Does the Gender Composition of Scientific Committees Matter?*

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Abstract

An increasing number of countries are introducing gender quotas in scientific committees. We analyze how a larger presence of female evaluators affects committee decision-making using information on 100,000 applications to associate and full professorships in all academic disciplines in two countries, Italy and Spain. These applications were assessed by 8,000 evaluators who were selected through a random draw. A larger number of women in evaluation committees does not increase either the quantity or the quality of female candidates who qualify. If anything, when evaluators' are not familiar with candidates' research area, gender-mixed committees tend to be less favorable towards female candidates than all-male committees, with the exception of evaluations to full professorships in Spain. Data from 300,000 individual voting reports suggests that men become less favorable towards female candidates as soon as a woman joins the committee.

Keywords: scientific committees, gender discrimination, randomized natural experiment.

JEL Classification: J71, J16.

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1 Introduction

The underrepresentation of women in academia remains a cause for concern among universities and policy makers around the world. In Europe, women account for 46% of PhD graduates, 37% of associate professors and only a mere 20% of full professors (European Commission 2013). Similar patterns may be observed in the US and the gender imbalance is even larger in Japan (National Research Council 2009, Abe 2012).

Several explanations may account for the lack of women in high-level positions. According to the pipeline theory, once women have entered the lower rungs of the academic career it is mainly a matter of time that they would move their way through a metaphorical pipeline to reach high-level jobs. However, in most disciplines, the share of women among faculty members remains low even after decades of improved recruitment of women at the undergraduate and the doctoral level (Ginther and Kahn 2004, 2009). Gender differences in promotion rates might also reflect differences in productivity, perhaps due to the existence of gendered roles at the household level or the lack of female mentors and role models (Blau, Curie, Croson and Ginther 2010). Some women may also devote excessive time to tasks that are socially desirable but which are not taken into account in promotion decisions (Vesterlund, Babcock and Weingart 2014). Furthermore, some authors have pointed out that women are less likely to apply for promotions (Bosquet, Combes and Garcia-Peñalosa 2013; De Paola, Ponzo and Scoppa 2015), perhaps due to the existence of gender differences in the preference for competitive environments (Niederle and Vesterlund 2007; Buser, Niederle and Oosterbeek 2014) or in bargaining abilities in the labour market (Babcock, Gelfand, Small and Stayn 2006; Blackaby, Booth and Frank 2005).

Beyond these supply-side explanations, the slow progress made by women has been sometimes attributed to the existence of gender discrimination by the (mostly male) evaluators who decide on hiring and promotions.[1] In this paper we examine whether

[1] Gender discrimination in academia remains a controversial issue. According to a meta-analysis by Ceci and Williams (2011), the more recent empirical evidence fails to support assertions of discrimination in manuscript reviewing, interviewing, and hiring. However, other studies show that female researchers might still receive lower evaluations than male researchers with identical characteristics (Steinpreis, Anders and Ritzke 1999, Moss-Racusin, Dovidio, Brescoll, Graham and Handelsman

having more women in scientific committees might help to increase the chances of success of female candidates. There are several reasons for considering this hypothesis. First, there is evidence of gender segregation across different scientific subfields (Dolado, Felgueroso and Almunia 2012, Hale and Regev 2014). If men and women tend to do research in different subfields and evaluators overrate the importance of their own types of research, the lack of female evaluators might be detrimental for female candidates (Bagues and Perez-Villadoniga 2012, 2013). Second, research networks tend to be gendered (Boschini and Sjögren 2007, Hilmer and Hilmer 2007). If evaluators are mostly male, male candidates might have a better chance to be acquainted with committee members and could perhaps benefit from these connections (Zinovyeva and Bagues 2015; Bagues, Sylos-Labini, Zinovyeva 2015). Third, men may be subject to gender stereotypes or they may be biased against women reaching high-level positions. For instance, according to the World Value Survey, around 25% of US males believe that men make better political leaders and 16% think than men make better business executives.[2] Women are half as likely to hold such views. A similar pattern is observed in Europe.[3] According to some experts in gender studies, these biases may have reached the academic world.[4] Finally, the presence of women in evaluation committees might also improve the quality of the evaluation. It has been argued that group performance is positively correlated with the proportion of women in a group (Woolley, Chabris,

2012).

