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A Further Look at the Gender Gap in Italian Academic Careers

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Abstract

In developed countries women have now achieved educational parity with men. Yet disparities persist in reaching top positions in the job market, with academia making no exception. This paper assesses the gender gap in career advancements in Italian universities over the 2013-2021 period, and explores the potential role of a third factor, i.e. mobility, besides competitiveness and scientific productivity typically investigated in the literature. The results, strongly robust, show a gender gap in advancements to associate professorship of about 4 percentage points, which is only partially explained by competitiveness, while scientific productivity and mobility do not seem to play a role. The estimated gender gap almost doubles for transitions to full professorship, and it remains unaffected when both competitiveness and scientific productivity are considered. Interestingly, mobility in this case matters: the gap is still there but (as much as 5 times) smaller when career advancements occur along with a move to a different University.

JEL Codes: J16, J71

Keywords: gender gap, competitiveness, productivity, mobility, higher education, academia

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1 Introduction

In developed countries women have finally caught up to men in terms of educational achievements. Nonetheless, they still struggle to reach the top positions in the job market. Academia makes no exception. Despite the relevant increases in women representation in academia worldwide during the 20th century, which according to Iaria et al. (2022) has increased from 1% in 1900 to 11% in 1969, significant gaps still persist, regardless of the discipline and countries (Ginther and Kahn (2009); Ginther and Kahn (2004); Baker (2012). More recent examples include, e.g. Ooms et al. (2018) for Germany, Howe-Walsh and Turnbull (2016) for UK, Seierstad and Healy (2012) for Scandinavian countries, and Sara Diogo and Breda (2021) for Portugal. Italy makes no exception: in 2021, 57.2% of the graduates and 49% of phd were female, while moving along the career: female represents the 49% of post doc (Grade D), the 46% of assistant professors (Grade C), the 41% of associate professors (Grade B) and the 26% of full professors (Grade A) working in the Italian universities (last data available referring to 2021 from the Minister of Italian University and Research Sagramora et al. (2023)).

Several attempts have been done by the existing literature to investigate the potential drivers of this gap. The first argument typically put forward is the lower scientific productivity that female professors have with respect to their male colleagues (Larivière et al. (2013), Mairesse and Pezzoni (2015), Nielsen (2016)Nielsen (2016), Jappelli et al. (2017)). A second argument refers to the lower propensity of women with respect to men to engage in competition (see, e.g. De Paola et al. (2017), or Ramos et al. (2020) specifically for promotions in academia).

Nonetheless, the existing empirical evidence agrees on a gender gap in career advancement that survives even after both of these arguments are taken into account, thus calling for further investigation. For instance, exploiting the case of Italy, Filandri and Pasqua (2021) are able to rule out both the average lower productivity and the average higher reluctance to apply for promotions that characterizes females. Yet, they still report a gender gap of 6 percentage points for advancement to associate professorship, and of as much as 10 percentage points for full professorship.

This paper carries a threefold contribution. First, it extends the analyses presented in Filandri and Pasqua (2021) along the time dimension. Using all data available from 2012 to 2021, we are able to account for all the rounds of the National Scientific Habilitation (NSH) occurred after the very first one in 2013. This is relevant, as the requirements to apply where slightly changed in 2016 and 2018 rounds, along with the benchmark considered to be eligible for the NSH. Moreover, it allows to evaluate the potential effect of a different macroeconomic conjuncture. Indeed, after the 2007-2008 financial crisis, Italy adopted, along with all the Eurozone members, austerity measures that dramatically impacted the Italian academia, resulting de facto in a hiring ban for most of the Universities. These restrictions were lifted only after 2016, when Universities' budgets finally started to enjoy the inflow of new financial resources. The temporal extension is thus required to assess if and how the gender gap has evolved in a setting where the new procedure introduced by the Gelmini Law [1] become fully operative and where macroeconomic condition were definitely more favourable. Second, it investigates the potential role of gender (dis)parity in affecting the gender gap in career advancement. The richness of the our dataset allows indeed to enrich our model specification with a variety of indicators measuring female prevalence at several levels, ranging from scientific sector to University, and even to single Department. Third, it explores the role of mobility in explaining the gender gap in career advancement, dissecting the results by promotions occurred within the same institution and those occurred along with a move to a different University. The rationale behind this is that promotions within one's own university may be influenced by factors associated with the candidate's personal attitudes and relationships, which show up to a lesser extent - if any - when the career advancement occurs moving to another University.

Our results show that, even conditioning on scientific area, and university Glass Ceiling Index, size, and/or fixed effects, female assistant professors have a 4 percentage points lower likelihood of getting promoted to associate professors than their male counterparts. This gender gap widens further, nearly reaching 7 percentage points, for the transition from associate to full professorship. Once reluctance towards competition is controlled for, i.e. once we focus on the subset of professors being accredited with (and hence having applied for) the NSH, the gender gap in progressions to associate professors is partially absorbed, reducing from 4 to 2.8 percentage points. The gap however remains unchanged when promotions from Associate to Full professorship are considered. This implies that while the argument of shying away from competition partially mitigates the gender gap in advancement from assistant to Associate, it does not alter the observed gap for the promotion to Full professorships. Once scientific productivity is factored in, the gender gap estimates in career advancements remain unchanged at 2.6 percentage points and 6 percentage points for transitions to Associate and Full professorships, respectively. Therefore, the lower average scientific productivity traditionally characterizing female professors does not seem to account for the observed gender gap in career advancement. Finally, dissecting the results by mobility across university we find remarkably different results for transition to associate and full professorship. On the one hand, we find a consistent and robust gender gap of about 3 to 4 percentage points for both internal and external promotions to associate professorship, respectively. On the other hand, when it comes to advancements to Full professorships, despite the gender gap persists in both scenario, we find a significantly (almost 5 times) higher effect when the promotion occur within the same university. In other words, the bulk of the identified gender gap stems from promotions within the same university, while it is substantially lower among those who moved to secure their promotions. A suggestive conclusion is that promotions are not all alike, as different factors play a role depending on whether they occur within the same University or not. Internal promotions might be commingled by personal attitudes, long-lasting relationships, and negotiation skills, which typically disadvantage women. On the other hand, career advancements outside one's previous institution might follow a more purely competitive mechanism based on

[1] We refer to the Italian law 240/2010, for further details see Section 3

skills and credentials inferable from the candidate's overall curriculum vitae.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature, Section 3 provides the institutional background of the Italian university system. Section 4 describes the dataset and outlines the empirical specification. Section 5 presents the results, Section 6 performs some robustness checks and finally Section 7 concludes.

2 Literature Review

Women have historically been under-represented in academia. According to Iaria et al. (2022), despite relevant increases in women hired in academia worldwide in the 20th century, significant gaps still persisted in most disciplines and countries at the end of the century. Only 1 percent of academics were women in 1900, which became 11 percent in 1969. Looking at full professor positions, the highest academic rank, women represented 1 percent in 1900 and about 8 percent in 1969. The gender gap in academia persists nowadays, as confirmed by a plurality of studies that refer to different scientific disciplines and countries (Ginther and Kahn (2009); Ginther and Kahn (2004); Baker (2012).

A large literature has investigated the mechanisms that may explain the pervasive under-representation of women in academic rankings. There is no consensus on the relevance of the different factors, but two main explanations that may motivate the gender gap can be identified.

One refers to the so-called productivity puzzle (Cole and Zuckerman (1984), Stack (2004). Leahey (2006)). Many contributions have documented that on average female academics are less scientifically prolific than men, although the gap differs across fields. This holds when looking at all indicators generally considered by scholars to measure individual scientific productivity, i.e., the number of publications, the number of citations, and citation indexes (Larivière et al. (2013); Mairesse and Pezzoni (2015); Nielsen (2016) Jappelli et al. (2017)). Several, often interrelated, motivations have been provided for these gender differences in research output. Some refer to the different family duties and childbearing responsibilities (Ceci and Williams (2011); Lutter and Schröder (2020)), which may in turn explain why women tend to have fewer collaborations and weaker links with international networks (Beaudry and Larivière (2016)). Larivière et al. (2013) analyzed the proportion by gender of papers resulting from national and international collaboration on a sample of more than 5 million articles, finding that female collaborations are more domestically oriented than male ones from the same country. Weaker connections may adversely affect the ability to attract funds (Beaudry and Larivière (2016)) and, therefore, the research productivity. Larivière et al. (2013) also find that an article attracts fewer citations when a woman is in a prominent author position than when a man is in this role. Other scholars find evidence that female authors face higher barriers to publishing. Focusing on submissions to four leading economic journals, Card et al. (2020) find that the refereeing process is not gender neutral when the paper quality, proxied by the number of future citations, is considered. For a comparable set of journals, Hengel (2022) shows that female-authored papers are better written than men-authored ones, that this gap widens during peer review, and that, as a consequence, the reviewing process takes a much longer time for women than for men. Finally, Bransch and Kvasnicka (2022) reveal that the gender composition of editorial boards is related to the publishing success of female scholars in the top economic journals. Independently of productivity, weaker networks of female researchers reduce promotion opportunities even directly in the selection process. Zinovyeva and Bagues (2015), looking at data on the results of centralized selection exams to obtain the Habilitation for Full Professor and Associate Professor positions in Spain, show that direct connections in committees between the candidate and the evaluator increase the probability of being promoted by about 50 percent. They also find that candidates promoted by a strong connection have worse productivity indicators at the time of the evaluation and during the five years following their promotion than other promoted candidates. For Italy, Checchi et al. (2019) confirm that previous connections are a relevant predictor of recruitment in a leading hard science research institute. The weaker network links of female candidates with the institute operate as a selection device that discriminates against women.

The second main explanation for the gender gap in high academic rankings is related to differences in preferences and attitudes. Evidence suggests that women have higher risk aversion and lower self-confidence (Barber and Odean (2001)) and suffer more from receiving negative feedback (Azmat and Petrongolo (2014)) than men. All these factors affect their preference for less competitive environments (Eckel and Grossman (2008)), but other psychological factors are also relevant. Niederle and Vesterlund (2007) show that, when asked to choose between a noncompetitive piece rate and a competitive tournament incentive scheme, men choose the tournament at a significantly higher rate than women. This gap persists even when comparing the choices of men and women with equal performance. Overconfidence and risk aversion differences only partly explain the gap. According to the author, a sizeable part of the gender difference in tournament entry is explained by different gender preferences for performing in a competitive environment. The author's conclusion that "women shy away from competition" holds for promotion applications in academia. For instance, **?** find that the probability of applying for the National Scientific Habilitation in Italy is 4-5 percentage points lower for female scholars than their male colleagues, even after controlling for individual productivity. Similar results in low female participation and a small number of female applications for accreditation to full professorship are also found by Ramos et al. (2020) for Spain.

