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Vertical gender differences in Greek Economics Departments

Does research productivity matters?

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***Abstract*—This study investigates possible vertical gender differences in the academic hierarchy related to the research performance and academic life of faculty members in the Economics departments of Greek Universities. The statistical analysis carried out confirms the existence of significant gender differences facing women in the academic hierarchy, with a relative overrepresentation of female faculty members in the two lower—non-tenured—academic ranks. This overrepresentation coincides with a longer academic life than that of men, suggesting a greater delay in their hierarchical advancement. Differences in research productivity and the quality of their research work cannot explain, statistically, this delay. The finding contradicts the outcomes of similar studies that deal with gender differences in research productivity, which have mainly been carried out in the Anglo-Saxon world. In addition, logistic regression analysis shows that research performance facilitates men's academic promotion to a higher rank, but not women's.**

***Keywords*—gender, discrimination, academic career, research productivity, women economists, Greece**

I. Introduction

The quantity and quality of published research work, the educational and research background, and the length of academic life (defined as the number of years since obtaining a doctoral degree) have each been empirically investigated as determinants of academic advancement, e.g. [1]-[3]. With regard to gender differences, many empirical works, carried out in several countries, have indicated a relative overrepresentation of females in the lower—i.e., non-tenured—ranks. Considering, however, the relevant Greek literature, only a few studies deal with vertical gender differences in Greek universities. All of these studies, e.g. [4]-[5], are rather limited, consisting of only a descriptive statistical presentation of these differences without an empirical investigation that attempts to identify the factors that explain these differences.

According to the statistical data from UNECE (United Nations Economic Commission for Europe) for Greece during the 2006-2007 academic year, women accounted for 57% of the total number of undergraduate students in Social Sciences departments—the group to which Economics departments belong—while this percentage drops to 47.5% at the postgraduate level, which leads to a Ph.D. According to both international and Greek academic literature, the proportion of women significantly decreases as they rise in the academic hierarchy, from the rank of lecturer to that of full professor [6]-[8]. There are four faculty ranks in Greek universities: professor, associate professor, assistant professor, and lecturer. Only the first two are tenured.

The purpose of this research is to empirically study vertical gender differences in the academic hierarchy in Greek Economics departments, and their correlation with variables related to research performance (productivity, impact, h-index) and academic age. At the same time, we attempt to use a logistic regression to investigate factors, such as research performance and age, as explanatory variables for advancement of men and women in the academic hierarchy.

The paper is organized as follows. In the next section, we present a brief literature review pertaining to the link between gender differences in academic development and research performance, supply a general framework for the interpretation of these differences, and list our research questions. Following that, we outline the statistical methodology and present information related to the data used in the empirical part of the study. Then, we present and discuss the empirical results. The paper ends with a summary of its main conclusions.

II. Literature Review

In most European Union (EU) countries, over 50% of university degrees are awarded to women each academic year. The ratio of females to males begins to significantly decrease at the doctoral and postdoctoral levels. Among the members of universities' teaching and research staff (faculty), this ratio becomes considerably smaller than the corresponding ratio of Ph.D. holders. Within universities, the higher one's rank in the academic hierarchy, the lower the likelihood of that person being a woman. In particular, women at the rank of full professor (first rank) constitute a very low percentage in all of the EU countries, the U.S., and Canada, ranging from 9% in the Netherlands and Germany to 21% in Finland and 29% in Romania (for Greece, the figure is around 11%) [7]. Furthermore, even in scientific fields with a greater representation of women (for example, in behavioral and educational sciences and biomedical sciences), the differences in the distribution of women within the academic hierarchy (vertical differentiation) are important. There are also significant differences in the proportion of women among the different scientific fields/disciplines (horizontal differentiation). Women are still under-represented in the

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Sciences (an exception is biomedical science, which is carries the stereotypical role of caring for others, often attributed to women). In the humanities on the other hand, there is, in general, a greater representation of women [7],[9].