[2]World Value Survey Wave 6: 2010-2014. Official aggregate v.20140429. World Values Survey Association (www.worldvaluessurvey.org).

[3]The 6th wave of the World Value Survey provides information on eight members of the European Union: Estonia, Germany, Netherlands, Poland, Romania, Slovenia, Spain and Sweden. In these countries 30% of men and 21% women believe that men make better political leaders than women do, and 29% of men and 17% women think that men make better business executives than women do.

[4]For instance, in a report commissioned by the European Commission, the expert group *Women In Research Decision Making* argues that "(a)t the very least, having male only committees risks replicating stereotypes and bias, both regarding applicants and issues in research. Therefore, measures are needed to have both women and men fairly represented on decision making bodies" (European Commission 2008, page 27). In an another expert report on the situation of women researchers in Spain it is also argued that "there are prejudices about women among those who co-opt, promote or have the key to promotion. The bodies which control this are mostly male and, even if they are not totally conscious of it, they see an academic woman first as a woman and secondly as a colleague." (Fundación Española para la Ciencia y la Tecnología, *Mujer y Ciencia: La situación de las Mujeres Investigadoras en el Sistema Español de Ciencia y Tecnología*, (FECYT, 2005), page 48). Other researchers have voiced similar views (Bagilhole 2005, Barres 2006, European Commission 2013, Smith et al. 2015).

Pentland, Hashmi and Malone 2010).

These arguments have reached policy makers and a number of countries have introduced quotas requiring the presence of at least 40% of women (and men) in scientific committees.[5] Many universities and institutions all around the world also have internal guidelines requiring the presence of women in committees. But despite the increasing popularity of gender quotas in scientific committees, there are some important concerns about their effectivity (Vernos 2013). Quotas are costly for senior women, as they increase disproportionally the amount of time that female professors have to devote to evaluation committees. Furthermore, a larger presence of women in committees may not necessarily benefit female candidates. Both men and women have developed their careers in an academic environment dominated my men, and both genders may tend to associate important academic positions, and the features they require, with men, not with women (Mendez and Busenbark 2012). Women who made it to the upper echelons of academia may also exercise a type of "queen bee syndrome" in which they make exaggerated demands upon junior female staff (Staines, Jayaratne and Tavris 1973), and even if women are relatively more sympathetic towards female candidates, they may not have equal levels of voice and authority in deliberation processes (Karpowitz, Mendelberg and Shaker 2012, Brescoll 2011).

The empirical evidence on the impact of scientific committees' gender composition has been so far scarce, typically based on small samples and rather inconclusive. Sometimes researchers seem to benefit from the presence of evaluators who share the same gender (Casadevall and Handelsman 2013, De Paola and Scoppa 2014), sometimes applicants seem to obtain relatively better evaluations from opposite-sex evaluators (Broder 1993; Ellemers, Heuvel, de Gilder, Maass and Bonvini 2004), and in some other cases gender does not seem to play any (statistically) significant role (Abrevaya and Hamermesh 2012; Jayasinghe, Marsh and Bond 2003; Moss-Racusin, Dovidio, Brescoll,

[5] In 1995 gender quotas were introduced in Finland through the amendment of the Finnish Act on Equality between Women and Men. In 1999, the European Commission stated the aim to achieve at least a 40% representation of women in Marie Curie scholarships, advisory groups, assessment panels and monitoring panels (COM(1999) 76 Final). In 2007, gender quotas were introduced in Spain within the Equality Law. More recently, France has also introduced quotas in all scientific committees (decree n 2014-997, September 2 2014, article 8).

Graham and Handelsman 2012; Steinpreis, Anders and Ritzke 1999; Williams and Ceci 2015). A brief summary of these papers is available in Table A1 in the Appendix.[6] It is unclear whether these mixed findings reflect the idiosyncrasies of the different situations and samples analyzed in each study, or simple random sampling variation. From a policy perspective, the lack of more extensive and clear evidence is disappointing.

In this paper we analyze the role of evaluators' gender in academic evaluations using the exceptional evidence provided by two large-scale randomized natural experiments in two different countries, Spain and Italy. In order to be promoted at the university level to an associate or full professorship, in both countries researchers are required to first obtain a qualification granted by a centralized committee at the national level. These qualification exams are performed periodically in all disciplines. Our database includes information on approximately 300,000 individual evaluation reports, 100,000 applications and 8,000 evaluators in 200 different disciplines. Approximately one third of evaluation committees include no women and very rarely we observe a female majority in the committee.

