate the existence of gender moderator effect of academic position and research productivity that might have implications for interventions since the career advancement seems to be friendlier for male academics.*
Keywords: *Female Academics, Gender Equality, Research Productivity, H-index, Research Funds, Academic Seniority*

Introduction

The participation rates of female undergraduate students worldwide are increasing. Although over 50% of European students are female, barely one-third of academics are women (Mitroussi and Mitroussi 2009) The same trend can be found in Slovenia (Kump 2010). Women are underrepresented in senior academic and leadership positions (Eloy et al. 2013). Despite the fact that

women do advance, they do not advance as quickly and with as much ease as men (Dominici et al. 2009; Thomas et al. 2004). Female academics indeed lose interest in advancing in the leadership hierarchy much more quickly than men, which is not the consequence of their lower ambitions but rather due to the barriers to advancement and non-existent opportunities (Madsen 2012; Mitroussi and Mitroussi 2009). International studies confirm the striking similarity of female representation in academia across different countries.

It is essential to assure equal opportunities for all academics focusing on the accomplishments of an individual rather than on other norms like gender or race (Kump 2010; Mali and Jug 2006). Due to gender-biased advancement patterns and the consequently accumulated advantages, men of all professions face much smoother advancement (Bailyn 2003; Valian 2007). Men dominate the natural sciences. It is believed that they act independently and rationally, whereas women are assumed to be much more sensitive, emotional, expressive, and inclined to welfare work. The typical characterization of men and women is based on physical gender differences; therefore, it causes misconceptions and even elicits certain behavior that is apparently coherent with the differentiation of men and women (Valian 2007). White (2003) reports that female academics face higher workloads in pedagogical and administration work; therefore, they are mostly excluded from research, and consequently, there is a relatively low share of women that win full professorships (Kump 2010). However, women are valued as excellent researchers. Research work is quite intense and under the constant pressure of attaining expected norms for academic excellence. Therefore, it takes the full dedication of an individual (Ule 2012). De Cheveigné (2009) confirms the outstanding dedication of women in research even when working in a poor work environment, which could lead to a decline in motivation. Nevertheless, research productivity is strongly associated with academic career advancement (Lopez et al. 2014). Many studies confirm that women publish less in comparison to men (Diamantopoulos 1996; Grapin et al. 2013; Kaufman and Chevan 2011). But some authors (like Eloy et al. 2013) conclude that in their early careers men achieve higher productivity rates, although in more senior positions female academics outperform male academics. Additionally, Long (1992) reports that on average papers published by female academics are cited more frequently than papers written by their male colleagues.

During the past few decades, much attention has been devoted to examining research productivity (Abramo et al. 2015; Bordons et al. 2003; Diamantopoulos 1996; Eloy et al. 2013). Assessments of research performance can be made using publication-based indicators and bibliometric indicators, which have also proved useful when investigating gender differences in research productivity (Bordons et al. 2003). Many researchers approached measuring research productivity by analyzing the number of publications. But studies focusing on raw output like the number of published articles have been

criticized due to the nature of the work and communication between researchers (Hunter and Leahey 2010), and because these studies would not provide true measures of research productivity regarding its quality. The number of citations is a quantitative expression of the acceptance and visibility of academic research; therefore, it reflects the quality of a research publication (Gu et al. 2011). In this regard, Eloy et al. (2013) examine gender differences in research productivity by using the objective measure of research contribution, namely the "H-index," which quantifies the number and significance of papers published by an author. Some researchers (Paik et al. 2014) confirmed that research productivity is closely related to the academic position.

Different authors (Eloy et al. 2013; Grapin et al. 2013), by examining the "H-index," confirmed gender differences in research productivity. Other researchers have provided useful insights into changes in research productivity over time such as Paik et al. (2014), who exposed a significant difference in research productivity between genders in assistant and associate professor positions, but no significant difference in the academic positions of professor or departmental leader. On the contrary, Bordons et al. (2003), using bibliometric indicators, found no significant differences in productivity between the genders and no signs of gender discrimination. Similarly, Stack (2002) found no gender differences in the number of articles published or regarding citations of academic work. However, Lopez et al. (2014) ascertained that the "H-index" of female academics is lower at early and intermediate levels of seniority. Furthermore, others (Eloy et al. 2013) claimed that there is a major stream of scientific debate that demonstrates the presence of a gender productivity gap in favor of men from diverse disciplines, but over time the phenomenon lessens. Female academics, later in their careers, catch up with male academics or even surpass them (Eloy et al. 2013; Reed et al. 2011). However, the literature on gender differences in research productivity has mainly focused on the underrepresentation of female academics (Bartlett 2009; Gardiner and Tiggemann 1999; Hilard et al. 2014) suggesting the occurrence of gender discrimination (Shober 2014; Wroblewski 2014). The underrepresentation of women in science is unjust and very costly for society due to the economic potential that women embody (Bordons et al. 2003). Cadwalader et al. (2014) discuss gender bias such as the failure to recognize female academics' research performance, and Feller (2004) further discusses the "feminization" of particular fields of science. The present study attempts to ascertain gender differences in Slovene academia by answering the following research questions:

Are there any gender differences in research productivity within different academic fields?
Do the differences exist when evaluating different parameters of research performance?

Do gender differences in research performance vary within different academic positions?

Previously, researchers attempted to answer these research questions. However, the results are rather inconsistent. Therefore, the current study examines gender differences in different academic positions within different academic fields with a focus on identifying the potential moderating gender impact on research productivity. The objective of the current study is to identify which variables are the most influential egarding explaining the effects of gender and academic position on research productivity regarding different academic fields. The data are objective and reliable, taken from the Slovene Research Agency database (Sicris). It serves as a database on allotted research grants, and presents the data of all the registered researchers in Slovenia, taking the information from the Web of Science and Scopus on different research productivity indicators together with information about their respective employment. However, the data on gender and the academic position of individuals were collected from selected faculties' websites. Coupling the data from the two different sources (the Sicris database and the selected faculties' websites) resulted in a dataset of all the academics currently employed by selected faculties in the two major academic fields. Four academic positions were included, namely teaching assistant, assistant professor, associate professor, and full professor, respectively. For the evaluation of research productivity, different parameters were used, namely the "H-index," "Research Funds Granted," and the "Citing Score," respectively. The cross-sectional study design was chosen, which is usually considered inferior to the longitudinal approach. Many authors have established cross-sectional designs when examining the specifics of research productivity (Abramo et al. 2015; Kaufman and Chevan 2011; Sax et al. 2002), while others have conducted longitudinal studies (Reed et al. 2011). Overall, publication frequencies are increasing (because authors per paper are increasing over time); therefore, the longitudinal method might also have its limitations.

The structure of this paper is divided into four sections. After reviewing the literature, the second section presents the research framework, the third, the core part, deals with the data analysis and discusses the results, while the final chapter ends with a discussion.

Methodology

Gender differences have been investigated in a variety of disciplines, including medical science (Eloy et al. 2013; Kaufman and Chevan 2011; Lopez et al. 2014; Paik et al. 2014), business and management (Brooks et al. 2014; Groot and García-Valderrama 2006), criminal justice (Stack 2002), marketing (Diamantopoulos 1996), and psychology (Grapin et al. 2013). However, to the best of our knowledge, no study has focused on examining whether gender

differences exist across different academic fields in Slovenia while simultaneously examining the gender moderation effect on research productivity. The current study focuses on the simultaneous examination of the impact of gender and academic position on research productivity, thus ascertaining the gender moderator effect. The data on academic positions were recorded to categorical variables due to the demands of the research framework. The research framework was established in a particular way (selecting particular faculties) to: (1) Ascertain possible differences between academic fields and (2) to undertake an analysis between balanced groups of male/female academics researching within the social/natural sciences. For the social science sample, all full-time academics employed by the Faculty of Economics (University of Ljubljana), and the Faculty of Organizational Sciences (University of Maribor), and the Faculty of Economics and Business (University of Maribor) were chosen, while for the natural science sample, all full-time academics employed by the University of Ljubljana, Biotechnical Faculty and the Faculty of Natural Sciences were chosen. The distribution of the population according to academic field and gender regarding the number of academics is presented in Table 1. The faculties' listings were used to determine the academic position and gender of the academics, while the Sircis database provided the required data on the examined performance predictors, namely, the "H-index," "Research Funds Granted," and "Citation Score".

Table 1: The number of academics in the natural/social science sample by academic position

Academic position	Natural Sciences			Social Sciences		
	Female	Male	Total	Female	Male	Total
Teaching assistants	32	44	76	27	34	61
Assistant professors	38	31	69	37	25	62
Associate professors	23	32	55	28	31	59
Full professors	18	24	42	11	39	50

To examine potential gender differences, an independent-sample t-test was conducted (examining both populations of academics) and to investigate the impact of gender and academic position on the research productivity of both academic fields to ascertain the gender moderator effect, a two-way ANOVA was conducted, as recommended by Cohen et al. (2013). The analysis shows rather mixed results, which are presented in the following section.