It is telling that this overview of the path of women in the academic world has, with small variations, a global universality. This path is often compared with a leaky pipeline [10]-[15]. Specifically, academic life is portrayed as a path in a pipeline, starting with the first degree and continuing up to doctoral studies and beyond to the hierarchical level of the senior academics. This course show significantly more departures (leaks) among women than among men, especially after they receive a doctorate degree and, to a greater extent, with tenure at the highest ranks. It can also be compared to a route, which, as far as women are concerned, is hampered by an often insurmountable "glass ceiling" [7], [16]-[19]. In other words, women on this route meet "invisible" structural barriers, informal and without legal standing, that impede their progress toward the highest and most prestigious academic posts. The current resistance of these structural barriers, even in countries that have, for decades, implemented gender equality policies in universities, have led some to refer to an invisible and once again impenetrable "roof" that consists of a more modern and durable material— "plexiglass ceiling" [20]—or one that is even more intense—a well-defined, non-transparent, and compact ceiling [21].

According to the existing literature, academic advancement is closely linked, at least in principal, to research productivity [22]. In addition, vertical gender differences in academic advancement are usually attributed to the low research productivity exhibited by women. Indeed, many studies confirm the argument for women's low productivity, e.g. [1], [23]-[26]. The same also applies to research studies that focused on female economists, e.g. [27]-[33]. Only a few research studies have found an absence of gender differences in research productivity. These works either focus on specific disciplines and family-related factors [34], refer to non-Anglo-Saxon cultural contexts [35]-[36], take the quality and quantity of research output into consideration [37], or use criteria for productivity or academic advancement that limit the surveyed population [38]-[39]. In a recent paper, D'Amico, Vermigli and Canetto [40] emphasized the importance of considering cultural, academic, and social contexts when analyzing research productivity. Studies that examine the academic systems of southern European countries—such as those of Maas and Casotti [41] and Abramo, D'Angelo, and Caprasecca [42]—observe considerably lower gender discrepancies in research productivity.

Furthermore, it should be noted that, unlike research regarding the quantitative dimension, many studies did not detect significant gender differences in the qualitative dimension of research productivity (measured by the number of citations per published paper) [24], [43]-[44]. This topic is, however, rather controversial. Some studies show that papers written by women receive, on average, fewer citations [45]-[47] while other studies show that they receive more citations than papers written by men [1], [48].

Two models attempt to explain gender differences in productivity. The first, known as the deficit model, emphasizes structural obstacles that exist in the social system of science. Proponents of this model argue for the existence of mechanisms that exclude female scientists, either in a formal or an informal way. The second, referred to as the difference model, relies on innate differences, such as deeply ingrained differences in the behaviors, perspectives, and goals of the two sexes [48]. According to the first approach, when compared to men, women as a group face significant impediments of an institutional (legal), political, and social nature. The result is that women enjoy fewer opportunities during their professional and academic journey, ultimately accomplishing fewer academic and professional achievements. According to the second approach, the main problems are deeply rooted in differences between men and women in terms of their social and behavioral goals and perspectives. These differences lead to a lower academic and professional performance by women.

What happens, however, when the delays in academic advancement that are caused by gender are not associated with gender differences in research productivity? In this case, should such delays be attributed to internal structural barriers within the university, i.e. barriers that impede equal promotion? The interpretative pattern of Sonnert and Holton [48], which we mentioned above, is in favor of such a finding.

Empirical research on the gender differences of the academic staff at Greek universities is almost entirely limited to archival data and the strictly descriptive mapping of the distribution of faculty by gender and academic rank. In general, research on vertical and horizontal gender discrimination in the Greek academic community simply describe the phenomenon without attempting to empirically investigate the circumstances that determine its form. It is notable that no research of this kind has focused on Economics departments; the general issue of gender differences in research productivity and the impact that research work has on the faculty members of Greek universities have not been investigated, nor have they been associated with gender differences in academic advancement.

First, in order to fill this research gap, the effort to identify gender differences in the academic hierarchy of Economics departments in Greek universities is a prerequisite. Second, a simultaneous investigation of the relation between academic promotion and research performance is required. Third, there is a need for a study that carries out control tests for any gender differences in research performance (productivity, overall impact, and academic age), and, finally, a study on the extent to which gender differences in the academic hierarchy can be interpreted as gender differences in research performance.