The Spanish and Italian institutional arrangements provide some exceptional features. First, evaluators are selected from of a pool of eligible professors using a random draw. This allows us to consistently estimate the causal effect of committees' gender composition on evaluations. Second, evaluations are performed in all disciplines and at two different levels, qualification for assistant and full professorships. Therefore we can study how the role of evaluators' gender varies according to a number of relevant dimensions. Third, we observe extensive and detailed information on evaluators' and candidates' academic connections and their field of specialization. We use this information to test explicitly the role of gendered networks, gender segregation across different subfields, and gender stereotypes. Fourth, in the Italian case, we observe the evaluation reports submitted by individual committee members. Using this information we explore the interactions that arise within committees and we study whether the presence of women in the committee affects the voting behavior of male evaluators.

[6]A related literature also analyses the role of evaluators' gender in non academic occupations (e.g. Bagues and Esteve-Volart 2010, Booth and Leigh 2010) or in sport activities (e.g. Sandberg 2014).

Finally, we can observe the research output of candidates before the evaluation and, in the case of Spain, also their research output during the five following years. We use this information to explore whether committees with more women are better able to identify candidates with more potential.

There exist also a number of interesting institutional differences between the evaluation processes in the two countries. In Spain, evaluations involve oral presentations by the candidates, while in Italy evaluations are based only on candidates' CVs and publications. In Spain qualification leads almost automatically to promotion, while in Italy the chances are much lower. Finally, the Italian system is relatively more transparent and exposed to public scrutiny. Having data for the two slightly different institutional arrangements allows us to cross-validate the findings and to explore their robustness.[7]

We find no empirical support, either from the average in the two countries or from the majority of subsamples analyzed, to suggest that a larger presence of female evaluators in the evaluation committees has a statistically or economically significant positive effect on the chances of success of female candidates. In the case of Italy we can discard any positive impact. In fact, in the Italian sample gender-mixed committees exhibit a small but significant bias against female candidates, relative to committees composed only by male evaluators. In the Spanish case, we can reject any sizable impact. An additional woman in a committee of seven members may increase the number of women promoted by at most 0.6 p.p. (5%) or it might also decrease it by up to 1 p.p. (9%). We also examine whether committees with a relatively larger proportion of women promote better candidates, using as a proxy of candidates' quality their research output before the evaluation and during the following five years. We do not observe any significant difference in the observable quality of candidates who have qualified in committees with different gender compositions.

To get a better understanding of these findings and also to determine their validity in other contexts, we explore the different specific mechanisms suggested by the theory.

[7]For instance, some authors have argued that the degree of transparency in an evaluation procedure can affect gender biases (van den Brink, Benschop and Jansen 2010)

As discussed above, one common argument is the existence of gender segregation across academic subfields. Within each discipline, some subfields are significantly more feminized than others, but the level of segregation that we observe in our data is relatively small (2-4%). We also study segregation across research networks. Researchers are significantly more likely to have an advisor, a colleague or a co-author of the same gender (10-20%). However, although committee members tend to favor connected candidates, in these national examinations the likelihood of having a connection in a committee is low and gender segregation across research networks has only a limited effect on the evaluation outcomes. We also examine separately evaluations for high-level positions. Male evaluators might have prejudices against women being promoted to full professorships, but not to positions at lower levels of the career ladder. Results are mixed: we find support for this hypothesis in the case of Spain, but not in the case of Italy.

We also study gender stereotypes. Stereotypes may be more relevant when evaluators cannot observe accurately the quality of candidates, for instance, because evaluators and candidates are specialized in different subfields of research. In our data, when the evaluators and the candidate belong to the same subfield or research, gender does not seem to play any role. However, when information asymmetries are expected to be larger because the candidate belongs to a different subfield, female candidates have relatively better chances of success in all-male committees than in gender-mixed committees. Evidence from individual voting reports suggests that this is partly due to the impact of women in the committee on male evaluators' voting behavior. The presence of female evaluators in committees makes male evaluators tougher upon female candidates, although this effect is only marginally significant. It is unclear whether this effect reflects the information that female evaluators provide to their male colleagues or, perhaps, male evaluators' reaction to the presence of women. On the other hand, in mixed-gender committees female evaluators are slightly more favorable towards female candidates than male evaluators but this difference is not statistically significant.