Notably however, a common finding in the literature is that, even after controlling for the above explanations, at least part of the gender gap in academic ranks remains unexplained. For instance,

The paper most close in spirit to our analysis is Filandri and Pasqua (2021), who analyse the career advancements occurred in the 2012-2016 period of the assistant and associate professors hired between 2002 and 2011, who were continuously employed up to the end of their sample period in Italian Universities, and who got accredited with the National Scientific Habilitation (NSH) in the first round 2012/2013. Recalling that in order to apply for (and obtain) the NSH every candidate must comply a minimum level of scientific productivity, Filandri and Pasqua (2021) argue that, in their setting, they are able to rule out the effects of both the lower scientific productivity and the higher reluctance to apply for promotions that characterize on average female professors. Their estimates show that the probability of becoming associate professor is 6 percentage points lower for female assistant professors, and that the gap reaches 10 percentage points when the advancement goes from associate to full professor. These results are robust to the inclusion of seniority, macro disciplinary area, size of university of affiliation and dummies for each university of affiliation. Repeating the analysis on the subsample of bibliometric sectors and completing the model with various measures of scientific productivity (number of publications, of citations and h-index), their estimates for the gender gap are even higher: 8 percentage points for advancements to associate professors and 17 percentage points for transitions to full professors.

To sum up, the empirical literature unanimously reports that the chances of career advancements are remarkably lower for female scholars than for their male counterparts. The two main arguments put forward to explain this gap are the lower scientific productivity and the lower competitiveness that typically characterize women with respect to men. However, even after controlling for both these factors, most of the gender gap in academic ranks remains unexplained, thus claiming for further investigation. With this paper, we aim at contributing in this direction.

3 Institutional background

In the last 20 years the Italian university system has undergone several revisions to the recruitment and career advancement rules. The most recent and relevant reform, enacted in 2010 (Law 240/2010) and commonly referred to as the "Gelmini reform", named after the Minister Mariastella Gelmini who introduced it, established a two-stage process for career advancement within Italian academia, intending to enhance transparency and merit-based selection.

The first stage involves attaining the National Scientific Habilitation (NSH). More specifically, assistant professors seeking promotion to associate professors and associate professors aspiring to become full professors must first of all apply for a national qualification.

The NSH is granted by a national committee with the agreement of at least four out of its five members. The members are randomly chosen among the eligible full professors in each academic sub-field[2] who volunteer for the role and satisfy specific scientific productivity criteria. For the so-called bibliometric sectors (science, technology, engineering, mathematics, medicine, and psychology), the committee member candidates are required to have a research output - measured in terms of number of articles pub-

[2]The scientific disciplines of the Italian university are divided into 14 macro-disciplinary areas, divided into 184 subfields. For example, within the macro-category of Economics, some subfields are Economic Policy and Econometrics.

lished in scientific journals, as from the Scopus and Web of Science databases, in the last 10 years, and the number of citations and H-index in the last 15 years - that exceeds, in at least two out of the three indicators, the corresponding median for the entire set of full professors in the discipline. To give an example, with reference to the last NSH tournament (2018-2020), and to the sector 03/C1 - Organic Chemistry, the median number of articles published in scientific journals (reported either on Scopus or Web of Science databases) by full professors in the last 10 years is 41, the median number of citations in the last 15 years is 1277 and the median h-index in the last 15 years is 21. Full professors willing to volunteer as committee members in that sector must prove to have a scientific record that meets (i.e. it's equal or higher than) at least 2 of 3 of these indicators. Very similar requirements are needed for the committee member candidates of non-bibliometric sectors, i.e. social sciences and humanities. Their research output has to exceed the median observed on the entire set of full professors in the discipline in at least two of three dimensions: the number of authored books, and the number of articles published in high-quality (class A) scientific journals in the last 15 years, and the number of articles published in any scientific journals and book chapters in the last 10 years.

Similarly, scholars can apply for the NSH only if their scientific productivity meets the following minimum requirements. For bibliometric sectors, the candidates must have at least two of the following three indicators higher than the corresponding median observed on the entire set of associate (full) professors in the scientific sector: number of articles published in scientific journals in the last 5 (10) years, and the number of citations and H-index in the last 10 (15) years. To give an example, consider again the sector 03/C1 - Organic Chemistry and the last NSH tournament: the thresholds required to apply for the NSH to associate professor were set to 13 articles published in scientific journals in the last 5 years, 329 citations in the last 10 years, and an h-index of the articles published in the last 10 years of at least 11. The corresponding thresholds for applying to the NSH to full professor were set equal to 27 articles in the last 10 years, 751 citations in the last 15 years, and an h-index of at least 16 computed on the articles published in the last 15 years. By the same token, the research output of the aspiring candidates applying for NSH to associate (full) professor in non-bibliometric sectors must exceed the median observed on the entire set of associate (full) professors in their scientific sector in at least two of the following three indicators: the number of authored books, and the number of articles published in high-quality (class A) scientific journals in the last 10 (15) years, and the number of articles published in any scientific journals and book chapters in the last 5 (10) years.

The NSH is however not automatically granted to all the candidates meeting these minimum requirements. The committees are given large autonomy and can set additional criteria for the evaluation of the candidate's CVs, such as a relevant individual contribution to each publication, the coherence of the topics investigated with the scientific sector, the methodological rigor, the national and international prestige of publication outlets and its temporal continuity, besides the originality and the innovation characterizing the research interests. In other words, candidates are evaluated based on field-specific standards, whereby the minimum level of scientific productivity is set with reference to the performance of current professors working in Italian Universities in the field. This evaluation is carried out only based on the CV of the candidates and no research seminar or mock-teaching oral presentation has to be given (differently from, e.g., the Spanish NSH, where candidates are also required to make oral presentations to the committees, see Bagues et al. (2017)).

Notice that if the NSH is not granted, the candidate incurs in a penalty as s/he cannot apply for further evaluation in the same sector (for the same level or further) in the following 12 months. On the other hand, if the NSH is granted it has a term validity (originally set to 4 years, and subsequently extended to 9 and now 11 years).

The Habilitation does not lead automatically to the promotion. Indeed, the process for career advancement requires a second stage, in which the professors accredited with the NSH apply to selections performed locally, at the University level. These procedures could either be "selective" (as set by Law 240/10, Art. 18) or "valuative" (as set by Law 240/10, Art. 24). The latter are reserved to professors already affiliated to the University, while the former are opened to all scholars, regardless of their current affiliation, provided that they either qualified for the NSH in that sector and for that position or already are in that position in another university. The two procedures respond to slightly different regulations, but they share the main process: a local committee of full professors, either affiliated with the department or from other universities, evaluates the candidates' CVs and indicates the professor(s) suitable for promotion. Then, the Department chooses the professor to be promoted.

It is worth mentioning that the annual salary of the academic staff is determined at the national level based on job seniority and academic positions only. The universities cannot introduce performance-based contracts.

The Gelmini reform introduced another change relevant to understanding our subsequent empirical analysis. It replaced the assistant professors with a permanent contract, the so-called "Ricercatore a tempo indeterminato" (RTI) with two new short-term figures: the "junior" assistant professor without tenure track ("Ricercatore a tempo determinato di tipo A", RTDA), and the "senior" assistant professor with tenure track ("Ricercatore a tempo determinato di tipo B", or RTDB). The RTDb got an almost automatic promotion to associate professor, conditional on on being qualified with the NSH for associate professor in the scientific sector of affiliation and on a positive evaluation of the Department of affiliation.

Since the implementation of the Gelmini reform, different rounds of the NSH have been implemented: the first occurred in 2012 and 2013, the second, with revised indicators, between 2016 and 2018 (organized in 5 quarters), the third one between 2018 and 2020 (organized in 6 quarters, with an extension up to the second semester of 2020 due to Covid-19 disruption), and the fourth one occurred between 2021 and 2023 (organized again in 6 quarters).

4 Dataset and Methodology

4.1 Dataset

The data for the empirical investigation are retreived from three different sources.

First, we obtain the list of all professors working in all Italian Universities in the last 10 years, i.e., between 2012 and 2021 from the MUR website[3]. This corresponds to an unbalanced panel of more than 75,000 individuals, for a total of 560,028 observations. For each person, this dataset provides the name and surname, gender, and academic position as of the 31st of December of each year, which we categorize as follows: junior assistant professors (RTDA), tenured assistant professor (RTI), tenured associate professors (RTDB), associate professors (PA), and full professors (PO)[4]. For each professor, it also reports the department and university of affiliation and the scientific area (macro disciplinary area and scientific sub-sector), which we use to compute the measures of female segregation at different levels (see Section 4.2). We dropped all observations whose position is "Incaricato" (57 obs) or "Assistente di r.e." (173 observations) and those where the scientific sector was missing (873 observations). Moreover, we discarded all the junior assistant professors (RTDA, 36,002 observations) in order to focus on the career advancement of permanent staff only. Finally, we dropped all professors with the same name and surname (24,086 observations, around 4.61% of the cases). This is done because the merge with the other two data sources is done based on name and surname and we want to avoid any risk of misidentification. This first dataset counts 498,837 observations, corresponding to 66,193 individual professors.

The first dataset is then merged with information about the National Scientific Habilitation (NSH).[5] This second dataset reports all the 84,063 Habilitations to associate and full professorships accredited in all the NSH implementations that occurred up to 2021[6]. For each given tournament (or quarter of tournament) of the Habilitation and for each sector, this dataset reports the name and surname of the scholar, (55,438 unique names) which we use as a key variables for merging with with the first dataset, as well as the day on which the Habilitation was accredited.

In merging these two datasets, three cases are possible: i) professors working in the Italian academia who got qualified (36,440 cases); ii) professors working in the Italian academia who do not have the Habilitation (29,753 cases); and iii) individuals not currently working in Italian universities who got qualified (18,998 cases). Since

[3]https://cercauniversita.cineca.it/php5/docenti/cerca.php

[4]The detailed list of possible positions includes: Ordinario, Straordinario, Straordinario a tempo determinato and Ordinario r.e. (which we gather in the category "Full Professor"), Associato, Associato non confermato, and Associato confermato (gathered in the category "Associate professor"), Ricercatore, Ricercatore non confermato (forming the category "Tenured Assistant Professor"), Ricercatore a tempo determinato di tipo B (according to either 2010 Gelmini Law or 2005 Moratti Law, both full and part time contracts, forming the category "Tenured Associate Professors, RTDB) and Ricercatore a tempo determinato di tipo A (both full and part time contracts, for the category "Junior Assistant Professors, RTDA").

[5]Data are taken from https://abilitazione.miur.it/public/index.php

[6]We only observe the list of those who qualified, as for privacy reasons the names of those not qualified are removed 120 days after the publication of the accredited Habilitations. However, the list of those who did not qualify for the accreditation is not relevant to the analysis in this paper.

this study aims to assess the potential gender gap in academic career advancements, we focus only on professors from the first two cases.

The third and last data source was suitably generated for this analysis by downloading from the Scopus webpage of each professor present in our dataset (30,773 unique professors) summary information about her/his scientific productivity, namely: the number of publications, the total number of citations, and the h-index [7]. Since these indicators are clearly strongly correlated, we will consider the h-index in our main analysis and use the others for our robustness analysis.[8]

The resulting dataset counts 85,191 individual professors observed from 2012 until 2021. Since this study aims to assess the potential gender gap in academic career advancements, we discard the 18,998 individuals who qualified but do not already hold a permanent position in the Italian Universities, 355 for whom we observe career "anomalies" (e.g., Associate moving to RTDB or PO moving to PA), and 14 professors who were accredited more than 10 NSH, for a final dataset counting 65, 824 unique professors. We when drop all those entering the dataset as Full professors (14,729 observations), since for these scholars no further career advancement is possible. Our estimation sample for the econometric analysis thus consists of an unbalanced panel of 51,109 unique professors (41.57% of whom are women) whose career in the Italian university is continuously observed during the 10 years between 2012 and 2021.

