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Are Men Given Priority for Top Jobs? Investigating the Glass Ceiling in the Italian Academia

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Maria De Paola[*], Michela Ponzo[**], Vincenzo Scoppa[***]

Abstract
We aim to investigate if men receive preferential treatment in promotions using the Italian system for the access to associate and full professor positions that is organized in two stages: first, candidates participate in a national wide competition to obtain the National Scientific Qualification (NSQ), then successful candidates compete to obtain a position in University Departments opening a vacancy. We investigate the probability of success in the two stages in relation to the candidate's gender, controlling for several measures of productivity and a number of individual, field and university characteristics. Whereas no gender differences emerge in the probability of obtaining the NSQ, females have a lower probability of promotion at the Department level. Gender gaps tend to be larger when the number of available positions shrink, consistent with a sort of social norm establishing that men are given priority over women when the number of positions is limited.

JEL classification: J71; M51; J45; J16; D72, D78

Keywords: Gender Discrimination; Glass Ceiling; Academic Promotions; Natural Experiment.

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1. Introduction

A number of papers has shown that the gender wage gap is increasing across the wage distribution in many countries (Arulampalam, Booth and Bryan, 2007; Albrecht, Bjorklund and Vroman, 2003) and that women remain greatly underrepresented in higher paying jobs and in top positions (the so-called "glass-ceiling"). These results can be explained by lower females' productivity, since women may work fewer hours, be less attached to work or have lower experience, but they may also derive from discrimination against women. For example, some recent studies examining promotions and pay in the academic labor market show that, controlling for scientific productivity, women suffer a disadvantage in career progression and a within-rank pay gap (Blackaby, Booth and Frank, 2005; McDowell, Singell and Ziliak, 1999; Ginther and Hayes, 2003; Ginther and Kahn, 2004).

The empirical literature investigating gender discrimination in the labor market has followed three main strands: regression analyses, correspondence studies and natural experiment. The first uses regression analyses on observational data, typically explaining wage differentials on the basis of observable workers' and jobs' characteristics. This literature finds large unexplained wage gaps between males and females and interprets these as evidence of discrimination (see Altonji and Blank, 1999, for a review).[1] However, since most of these studies lack accurate measures of productivity, some unobserved factors might lead to upward biased gender differentials.

The second strand of the literature adopts an experimental approach and mainly uses correspondence studies (relying on fictitious matched CVs submitted to employers), to test if women are less likely than men to be considered for hiring. This literature shows that gender differences in call-back rates depend on the type of occupation and sector (Neumark, 1996; Riach and Rich, 2006; Booth and Leigh, 2010; Petit, 2007; Steinpreis, Anders and Ritzke, 1999).[2] Even if CVs are made equivalent in terms of observable characteristics, differences in the probability of being hired could be explained by the fact that from the applicant's gender employers infer characteristics that are not included in the CV .

Finally, Goldin and Rouse (2000) exploit one of the few natural experiments in this literature and show that female musicians have increased their probability of being hired in prevailingly male symphony orchestra after the adoption of "blind" auditions with a screen to conceal the candidate's identity from the jury. Other forms of natural experiments are used by some recent works investigating whether gender discrimination depends on the gender of evaluators (Bagues and Esteve-Volart, 2010; Bagues, Sylos-Labini and Zinovyeva, 2015; De Paola and Scoppa, 2015) finding rather ambiguous results.

[1] In the academic field, Wenneras and Wold (1997) carry out this type of analysis analysing the probability of success for postdoctoral fellowship applications, finding that females have to be much more productive to have the same chances of males.

[2] Steinpreis, Anders and Ritzke (1999) conducted an experiment in the academic setting asking 238 psychologists to review CVs in order to provide recommendations for hiring. They used the same CVs changing randomly gender and found that reviewers preferred CVs with male names.

Overall, because of the related econometric challenges the evidence on gender discrimination remains controversial.

Our work aims at providing new evidence on this issue focusing on the Italian University system and considering promotions to associate and full professor positions. The underrepresentation of women in academia remains a cause for concern. In Italy, women account for 45% of assistant professors, 37% of associate professors and only a mere 20% of full professors. Similar figures are found for other European countries and for US.

Exploiting the features of the system currently governing academic promotions in Italy we are able to compare gender gaps in two different settings: the first in which candidates have to reach a certain standard and where there are no limits to the number of slots available and the second in which candidates compete one against the others to fill a limited number of vacancies.

In fact, the new Italian system for promotions to associate and full professor positions is organized in two stages: first, candidates need to obtain a National Scientific Qualification (NSQ) awarded by a national committee who consider candidates' publications and CVs in relation to a field specific minimum standard; subsequently, successful candidates compete to be promoted by local University Departments to the higher academic position through a sort of tournament in which applicants are compared one against the other.

Using data on about 26,300 applicants for the NSQ and data on 14,000 successful candidates competing for local promotions, we investigate whether the probability of obtaining the NSQ and the probability of promotion at the local level are related to the candidate's gender. Controlling for good measures of scientific productivity, we find that while there are no gender differences whatsoever in the probability of obtaining the NSQ, females, ceteris paribus, have a lower probability of promotion at the local level of 6-7 percentage points. This is especially true for promotion to full professors. These results hold true also when we control for a number of individual, field and university characteristics (seniority, tenure, connections, number of available positions at the local level, etc.).

Interestingly, we find that gender gaps tend to be larger when the number of available positions shrink, consistent with a sort of social norm establishing that when positions are scarce priority has to be given to men.

Three features distinguish our work from the existing literature. First, we are able to investigate gender differentials in two different settings, one with unlimited positions and the other with a limited number of positions. Second, we have available very good measures of scientific productivity since we use the measures adopted by the national committees to award the NSQ. Third, we can confidently exclude that our results on gender gaps at local competitions are related to gender differences in the propensity to apply for promotion (since all researchers in our sample have already applied for the NSQ) or to gender differences in the propensity to move to a new Department since almost all promotions take place within the same Department in which individuals are already employed.