2 Institutional background

Several European countries have national systems of quality assurance which are meant to guarantee the academic quality of professors in public universities. The evidence presented in this paper is based on an analysis of two variants of such systems: the Italian system known as *Abilitazione Scientifica Nazionale*, which was introduced in 2012, and the Spanish system known as *Habilitación*, which was in place between 2002 and 2006.

Both systems require candidates for associate and full professorships to qualify in national evaluations held by an academic board in the appropriate discipline. In each country, there are nearly two hundred legally defined academic disciplines, each corresponding to a certain area of knowledge. Successful candidates can then apply for a position at a given university.

In both countries, the time line of evaluations has the following steps. First, a call for applicants is announced in which candidates can apply for multiple disciplines and positions. Once the list of initial applicants is settled, committee members are randomly selected from the list of eligible evaluators in the corresponding discipline. Once the committees are formed, the evaluation process begins and once this is over, the evaluation results are made public. Rostered evaluators can potentially resign at any point of the process, something that happens in 2% of cases in Spain and in 8% of cases in Italy. Resigned evaluators are substituted by randomly selected evaluators. The procedure has also distinctive features specific to each country. We summarize these features below (see also Table A2 in the Appendix).

2.1 Abilitazione Scientifica Nazionale

In Italy, four out of five committee members are selected through a random draw from the pool of 'Italian' eligible evaluators and the remaining evaluator is drawn out of the pool of 'foreign' eligible evaluators. The former pool consists of full professors affiliated to Italian universities who volunteered to be members. The latter pool consists of professors affiliated to universities from OECD countries, who also volunteered to participate in Italian evaluations. The randomization procedure is subject to one important constraint: no university can have more than one evaluator within a single committee

The eligibility of evaluators is decided in the following way. In science, technology, engineering, mathematics and medicine (STEMM), evaluators are required to have a research output above the median for full professors in the discipline in at least two of the following three dimensions: (i) the number of articles published in scientific journals, (ii) the number of citations, (iii) and the H-index. In the social sciences and the humanities (SSH), the research performance of evaluators has to be above the median in at least one of the following three dimensions: (i) the number of articles published in high quality scientific journals (in what follows, A-journals),[8] (ii) the overall number of articles published in any scientific journals and book chapters, and (iii) the number of published books. 'Foreign' eligible evaluators have to satisfy the same research requirements as 'Italian' ones. While 'Italian' evaluators work *pro bono*, OECD evaluators receive €16,000 for their participation.

Evaluations are based solely on the material provided in candidates' application packages consisting of CVs and recent publications. Committees have full autonomy regarding the criteria to be used in the evaluation and the number of qualifications to be granted. Each evaluation committee is required to draft and publish online a document describing the general criteria to be used in providing a positive assessment. Candidates may withdraw their application up until two weeks after evaluation criteria are publicized. A positive assessment of the candidate requires a qualified majority of four out of five votes. Once granted, qualifications are only valid for four years, while a negative evaluation means that candidates are excluded from participating in further national evaluations during the following two years.

An important feature of the Italian system is its extreme transparency: all the relevant information – including candidates' and evaluators' CVs, as well as individual evaluation reports – is published online. An independent evaluation agency appointed

[8]An evaluation agency determined with the help of several scientific committees the set of journals to be considered as high quality in each field.

by the ministry also collects and publicizes information on the research output of final candidates in the ten years preceding the evaluation, as measured by the three bibliometric indicators described above. The evaluation agency compared the research productivity of candidates in each of these three dimensions with the research productivity of professors in the category to which they applied, and committees were asked to take this information into consideration.

2.2 Habilitación

In Spain, committees are composed of seven members. In evaluations for full professorships, all evaluators are full professors based in Spanish universities or research institutes. In evaluations for associate professorships, three committee members are full professors and four evaluators are associate professors. No more than one non-university researcher is allowed to be selected as a member of the committee for a given exam. Similarly, no more than one emeritus professor may be selected as a member of a given committee.

In order to be eligible, evaluators are required to satisfy some minimum research level which is assessed by the Spanish education authority.[9] This requirement is satisfied by approximately 81% of full professors and 70% of associate professors. Unlike the Italian system, where participation is voluntary, in Spain all eligible professors can be selected to serve in committees.