4.2 Methodology

Our dataset reports each professor i the position held in each year t. We are thus able to depict for each professor i whether a career advancement occurred during the sample period or not. We model advancement to Associate and Full professors separately, so the outcome variable, denoted with Y_i, will be either an indicator for promotion of professor i from Assistant to Associate, or from Assistant/Associate to Full professor.[9] Given the binary nature of the event career advancement for each professor i, our empirical investigation relies on the estimation of the following probit model:

$$Y_i = \beta_0 + \beta_1 Female_i + \mathbf{X_{ij}}\beta + \epsilon_i \tag{4.1}$$

where the dependent variable Y_i denotes promotion to Associate or to Full, depending on which career advancement we model, $Female_i$ is an indicator for professor i being female, $\mathbf{X_{ij}}$ is a vector of control variables, and ϵ_i denotes robust standard errors, clustered at the $j-th$ university level whenever the model features controls that vary at the university level only. The coefficient β_1, capturing the potential gender gap in career advancements between male and female professors, is our parameter of interest. In order to get unbiased estimates for the parameter β_1, the vector $\mathbf{X_{ij}}$ features the largest

[7]Introduced by Hirsch (2005), the h-index is a quantitative metric that jointly measures the scholars' productivity and impact. It is calculated by counting the number of publications for which an author has been cited at least the same number of times.

[8]We apply these measures to control for the scientific productivity of professors in all scientific sectors, even though they are more suitable to capture actual scientific productivity mainly for bibliometric sectors.

[9]Passages from RTI Non Confermati to RTI, from RTDB to Associate, and from Straordinari to Ordinari are considered automatic, so the dependent variable Y_i in those cases is set to 0.

large set of controls possible, including both professors' i individual characteristics and characteristics of the university j in which s/he is employed.

In line with the previous literature, we try alternative university characteristics. First, we include the quintile of university size (in terms of academic staff), following Filandri and Pasqua (2021), who argue that it is a good proxy for resources available for recruitment and promotions [10].

Then, we include the Glass Ceiling Index, as a specific measure of female segregation, computed at the university level as:

$$GCI_j = (F_j/N_j) * (Full_j/FullF_j) \tag{4.2}$$

where N_j denotes the total number of professors working in University j, F_j the total number of female professors, while $Full_j$ and $FullF_j$ are the number of Full professors and the number of female Full professors in service in the University j, respectively. Finally, our preferred model specification includes the University fixed effects.

As for the individual professors' characteristics, we start including dummies for the scientific macro-area professor i belongs to, codified in 14 categories, and having Mathematics and informatics used as reference category.

In order to get an estimate of the gender gap net of the effect of the first argument, i.e. shying away from competition, we re-estimate model 4.1 on the subsample of professors who actually got the Habilitation, i.e.:

$$P(Y_i = 1) = \Phi(\beta_0 + \beta_1 Female_i + \mathbf{X_{ij}}\beta) \qquad if \quad NSH_i = 1 \tag{4.3}$$

where NSH_i is a dummy taking value 1 for professor i having been accredited the National Scientific Habilitation, and 0 otherwise.

The second argument put forward by the literature is that female are less likely to be promoted since they are, on average, less scientifically productive than their male counterparts. Having qualified for the NSH for the next career advancement already controls for this, albeit partially, since in order to apply for the NSH a minimum threshold of productivity is required. However, to further and better control for this, we augment the model with a specific measure for scientific productivity, namely the standardized h-index [11]:

$$P(Y_i = 1) = \Phi(\beta_0 + \beta_1 Female_i + \beta_2 HindexStd_i + \mathbf{X_{ij}}\beta) \qquad if \quad NSH_i = 1 \tag{4.4}$$

where $HindexStd_i$ is the h-index of professor i, $Hindex_i$, standardized by scientific area, i.e.:

[10] Results, available upon request, remain qualitatively unchanged when using quartiles instead, or the number of professors in linear or quadratic terms

[11] Along with the h-index, the number of citations, and the number of publications up to the year 2022 of each professor i were retrieved from the Scopus webpage. These three indicators, being highly correlated, cannot be used jointly in the same model. We thus decided to include the h-index in our preferred model specification, and use the others in the robustness checks (see Section 6.4).

$$HindexStd_i = \frac{Hindex_i - m_a}{sd_a} \quad (4.5)$$

where m_a is the average and sd_a is the standard deviation of the h-index of the scientific area a to which professor i belongs. We do so in order to take into account the huge heterogeneity that this measure displays across scientific sectors (see Table 1).

Table 1: H-Index descriptive statistics, full sample, by scientific area

	N	Mean	Std.Dev.	Median	Min	Max
Math	1,743	13.9	6.7	13	0	57
Physics	1,569	40.7	29.5	30	0	142
Chemistry	1,829	29.1	10.0	28	0	141
Science	671	21.5	7.9	20	3	53
Biology	2,961	26.5	9.7	25	0	94
Medicine	5,562	30.6	14.7	28	0	178
Agric & Vet	1,890	20.0	8.8	19	0	73
Architecture	1,995	10.6	9.8	9	0	68
Engineering	3,475	21.3	8.6	20	0	92
Literature	2,122	1.7	2.6	1	0	52
History and pedagogy	2,447	7.7	9.2	3	0	71
Law	962	1.5	4.2	1	0	105
Econ & Stat	2,563	8.5	6.2	7	0	85
Social Sciences	984	3.6	3.7	2	0	27
Total	30,773	19.1	16.0	18	0	178

The table reports the main descriptive statistics for the HIndex, by scientific macroarea.

Finally, we investigate the potential role of mobility across universities.

Knowing the University of affiliation of each professor i in year t we are able to distinguish whether the career advancement occurred in the same University (the vast majority) or along with a passage to another University (around the 5% of the overall number of promotions). In order to estimate the gender gap in the two different cases, we define the variable y_i^{INT} as taking value 1 whenever professor i has a career advancement (to Associate or to Full, depending on the case under analysis) but does not change the University of affiliation, NA if the career advancement occurred along with a change of affiliation, which represents the other case of interest, and 0 if no career advancement is observed. Similarly, the variable y_i^{OUT}, capturing career advancements outside the original university of affiliation, takes value 1 whenever professor i is promoted (again either to Associate or to Full) along with a passage to another University, value NA if the promotion occurred within the same university,and 0 if the promotion of interest did not occur.

We thus estimate the following models:

$$Y_i^{IN} = \beta_0 + \beta_1 Female_i + \beta_2 HindexStd_i + \mathbf{X_{ij}}\beta \qquad if \;\; NSH_i = 1$$
$$Y_i^{OUT} = \gamma_0 + \gamma_1 Female_i + \gamma_2 HindexStd_i + \mathbf{X_{ij}}\gamma \qquad if \;\; NSH_i = 1 \tag{4.6}$$

To the extent that promotions within one's university of affiliation are more affected by personal relationships and attitudes, which in turn might pave the way to prejudices and stereotypes, we expect the gender gap in the probability of career advancement to be higher among those who (for whatever reason) are "stuck" in their university and are not able to move to another one. In other words, we expect $\beta_1 < \gamma_1$.

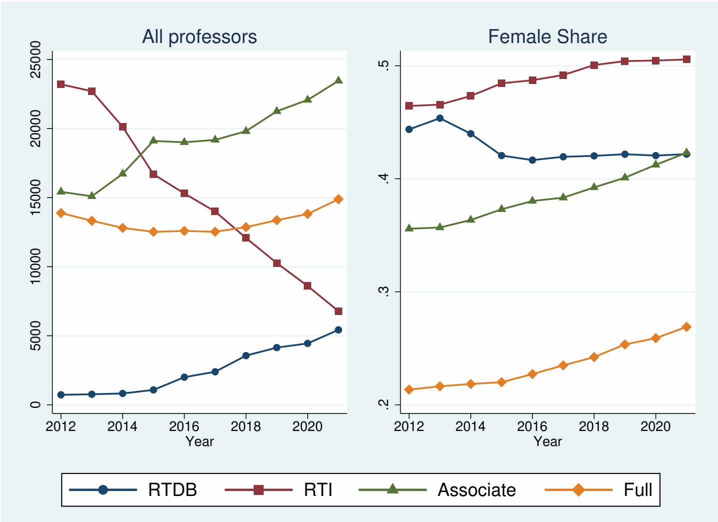
4.3 Descriptive statistics

Figure 1 provides a general picture of the evolution of the staff of Italian universities over the last decade. The panel on the left shows the composition of the academic staff between 2012 and 2021, distinguishing among full and associate professors, assistant professors with a permanent contract (RTI), and the newly introduced senior assistant professor position with tenure track (RTDB). The opposite trend observed for the two latter positions reflects the progressive substitution of RTI with RTB induced by the Gelmini reform. Besides, the increasing trend in the number of both associate and full professors reflects the more favorable macroeconomic conjuncture which led to the end of financial restrictions in 2016. The panel on the right shows the share of women in different positions. Despite the increasing trend for most of these shares along the entire period, three observations are in order. First, while the overall share of RTI decreases as this role is being phased out, the share of females among the RTI steadily increases, suggesting that progression to Associate professorship occurred mostly for male RTI. Second, and similarly, the female share among RTDB decreases during the first years of the sample period and then remains quite stable. Recalling that the new RTDB position guarantees an (almost) automatic promotion to the role of associate professor, and coupling this with the increasing trend which is observed in the overall number of RTDB (see left panel), a potential gender bias might also be suspected in this respect. Finally, for both full and associate professors, the share of women is well below gender parity, whereby females are less than 30% of the full professors in Italy, thus confirming the well-known glass-ceiling phenomenon.

For our empirical analysis, we rely on a subset of those observations. First, we drop the 14,729 professors who already have a position as Full in our starting sample. Then, when modeling the advancement from Assistant to Associate professors, we drop the 9,965 RTDB, whose passage to Assistant professor is basically automatic, and the 17,859 professors who are already Associates. Our estimations sample, in this case, counts 23,285 individual professors.

For the advancement from Associate to Full professors, we focus on the Associates only (both those already in that position at the beginning of our sample period and those

Figure 1: Italian University staff, by position



who started as RTI or RTDB and had a promotion to Associates during the estimation sample). Our estimations sample, in this case, counts 35,141 individual professors. Table 2 reports the main descriptive statistics over the two estimation subsamples.