III. Methodology

The present survey collected data on 190 economists who are faculty members in ten Economics departments at Greek universities. Of the total number of faculty members included in the study (N = 190), 152 were men (80%) and 38 women (20%).

The data were collected in November 2009. The data for faculty members (name, academic rank, subject of the Ph.D. thesis, university that awarded the doctorate, and the year that the doctorate was awarded were collected from the websites belonging to the ten Greek Economics departments. If no information was provided for the doctoral thesis on the website, the data were collected from research in bibliographic databases and on the Internet (e.g. National Archive of Ph.D. Theses of the National Documentation Centre, Dissertation Abstracts International).

Data on the research work of each faculty member (the number of papers in international journals per faculty, the number of citations per faculty, and the h-index) were collected from the Scopus citation database. Scopus was preferred over the Social Science Citation Index, via the platform Web of Science (SSCI/WoS), because of its better coverage, especially regarding research in the social sciences [49]. Google Scholar, despite the huge advantage that it has in data coverage, is avoided because of its serious credibility problems [49].

Besides faculty members' gender (a categorical variable) and their level in the academic hierarchy (measured both as a categorical variable and a ranked variable on a scale from 1–4, corresponding to the four academic ranks), the rest of the variables in this paper are related to faculty members' research performance and the length of their academic life.

As a measure of research performance, we consider publications in international scientific journals. The reasons for limiting the scope of research to journal articles are: first, the presence of the referee system in the publication process, which generally ensures a more indisputably objective and transparent process for accepting research for publication than any other format (e.g., books, monographs, textbooks, papers at conferences, etc.); second, the fact that, internationally, the vast majority of the research output in economics is published in scientific journals, rather than in other types of publications [50]; and last, the existence of the necessary international databases that enable us to find not only the number and scope of published papers, but also the citations made by other researchers to them.

To evaluate research performance, we used three variables: a) productivity, b) overall impact, and c) the h-index. Productivity is defined as the number of articles in international refereed journals that are contained in Scopus and published throughout the research life of each faculty member, up to the time of this inquiry. The overall impact of the research work is measured by the total number of citations. Finally, Hirsch [51] defined the h-index as follows: "A scientist has index h if h of his or her N_p papers have at least h citations each and the other (N_p - h) papers have fewer than ≤ h citations each."

To measure the research age of each faculty member, we counted the years that had elapsed since they gained their doctoral degree, up to the year covered by the information collected for this study (December 2009).

Before conducting any statistical tests, we checked the normality of the data distribution using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The decisions concerning normality were based on the results of the Kolmogorov-Smirnov test. For categorical variables (gender and tenured vs non-tenured ranks) that appear in two independent samples we used the homogeneous χ^2 (Chi-Square) test. For ranked variables (academic ranks: lecturer, assistant professor, associate professor, full professor) in two independent samples we used the Mann-Whitney test. For continuous variables (academic life, papers per faculty, citations per faculty, and the h-index) we apply the t-test to the two independent samples if they are normally distributed, and the non-parametric Mann-Whitney test if they are not. For ranked variables, and continuous variables with data that are not normally distributed, in more than two independent samples we applied the Kruskal-Wallis test, accompanied by the Mann-Whitney test for paired samples.

The next step was to apply the logistic regression method to estimate four equations. In all cases, the dependent variable is academic rank, which takes the value of 1 for tenured academic staff (professors and associate professors) and 0 for non-tenured academic staff (assistant professors and lecturers). In each of the four regressions, one of the following independent variables is used: the length of academic life, the number of papers per faculty member, the number of citations per faculty member, and the h-index. The objective of our analysis is to examine gender differences in academic hierarchy, given (possible) discrepancies in academic performance.