Candidates for evaluation are required to make several oral presentations in front of a committee. For candidates to full professorships, these exams have two qualifying stages. In the first stage, each candidate presents their CV and then, in the second, an example of their research work. Exams for the position of associate professor, in addition to these two stages, have an intermediate stage where candidates give a lecture on a topic randomly chosen from a syllabus proposed by the candidate. In each stage

[9] The Spanish education authority determines professors' eligibility according to the number of *sexenios* completed. *Sexenios* are granted periodically by the ministry on the basis of applicants' research output in any non-interrupted period of a maximum of six years. Eligible associate professors are required to have held at least one *sexenio* while eligible full professors are required to have held at least two *sexenios*.

evaluations are made on a majority basis. Qualifications have unlimited validity once they have been granted. The number of qualifications conceded at the national level is very limited and being accredited is, in most cases, equivalent to being promoted.

3 Data

We use data on all evaluations from the first edition of the Italian *Abilitazione Scientifica Nazionale* and on all evaluations from the Spanish *Habilitación*. In Italy, the data includes information on 184 committees, one per each academic discipline. Each committee assessed both applications to associate and to full professorships. In Spain, there are in total 967 committees in 174 disciplines, of which 502 are committees evaluating candidates for full professorships and 465 evaluate candidates for associate professorships.

The dataset includes information on eligible and actually selected evaluators, applicants, and the final outcome of the evaluation. In addition to demographic characteristics and a number of productivity measures, we have also gathered information on research networks and research specialization. In Appendix A we provide detailed information on how this information was collected, and how each variable was constructed. Below we briefly summarize the main features of the dataset.

3.1 Evaluators

In Italy, 39% of Italian female full professors and 41% of Italian male full professors volunteered and were considered eligible to sit in evaluation committees. The list of eligible evaluators includes 5,876 professors based in Italian universities and 1,365 evaluators based in OECD universities. In the average field, the pool of eligible evaluators includes 32 'Italian' professors and eight 'foreign' professors. While approximately 20% of 'Italian' evaluators are women, the 'foreign' pool is less feminized and only 12% of 'foreign' evaluators are women. Taking into account the composition of both pools, the expected share of women in the committee is around 18%.[10] Approximately one out of every thirteen evaluators resigned and was replaced by another eligible evaluator. These replacements slightly increased the share of women in committees, but the difference is not statistically significant. 41% of committees include no women at all, in 35% of committees there is one woman, and only 8% of committees have a majority of female evaluators.

The CVs of potential evaluators are publicized by the Ministry. Table 1 provides descriptive statistics on the research productivity of evaluators, based on their CVs.[11] Eligible professors have on average 13 years of tenure in the position. They list on average 131 publications in their CVs, of which just over half are articles in scientific journals, and the rest are books, book chapters, publications in conference proceedings, patents, etc. To assess the quality of research output, in STEMM disciplines we compute the total Article Influence Score; in SSH disciplines we measure the number of articles in high impact journals, or A-journals.[12] In columns 2-4 we compare the length of tenure and the research output of male and female evaluators. For this comparison, we normalize all variables at the discipline level. Female evaluators have significantly shorter tenure than their male counterparts and they also have lower research output in almost all dimensions.

In Spain, the lists of eligible evaluators include 49,199 full professors and 61,052 associate professors.[13] Women constitute 35% of eligible associate professors, but only 14% of full professors are women. Overall, 32% of committees are composed by only male evaluators, 39% of committees have one woman on board, while only 6% have more women than men.

[10] We have calculated the expected gender composition of committees using a simulation with 1,000 draws, taking into account that the lottery that decided committee composition was subject to the constraint that committees cannot include more than one member from the same university.

[11] CVs of 'foreign' evaluators are not in a standardized format and are often incomplete, so they are not considered in this paper.

[12] Article Influence Score is available for all journals in the Thomson Reuters Web of Knowledge. It is related to *Impact Factor*, but it takes into account the quality of the citing journals, the propensity to cite across journals and it excludes self-citations.

[13] The Spanish data covers information from several evaluation waves, so many professors appear in the lists several times. In total, there 7,963 individual full professors and 21,979 individual associate professors in these lists.