During our sample period, more than 50% of the professors working in the Italian universities had an advancement to Associate, while around 38% reached the highest academic role, and - in both cases - the vast majority of these promotions occurred within the same university. Female professors represent about 45.5% of the first estimation sample and 39% of the second one, confirming the progressively reduced representation of females along the career at a descriptive level. Moreover, most university professors belong to the Medicine scientific area, which represents one-fifth of both estimation samples. On the other hand, the least numerous are Science and Social Sciences scientific areas. Most of the potential Associate and Full professors qualified for the corresponding NSH (about two-thirds for the former and 55% for the latter), with a "seniority" of Habilitation that reaches up to 7 and 9 years. Besides, the average H-index is about 18 and 20 in the two samples, respectively, but with a wide variability across scientific areas (see Table 3): it is higher in the hard sciences (Physics, Chemistry, Science, Biology, Medicine, and Engineering), which have a median between 20 and 30, while lower for Architecture, Economics, and Statistics, whose median is around 7 (apparently, for Literature, Law, and Social Sciences, Hindex might not be the best measure of productivity). For this reason, we standardized each measure of productivity used in the empirical analysis. Finally, Figure 2 shows that changes of University of affiliation are pretty rare (an average of 0.41%) and that females are the ones systematically changing more often compared to men.

Table 2: Descriptive Statistics, by estimation sample

	Advancement to Associate					Advancement to Full				
Variable	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max
Prom to Associate	23,285	0.569	0.495	0	1	35,141	0.377	0.485	0	1
Prom to Full	23,285	0.086	0.281	0	1	35,141	0.218	0.413	0	1
Same Uni prom to Associate	22,902	0.562	0.496	0	1					
Other Uni prom to Associate	10,420	0.037	0.188	0	1					
Same Uni prom to Full						34,826	0.211	0.408	0	1
Other Uni prom to Full						27,787	0.011	0.106	0	1
Female	23,285	0.464	0.499	0	1	35,141	0.392	0.488	0	1
Scientific Area										
Math	23,285	0.051	0.220	0	1	35,141	0.055	0.229	0	1
Physics	23,285	0.036	0.185	0	1	35,141	0.046	0.210	0	1
Chemistry	23,285	0.054	0.226	0	1	35,141	0.055	0.229	0	1
Science	23,285	0.018	0.134	0	1	35,141	0.020	0.139	0	1
Biology	23,285	0.094	0.293	0	1	35,141	0.083	0.276	0	1
Medicine	23,285	0.197	0.398	0	1	35,141	0.161	0.368	0	1
Agriculture and Veterinary	23,285	0.055	0.228	0	1	35,141	0.052	0.222	0	1
Architecture	23,285	0.063	0.242	0	1	35,141	0.067	0.250	0	1
Engineering	23,285	0.078	0.269	0	1	35,141	0.096	0.294	0	1
Literature	23,285	0.091	0.288	0	1	35,141	0.097	0.296	0	1
History and pedagogy	23,285	0.078	0.268	0	1	35,141	0.085	0.279	0	1
Law	23,285	0.081	0.272	0	1	35,141	0.067	0.251	0	1
Economics and Statistics	23,285	0.072	0.258	0	1	35,141	0.081	0.272	0	1
Social Sciences	23,285	0.032	0.175	0	1	35,141	0.033	0.179	0	1
University size	23,285	1699	1117	14	4270	35,141	1663	1113	2	4,270
GCI	23,278	1.571	0.552	0	11.5	35,113	1.543	0.560	0	8
Position										
RtdB						35,141	0.115	0.319	0	1
Assistant Professor	23,285	1.000	0.000	1	1	35,141	0.377	0.485	0	1
Associate Professor	-	-	-	-	-	35,141	0.508	0.500	0	1
Full Professor	-	-	-	-	-	-	-	-	-	-
Has NSH to Associate	23,285	0.668	0.471	0	1	35,141	0.546	0.498	0	1
Nr NSH Associate	23,285	0.814	0.727	0	7	35,141	0.688	0.774	0	9
Years since NSH Associate	15,482	6.735	2.254	0	9	19,173	6.775	2.010	0	9
Has NSH to Full	23,285	0.364	0.481	0	1	35,141	0.548	0.498	0	1
Nr NSH Full	23,285	0.429	0.642	0	9	35,141	0.673	0.736	0	9
Years since NSH Full	8,307	4.068	2.111	0	9	19,045	5.155	2.612	0	9
Hindex	13,573	18.039	15.064	0	142	24,062	19.804	16.546	0	142
Citations	13,573	1134.459	4500.197	0	117819	24,062	1448.379	5089.061	0	117,819
Documents	13,573	711.823	3248.148	0	107045	24,062	880.575	3868.975	0	107,045
Hindex Std	13,573	-0.083	0.920	-2.91384	24.39601	24,062	0.092	0.990	-3	19
Citations Std	13,573	-0.053	0.801	-0.65372	29.39937	24,062	0.041	1.003	-1	45
Document Std	13,573	-0.042	0.839	-0.5945	18.36594	24,062	0.023	1.002	-1	23

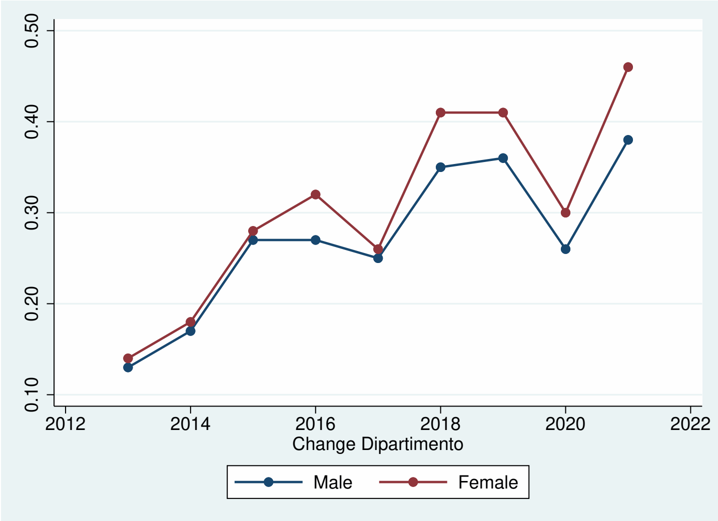
The table reports the main descriptive statistics over the two main estimation samples.

Table 3: H Index descriptive statistics on estimation samples, by scientific area

	Advancement to Associate					Advancement to Full				
Hindex	Mean	Std.Dev	Median	Min	Max	Mean	Std.Dev	Median	Min	Max
Math	13.4	6.0	12	2	57	14.5	6.7	13	0	57
Physics	40.6	30.9	28	0	142	42.4	30.0	31	0	142
Chemistry	28.5	8.7	28	0	141	30.8	9.9	29	0	141
Science	20.7	7.3	20	3	50	22.8	7.7	22	3	53
Biology	25.6	8.4	24	0	62	28.0	9.3	26	0	94
Medicine	28.1	12.7	26	0	120	32.6	14.5	30	0	130
Agric & Vet	19.7	8.8	18	2	71	21.2	9.0	20	0	73
Architecture	10.1	9.8	7	0	68	11.0	10.3	9	0	68
Engineering	20.6	7.5	20	0	62	22.6	8.8	21	0	92
Literature	1.5	2.2	1	0	23	1.7	2.7	1	0	52
History and pedagogy	7.8	9.1	3	0	48	7.8	9.5	3	0	69
Law	1.4	5.3	1	0	105	1.4	2.2	1	0	27
Econ & Stat	7.8	5.5	7	0	53	8.8	5.8	8	0	52
Social Sciences	2.9	3.0	2	0	24	3.6	3.7	2	0	24
Total	18.0	15.1	17	0	142	19.8	16.5	19	0	142

The table reports the main descriptive statistics for the HIndex, by scientific macroarea.

Figure 2: Share of professors having changed University of affiliation, by gender



5 Results

We start by modeling advancement from Assistant to Associate professor. Table 4 shows an unconditional gender gap of about 4.5 percentage points. Even controlling for the scientific area, the university Glass Ceiling Index, the university size, and university fixed effects, the chances of being promoted to associate professors remain stable at around 4 percentage points lower for female assistant professors than their male counterparts. The effect corresponds to the 7% of the estimation sample mean of 0.57.

Table 4: Promotion to Associate

	(1)	(2)	(3)	(4)	(5)
Female	-0.045***	-0.038***	-0.038***	-0.041***	-0.041***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)
Size Uni (Q2)			-0.035		
			(0.041)		
Size Uni (Q3)			-0.063*		
			(0.036)		
Size Uni (Q4)			-0.031		
			(0.035)		
Size Uni (Q5)			-0.055		
			(0.034)		
GCI				-0.154***	
				(0.030)	
Scientific Sector	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES
Obs.	23,285	23,285	23,285	23,278	23,264
Pseudo R^2	0.002	0.036	0.036	0.045	0.064

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for the female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

When the focus is moved to advancements from Associate to Full professorship, the estimated gender gap is even larger, reaching almost 7 percentage points (see Table 5). The estimates, robust across all model specifications, are economically particularly relevant if compared to the 0.22 sample mean.

5.1 The role of NSH

In order to account for the first argument put forward by the literature to explain the observed gender gap, that is the lower propensity to competition of females we repeat our baseline specification on the subsample of professors who were accredited with, and hence applied for, the NSH. Table 6 shows that the gender gap in the likelihood of advancing from Assistant to Associate reduces from slightly more than 4 percentage points to 2.8 percentage points. In other words, the gap is partially absorbed once the accreditation of NSH enters the picture. When it comes to the advancements to the highest career level though, the estimated gender gap does not change with respect to the baseline results. Table 7 shows in fact that the gender gap remains around 7 percentage points even after having taken into account the role of the NSH. We thus conclude that the "shying away from competition" argument can absorb the gender gap in career advancement only partially and limited to the passage from assistant to

Table 5: Promotion to Full

	(1)	(2)	(3)	(4)	(5))
Female	-0.066***	-0.064***	-0.063***	-0.065***	-0.065***
	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)
Size Uni (Q2)			-0.004		
			(0.026)		
Size Uni (Q3)			-0.056**		
			(0.023)		
Size Uni (Q4)			-0.062***		
			(0.023)		
Size Uni (Q5)			-0.066***		
			(0.023)		
GCI				-0.046**	
				(0.019)	
Scientific Sector	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES
Observations	35,141	35,141	35,141	35,113	35,139
Pseudo R^2	0.006	0.010	0.011	0.012	0.028

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for the female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: Promotion to Associate, conditioning on NSH

	(1)	(2)	(3)	(4)	(5))
Female	-0.028***	-0.026***	-0.026***	-0.028***	-0.028***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)
Size Uni (Q2)			-0.076**		
			(0.037)		
Size Uni (Q3)			-0.064**		
			(0.031)		
Size Uni (Q4)			-0.017		
			(0.030)		
Size Uni (Q5)			-0.029		
			(0.030)		
GCI				-0.089***	
				(0.029)	
Scientific Sector	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES
Observations	15,563	15,563	15,563	15,557	15,409
R-squared	0.0015	0.018	0.019	0.025	0.079

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for the female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

associate, while no role for that is found with respect to the promotions to the highest academic position.