The paper is organized as follows. Section 2 presents the Italian academic promotion system. In Section 3 we describe our data. In section 4 we investigate whether females have a lower probability to obtain the NSQ. In Section 5 we focus on the probability of being effectively promoted at the University Department level for researchers who obtained the NSQ. Section 6 investigates whether gender differences are related to the abundancy of positions at the department level. Section 7 concludes.

2. The Institutional Background

The rules governing careers in the Italian Universities have changed repeatedly over time. The system currently governing promotions to associate and full professor positions has been introduced in the Italian academic system in 2012, following a major reform of the University system in 2010 (the so-called "Gelmini Law", after the name of the former University Minister). The reform was aimed at increasing transparency and meritocracy through a two-stage procedure: in a first stage candidates aiming for promotion to associate or full professor positions are required to qualify in a centralized national competition held at the field level (National Scientific Qualification); a second stage, in which effective promotions (or new hiring) are managed at local level by each university.[3]

In this study we consider the procedure for obtaining the National Scientific Qualification launched in 2012 (the deadline for applications was the 20th November 2012 and evaluation procedures have been completed by the first semester of 2014). For details of this procedure, we refer to De Paola, Ponzo and Scoppa (2015) and Bagues, Sylos-Labini and Zinovyeva (2015) who have analyzed different aspects of this system.

The Italian academia is organized in 14 different areas (for example, "Physics", "Medicine", "Economics and Statistics"); each area is in turn divided in different fields (for example, "Applied Physics", "Econometrics", "Private Law") for a total of 184 fields. The NSQ is awarded by a committee (specific to each field) of five members (four full Professors from Italian Universities and one foreign member from OECD countries) who are randomly selected among the full professors in each field who reached some scientific productivity standards and volunteered for the task.

Committee members evaluate candidates to both associate and full professor positions and award the NSQ. There are no limits to the number of qualifications awarded in each field.[4] Committees had full autonomy on the criteria to be used in the evaluation but some criteria were suggested by the Ministry of Education, University and Research in relation to the research productivity of candidates in the previous ten years, as measured by some bibliometric indicators (see below).

[3] Previously, promotions were entirely decided at the local level. The system is described in De Paola and Scoppa (2015).

[4] Candidates who fail to obtain the qualification cannot participate in the NSQ taking place in the following two years.

The Italian system is similar to that currently in place in Spain and France. However, while in the French and Spanish systems candidates are evaluated both on their CVs and on the basis of some oral presentations, in the Italian NSQ evaluation committees assess candidates exclusively on the basis of their publications and CVs.

Obtaining the National Qualification is only the first step to get a promotion.[5] In fact, University Departments can autonomously choose the full and associate professors to hire among individuals who have obtained the NSQ, through an open competition for both internal and external candidates or, alternatively, through a competition reserved to internal candidates. Then, the probability on being effectively promoted by individuals who gained the NSQ depends on the number of vacancies opened by University Departments.

In November 2015, after about two years since the conclusion of the NSQ 2012, 55% of individuals who have obtained the NSQ as associate professor and 10.4% of qualified full professors have been effectively promoted to the new position. Although University Departments can select, in principle, internal or external candidates, due to a notable difference in costs, in the vast majority of cases (98.4%) Departments have promoted internal candidates.

3. The Data

The data we use in our analysis are mainly gathered from the website of the Italian Ministry of Education, University and Research (MIUR).[6] We have collected the lists of all individuals holding a position in the Italian University system either as assistant professors or as associate professors on the 31th December 2013 (before the promotions procedures began[7]) and on the 1st November 2015. We have also information on candidates' gender, affiliation, tenure and experience (since the year 2000).

In our analysis we mainly focus on researchers affiliated to an Italian University in 2013 and we disregard all the external candidates obtaining a qualification, that is, those who in 2013 were neither assistant nor associate professors in Italian Universities. This choice is due to two reasons: first, external candidates are rarely considered for promotion by University Departments, since promotion of an internal candidate is much less expensive (about 70% less both for associate and full professor promotions); second, for this sample we do not observe age, years of experience, careers, affiliation, and so on.

[5] Italian academics have similar obligations and constraints at all the hierarchical levels, carry out similar tasks and promotions do not imply longer working hours. Teaching loads are quite uniform and determined by the Law and by University regulation.
[6] See the website: http://cercauniversita.cineca.it/php5/docenti/cerca.php
[7] The deadline for application for ASN was in November 2012. The first outcomes of the ASN evaluations were published in December 2013 (149 out of 184 committees concluded their evaluations around this period) and the last in August 2014.

From the National Scientific Qualification's website we have collected data for each field on the list of candidates to the NSQ and on those who obtained the National Qualification.[8] Then, we built a dummy variable, *Qualification*, equal to one when a candidate has obtained the NSQ (and zero otherwise).

In addition, the NSQ's website provides information on three measures of candidates' scientific productivity (in the ten years preceding the evaluation) that were used by committee members to award the qualification. In bibliometric fields (mainly scientific fields)[9] the productivity indicators used are: a) the number of articles published in scientific journals; b) the total number of citations; c) the h-index. In non-bibliometric fields (Social Sciences and Humanities) the indicators are: a) the number of articles published in scientific journals; b) the number of articles published in high quality journals;[10] c) the number of books.[11]

Since these indicators of scientific productivity tend to be highly correlated, to avoid multicollinearity problems we have undertaken a principal component analysis for each field to obtain a comprehensive measure of individual scientific productivity (only the first component was considered), which we call *Productivity*.

In the Italian system, professors hired at any level have to spend an initial period of three years ("No Tenure") after which they are hired permanently (conditional on satisfactory performance). Although almost everyone obtains tenure, the indicator variable "*No tenure*" is useful as a measure of seniority. Furthermore, since we observe for each candidate when he/she was hired by an Italian university (starting from year 2000), we use this information to build the variable *Experience*, that is, the number of years since a researcher has been hired.[12] Using the affiliations of both evaluators in the NSQ and candidates we build an indicator of professional networks between candidates and committee members, *Connections*, taking the value of one when at least one professor in the set of evaluators works (or has worked in the past) in the same university in which the candidate is employed, and zero otherwise. Finally, we build 5 geographical dummies (North-West, North-East, Centre, South, Islands) using the geographical location of the University in which each individual is affiliated.