We collect from several sources information on the research outcomes of Spanish researchers. We observe their publications in international journals covered by the Web of Knowledge and their articles and books in the Spanish language included in the database Dialnet, as well as patents in the European Patent Office in which they are listed as inventors. We also have information on researchers' activity as Ph.D. advisors and as members of dissertation committees. We compare female and male eligible evaluators, normalizing their characteristics at the level of exam and category. The results are very similar to the ones observed for the Italian academia (see columns 6-8 and 10-12 of Table 1). Female eligible evaluators have shorter tenure, and on average they published less than male researchers in the same discipline and rank. They have also lower accumulated quality-adjusted scientific production: women in STEMM disciplines have a relatively lower total Article Influence Score, and women in SSH disciplines have fewer A-journal articles.[14] Among both full and associate professors, women tend to have participated less in advising and evaluating doctoral students.

3.2 Candidates

There were 69,020 applications in Italy. On average, there were 375 applications per field, with 117 of them participating in evaluations for full professor positions and 258 participating in evaluations for associate professor positions. Some candidates applied to more than one position: the average candidate participated in 1.5 evaluations.

As shown in the upper panel of Table 2, 31% of applications for the position of full professor and 41% of applications for the position of associate professor were submitted by women. Candidates for a full professorship are about 49 years old and candidates for an associate professorship are six years younger. Most applicants are based in Italian universities. About a half of applicants for associate professorships hold a permanent contract and about three fourths of applicants for full professorships do. Candidates mainly apply for an evaluation in the field in which they currently hold a permanent

[14] In Spain, we define A-journals following the journal rank developed by Dialnet, which categorizes journals in four groups according to their prestige.

contract.

Female applicants tend to be younger among applicants for associate professorships, and they are of a similar age to their male counterparts in evaluations for full professor (columns 3-5 and 8-10). In both cases the publication record of female candidates is significantly weaker. The only dimension in which women seem to be achieving better results than men is in publishing conference proceedings. In addition to information on productivity coming from candidates' CVs, we observe the order in which candidates submitted their applications. In principle, the timing of the application might reflect both candidates' self-confidence and quality. We normalize this variable uniformly between 0 and 1. We observe that female candidates for the post of full professor apply a bit later than their male counterparts, but no similar gender difference can be observed among candidates for associate professor positions.

In Italy, approximately 14% of applicants (9,870 out of 69,020 applications) withdrew their application once the identity and the criteria of evaluators were made public. Withdrawals were more common among female applicants. Overall, approximately 38% of applications by male candidates and 35% of applications by female candidates were successful.

As explained above, the evaluation agency of the Ministry of Education published detailed information regarding the research production of the final set of applicants in the 10 previous years. Around 38% of candidates were above the median in each of the three corresponding bibliometric dimensions. Performance according to these indicators is strongly correlated with candidates' success. Among those candidates whose quality was below the median in every dimension there was a success rate of only 4%, while among those who excelled in every dimension there was a success rate of 63%.

In addition to the final decision of the committee, we also collected information on the individual evaluation reports.[15] 44% of these reports were favorable to the

[15]We conducted a text analysis of the individual evaluation reports. We identified approximately 9,000 different sentences that indicate the evaluator's decision to fail or to pass a given candidate. These sentences were used in approximately 279,000 of the 295,000 available individual evaluation reports. Due to the data collection problem, we are missing information on individual evaluations for

candidate and most of the time (in 83% of the cases) decisions were taken unanimously.

In Spain, overall there were 13,444 applications for full professorships and 17,799 applications for associate professorships (lower panel of Table 2). The gender ratios among applicants are very similar to the ones in Italy: around 27% of applicants to full professor are women and there are around 40% of women among applicants to associate professor. Once again, male applicants seem to have stronger research records than their female counterparts. They also tend to be slightly more successful in evaluations.

Finally, for the candidates who qualified in Spain, we collected information on their individual research productivity in a five-year period following the national evaluations and on their performance in future evaluations for promotion to full professor. This information allows us to assess the quality of selection not only in terms of candidate characteristics easily observable at the moment of the exam, but also in terms of dimensions that are difficult to observe but that are nevertheless important determinants of future productivity of the candidate.

3.3 Connections

We identify professional links between candidates and eligible evaluators. We consider all the possible interactions within each discipline, around 2.5 million possible pairs in Italy and 5 million in Spain. As shown in Table 3, the probability that a candidate and an eligible evaluator are affiliated to the same institution is around 3% in Italy and 5% in Spain. The probability that they have co-authored a paper is smaller: 1.4% in Italy and 0.4% in Spain.