Table 7: Promotion to Full, conditioning on NSH

	(1)	(2)	(3)	(4)	(5))
Female	-0.065***	-0.068***	-0.067***	-0.070***	-0.069***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Size Uni (Q2)			-0.055		
			(0.040)		
Size Uni (Q3)			-0.153***		
			(0.037)		
Size Uni (Q4)			-0.156***		
			(0.036)		
Size Uni (Q5)			-0.158***		
			(0.036)		
GCI				-0.053*	
				(0.029)	
Scientific Sector	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES
Observations	19,270	19,270	19,270	19,256	19,251
R-squared	0.0033	0.010	0.012	0.011	0.039

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

5.2 The role of scientific productivity

We now move to the second argument put forward by the literature for justifying the gender gap in career advancement, i.e. the average lower productivity of female scholars with respect to their male counterparts. Tables 8 and 9 report the results of the estimates of various specifications of model 4.4. According to expectations, we find that the higher the H-index the higher the chances of being promoted. More precisely, in our preferred specification for every additional point in this measure of productivity, the chances of being promoted - either to Associate or Full professorships - increase by almost 9.3 percentage points. Nevertheless, the point estimates of the gender gap in career advancements remain quantitatively unchanged and equal to 2.6 percentage points and 6 percentage points for passages to Associate and to Full professorships, respectively. We thus conclude that the lower average productivity of female professors is not able to explain the observed gender gap in career advancement.

Table 8: Promotion to Associate, conditioning on NSH and productivity

	(1)	(2)	(3)	(4)	(5))
Female	-0.027***	-0.024***	-0.024***	-0.021***	-0.026***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)
Size Uni (Q2)			-0.076*		
			(0.045)		
Size Uni (Q3)			-0.056		
			(0.039)		
Size Uni (Q4)			-0.020		
			(0.038)		
Size Uni (Q5)			-0.029		
			(0.037)		
GCI				-0.038*	
				(0.023)	
HindexStd	0.097***	0.093***	0.093***	0.093***	0.093***
	(0.006)	(0.006)	(0.006)	(0.008)	(0.006)
Scientific Sector	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES
Observations	13,334	13,334	13,334	13,330	13,227
R-squared	0.0515	0.0702	0.0714	0.0722	0.133

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for the female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. HindexStd is the Hindex standardized by the scientific area. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

5.3 The role of mobility

We now dissect our results by internal promotions, i.e. career advancement occurred within the same university, and external ones, i.e. those that occurred along with a change of university affiliation. Several interesting comments are in order looking at the results for promotions to Associate, reported in Table 10. First, a strongly robust gender gap - again in favor of men - is found for both types of promotions. In other words, even after controlling for shying away from competition and for productivity, women seem to have lower chances of being promoted with respect to men both within their university and when moving to another university. The point estimates of the gap is somewhat lower in magnitude in the subsample of those progressing within the same university, but the difference is not statistically significant. Thus, our evidence is that mobility across universities does not play a significant role in explaining the gender gap regarding the first step in career advancement.

A remarkably different picture appears when we focus on advancement to Full professorships (Table 11). Women have lower chances of being promoted compared with men, regardless of the promotion occurring within the same University or entailing a move to another university. However, the gap is statistically and remarkably higher (almost 5 times) for promotions that occurred inside the same university, which we label as "no mobility". In other words, the gap found is almost entirely driven by those who - for whatever reason - cannot move from their University, while it is remarkably reduced

Table 9: Promotion to Full, conditioning on NSH and productivity

	(1)	(2)	(3)	(4)	(5))
Female	-0.055***	-0.057***	-0.057***	-0.054***	-0.060***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Size Uni (Q2)			-0.041		
			(0.048)		
Size Uni (Q3)			-0.102**		
			(0.045)		
Size Uni (Q4)			-0.100**		
			(0.044)		
Size Uni (Q5)			-0.111**		
			(0.044)		
GCI				-0.057**	
				(0.024)	
HindexStd	0.087***	0.092***	0.091***	0.092***	0.093***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Scientific Sector	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES
Observations	16,906	16,906	16,906	16,898	16,886
R-squared	0.0295	0.0393	0.0401	0.0409	0.0685

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for the female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. HindexStd is the Hindex standardized by the scientific area. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

among those who had the chance to move in order to get their promotion.

To sum up, most of the observed gender gap is retrieved in internal promotions, where negotiation skills, personal relationships, preferences and attitudes, and even stereotypes might wield more influence compared to career advancements towards new institutions.

Table 10: Promotion to Associate, by internal vs external advancement

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Same University Promotions No Mobility					Other University Promotion Mobility				
Female	-0.027***	-0.023***	-0.023***	-0.020***	-0.026***	-0.045***	-0.042***	-0.041***	-0.040***	-0.042***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.012)	(0.012)	(0.012)	(0.014)	(0.012)
Size Uni (Q2)			-0.079					-0.110		
			(0.050)					(0.109)		
Size Uni (Q3)			-0.046					-0.260**		
			(0.042)					(0.102)		
Size Uni (Q4)			-0.010					-0.243**		
			(0.041)					(0.100)		
Size Uni (Q5)			-0.018					-0.290***		
			(0.041)					(0.100)		
GCI				-0.039*					-0.021	
				(0.024)					(0.018)	
HindexStd	0.098***	0.094***	0.094***	0.094***	0.094***	0.079***	0.073***	0.070***	0.073***	0.065***
	(0.006)	(0.006)	(0.006)	(0.008)	(0.006)	(0.008)	(0.009)	(0.009)	(0.010)	(0.009)
Scientific Sector	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
Observations	13,049	13,049	13,049	13,046	12,962	2,441	2,441	2,441	2,440	2,263
R-squared	0.0506	0.0691	0.0704	0.0712	0.132	0.0998	0.148	0.171	0.149	0.245

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. HindexStd is the Hindex standardized by the scientific area. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 11: Promotion to Full, by internal vs external advancement

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Same University Promotions No Mobility					Other University Promotion Mobility				
Female	-0.052***	-0.055***	-0.054***	-0.051***	-0.058***	-0.013***	-0.012***	-0.012***	-0.012***	-0.011***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Size Uni (Q2)			-0.001					-0.120***		
			(0.050)					(0.045)		
Size Uni (Q3)			-0.050					-0.159***		
			(0.047)					(0.044)		
Size Uni (Q4)			-0.046					-0.162***		
			(0.046)					(0.043)		
Size Uni (Q5)			-0.058					-0.158***		
			(0.046)					(0.043)		
GCI				-0.059**					0.000	
				(0.025)					(0.006)	
HindexStd	0.084***	0.089***	0.088***	0.090***	0.091***	0.013***	0.013***	0.012***	0.013***	0.014***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Scientific Sector	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
Observations	16,675	16,675	16,675	16,667	16,655	10,686	10,686	10,686	10,680	9,906
R-squared	0.0274	0.0371	0.0375	0.0389	0.0658	0.0673	0.0911	0.119	0.0915	0.176

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. HindexStd is the Hindex standardized by the scientific area. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

6 Further results and Robustness

In this section, we investigate the heterogeneity by Scientific area (Subsection 6.1) and the time evolution of the estimated gap (Subsection 6.2). Then, we provide evidence of the robustness of our results to the inclusion of NSH seniority (Subsection 6.3), to the use of alternative measures of scientific productivity (Subsection 6.4), and of gender segregation (Subsection 6.5).

6.1 Results by Macroarea

Figures 3 and 4 picture the estimated gender gap in transition to Associate and Full professorships, respectively, dissected by scientific macro-area.

The estimates, reported in the top panel, refer to our preferred model specification, featuring the measure of productivity and estimated on the subsample of those accredited with the NSH. Several considerations are in order.

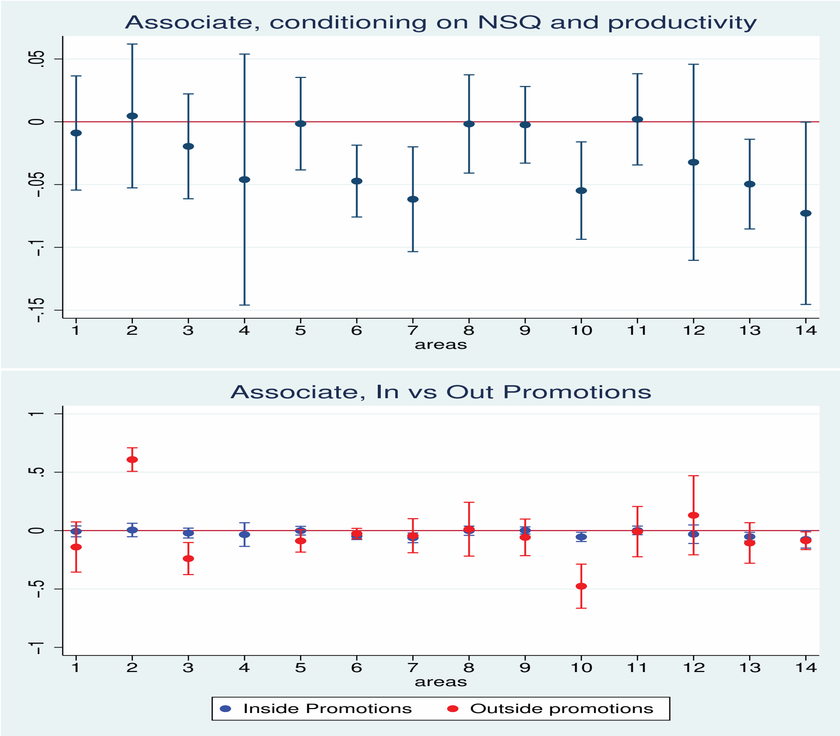
First, the estimated gender gap is either null or negative, with the width of confidence intervals varying a lot due to the high heterogeneity of the size of scientific sectors. This is due to either the actual small size of the sector (for instance, sector 04 - Sciences counts 405 individual professors only) and/or to the suboptimal use of the metrics provided by Scopus webpage as measures of scientific productivity (for instance, of the 1,854 individual professors working in sector 12 - Law, we end up with 248 only are actually on Scopus).

Second, the observed lower chances for female scholars of career advancement to associate professors are mostly found in the following sectors: Medicine, Agricultural and veterinary sciences, Antiquities, philology, literary studies, art history, Economics and statistics, and Political and Social Sciences.

Third, results for promotions to full professorships are even stronger, in terms of both magnitude and sectors involved, which now extend to 9 areas out of 14, including Biology, Civil engineering and architecture, Industrial and information engineering, Antiquities, philology, literary studies, art history, and History, philosophy, pedagogy and psychology.

Fourth, the main results found dissecting by promotions within the same university or across different universities are confirmed, as - whenever different - the estimated gender gap is higher in magnitude for promotions within the same university compared to those occurring along with a move to another institution, and this is especially apparent when transitions to the highest academic position are considered.