In Panel (a) of Table 1 are reported the descriptive statistics for the 26,307 applications at the NSQ from researchers who were affiliated in 2013 at an Italian University (15,422 applications for associate professor and 10,885 for full professor). Notice that the observations are at the level of applications, corresponding to 22,659 researchers, since about 25% of them apply for more than one

[8] See the website: http://abilitazione.miur.it/public/pubblicacandidati.php

[9] Bibliometric fields include Mathematics, Physics, Chemistry, Earth Sciences, Biology, Medicine, Agricultural and Veterinary Sciences, Civil Engineering and Architecture, Industrial and Information Engineering, Psychology.

[10] The list of high quality journals in each field has been determined by an evaluation agency (ANVUR) with the help of the corresponding National Scientific Associations.

[11] According to the suggestions of MIUR to committees, candidates deserving qualification should have a score above the median (calculated among professors of the targeted position) in at least two of three indicators in Scientific fields and in at least one in Social Sciences and Humanities.

[12] We impute 5 more years of experience to assistant professors who in the year 2000 were already tenured and impute 10 more years of experience to associate professors who in the year 2000 were already tenured.

competition. About 58% of applicants have obtained the qualification and about 4% have obtained more than one national qualification in related fields (*Number of Qualifications*). Females are 38%. Average experience is 8.5 years. Almost 18% of candidates have connections.

While it was quite easy to gather information on the NSQ, collecting data on local competitions opened by University Departments would have been an unmanageable task since there is not a unique source. Therefore, we follow a different strategy. Using data on researchers holding a position in Italian Universities in 2013 and 2015, we define a dummy *Promotion* equal to one if an assistant professor in 2013 obtained the national qualification for the higher position and on the 1st of November 2015 he/she is an associate professor (and 0 otherwise); in the same way, we set *Promotion* equal to one if an associate professor in 2013 obtained the national qualification for the higher position and on the 1st November 2015 he/she is a full professor (and 0 otherwise).

A total of 13,967 professors (9,090 assistant professors and 4,877 associate professors) were successful in obtaining the NSQ for the higher position and represent the base for our second sample. Descriptive statistics for the sample of assistant and associate professors who were awarded the national qualification are reported in Panel (b) of Table 1.[13]

Among qualified professors, promotion rate to associate professor was 55.1%, while promotion rate to full professor was only 10.4%. Females are 37.7%. Individuals have 9.8 years of experience and 15.2% have still no tenure. 65% of our sample are assistant professors competing for associate professor positions.

For each field, university and position, we calculate the number of professors obtaining the qualification and the number of promotions awarded. Dividing the number of promotions for the number of competitors, we obtained the *Percentage of Open Positions* at the Department level that we use as an explanatory variable in our models to explain the probability for each individual of being promoted.

[13] In the appendix of this paper we report separate descriptive statistics for candidates to associate (Table A) and full professor positions (Table B).

Table 1. Descriptive statistics

Panel (a). Applications for the National Scientific Qualification

	Mean	St. Dev.	Min	Max	Obs.
Qualification	0.585	0.493	0	1	26307
Female	0.378	0.485	0	1	26307
Ass. Prof. Comp.	0.586	0.493	0	1	26307
Productivity	0.028	1.269	-4.090	19.745	26307
Experience	9.536	5.610	0	27	26307
Years in Position	7.871	5.009	0	22	26307
No tenure	0.160	0.367	0	1	26307
Connections	0.177	0.382	0	1	26307
North-West	0.254	0.436	0	1	26307
North-East	0.210	0.407	0	1	26307
Centre	0.278	0.448	0	1	26307
South	0.169	0.375	0	1	26307
Islands	0.088	0.283	0	1	26307

Panel (b). Researchers with Qualification competing for Promotions

	Mean	Std. Dev.	Min	Max	Obs.
Promotion	0.394	0.489	0	1	13967
Female	0.377	0.485	0	1	13967
Experience	9.855	5.225	0	22	13967
Years in Position	8.250	4.770	0	23	13967
No Tenure	0.152	0.359	0	1	13967
Productivity	0.000	1.385	-5.293	16.178	13967
Open Positions (%)	0.390	0.355	0	2	13967
North-West	0.266	0.442	0	1	13967
North-East	0.226	0.418	0	1	13967
Centre	0.266	0.442	0	1	13967
South	0.163	0.369	0	1	13967
Islands	0.079	0.269	0	1	13967
Ass. Prof. Comp.	0.651	0.477	0	1	13967
Connections	0.203	0.403	0	1	13967
Number of qualifications	1.043	0.228	1	4	13967

Notes: The data are drawn from the websites of the Italian Ministry of Education, University and Research (MIUR) and of the National Scientific Qualification.

4. No Gender Gaps in the National Scientific Qualification

As explained above, to be promoted to associate or full professor positions in Italy researchers have first to participate in a nation-wide competition "National Scientific Qualification". In this Section we examine the determinants of the probability of obtaining the Qualification and investigate if it is related to the candidate's gender (see also Bagues, Sylos-Labini and Zinovyeva, 2015; De Paola, Ponzo and Scoppa, 2015).

We estimate the following equation with a Probit model on the sample of 26,307 individuals who have applied for the NSQ and are affiliated to an Italian university:

$$\Phi\left(Qualification_{ijp} \mid X\right) = \Phi\left(\beta_0 + \beta_1 Female_i + \beta_2 Productivity_i + \beta_3 X_i + \mu_j + \lambda_k + \theta_p\right)$$

where the probability of $Qualification_{ijp}$ (a dummy variable taking value of 1 if the candidate *i* has obtained the qualification in field *j* and position *p* and 0 otherwise), depends on the candidate's gender

$Female_i$, on his/her scientific $Productivity_i$, on a vector X_i of the candidate's characteristics (including years of experience, tenure, connections, etc.), dummies for scientific fields μ_j, universities λ_k, and for position θ_p.

In all the regressions, standard errors are robust to heteroskedasticity and allowed for clustering at the field level.