We estimate four different equations, one for each independent variable. The general form of the regression equation is:

$$\log\left(\frac{\pi}{1-\pi}\right) = a + \beta_1 X_i + \beta_2 D_1 X_i + u_i$$

where π is the probability academic rank to be equal to 1 and D_1 is a dummy variable for gender, taking the value 1 for male and 0 for female.

Additionally, X_i corresponds to the length of academic life in the first model, the number of papers per faculty member in the second, the number of citations per faculty member in the third, and to the h-index in the fourth model. We specified our model in this way because the variables for papers per faculty, citations per faculty, and h-index are positively correlated. The correlation test results are presented in Table I

TABLE I. PEARSON CORRELATION RESULTS

	Papers per faculty	***Citations per faculty***	***h-index***
Papers per faculty	1[a]	0.837*** (0.000)	0.830*** (0.000)
Citations per faculty	0.837*** (0.000)	1	0.882*** (0.000)
h-index	0.830*** (0.000)	0.882** (0.000)	1

In all cases there is a positive and statistically significant correlation between the variables. Therefore, if we include all of these variables in the same equation, the results will not be consistent due to multicollinearity.

IV. Results

A. Gender differences in the academic hierarchy

According to the data presented in Table II, the ratio of men to women at the lower academic ranks is 2.15:1, while at the higher ranks it rises to 8.55:1.

TABLE II. DISTRIBUTION IN ACADEMIC RANKS

	Number	*Percentage*
Total		
Male	152	80%
Female	38	20%
Tenured academic ranks		
Male	94	89,5%
Female	11	10,5%
Non - tenured academic ranks		
Male	58	68,2%
Female	27	31,8%

In percentage terms, women represent 20% of the total faculty members. Among the faculty members belonging to the two lower ranks, women represent 31.8%. Nevertheless, this is the reverse of the situation seen at the two highest ranks, where women constitute a much lower percentage, equal to 10.5%.

According to the χ^2 test of independence, the rank occupied by faculty members in the academic hierarchy is associated with gender ($\chi^2(3, N = 190) = 16.14$, $p = .001$). When considering academic level as a ranked variable (with values from 1 to 4 = lecturer to full professor), the Mann-Whitney test confirmed that women are significantly more likely to occupy lower positions in the academic hierarchy (U=2013.5, Z = -2.98, p = .003)

B. Gender differences in research performance

In Table III we present the means and, in parentheses, the corresponding standard deviations for bibliometric indicators: i) research productivity (papers per faculty member), ii) overall impact (citations per faculty member), and iii) the h-index. According to the data presented in this table, there are on average 8.26 papers and 27.58 citations per male faculty member, with an h-index equal to 2.19. The corresponding figures for women are 5.85 papers and 23.21 citations per faculty member, with an h-index equal to 1.97. The results of the Mann-Whitney test demonstrate that the observed differences in favor of men, regarding the three parameters for research work, are not statistically significant (productivity: U = 2581.5, Z = -1.014, p = .311; overall impact: U = 2722, Z = -0.551, p = .582; h-index: U = 2772, Z = -0.39, p = .697).

TABLE III. BIBLIOMETRIC INDICATORS AND LENGTH OF ACADEMIC LIFE

	Productivity	*Total Impact*	*h-index*	*Academic Life*
Total				
Male	8,26 (9,98)	27,58 (46,46)	2,19 (2,08)	18,46 (9,09)
Female	5,85 (5,54)	23,21 (38,31)	1,97 (1,72)	16,79 7,99
Tenured academic ranks				
Male	10,63 (11,56)	39,16 (54,35)	2,74 (2,20)	23,51 (6,65)
Female	7,92 (5,78)	43,75 (50,37)	2,92 (1,83)	22,75 (4,45)
Non - tenured academic ranks				
Male	4,43 (4,66)	8,81 (17,84)	1,29 (1,48)	10,28 (6,05)
Female	4,93 (5,28)	14,07 (28,11)	1,56 (1,53)	14,15 (7,83)

Numbers in parenthesis correspond to the standard deviation

The same analysis was repeated separately for faculty members at lower—non-tenured—and higher—tenured—levels of the academic hierarchy. At lower levels, it should be noted that these indicators show higher values in favor of women, but that differences have no statistical value. According to the Mann-Whitney control test, these differences, which are in favor of women in all three parameters, are not statistically significant (productivity: U = 760, Z = -0.28, p = .827; overall impact: U = 696, Z = -0.84, p = .404; - h-index: U = 690.5, Z = -0.91, p = .363).