Figure 3: Gender gap in promotion to Associate professor, by macroarea



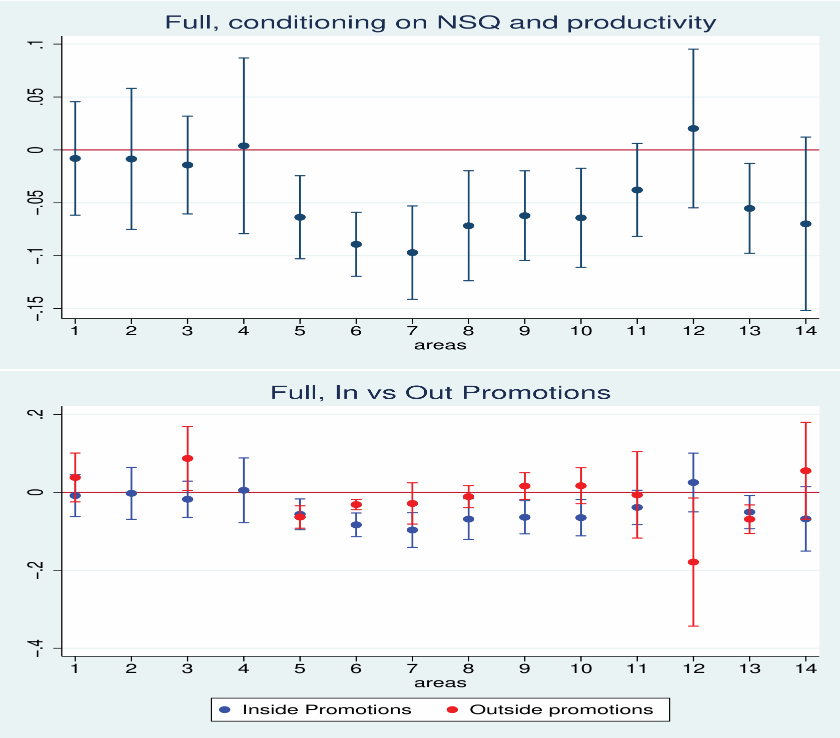
The figure reports marginal effects from the estimated model, along with the 90% confidence interval, by scientific area. Legend of the Italian scientific areas: 1 "Mathematics & informatics" 2 "Physics" 3 "Chemistry" 4 "Earth sciences" 5 "Biology" 6 "Medicine" 7 "Agricultural & veterinary sciences" 8 "Civil engineering & architecture" 9 "Industrial & information engineering" 10 "Antiquities, philology, literary studies, art history" 11 "History, philosophy, pedagogy & psychology" 12 "Law" 13 "Economics & statistics" 14 "Political & social sciences".

6.2 Time perspective

Taking advantage of the long time span covered by our dataset, we are able to provide a picture of the potential evolution of the gender gap over time. Figure 5 pictures the estimates for promotions to Associate, which display a progress from negative to positive, suggesting progressively more favorable conditions for women, driven entirely by promotions within the same university. The interplay of two factors might explain such a result. First, the discernible disparity in the university's financial resources. During the initial years within our sample, financial constraints prevailed. In contrast, the last period witnessed the implementation of exceptional initiatives, earmarking specific financial provisions aimed at advancing RTI to Associate [12].

[12] After the introduction of Law 240/2010, the Italian government and the Ministry of University devised certain specific plans known as "Piano Straordinario associati", such plans were proposed in 2012/13 (DM 28/12/2012), in 2019 (DM n.364 11/04/2019), in 2021 (DM 561 28/04/2021), and 2022 (DM 445 06/05/22), following the Italian government's budget law n. 234 (30/12/2021) which allocated specific funds for such career progression (see art. 1, co. 297, lett. a), stating that "il fondo per il finanziamento ordinario delle universitá (FFO) é incrementato di 75 milioni di euro per l'anno 2022, 300 milioni di euro per l'anno 2023, 640 milioni di euro per l'anno 2024, 690 milioni di euro per l'anno 2025 e 740 milioni di euro

Figure 4: Gender gap in promotion to Full professor, by macroarea



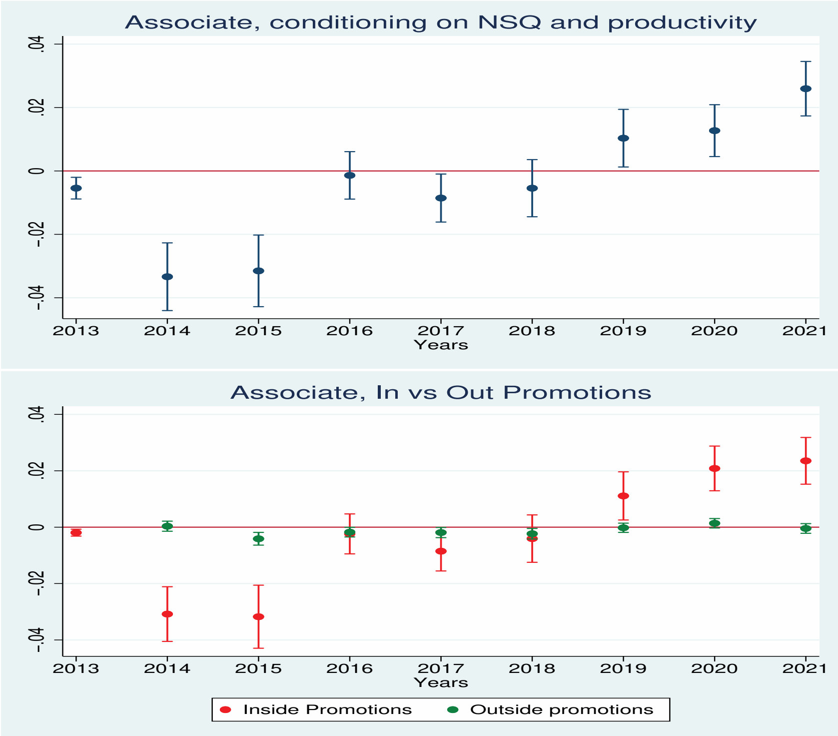
The figure reports marginal effects from corresponding model, along with the 90% confidence interval, by scientific area. Each specification features University fixed effect. Legend of the Italian scientific areas: 1 "Mathematics & informatics" 2 "Physics" 3 "Chemistry" 4 "Earth sciences" 5 "Biology" 6 "Medicine" 7 "Agricultural & veterinary sciences" 8 "Civil engineering & architecture" 9 "Industrial & information engineering" 10 "Antiquities, philology, literary studies, art history" 11 "History, philosophy, pedagogy & psychology" 12 "Law" 13 "Economics & statistics" 14 "Political & social sciences".

Second, the evolved composition of the candidate pool over time, demonstrating a pronounced increase in female representation, as illustrated in Figure 1. In other words, men were prioritized in promotion while women had to wait until sufficient financial resources were available and they were the vast majority of the candidates.

On the other hand, estimates for promotions to Full, pictured in Figure 6, remain steadily negative over the entire sample period and are, once again, driven by progressions occurring within the same university.

a decorrere dall'anno 2026 destinati all'assunzione di professori universitari, di ricercatori di cui all'articolo 24, comma 3, lettera b), della legge 30 dicembre 2010, n. 240").

Figure 5: Gender gap in promotion to Associate professor, over time



The figure reports marginal effects from corresponding model, along with the 90% confidence interval, by scientific area. Each specification features University fixed effect. Legend of the Italian scientific areas: 1 "Mathematics & informatics" 2 "Physics" 3 "Chemistry" 4 "Earth sciences" 5 "Biology" 6 "Medicine" 7 "Agricultural & veterinary sciences" 8 "Civil engineering & architecture" 9 "Industrial & information engineering" 10 "Antiquities, philology, literary studies, art history" 11 "History, philosophy, pedagogy & psychology" 12 "Law" 13 "Economics & statistics" 14 "Political & social sciences".

6.3 NSH Seniority

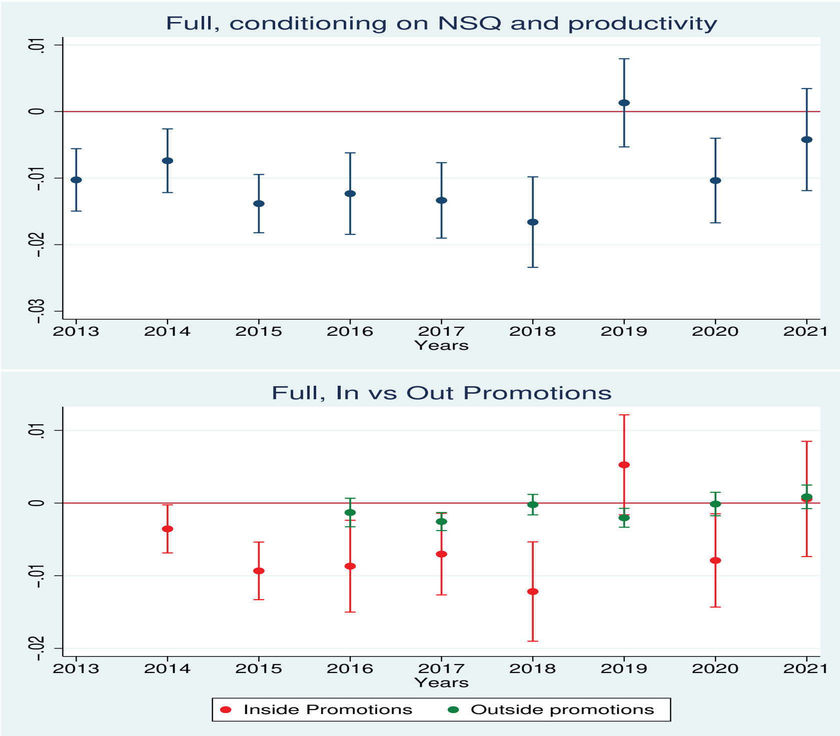
In order to investigate the robustness of our results to the inclusion of the "seniority" of the NSH, we augment our preferred model specification with a variable counting the number of years passed since the first NSH was accredited, denoted with $Years\ NSH_i$ as well as its interaction with the $Female$ dummy in order to identify a potential further gap also in this respect.

Tables 12 and 13 report the estimates obtained for transitions to Associate and Full, respectively. The results lead to interesting interpretations.

First, NSH "maturity" matters, as in all cases, the variable is strongly statistically significant and with an economic effect particularly relevant: for every additional year since the NSH, the chances of career advancement increase by 3.8 to 4.8 (1 to 8.5) percentage points for Associate (Full) professorships.

Second, the NSH seniority completely absorbs the gender gap in the transition to Associate professorships, regardless of the promotion occurring within or outside the original university. This is somewhat consistent with the fact that women, on average,

Figure 6: Gender gap in promotion to Full professor, over time



The figure reports marginal effects from corresponding model, along with the 90% confidence interval, by scientific area. Each specification features University fixed effect. Legend of the Italian scientific areas: 1 "Mathematics & informatics" 2 "Physics" 3 "Chemistry" 4 "Earth sciences" 5 "Biology" 6 "Medicine" 7 "Agricultural & veterinary sciences" 8 "Civil engineering & architecture" 9 "Industrial & information engineering" 10 "Antiquities, philology, literary studies, art history" 11 "History, philosophy, pedagogy & psychology" 12 "Law" 13 "Economics & statistics" 14 "Political & social sciences".

remain for a longer time in the lower academic positions (or, have to wait longer to achieve the higher ones).

Third, and opposite to what we find for Associate, the NSH seniority does not completely explain the gender gap in the career advancement to the highest academic position, which remains statistically significant at about 4.4 percentage points when promotions within the same university are considered. However, consistently to what we find in our baseline results, this gap is way lower - and in this case not even statistically significant - when promotions entailing a move to another university are considered instead.