As shown in Table 2, in which we report the marginal effects of the Probit estimates, we do not find any difference in the probability of success between males and females. Results are quite stable across specifications. In column (1) we run our regression controlling only for *Female*, *Productivity*, a dummy for associate professor competition and 14 dummies for scientific areas. We do not find any gender differences.[14] In column (2), as a robustness check, we also run a regression on the whole sample of applications (59,156 observations, including individuals not affiliated to an Italian university), and we find very similar results.

No gender differences are found in column (3) in which – using the sample of university affiliated – we include among regressors our measures of individual characteristics and 184 dummies for scientific fields and in column (4) when we control in addition for university fixed effects (90 dummies). In columns (5) and (6), where we run separate regressions for competitions to associate and full professor positions, in both cases we find no gender differences.

Research productivity has a strong impact on the likelihood of succeeding in the competition. An increase of one standard deviation in *Productivity* (Standard Deviation=1.269) leads to an increase in the probability of success of about 22 percentage points (notice that in our sample the unconditional probability of qualification is 58%). *Experience* has a positive effect (but decreasing) on the probability of qualification. We also show that *Connections* play a very relevant role: the probability of success increases of about 11 percentage points when a colleague of the Department is a member of the national evaluation committee. Using an interaction term (results not reported), we do not find any difference in the impact of connections between males and females.

Overall, our estimates show that, in a setting in which there are no limits to the number of positions available, males and females have equal opportunity of success (controlling for scientific productivity and other individual characteristics).

[14] We find some gender differences (*Female*=–0.033; *t*-stat=–3.37) when we do not control for scientific productivity, implying that females have on average a lower scientific productivity. On this aspect, see the evidence shown by Jappelli, Nappi and Torrini (2015) using data from the National Research Assessment (VQR) conducted in Italy for the years 2004-2010.

Table 2. Probability of Obtaining the National Scientific Qualification. Probit Estimates (Marginal Effects)

	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.006	-0.005	0.000	0.001	-0.005	0.007
	(0.010)	(0.008)	(0.009)	(0.009)	(0.009)	(0.014)
Productivity	0.157***	0.102***	0.171***	0.172***	0.187***	0.157***
	(0.012)	(0.009)	(0.012)	(0.013)	(0.014)	(0.016)
Ass. Prof. Comp.	0.085***	-0.000	0.115***	0.118***		
	(0.011)	(0.009)	(0.015)	(0.015)		
Experience			0.014***	0.013***	0.032***	0.036***
			(0.003)	(0.003)	(0.009)	(0.007)
Experience Sq.			-0.000**	-0.000**	-0.001***	-0.001***
			(0.000)	(0.000)	(0.000)	(0.000)
Years in Position			-0.014***	-0.014***	-0.020***	-0.009***
			(0.002)	(0.002)	(0.005)	(0.002)
No tenure			-0.047***	-0.041***	-0.042**	0.010
			(0.013)	(0.013)	(0.019)	(0.023)
Connections			0.113***	0.114***	0.113***	0.111***
			(0.010)	(0.010)	(0.012)	(0.014)
Scientific Areas Dummies	YES	YES	NO	NO	NO	NO
Scientific Field Dummies	NO	NO	YES	YES	YES	YES
Geographical Dummies	NO	NO	YES	NO	YES	YES
University Dummies	NO	NO	NO	YES	NO	NO
Observations	26307	59156	26307	26304	15422	10856
Pseudo R-squared	0.111	0.071	0.183	0.189	0.220	0.167

Notes: The Table reports marginal effects of Probit estimates (evaluated at the mean values of the explanatory variables in the sample). The dependent variable is *Qualification*. Standard errors (corrected for heteroskedasticity and robust to clusters at the field level) are reported in parentheses. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

5. Academic Promotions and Gender: Results from Local Evaluations

The main difference between the NSQ and the evaluation procedures undertaken at the University Department level for deciding effective promotions is that while in the NSQ there are no limits to the number of qualifications to be awarded, at the local level – given Departments' budget constraints– awarding a promotion to one candidate implies denying it to other candidates. In other terms, while qualifications can be considered as non "rival goods", promotions are "rival goods".

Given this crucial difference, it is interesting to examine whether males and females obtained similar results also in local competitions leading to effective promotions. At this aim, in this Section, we examine whether the probability of being promoted to associate or full professor for individuals who have obtained the NSQ is related to gender. As in the previous analysis, we control for measures of scientific productivity, years of experience, tenure, field and university dummies etc. In addition, we consider the number of positions available for promotions at the University Department level.

We estimate the following Probit model:

$$\Phi\left(Promotion_{ijkp} \mid X\right) = \Phi\left(\beta_0 + \beta_1 Female_i + \beta_2 Productivity_i + \beta_3 X_i + \beta_4 OpenPositions_{jkp} + \mu_j + \lambda_k + \theta_p\right)$$

where the probability of $Promotion_{ijkp}$ (a dummy variable taking value of 1 if the candidate *i* has been promoted in field *j*, university *k* and position *p* and 0 otherwise), depends on the candidate gender $Female_i$, on his/her scientific *Productivity*, on a vector X_i of the candidate's characteristics (including years of experience, tenure, connections, etc.), a variable $OpenPositions_{jkp}$ measuring the number of open positions in field *j*, university *k* and position *p* (as a percentage of qualified candidates), dummies for scientific fields μ_j, universities λ_k, and for position θ_p.

The marginal effects of Probit estimates are reported in Table 3. In column (1) we only control for the candidate's gender, the percentage of *Open Positions*, for scientific areas dummies (14) and for a dummy of *Associate Professor Competition*. We find that females have a lower probability of being promoted of about 6.4 percentage points, highly statistically significant (*t*-stat=– 6.4).

As expected, given that competition is often restricted to internal candidates, the percentage of opened position is a strong determinant of the probability of promotion.

In column (2) we add among controls the candidate's scientific productivity. The latter variable is very relevant for the probability of promotion: an increase of one standard deviation raises the probability of 5.2 percentage points (*t*-stat=9.9). However, controlling for scientific productivity the marginal effect of *Female* is -5.5 p.p., only slightly lower with respect to column (1).