Research results

Conducting an independent-sample t-test, firstly the research productivity means were examined for the natural science sample. The results are presented in Table 2.

Table 2: Male vs. female academics' research performance ($p < 0.05$)

Variable	Female academics		Male academics		t-value
	Mean	St. Dev	Mean	St. Dev	
Natural science academics					
"H-index"	5.20	4.36	4.50	3.89	-1.32
"Citation Score"	2.72	2.91	2.12	2.47	-1.69
"Research Funds Granted"	.59	1.82	.96	1.49	1.75
Social science academics					
"H-index"	1.85	1.92	2.38	2.35	1.83
"Citation Score"	1.59	2.73	2.07	2.86	1.31
"Research Funds Granted"	.19	.51	.37	0.85	1.99*

None of the variables of research productivity showed statistically significant differences between female and male natural science academics. However, when examining the differences between female and male social science academics no statistically significant differences were found examining the "H-index" and "Citation Score". However, there was significantly higher value in "Research Funds Granted" for male social science academics (0.19 ± 0.51), a statistically significant difference of 0,18 (95% CI, 0.002 to 0.357), $t(230) = 1.993$, $p = 0.048$. To further gain insights into the effects of gender and academic position on research productivity, and to ascertain the gender moderator effect on research productivity, a two-way ANOVA was conducted.

The natural science sample and the "H-index"

A two-way ANOVA was conducted to examine the effects of gender and academic position on the "H-index". There was a statistically non-significant interaction between gender and academic position for the "H-index" score, $F(3,234) = 1.411$, $p = .240$, partial $\eta^2 = .018$, as presented in Table 3.

Table 3: Tests of between-subject effects for the natural science sample on the "H-index"

Source	Type III Sum of Squares	df	Mean Square	F	Statistical Significance	Partial Eta Squared
Corrected model	865.34	7	123.62	8.95	.000	.211
Intercept	6,224.51	1	6224.51	450.85	.000	.658
Gender	37.15	1	37.15	2.69	.102	.011
Academic position	778.25	3	259.42	18.79	.000	.194
Gender*Academic position	58.44	3	19.48	1.41	.240	.018
Error	3,230.66	234	13.81			
Total	9,714.00	242				
Corrected Total	4,096.00	241				

The social sciences sample and "H-index"

There was a statistically significant interaction between gender and academic position for the "H-index", $F(3, 224) = 2.860$, $p = .038$, partial $\eta^2 = .037$, as presented in Table 4 for the social science academic field.

Table 4: Tests of between-subjects effects for the social science sample on the "H-index"

Source	Type III Sum of Squares	df	Mean Square	F	Statistical Significance	Partial Eta Squared
Corrected model	489.29	7	69.90	25.68	.000	.445
Intercept	1,117.13	1	1117.13	410.41	.000	.647
Gender	.75	1	.75	.277	.599	.001
Academic position	458.01	3	152.67	56.09	.000	.429
Gender*Academic position	23.35	3	7.78	2.86	.038	.037
Error	609.72	224	2.72			
Total	2,168.00	232				
Corrected Total	1,099.02	231				

The natural science sample and the "Citation Score"

A two-way ANOVA was conducted to examine the effects of gender and academic position on the "Citing Score". There was statistically non-significant interaction between gender and academic position for the "Citing Score", $F(3,234) = 1.554$, $p = .201$, partial $\eta^2 = .020$.

Table 5: Tests of between-subjects effects for the natural science sample on the "Citation Score"

Source	Type III Sum of Squares	df	Mean Square	F	Statistical Significance	Partial Eta Squared
Corrected model	378.53	7	54.07	9.23	.000	.216
Intercept	1,626.22	1	1626.22	277.57	.000	.543
Gender	28.13	1	28.13	4.80	.029	.020
Academic position	340.38	3	113.46	19.37	.000	.199
Gender*Academic position	27.31	3	9.10	1.55	.201	.020
Error	1,370.97	234	5.86			
Total	3,140.26	242				
Corrected Total	1,749.50	241				

The social science sample and the "Citation Score"

There was a statistically significant interaction between gender and academic position for the "Citing Score", $F(3,224) = 5.874$, $p = .001$, partial $\eta^2 = .073$ for the social science academic field as presented in Table 6.