Finally, there is evidence of a further difference between males and females in terms of the effect of NSH seniority on the chances of being promoted, albeit limited to career advancements entailing a move to a different university. The estimated difference is about 1 percentage point for transitions to Associate and almost a third of a percentage point for transitions to full professorships. A suggestive conclusion is that female professors who had to move to another University experienced further "waiting time" with respect to their male counterparts to get a promotion.

Table 12: Promotion to Associate: role of NSH seniority

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Same University Promotions No Mobility					Other University Promotion Mobility				
Female	-0.021	-0.017	-0.017	-0.015	-0.020	0.010	0.028	0.030	0.029	0.021
	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)	(0.035)	(0.033)	(0.033)	(0.033)	(0.029)
Size Uni (Q2)			-0.101**					-0.151		
			(0.042)					(0.098)		
Size Uni (Q3)			-0.053					-0.239***		
			(0.034)					(0.093)		
Size Uni (Q4)			-0.030					-0.225**		
			(0.034)					(0.092)		
Size Uni (Q5)			-0.043					-0.279***		
			(0.033)					(0.091)		
GCI				-0.037*					-0.016	
				(0.021)					(0.015)	
HindexStd	0.036***	0.033***	0.033***	0.033***	0.033***	0.046***	0.043***	0.041***	0.043***	0.034***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Years NSH	0.048***	0.047***	0.047***	0.047***	0.047***	0.038***	0.038***	0.038***	0.038***	0.038***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Female × Years NSH	0.002	0.002	0.002	0.002	0.002	-0.006	-0.008*	-0.008*	-0.008*	-0.006
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Scientific Sector	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
Observations	12,980	12,980	12,980	12,977	12,885	2,373	2,373	2,373	2,372	2,196
R-squared	0.191	0.205	0.206	0.208	0.278	0.224	0.272	0.296	0.274	0.389

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. HindexStd is the Hindex standardized by the scientific area. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 13: Promotion to Full: role of NSH seniority

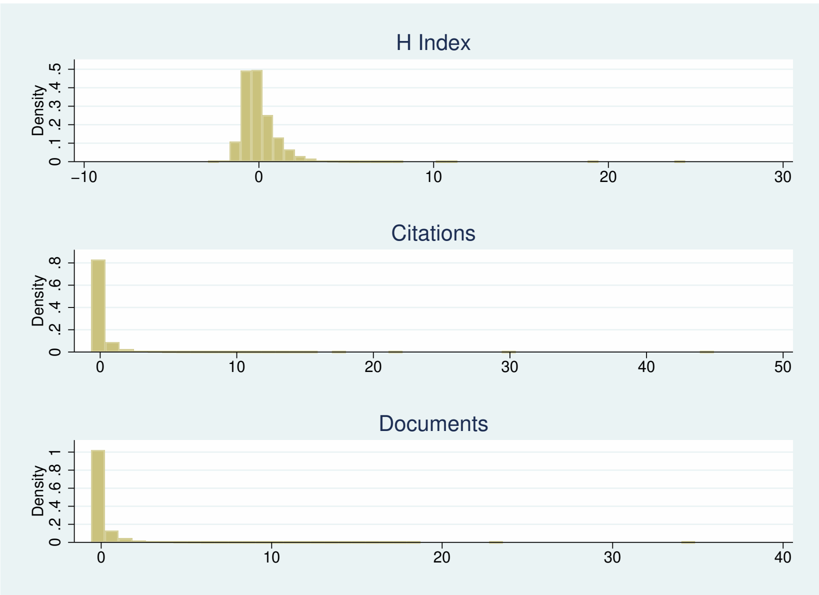
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Same University Promotions No Mobility					Other University Promotion Mobility				
Female	-0.035**	-0.034**	-0.032**	-0.030	-0.044***	0.005	0.006	0.007	0.006	0.010
	(0.016)	(0.016)	(0.016)	(0.019)	(0.016)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Size Uni (Q2)			-0.072					-0.120***		
			(0.044)					(0.040)		
Size Uni (Q3)			-0.147***					-0.162***		
			(0.041)					(0.038)		
Size Uni (Q4)			-0.149***					-0.165***		
			(0.040)					(0.038)		
Size Uni (Q5)			-0.170***					-0.162***		
			(0.040)					(0.038)		
GCI				-0.057**					-0.003	
				(0.027)					(0.006)	
HindexStd	0.032***	0.036***	0.035***	0.036***	0.037***	0.009***	0.010***	0.009***	0.010***	0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Years NSH	0.083***	0.083***	0.084***	0.083***	0.085***	0.009***	0.009***	0.009***	0.009***	0.010***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Female × Years NSH	0.003	0.002	0.002	0.002	0.004	-0.003**	-0.002**	-0.003**	-0.002*	-0.003**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Scientific Sector	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
University FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
Observations	16,472	16,472	16,472	16,464	16,453	10,483	10,483	10,483	10,477	9,717
R-squared	0.216	0.228	0.230	0.230	0.276	0.178	0.200	0.229	0.200	0.298

The table reports marginal effects from probit models, estimated with robust standard errors. Female and Size Uni Q2 till Q5 are dummies for female gender and for the corresponding quintile of the size of the University, respectively. GCI is the University Glass Ceiling Index. HindexStd is the Hindex standardized by the scientific area. When the model specification features GCI, standard errors are clustered at the University level. * significant at 10%; ** significant at 5%; *** significant at 1%.

6.4 Alternative measures of scientific productivity

We now try alternative measures of scientific productivity. Our dataset features, for each professor the h-index, the number of citations, and the number of publications up to the year 2022. For each measure we compute the corresponding value standardized by scientific area, in order to take into account both the different productivity level as well as the typical gender segregation across scientific areas. Moreover, we also compute, for each measure, the corresponding value standardized by both scientific area and University, in order to capture the potential position of each professor within its own university. Results are reported in Tables 14 and 15 for Associate and Full professorship, respectively (columns (1) and (7) reports the results already seen in the baseline specification). Finally, in Table 16 for Associate and 17 for Full professorship we also try with dummies for quartile of the distribution, in order to handle the high skewness of all these measures (see Figure 7), as well as to reduce the effect of outliers. In all cases, our main results are confirmed. Regardless of the measure of productivity and of its specification used, a positive and statistically significant gradient of productivity is observed, and - most importantly - the estimates of the gender gap remain remarkably stable in terms of both significance and magnitude.

Figure 7: Measures of productivity



The top panel reports the distribution HIndex, the center panel the number of citations, and the bottom panel the number of documents up to year 2022. All measures are standardized by scientific area.

Table 14: Promotion to Associate: alternative measures of productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Same University Promotions No mobility						Other University Promotion Mobility					
Female	-0.026***	-0.026***	-0.030***	-0.026***	-0.032***	-0.030***	-0.042***	-0.043***	-0.045***	-0.046***	-0.054***	-0.048***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
Hindex Std	0.094***						0.065***					
	(0.006)						(0.009)					
Hindex Std (Uni)		0.088***						0.067***				
		(0.005)						(0.007)				
Citations Std			0.076***						0.055***			
			(0.014)						(0.014)			
Citations Std (Uni)				0.070***						0.049***		
				(0.007)						(0.008)		
Documents Std					0.038***						0.027***	
					(0.008)						(0.007)	
Documents Std (Uni)						0.030***						0.034***
						(0.004)						(0.006)
Observations	12,962	12,931	12,962	12,938	12,962	12,936	2,263	2,255	2,263	2,257	2,263	2,257
R-squared	0.132	0.132	0.0966	0.108	0.0901	0.0908	0.245	0.251	0.203	0.215	0.189	0.201

The table reports marginal effects from probit models, estimated with robust standard errors. Female is a dummy for female gender. All models feature scientific macroarea as well as University fixed effects. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 15: Promotion to Full: alternative measures of productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Same University Promotions No mobility						Other University Promotion Mobility					
Female	-0.058***	-0.058***	-0.063***	-0.058***	-0.066***	-0.061***	-0.011***	-0.011***	-0.012***	-0.012***	-0.013***	-0.012***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Hindex Std	0.091***						0.014***					
	(0.004)						(0.001)					
Hindex Std (Uni)		0.095***						0.014***				
		(0.004)						(0.001)				
Citations Std			0.064***						0.009***			
			(0.006)						(0.001)			
Citations Std (Uni)				0.074***						0.011***		
				(0.004)						(0.001)		
Documents Std					0.041***						0.005***	
					(0.005)						(0.001)	
Documents Std (Uni)						0.068***						0.010***
						(0.004)						(0.001)
Observations	16,655	16,602	16,655	16,612	16,655	16,612	9,906	9,883	9,906	9,886	9,906	9,886
R-squared	0.0658	0.0689	0.0486	0.0580	0.0424	0.0538	0.176	0.178	0.150	0.163	0.129	0.149

The table reports marginal effects from probit models, estimated with robust standard errors. Female is a dummy for female gender. All models feature scientific macroarea as well as University fixed effects. * significant at 10%; ** significant at 5%; *** significant at 1%.

6.5 Alternative measures of gender segregation

Our main analysis relies on the Glass Ceiling Index at the University level as a measure of female segregation.

Taking advantage of our rich dataset, we are able to compute this measure of gender unbalance not only at the University level, but also at the Faculty, the Department, the Scientific Sector (SSD), the Scientific Area (SC), and the Scientific MacroArea level. The estimates obtained including the Glass Ceiling Index computed at the corresponding level are reported in Tables 18 and 19 for Associate and Full professors, respectively. Again, our main conclusions remain unchanged.

Besides, we also investigate a different measure of female segregation, i.e. the Female Ratio (FR), defined as:

$$FR = F/(N - F) \tag{6.1}$$

where N denotes the total number of professors working in the University, and F the total number of female professors. This measure is again computed both at the University level as well as at lower levels. Results, reported in Tables 20 and 21 remain once again largely unchanged.