Starting from column (3) we add as controls a bunch of individual characteristics: years of experience, experience squared, years in the position, no tenure, number of national qualifications obtained, connections, geographical area dummies and fields dummies (184). We find that *Experience* has a positive (concave) effect on the probability of promotion while the lack of "tenure" has a negative effect.[15] Controlling for all these variables, females have a lower probability of being promoted of 6.7 p.p. In column (4) we add among controls university dummies instead of geographical area dummies. Estimates remain almost the same.

Finally, in column (5) and (6) we estimate specification (3) separately for associate and full professor competitions. As regards associate professors, we find a difference between males and females of about 6.4 p.p., ceteris paribus. Since on average the probability of promotion for individuals who have obtained the NSQ to associate professor is about 55%, females suffer a reduction of about 12% in the chances of being promoted with respect to males. On the other hand, for full professors the gender difference is 2.1 p.p., which on the basis of an unconditional probability of being promoted of 10.4% translates in a reduction of about 20% for females.

As a robustness check, we have estimated all the previous specifications with a Linear Probability Model obtaining very similar results (not reported to save space).

[15] The number of qualifications obtained represent a measure of productivity and increases the probability of promotion of about 8 percentage points. Connections have no effect, which is not surprising since this indicator takes into account connections with evaluators in the NSQ system who typically do not play a relevant role in local competitions.

Table 3. Probability of Promotion to Associate and Full Professor Positions. Probit Estimates (Marginal Effects)

	(1)	(2)	(3)	(4)	(5)	(6)
					Associate Prof.	Full Prof.
Female	-0.064***	-0.055***	-0.067***	-0.067***	-0.064***	-0.021***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.014)	(0.005)
Open Positions	1.269***	1.270***	1.317***	1.307***	1.359***	0.314***
	(0.028)	(0.028)	(0.030)	(0.031)	(0.034)	(0.016)
Ass. Prof. Comp.	0.086***	0.090***	0.094***	0.103***		
	(0.012)	(0.012)	(0.017)	(0.017)		
Productivity		0.038***	0.046***	0.046***	0.049***	0.009***
		(0.004)	(0.004)	(0.004)	(0.006)	(0.002)
Experience			0.046***	0.048***	0.088***	0.004
			(0.006)	(0.006)	(0.010)	(0.002)
Experience Sq.			-0.002***	-0.002***	-0.004***	-0.000**
			(0.000)	(0.000)	(0.000)	(0.000)
Years in Position			0.010***	0.009***	-0.003	0.003***
			(0.003)	(0.003)	(0.007)	(0.001)
No tenure			-0.088***	-0.095***	-0.056*	-0.007
			(0.021)	(0.021)	(0.031)	(0.007)
# Qualifications			0.085***	0.082**	0.103**	0.007
			(0.033)	(0.032)	(0.044)	(0.007)
Connections			-0.000	-0.001	-0.011	0.008
			(0.011)	(0.011)	(0.013)	(0.007)
Scientific Areas Dummies	YES	YES	NO	NO	NO	NO
Scientific Field Dummies	NO	NO	YES	YES	YES	YES
Geographical Dummies	NO	YES	YES	NO	YES	YES
University Dummies	NO	NO	NO	YES	NO	NO
Observations	13967	13967	13967	13912	9090	4591
Pseudo R-squared	0.442	0.448	0.481	0.483	0.363	0.524

Notes: The Table reports marginal effects of Probit estimates (evaluated at the mean values of the explanatory variables in the sample). The dependent variable is *Promotion*. Standard errors (corrected for heteroskedasticity and robust to clusters at the field level) are reported in parentheses. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Figure 1 shows the predicted probability of promotions of males (the blue solid line) and females (the red dashed line) in relationship to the individual scientific productivity, based on estimates of column (3) of Table 3, adding an interaction between *Female* and *Score* (the interaction term is positive, 0.009, but not statistically significant, *p*-value=1.08). The vertical distance between the two lines represents the gender difference in the probability of promotion (the grey areas represent 95% confidence intervals). It emerges a clear gap in favor of males for low and medium levels of standardized productivity, whereas there is almost no gender differences in the probability of being promoted for very high levels of productivity.

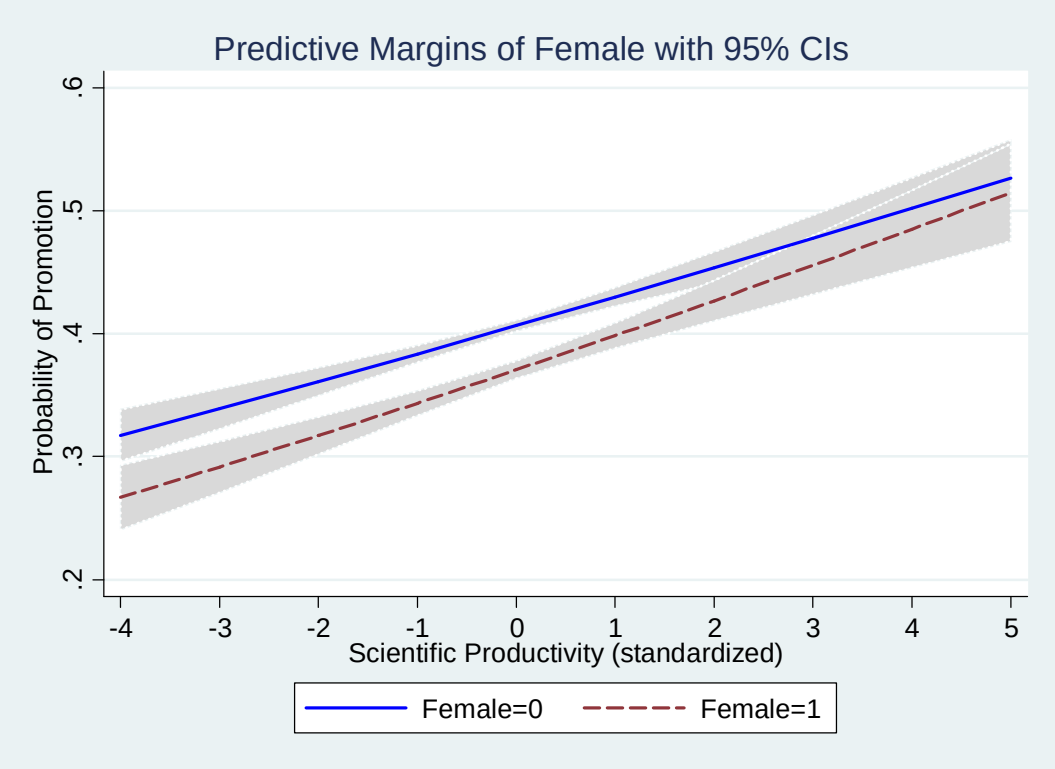

Figure 1. Probability of Promotion of Males and Females in relationship to the Scientific Productivity