Table 6: Tests of between-subjects effects for the social science sample on the "Citation Score"

Source	Type III Sum of Squares	df	Mean Square	F	Statistical Significance	Partial Eta Squared
Corrected model	714.88	7	102.13	20.67	.000	.392
Intercept	977.04	1	977.04	197.78	.000	.469
Gender	11.69	1	11.69	2.37	.125	.010
Academic position	690.29	3	230.10	46.58	.000	.384
Gender*Academic position	78.06	3	29.02	5.87	.001	.073
Error	1,106.57	224	4.94			
Total	2,623.34	232				
Corrected Total	1,821.45	231				

The natural science sample and "Research Funds Granted"

There was a statistically non-significant interaction between gender and academic position for the "Research Funds Granted" score, $F(3,234) = 0.641$, $p = .590$, partial $\eta^2 = .008$.

Table 7: Tests of between-subjects effects for the natural science sample on "Research Funds Granted"

Source	Type III Sum of Squares	df	Mean Square	F	Statistical Significance	Partial Eta Squared
Corrected model	101.85	7	14.55	6.12	.000	.155
Intercept	187.09	1	187.09	78.72	.000	.252
Gender	8.02	1	8.02	3,37	.068	.014
Academic position	86.01	3	28.67	12.06	.000	.134
Gender*Academic position	4.57	3	1.52	0.64	.590	.008
Error	556.16	234	2.38			
Total	809.31	242				
Corrected Total	658.01	241				

The study of the social science sample and "Research Funds"

There was a statistically non-significant interaction between gender and academic position for the "Research Funds Granted" score, $F(3,224) = 1.047$, $p = .373$, partial $\eta^2 = .014$ as presented in Table 8 for the social science academic field.

Table 8: Tests of between-subjects effects for the social science sample on "Research Funds Granted"

Source	Type III Sum of Squares	df	Mean Square	F	Statistical Significance	Partial Eta Squared
Corrected model	20.20	7	2.88	6.42	.000	.167
Intercept	19.58	1	19.58	43.57	.000	.163
Gender	.29	1	.29	.34	.426	.003
Academic position	12.56	3	4.19	9.32	.000	.111
Gender*Academic position	1.41	3	.47	1.05	.373	.014
Error	100.66	224	.45			
Total	140.69	232				
Corrected Total	120.86	231				

The current study identifies the impact of gender and academic position on the research productivity regarding both academic fields ascertaining the gender moderator effect offers mixed results that call for further research that would integrate the subjective norm into the model also using gender as a moderator.

Discussion

The primary aim of the current study is to simultaneously examine the impact of gender and academic position on research productivity. Previous studies, as Bordons et al. (2003), and many others, confirm significantly higher research productivity as the professional ranking improves. Tenure and promotion decisions are based on a tripartite model evaluating academics' performance by teaching, publishing, and doing service for the community (Dhillon et al. 2015). Similarly, Bordons et al. (2003) claim that promotion depends on research productivity, and once a higher position is attained it is easier to maintain high productivity, while other researchers (Grapin et al. 2013) did not find any significant differences in academic positions regarding research productivity. However, others (Abramo et al. 2015; Eloy et al. 2013; Tomei et al. 2014) came to the conclusion of statistically significant higher research productivity of male academics compared to female academics, while some reported that female academics catch up with men at later stages of their careers.

Husu (2004) explained the gate-keeping processes that can influence the evaluation of scientific accomplishments and that also serve as a control for the allocation of resources and information flow. He ascertained that women are underrepresented among academic gate-keepers, and therefore sometimes they have limited accesses to adequate financial support and resources. However, there is a body of literature that conveys rather contradictory results.

However, the study confirms the existence of differences in research productivity between different academic fields, whereas academic position was in all cases found to be statistically significantly related to research productivity. It means that research productivity significantly increases with

subsequent higher academic positions, as has already been well established. The current study goes further by examination of the gender moderator effect, which also provided mixed results for different academic fields/different research productivity parameters. In this regard, Holmbeck (1997) says that a moderator alters the direction or strength of the relation between a predictor variable and an outcome. In this light, the study shows significant interaction between gender and the academic position in predicting research productivity although depending on the academic field. It means that there exists a gender moderator regarding the academic position and research productivity, which might have implications for interventions because it means that career advancement might be friendlier for male academics than for female academics. It is essential to assure equal opportunities for all academics by the accomplishments of an individual and to try to overcome gender impartiality.

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