In the case of Spain, we also observe if there was a student-advisor relationship or if the candidate and the eligible evaluator have participated in the same thesis committee.[16] These links are relatively rare: in 0.2% of the cases the eligible evaluator is the PhD thesis director of the candidate and in 1.3% they have participated in the same thesis committee.

202 candidates.

[16] We consider three possible interactions: (i) the evaluator was a member of candidate's thesis committee, (ii) one of them had invited the other to sit in her students' thesis committee, or (ii) both of them sat in the same student thesis committee.

Male candidates tend to have more coauthors among eligible evaluators and they are more likely to have interacted with an eligible evaluator previously in a thesis committee (Table 3, columns 3-5).

3.4 Research similarity

We also collect information on the overlap of research interests between candidates and eligible evaluators. Due to data availability, there are some differences in how we define research similarity in the two countries. In the case of Italy, we have information on the field and the subfield where all researchers with a permanent contract in an Italian university are officially registered. There are 184 fields (*settore concorsuale*) and approximately 370 subfields (*settore scientifico-disciplinare*).[17] Approximately in 60% of the cases the candidate and the eligible evaluator belong to the same subfield (Table 3).

In the case of Spanish researchers, we infer their research interests using information on their participation in doctoral dissertations, either as authors, advisors, or committee members. In Spain, all doctoral theses are classified in more than two thousand categories.[18] Economics, for example, is divided into one hundred different research fields (e.g.: Labor Economics). We construct a measure of the overlap of the research interests of candidates and evaluators based on the subfield of every dissertation where they have been involved. More precisely we construct the following measure:

$$Overlap_{ij} = \sum_{c} \sqrt{S_i^c S_j^c} \tag{1}$$

where S^c is the ratio of the number of dissertations in category c over the total number of dissertations, in which a certain individual has been involved. This index takes value one if two individuals have participated in dissertations in the same subfields in the

[17] Historically, each Italian researcher was a assigned to certain *settore scientifico-disciplinare*. More recently, upon the introduction of the new system of competitive exams (*abilitazione scientifica nazionale*) researchers were assigned also to a *settore concorsuale*. The correspondence between the two classifications is not always unique, in some cases researchers belonging to the same *settore scientifico-disciplinare* may be assigned to different *settore concorsuale*.

[18] The author of the dissertation selects the subfield using the *International Standard Nomenclature for Fields of Science and Technology*, a system developed by Unesco.

same proportion and value zero if there is no overlap. On average, in our sample the degree of overlap between candidates and evaluators is equal to 0.20. Female candidates are slightly more likely than male candidates to share their research interests with eligible evaluators (Table 3).

4 Empirical analysis

We examine how the gender composition of committees affects the quantity and the quality of male and female candidates who qualify. To achieve a better understanding of the observed patterns, we then explore the potential mechanisms. We examine the role of gender segregation across research networks and across subfields of research, gender stereotypes and taste discrimination. Finally, we use the information provided by individual voting reports in order to explore the interactions that may arise between male and female evaluators

4.1 The impact of committees' gender composition on the chances of success of male and female candidates

We compare the assessments received by male and female applicants and examine how their performance varies with the gender composition of committees. First, we follow an empirical strategy based on observables. Then, we re-examine the data exploiting the random assignment of evaluators to committees.

4.1.1 Descriptive evidence

We estimate the following equation separately for the applicants in the two countries using the ordinary least squares (OLS) method:[19]

$$Y_{ie} = \beta_0 + \beta_1 Female_i + \beta_2 Female_i * Female_e + \mathbf{X_i}\beta_3 + \mu_e + \epsilon_{ie} \qquad (2)$$

[19]Results from probit estimations are very similar and are available upon request. We report the results for the linear probability model because interpreting the interaction effects is simpler.

where Y_{ie} is a dummy variable that takes value one if candidate i qualifies in evaluation e and value zero if the candidate fails to qualify. $Female_i$ is a dummy variable indicating the gender of the candidate and $Female_e$ represents the proportion of women in committee e. $\mathbf{X_i}$ includes observable productivity indicators and individual characteristics. We allow the effect of productivity indicators to vary across disciplinary groups, and the effect of age and contract type to vary across disciplinary groups and levels of promotion. Exam fixed effects (μ_e) control for any differences across exams that might affect the success rate of male and female candidates in a similar way. We cluster standard errors at the committee level.