Our estimates of gender differentials in the probability of promotion hinge upon the availability of good measures of productivity. However, it could be that the three indicators built for the NSQ that we used in the previous analyses are not the most appropriate. As a robustness check, we undertake now an alternative approach using – for a 20% sample of qualified professors – some measures of individual productivity based on Google Scholar using the "Publish or Perish" software: number of publications, number of citations, h-index and g-index.[16] We end up with a sample of 2,914 individuals. Using these indicators, we again undertake a principal component analysis and obtain a synthetic measure of *Productivity Google Scholar*.[17]

Then, in Table 4 we run the same specifications as in Table 3 using this new measures of productivity. The results are very similar in all the specifications. Females have a significant lower probability of promotion. The magnitude of the gender gap is around 5 p.p., although standard errors turn out to be much higher because of the lower number of observations.

[16] We used the same data in a related paper De Paola, Ponzo and Scoppa (2015).

[17] The rate of correlation between *Productivity Google Scholar* and *Productivity* is 0.28, highly statistically significant.

Table 4. Probability of Promotion controlling for measures of productivity based on Google Scholar (publications, citations, h-index, g-index)

	(1)	(2)	(3)	(4)	(5)	(6)
					Associate Prof.	Full Prof.
Female	-0.059***	-0.049**	-0.049*	-0.051**	-0.031	-0.068***
	(0.021)	(0.021)	(0.026)	(0.026)	(0.034)	(0.017)
Open Positions	1.269***	1.263***	1.485***	1.497***	1.526***	0.673***
	(0.050)	(0.051)	(0.071)	(0.076)	(0.085)	(0.092)
Ass. Prof. Comp.	0.087***	0.096***	0.123***	0.160***		
	(0.028)	(0.028)	(0.045)	(0.046)		
Productivity Google Scholar		0.012	0.038***	0.042***	0.045***	0.010
		(0.008)	(0.011)	(0.011)	(0.015)	(0.012)
Experience			0.042***	0.048***	0.093***	-0.021
			(0.014)	(0.015)	(0.029)	(0.016)
Experience Sq.			-0.002***	-0.002***	-0.003***	0.001
			(0.001)	(0.001)	(0.001)	(0.001)
Years in Position			0.009	0.007	-0.013	-0.001
			(0.007)	(0.007)	(0.017)	(0.006)
No tenure			-0.153***	-0.172***	-0.158**	-0.045**
			(0.049)	(0.047)	(0.080)	(0.021)
# Qualifications			0.137***	0.133***	0.204***	-0.014
			(0.050)	(0.051)	(0.071)	(0.022)
Connections			0.024	0.006	0.001	0.102*
			(0.034)	(0.034)	(0.040)	(0.055)
Scientific Areas Dummies	YES	YES	NO	NO	NO	NO
Scientific Field Dummies	NO	NO	YES	YES	YES	YES
Geographical Dummies	NO	YES	YES	NO	YES	YES
University Dummies	NO	NO	NO	YES	NO	NO
Observations	2914	2798	2765	2742	1766	455
Pseudo R-squared	0.438	0.439	0.527	0.547	0.412	0.628

Notes: The Table reports marginal effects of Probit estimates (evaluated at the mean values of the explanatory variables in the sample). The dependent variable is *Promotion*. Standard errors (corrected for heteroskedasticity and robust to clusters at the field level) are reported in parentheses. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Some recent explanations for gender gaps – based on psychological attitudes – argue that females obtain worse outcomes since they tend to shy away from competitive settings (see, among others, Niederle and Vesterlund, 2011, and Bertrand, 2010). Although our data do not provide information on applicants to each local competition, we are confident that the gender differences in promotions we observe are not due to females' reluctance to enter in competition. The reason is that we are considering a sample of individuals who have applied for the NSQ,[18] have been successful in obtaining it and who have all the incentives to apply for a promotion at the local level.[19]

A further possible factor explaining the gender difference in promotion could be, in principle, a different propensity of males and females to move to a new Department in a different location. If women are less willing to move (because of family responsibilities, for example) then they could lose some good opportunities to be promoted. However, in many cases promotions take place within the

[18] In a related paper (De Paola, Ponzo and Scoppa, 2015) we do examine the propensity of males and females to apply for the National Scientific Qualification finding small but significant gender differences.

[19] Italian academics have similar obligations and constraints at all the hierarchical levels, carry out similar tasks and promotions do not imply longer working hours. Teaching loads are quite uniform and determined by the Law and by University regulation.

same Department in which the individuals are already employed since it is both very costly to promote an external candidate[20] and disruptive for the morale of internal candidates. To better investigate this issue, we estimate the same specifications of Table 3 but restrict the sample only to candidates in Departments and fields in which at least one position was opened for the relevant field and hierarchical level, that is, we discard candidates for whom no position was available in their Department. Estimates are reported in Table 5. Using this restricted sample, we find very similar results: the gap between males and females in the probability of promotion tend to be around 6-7 percentage points. As regards promotions to full professor, in the restricted sample we find a very relevant gender gap of 14 p.p.[21]