We reached the same finding, which is to say that there are no statistically significant differences in the relevant tests for both tenured and non-tenured ranks. The Mann-Whitney control test produced the following results: productivity: U = 493, Z = -0.252, p = .801; overall impact: U = 481, Z = -0.377, p = .706; h-index: U = 476.5, Z = -0.429, p = .668.

C. Gender differences in academic life

The average academic life (years since the doctorate was awarded, up to the year of this survey) for all of faculty members in this study (N = 190) was 18.06 years. For men, the average academic life was 18.46 years, while for women it was 16.79 years. Using the t–test, we found that the larger academic life of men, compared to women, is not statistically significant ($t(188) = 1.05$, p = .148). However, at the two lower ranks, and according to the Mann-Whitney control test, women have a significantly higher academic life when compared to their male colleagues (U = 549, Z = -2.21, p = .027). According to the Mann-Whitney test, this finding does not hold at the two highest levels (U = 512, Z = -0.052, p = .958).

D. *Logistic Regression*

Our results indicate that the log of the odds of academic rank is positively related, and statistically significant, with academic life for both males and females. In other words, the longer a faculty member's academic life, the more likely it is that the faculty member would be a tenured academic staff. In light of our results, the number of papers, the number of citations, and the h-index are all factors that assist men in seeking promoted in their academic career, since these variables positively affect the odds of academic rank. The results are completely different for women. The estimated coefficients for the number of papers, the number of citations, and the h-index are each statistically insignificant. This implies that the above factors cannot explain the promotion of women to the higher ranks of the academic hierarchy. The estimation results are presented in Table IV.

TABLE IV. LOGISTIC REGRESSION RESULTS (CONTINUED)

Variables	**1st Model**		**2nd Model**	
	Coef	***Exp(B)***	***Coef***	***Exp(B)***
Constant	-4.794*** (0.760)	-	-0.547** (0.230)	-
Academic Life	0.203*** (0.040)	1.225	-	-
Gender*Academic Life	0.116*** (0.026)	1.123	-	-
Papers per Faculty	-	-	0.013 (0.046)	1.013
Gender* Papers per faculty	-	-	0.129*** (0.048)	1.138
R	0.49		0.12	

Numbers in parenthesis are standard errors. **significant at 5% level, ***significant at 1%level

TABLE IV. LOGISTIC REGRESSION RESULTS

Variables	**3rd Model**		**4th Model**	
	Coef	***Exp(B)***	***Coef***	***Exp(B)***
Constant	-0.410** (0.191)	-	-0.646*** (0.237)	-
Citations per faculty	0.008 (0.008)	1.007	-	-
Gender* Citations per faculty	0.035*** (0.013)	1.036	-	-
h-index	-	-	0.107 (0.143)	1.113
Gender* h-index	-	-	0.434*** (0.151)	1.543
R	0.14		0.13	

Numbers in parenthesis are standard errors. **significant at 5% level, ***significant at 1%level

The above analysis is based on the interpretation of the estimated coefficients. However, to make our conclusions more precise, we calculate the predicted probabilities for men and women using the four regressions mentioned above. The predicted probabilities are presented in Table V.