Table 16: Promotion to Associate: alternative measures of productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Same University Promotions No mobility						Other University Promotion Mobility					
Female	-0.028***	-0.030***	-0.033***	-0.027***	-0.027***	-0.028***	-0.045***	-0.049***	-0.054***	-0.046***	-0.047***	-0.050***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)
Hindex std - Q2	0.096***						0.035***					
	(0.009)						(0.013)					
Hindex std - Q3	0.151***						0.091***					
	(0.009)						(0.019)					
Hindex std - Q4	0.197***						0.257***					
	(0.008)						(0.031)					
Citations Std - Q2		0.060***						0.031**				
		(0.010)						(0.014)				
Citations Std - Q3		0.077***						0.065***				
		(0.011)						(0.018)				
Citations Std - Q4		0.148***						0.196***				
		(0.010)						(0.030)				
Documents Std - Q2			0.027**						0.005			
			(0.011)						(0.016)			
Documents Std - Q3			0.013						0.019			
			(0.010)						(0.017)			
Documents Std - Q4			0.066***						0.066***			
			(0.010)						(0.023)			
Hindex Std (Uni)- Q2				0.083***						0.037***		
				(0.009)						(0.013)		
Hindex Std (Uni)- Q3				0.143***						0.089***		
				(0.008)						(0.018)		
Hindex Std (Uni)- Q4				0.187***						0.254***		
				(0.008)						(0.030)		
Citations Std (Uni)- Q2					0.093***						0.022*	
					(0.009)						(0.013)	
Citations Std (Uni)- Q3					0.119***						0.108***	
					(0.009)						(0.017)	
Citations Std (Uni)- Q4					0.170***						0.174***	
					(0.008)						(0.026)	
Documents Std (Uni)- Q2						0.082***						0.040***
						(0.009)						(0.015)
Documents Std (Uni)- Q3						0.108***						0.077***
						(0.009)						(0.017)
Documents Std (Uni)- Q4						0.117***						0.118***
						(0.009)						(0.022)
Observations	12,962	12,962	12,962	12,962	12,962	12,962	2,263	2,263	2,263	2,263	2,263	2,263
R-squared	0.134	0.102	0.0894	0.131	0.120	0.104	0.254	0.217	0.187	0.254	0.235	0.208

The table reports marginal effects from probit models, estimated with robust standard errors. Female is a dummy for female gender. All models feature scientific macroarea as well as University fixed effects. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 17: Promotion to Full: alternative measures of productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Same University Promotions No mobility						Other University Promotion Mobility					
Female	-0.061***	-0.064***	-0.067***	-0.061***	-0.059***	-0.062***	-0.013***	-0.013***	-0.013***	-0.013***	-0.012***	-0.013***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Hindex Std- Q2	0.039***						0.001					
	(0.011)						(0.003)					
Hindex Std- Q3	0.098***						0.011***					
	(0.011)						(0.004)					
Hindex Std- Q4	0.235***						0.033***					
	(0.010)						(0.004)					
Citations Std- Q2		0.069***						0.013***				
		(0.010)						(0.003)				
Citations Std- Q3		0.070***						0.012***				
		(0.011)						(0.003)				
Citations Std- Q4		0.183***						0.037***				
		(0.012)						(0.006)				
Documents Std- Q2			-0.044***						-0.012***			
			(0.012)						(0.004)			
Documents Std- Q3			0.053***						0.007			
			(0.012)						(0.004)			
Documents Std- Q4			0.064***						0.018***			
			(0.013)						(0.006)			
Hindex Std (Uni) - Q2				0.038***						0.002		
				(0.010)						(0.003)		
Hindex Std (Uni) - Q3				0.098***						0.007**		
				(0.010)						(0.003)		
Hindex Std (Uni) - Q4				0.242***						0.039***		
				(0.010)						(0.004)		
Citations Std (Uni) - Q2					0.047***						0.002	
					(0.011)						(0.003)	
Citations Std (Uni) - Q3					0.097***						0.010***	
					(0.010)						(0.003)	
Citations Std (Uni) - Q4					0.226***						0.034***	
					(0.010)						(0.004)	
Document Std (Uni) - Q2						0.027**						-0.003
						(0.011)						(0.003)
Document Std (Uni) - Q3						0.069***						0.002
						(0.010)						(0.003)
Document Std (Uni) - Q4						0.193***						0.027***
						(0.011)						(0.004)
Observations	16,655	16,655	16,655	16,655	16,655	16,655	9,906	9,906	9,906	9,906	9,906	9,906
R-squared	0.0638	0.0472	0.0421	0.0664	0.0618	0.0558	0.154	0.143	0.138	0.165	0.157	0.149

The table reports marginal effects from probit models, estimated with robust standard errors. Female is a dummy for female gender. All models feature scientific macroarea as well as University fixed effects. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 18: Promotion to Associate: GCI at different levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Same University Promotions						Other University Promotion					
	No mobility						Mobility					
Female	-0.020***	-0.022***	-0.020***	-0.025***	-0.024***	-0.022***	-0.040***	-0.046***	-0.038***	-0.044***	-0.043***	-0.036***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.014)	(0.015)	(0.014)	(0.013)	(0.014)	(0.014)
Hindex Std	0.094***	0.092***	0.094***	0.093***	0.093***	0.094***	0.073***	0.077***	0.073***	0.073***	0.073***	0.072***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
GCI	-0.039*						-0.021					
	(0.024)						(0.018)					
GCI - Dept		-0.006*						-0.008				
		(0.003)						(0.007)				
GCI - Faculty			-0.049**						-0.048**			
			(0.019)						(0.022)			
GCI - SSD				-0.004*						-0.011**		
				(0.002)						(0.005)		
GCI - SC					-0.002						-0.002	
					(0.001)						(0.003)	
GCI - Macroarea						-0.009						-0.059**
						(0.017)						(0.023)
Observations	13,046	12,605	13,041	12,811	13,044	13,049	2,440	2,260	2,439	2,374	2,437	2,441
R-squared	0.0712	0.0650	0.0728	0.0674	0.0690	0.0692	0.149	0.143	0.155	0.153	0.148	0.154

The table reports marginal effects from probit models, estimated with standard errors clustered at the University level. Female is a dummy for female gender. All models feature scientific macroarea dummies, not reported for reasons of space. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 19: Promotion to Full: GCI at different levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Same University Promotions						Other University Promotion					
	No mobility						Mobility					
Female	-0.051***	-0.053***	-0.051***	-0.054***	-0.055***	-0.053***	-0.012***	-0.011***	-0.012***	-0.011***	-0.012***	-0.011***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Hindex Std	0.090***	0.091***	0.089***	0.088***	0.088***	0.089***	0.013***	0.013***	0.013***	0.013***	0.013***	0.013***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
GCI	-0.059**						0.000					
	(0.025)						(0.006)					
GCI - Dept		-0.012***						0.001				
		(0.004)						(0.001)				
GCI - Faculty			-0.047**						-0.001			
			(0.024)						(0.005)			
GCI - SSD				-0.003						-0.000		
				(0.002)						(0.001)		
GCI - SC					-0.001						-0.001	
					(0.002)						(0.001)	
GCI - Macroarea						-0.017						-0.013**
						(0.018)						(0.005)
Observations	16,667	16,210	16,664	16,312	16,664	16,675	10,680	10,320	10,680	10,433	10,678	10,686
R-squared	0.0389	0.0377	0.0382	0.0368	0.0371	0.0372	0.0915	0.0870	0.0897	0.0935	0.0915	0.0953

The table reports marginal effects from probit models, estimated with standard errors clustered at the University level. Female is a dummy for female gender. All models feature scientific macroarea dummies, not reported for reasons of space. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 20: Promotion to Associate: Female Ratio at different levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Same University Promotions						Other University Promotion					
	No mobility						Mobility					
Female	-0.023***	-0.026***	-0.024***	-0.024***	-0.023***	-0.025***	-0.042***	-0.042***	-0.042***	-0.047***	-0.044***	-0.044***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.014)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)
Hindex Std	0.094***	0.094***	0.094***	0.094***	0.094***	0.093***	0.073***	0.073***	0.073***	0.072***	0.073***	0.073***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Female Ratio	0.052						-0.039					
	(0.090)						(0.086)					
FR - Department		0.026**						-0.001				
		(0.013)						(0.017)				
FR - Faculty			0.311***						0.056			
			(0.119)						(0.061)			
FR - SSD				0.005						0.022*		
				(0.009)						(0.013)		
FR - SC					0.001						0.011	
					(0.009)						(0.015)	
FR - Macro						5.292***						2.618***
						(0.444)						(0.485)
Observations	13,049	13,046	13,049	13,049	13,049	13,049	2,441	2,441	2,441	2,441	2,441	2,441
R-squared	0.0694	0.0699	0.0719	0.0692	0.0691	0.0948	0.148	0.148	0.148	0.149	0.148	0.161

The table reports marginal effects from probit models, estimated with standard errors clustered at the University level. Female is a dummy for female gender. All models feature scientific macroarea dummies, not reported for reasons of space. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 21: Promotion to Full: Female Ratio at different levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Same University Promotions No mobility						Other University Promotion Mobility					
Female	-0.055***	-0.058***	-0.055***	-0.060***	-0.058***	-0.055***	-0.012***	-0.011***	-0.012***	-0.013***	-0.012***	-0.012***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Hindex Std	0.089***	0.089***	0.089***	0.088***	0.088***	0.088***	0.013***	0.013***	0.013***	0.013***	0.013***	0.013***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Female Ratio	0.067						-0.009					
	(0.088)						(0.023)					
FR - Department		0.026						-0.007				
		(0.016)						(0.005)				
FR - Faculty			0.164						0.042			
			(0.123)						(0.032)			
FR - SSD				0.024***						0.005		
				(0.007)						(0.004)		
FR - SC					0.019**						0.004	
					(0.008)						(0.004)	
FR - Macro						4.514***						0.356***
						(0.483)						(0.096)
Observations	16,675	16,672	16,675	16,675	16,675	16,675	10,686	10,683	10,686	10,686	10,686	10,686
R-squared	0.0373	0.0373	0.0376	0.0374	0.0373	0.0414	0.0914	0.0922	0.0946	0.0919	0.0917	0.0935

The table reports marginal effects from probit models, estimated with standard errors clustered at the University level. Female is a dummy for female gender. All models feature scientific macroarea dummies, not reported for reasons of space. * significant at 10%; ** significant at 5%; *** significant at 1%.

7 Conclusions

In this study, we evaluate the gender disparity within Italian universities' career trajectories from 2012 to 2021, using the universe of professors of Italian University. Our analysis focused on assessing career advancements and the underlying gender-based patterns, controlling for the two main arguments typically put forward as main drivers of the observed gender gap, namely the lower average productivity and the self-exclusion of women compared to men.

The analysis builds upon a previous work by Filandri and Pasqua(2021), which is extended in several respects. First, it covers a longer time-span, which allows the implementation of the University reform to reach regime and a more favorable economic conjuncture. Second, it incorporates a wider set of controls, revealing crucial insights. Controlling for various factors as scientific area, Glass Ceiling Index, university size, and fixed effects. Finally, it explores the potential effect of mobility in explaining the gender gap

The results show that female assistant professors faced lower promotion rates to associate positions by approximately 4 percentage points compared to their male counterparts (corresponding to 6% and 30% effect compared to sample means). This disparity widens to nearly seven percentage points for promotions from associate to full professorships. Conditioning on NSH the gap is partially absorbed, suggesting that the argument of 'shying away from competition' mitigates the gender gap, but only limited to transitions from assistant to associate positions. When career advancements to full professorships are considered, the gender gap widens further, reaching 7 percentage points, which represents a remarkable economic effect as it corresponds to almost a third of the sample mean. We also find that this gap is affected by neither the average lower competitiveness nor the average lower productivity of females.

Then we examined promotions within the same institution versus external moves with the emergence of intriguing facts. Despite controlling for competition avoidance and productivity, promotions from assistant to associate consistently favored men in both scenarios. However, promotions to full professorships revealed a distinctive pattern. While women faced lower chances of promotion compared to men in both scenarios, the disparity was significantly higher for promotions within the same university, indicating potential differences in promotion dynamics between internal and external transitions. Such a result suggests that the crux of the identified gender gap predominantly originates from internal promotions, involving additional factors at play compared to external promotions. Negotiation skills might wield more influence in internal promotions, while external promotions seem to rely on skills and credentials. Further investigations in this direction are essential for a comprehensive understanding.

In conclusion, our study sheds light on persistent gender disparities in Italian universities' career progressions, emphasizing the need to address internal dynamics affecting career advancements and the overall promotion system under a gender perspective.

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