Table 5. Probability of Promotion Considering Only Insiders. Probit Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
					Associate Prof.	Full Prof.
Female	-0.064***	-0.054***	-0.069***	-0.071***	-0.056***	-0.141***
	(0.011)	(0.011)	(0.012)	(0.012)	(0.013)	(0.032)
Open Positions	1.187***	1.195***	1.251***	1.241***	1.225***	1.053***
	(0.029)	(0.030)	(0.035)	(0.037)	(0.031)	(0.175)
Ass. Prof. Comp.	0.004	0.009	-0.007	-0.000		
	(0.014)	(0.014)	(0.022)	(0.023)		
Productivity		0.041***	0.050***	0.052***	0.048***	0.057***
		(0.005)	(0.006)	(0.006)	(0.006)	(0.013)
Experience			0.049***	0.052***	0.086***	0.018
			(0.007)	(0.007)	(0.010)	(0.016)
Experience Sq.			-0.002***	-0.002***	-0.004***	-0.001*
			(0.000)	(0.000)	(0.000)	(0.001)
Years in Position			0.012***	0.012***	-0.003	0.020***
			(0.004)	(0.004)	(0.006)	(0.006)
No tenure			-0.104***	-0.112***	-0.053*	-0.050
			(0.026)	(0.026)	(0.030)	(0.047)
# Qualifications			0.088**	0.090**	0.091**	0.061
			(0.038)	(0.038)	(0.043)	(0.047)
Connections			-0.008	-0.006	-0.013	0.016
			(0.012)	(0.012)	(0.013)	(0.040)
Scientific Areas Dummies	YES	YES	NO	NO	NO	NO
Scientific Field Dummies	NO	NO	YES	YES	YES	YES
Geographical Dummies	NO	YES	YES	NO	YES	YES
University Dummies	NO	NO	NO	YES	NO	NO
Observations	9477	9477	9470	9385	8065	1332
Pseudo R-squared	0.244	0.252	0.300	0.299	0.291	0.279

Notes: The Table reports marginal effects of Probit estimates (evaluated at the mean values of the explanatory variables in the sample). The dependent variable is *Promotion*. Standard errors (corrected for heteroskedasticity and robust to clusters at the field level) are reported in parentheses. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

[20] For a Department, hiring as a full professor an internal candidate costs 0.3 instead of 1 for an external candidate; hiring as an associate professor an internal candidate costs 0.2 instead of 0.7 for an external candidate.

[21] Similar results are found also when we exclude from our sample individuals who have been promoted in a different university from their original one, that is, when we focus on "stayers". Only 1.6% of professors get promoted in a new Department. Leaving them aside, gender differences are slightly reduced, but they remain very relevant and statistically significant.

6. Positions' Availability and Gender Differences

We have seen in Sections 4 and 5 that when the number of available positions is not limited – as in the NSQ – no gender discrimination emerges whereas when the available slots are limited females tend to have worse career opportunities than males.

This issue can be furtherly investigated exploiting the differences in the availability of resources (and, then, in the number of open positions) among departments. Because of the rather complex mechanisms that are adopted both by the Italian government to allocate resources to universities and by universities to allocate resources to their departments, we observe cases in which very few positions for promotion were opened and cases in which a large percentage of professors who obtained the qualification had the possibility of obtaining a promotion in their department.

To verify if gender discrimination is amplified when fewer positions are available, we run our main specifications (Table 3) including an interaction term between *Female* and the percentage of *Open Positions*. Results are reported in Table 6. We focus only on Associate Professors positions in columns (1)-(4) since for this type of position there is a wide variability in the percentage of open positions at the Department level, while we consider Full Professor competitions only in column (5).

We find that the interaction term *Female*(Open Positions)* is positive and quite large in magnitude although imprecisely estimated in some specifications (*p*-values are around 0.10-0.15) while *Female* is negative and larger in magnitude than in previous estimates. The estimated coefficients imply that the extent of gender discrimination depends on the number of available positions: when the number of open positions in the Department is very low, the difference in the promotion rate between males and females is around 10 percentage points while when positions are abundant gender discrimination tends to disappear.

This finding, and those in the previous Sections, are consistent with a sort of social norm that establishes that when positions are scarce men have more rights than women to obtain them.

Table 6. Probability of Promotion and Open Positions. Probit Estimates

	(1)	(2)	(3)	(4)	(5)
	Associate Prof.	Associate Prof.	Associate Prof.	Associate Prof. Only Insiders	Full Professor
Female	-0.103***	-0.113***	-0.107***	-0.095***	-0.031***
	(0.032)	(0.035)	(0.034)	(0.036)	(0.009)
Productivity	0.039***	0.050***	0.051***	0.048***	0.009***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.002)
Open Positions	1.262***	1.321***	1.331***	1.196***	0.284***
	(0.039)	(0.044)	(0.045)	(0.042)	(0.018)
Female*(Open Positions)	0.103*	0.096*	0.084	0.072	0.058
	(0.056)	(0.058)	(0.058)	(0.059)	(0.042)
Experience		0.088***	0.093***	0.086***	0.004
		(0.010)	(0.010)	(0.010)	(0.002)
Experience Sq.		-0.004***	-0.004***	-0.004***	-0.000**
		(0.000)	(0.000)	(0.000)	(0.000)
Years in Position		-0.003	-0.004	-0.003	0.003***
		(0.006)	(0.007)	(0.006)	(0.001)
No tenure		-0.057*	-0.071**	-0.053*	-0.006
		(0.031)	(0.033)	(0.030)	(0.007)
# Qualifications		0.103**	0.102**	0.091**	0.006
		(0.044)	(0.044)	(0.043)	(0.007)
Connections		-0.011	-0.007	-0.013	0.008
		(0.013)	(0.014)	(0.013)	(0.006)
Scientific Areas Dummies	YES	NO	NO	NO	NO
Scientific Field Dummies	NO	YES	YES	YES	YES
Geographical Dummies	YES	YES	NO	YES	YES
University Dummies	NO	NO	YES	NO	NO
Observations	9090	9090	9008	8065	4591
Pseudo R-squared	0.314	0.364	0.366	0.291	0.524

Notes: The Table reports marginal effects of Probit estimates (evaluated at the mean values of the explanatory variables in the sample). The dependent variable is *Promotion*. Standard errors (corrected for heteroskedasticity and robust to clusters at the field level) are reported in parentheses. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

As a robustness check, in Table 7 we estimate the specification (2) of Table 6 separately for quartiles of the distribution of the percentage of open positions (without including the interaction term). Except for the first quartile (when promotion rate is only 15%) we find that the gender gap declines as the number of available positions increases: it is almost 9 p.p. when the promotion rate (for males) is 41%, it reduces to almost 7 p.p. when the promotion rate is 62% and vanishes to zero when the promotion rate reaches 94%.[22] These alternative estimates confirm that the gender differentials are very large when few positions are available but tend to disappear when positions are abundant.