TABLE V. PREDICTED PROBABILITY FOR TENURE

	1st Model		**2nd Model**		**3rd Model**		**4th Model**	
	Male	***Female***	***Male***	***Female***	***Male***	***Female***	***Male***	***Female***
Mean	0.62	0.29	0.60	0.38	0.58	0.44	0.59	0.39
Minimum	0.02	0.01	0.37	0.37	0.40	0.40	0.34	0.34
Maximum	0.99	0.82	0.99	0.43	0.99	0.68	0.99	0.50
St. Deviation	0.36	0.25	0.19	0.02	0.21	0.07	0.20	0.05

In the first model, the explanatory variable is the length of academic life. In this case, a man with a given academic life has a 0.62 probability of becoming a tenured academic staff, while a woman has only a 0.29 probability. Additionally, a man who has published a considerable number of papers has a 0.60 probability of getting a promotion, but a woman has a 0.38 probability. When the number of citations is used as the explanatory variable for promotion to the higher ranks of the academic hierarchy, the corresponding probabilities are 0.58 for men and 0.44 for women. Finally, a man with a given h-index has a 0.59 probability to advance in the academic hierarchy, while the corresponding probability for a woman is 0.39.

Consequently, even in cases in which women have the same qualifications as men, they have a lower probability of advancing in the academic hierarchy. In light of our results, it seems that women are discriminated against in academic departments, which are usually dominated by men.

V. Conclusions

This study has empirically examined possible vertical gender differences in the academic hierarchy of Economics departments at Greek universities, and has related these findings to the research output (productivity, impact, h-index) of the relevant faculty members serving in the above mentioned departments.

The most important finding of this study is that there are significant ($p < .01$) vertical differences in the academic hierarchy of Economics departments at Greek universities, which come at the expense of women. This finding is in line with other studies of this topic. The scissor-shaped graph, representing the growing number of men and shrinking number of women who advance up the academic hierarchy, is typically found throughout this literature (see, for example, [9] p. 13).

According to our findings, however, this difference in prospects for promotion does not seem justified by differences in the volume and quality of published research work. Our finding holds for all three of the alternative measures of research performance that were used in this study (productivity, overall impact, h-index). In fact, at the two lower academic ranks, women slightly excelled (although not to a statistically significant extent) men in the volume of published research work. This slight superiority could be attributed to the (statistically significant) higher research life of women at these levels. Indeed, and this is also an important

finding of this study, women at the two lower—non-tenured—ranks have a significantly longer research life compared to male colleagues of the same rank. This finding may indicate the existence of structural barriers that impede the promotion of women into the prestigious higher ranks of the academic hierarchy. One could refer to the classical metaphor of the glass ceiling, by placing it between the ranks of assistant and associate professor. In this sense, this finding is consistent with the findings of all of the studies in the relevant literature.

The logistic regression results confirm these findings. Drawing on the analysis we conducted, we reached the conclusion that variables reflecting research performance (productivity, overall impact of the researcher's scientific work, and the h-index) play no role in the advancement of women in the academic hierarchy. In contrast, all these factors have a positive effect on the academic advancement of men. Taking into consideration the predicted probabilities, we found that, irrespective of the factors that affect academic performance, women have a lesser possibility of being promoted in the academic hierarchy.

Our study shows many new avenues for further research. For the sake of brevity, we will outline just two of them. First, when comparing our results with those of other relevant studies, we have reached similar conclusions regarding gender differences in academic hierarchy. Nevertheless, our study is among the few that highlight that differences in academic hierarchy cannot be attributed to discrepancies in research productivity. In fact, women appear to be equally productive compared to their male peers. This particular finding is partially in line with similar findings from studies using data from other non-Anglo-Saxon countries. Namely, in the Anglo-Saxon world, there seems to be a greater difference in research output between men and women. On the other hand, in countries with a less competitive research and academic environment, these differences are smaller. This may be the case because the latter set of countries lacks both working conditions and incentives that are conducive to promoting research. As a result, the academic performance of men, who otherwise receive favorable social treatment, does not outweigh that of women.

Second, our statistical analysis indicates that women are treated unfavorably when it comes to their academic promotion, a fact that is not related to their research performance. In other words, female faculty members seem to be treated differently than their male counterparts. A possible explanation for this discrimination could be that men are more often involved in what is known as "academic politics," and are thus more likely to be members of "power groups" within a department. Moreover, just as in the rest of the society—e.g. government, firms, organizations, etc.—men assume administrative positions more frequently than women. Involvement in both of these dynamics favors academic promotion. We plan to investigate both of these issues in the near future.

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