[22] As regards the first quartile, notice that although the gender gaps is only 3.8 p.p. this corresponds to a difference of 25.7 percent between males and females, since the promotion rate for males is only 0.148.

Table 7. Probability of Promotion and Open Positions. Probit Estimates

	(1)	(2)	(3)	(4)
	I quartile	II quartile	III quartile	IV quartile
Female	-0.038**	-0.087***	-0.068***	-0.005
	(0.017)	(0.032)	(0.019)	(0.014)
Productivity	0.015***	0.059***	0.054***	0.021***
	(0.006)	(0.014)	(0.010)	(0.005)
Open Positions	0.911***	1.110***	0.991***	0.449***
	(0.055)	(0.362)	(0.081)	(0.124)
Experience	0.027*	0.062***	0.107***	0.055**
	(0.016)	(0.022)	(0.014)	(0.027)
Experience Sq.	-0.001*	-0.003***	-0.005***	-0.001**
	(0.001)	(0.001)	(0.001)	(0.001)
Years in Position	0.002	0.006	-0.006	-0.022
	(0.011)	(0.011)	(0.010)	(0.032)
No tenure	0.022	-0.065	-0.108**	0.014
	(0.054)	(0.061)	(0.049)	(0.018)
# Qualifications	0.068	0.175***	0.077	-0.006
	(0.049)	(0.063)	(0.052)	(0.025)
Connections	-0.016	-0.005	0.001	-0.010
	(0.019)	(0.032)	(0.020)	(0.016)
Scientific Field Dummies	YES	YES	YES	YES
Geographical Dummies	YES	YES	YES	YES
Promotion rate for males	0.148	0.412	0.627	0.942
Gender gaps	-25.7%	-21.1%	-10.8%	-0.5%
Observations	1658	1537	3237	1331
Pseudo R-squared	0.210	0.094	0.132	0.258

Notes: The Table reports marginal effects of Probit estimates (evaluated at the mean values of the explanatory variables in the sample). The dependent variable is *Promotion*. Standard errors (corrected for heteroskedasticity and robust to clusters at the field level) are reported in parentheses. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

7. Concluding Remarks

Compared to men, women in the labor market typically receive lower wages, have worse employment perspectives and face more difficulties in advancing in their careers. Women are underrepresented in the academic world, especially in top positions. Whether this state of affairs is due to worse female performance or to some form of discrimination against them is not completely clear from the existing evidence, because of some thorny econometric issues.

We have tried to shed some more light on this issue comparing two different systems of competitions and using relatively good measures of productivity. Exploiting the features of the system currently governing academic promotions in Italy we have been able to compare gender gaps in two settings: one in which candidates are evaluated to obtain a National Qualification and no limits are imposed on the number of positions available and another in which qualified candidates compete in local competitions held at Department level to fill a limited number of open positions.

Controlling for several measures of scientific productivity and individual characteristics, we find that at the national level, without limits on the number of qualifications awarded, there are no gender difference in the probability of obtaining the Qualification. However, at the Department level, with a

limited number of positions available, we find that females have a significant lower probability of promotion. This is especially true for promotion to full professor positions. These findings are robust to a number of specification checks.

Similar results are found also restricting the sample by discarding candidates for whom no position was available in their Department, thus suggesting that gender differences in the propensity to move to a new Department do not play a particularly relevant role in explaining our results.

We are also confident that the uncovered gender differences cannot be imputed to a tendency of females to shy away from competitive settings, since in our setting potential candidates in the second stage have already applied for and obtained a qualification at the national level and they should have strong incentives to apply in order to be effectively promoted in their own Department.

Finally, comparing settings with different proportions of positions available, we have shown that when a small number of positions is available, females tend to be discriminated against, while no gender gaps emerge when there is abundancy of positions.

All in all our evidence suggests that females in the Italian academia are victims of a particular kind of discrimination arising from a social norm that establishes that when positions are scarce men have more rights to obtain them than women. This norm is consistent with a still widely held belief in some countries that when economically challenging times arise, men should be given preferential treatment over women in the search for employment. At this aim it is interesting to notice that according to the *World Values Survey: 2005-2009*, the proportion of Italian respondents who disagree with the statement "men should have more right to a job than women when jobs are scarce" is about 57%. This percentage is much lower compared to Northern European countries (about 90%) but also compared to other Mediterranean countries such as Spain (74%).

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Appendix

Table A. Descriptive Statistics. Researchers with Qualification competing for Promotions, breakdown by type of position

Associate Professors					
	Mean	Std. Dev.	Min	Max	Obs
Promotion	0.550	0.498	0	1	9090
Female	0.408	0.492	0	1	9090
Experience	7.770	4.067	0	17	9090
Years in Position	7.760	4.145	0	18	9090
No tenure	0.169	0.375	0	1	9090
Productivity	0.000	1.386	-5.293	16.178	9090
Open Positions	0.545	0.316	0	2	9090
North-West	0.267	0.443	0	1	9090
North-East	0.222	0.416	0	1	9090
Centre	0.261	0.439	0	1	9090
South	0.166	0.372	0	1	9090
Islands	0.084	0.277	0	1	9090
Connections	0.200	0.400	0	1	9090
Number of Qualifications	1.044	0.232	1	4	9090
Full Professors					
	Mean	Std. Dev.	Min	Max	Obs
Promotion	0.104	0.305	0	1	4877
Female	0.317	0.466	0	1	4877
Experience	13.743	4.912	0	22	4877
Years in Position	9.163	5.643	0	23	4877
No tenure	0.120	0.325	0	1	4877
Productivity	0.000	1.383	-3.890	9.766	4877
Open Positions	0.102	0.214	0	2	4877
North-West	0.265	0.441	0	1	4877
North-East	0.232	0.422	0	1	4877
Centre	0.276	0.447	0	1	4877
South	0.157	0.364	0	1	4877
Islands	0.070	0.254	0	1	4877
Connections	0.209	0.407	0	1	4877
Number of Qualifications	1.041	0.220	1	4	4877