In Italy, female candidates' success rate is 2.8 percentage points lower than male candidates in the same exam, unconditional on any measure of quality (Table 4, column 1). In Spain the unconditional gender gap is 2.2 percentage points (column 4). Approximately half of the gender gap can be explained by the differences in observable characteristics (columns 2 and 5). It is unclear whether the remaining gap should be attributed to differences in unobservable characteristics or to evaluators discriminatory behavior. Furthermore, the observable individual proxies of quality that we use in our analysis, such as position, affiliation or publications might also be the outcome of discriminatory processes, which would further hinder the interpretation of β_1.

The gender gap does not decrease when candidates are evaluated by committees including more female evaluators (columns 3 and 6). Actually, in both countries female candidates achieve worse results in committees with more female members, and in Italy this effect is statistically different from zero. Again, these estimates are only indicative and they do not necessarily have a causal interpretation. The gender composition of committees tends to reflect the degree of feminization of the field. There may be substantial differences in the (unobservable) quality of male and female candidates across different fields which are not fully captured by our controls. This may bias our analysis in either direction.

4.1.2 Causal evidence

In order to obtain causal estimates of the impact of committees' gender composition, we exploit the exogenous variation in committee composition provided by the random assignment of evaluators to committees. More precisely, we compare the success rate of male and female candidates who initially were expected to face an evaluation committee with the same gender composition but, due to the random draw, were assigned to committees with different gender compositions. To avoid any potential selection biases, we consider the initial pool of applicants and the initial set of evaluators, independently of whether they eventually withdrew their application or they resigned from the committee. We estimate the following equation using OLS:[20]

$$\begin{aligned} Y_{ie} = \beta_0 + \beta_1 Female_i + \beta_2 Female_i * Female_e^{initial} + \\ + \beta_3 Female_i * Female_e^{expected} + \mu_e + \epsilon_{ie} \end{aligned} \quad (3)$$

where $Female_e^{initial}$ represents the share of female evaluators in the committee that was initially randomly drawn, before any evaluator resigned. $Female_e^{expected}$ is the expected share of women in this committee, calculated based on the composition of the pool of eligible evaluators and the rules that determine the draw. Coefficient β_2 captures the causal effect of committees' gender composition upon the success rate of female candidates, relative to male candidates. Since $Female_e^{initial}$ is computed using the initial assignment of evaluators, coefficient β_2 provides an intention-to-treat estimate. In order to increase the accuracy of the estimation, in some specifications we also include information about individual observable productivity and individual characteristics ($\mathbf{X_i}$). Standard errors are clustered at the committee level.

The causal interpretation of β_2 relies on the assumption that the assignment was indeed random. The way in which the randomization was conducted in each country suggests that there was little room for manipulation.[21] Nonetheless, before moving into

[20] Idem.

[21] In Italy, a random sequence of numbers was drawn and was then applied to several disciplines. In Spain, the random draw was carried out publicly on the same day for all disciplines and was certified by the notary.

the discussion of the impact of committees' gender composition on candidates' chances of success, we verify empirically that, conditional on the expected composition of the committee, its actual composition is uncorrelated with any observable predetermined factor. We estimate equation (3) using the eleven predetermined variables that are common for Italian and Spanish databases. As expected, the evidence is consistent with the assignment being indeed random. Out of twenty two coefficients, only one is significantly different from zero at 5% level (Table 5). A joint F-test cannot reject that the difference in quality between female and male candidates is similar across committees with different gender compositions.

Next, we examine the causal impact of committees' gender composition. The estimates are in line with our preliminary results based on observables. In Italy, the proportion of women in committees has a significant negative impact on the relative chances of success of female candidates (Table 6, column 1). In Spain, the effect of female evaluators on the relative success of female candidates is also negative, though it is not significantly different from zero (column 5). These estimates are (statistically) unchanged when we include in the estimation the available information on candidates' research output and other observable characteristics (columns 2 and 6). In columns 3 and 7, we take into account that some evaluators declined to participate in committees. We instrument the final gender composition of the committee using the initial composition determined by the random draw. The results are very similar; if anything, the impact of committees' gender composition is slightly greater. In quantitative terms, in Italy an additional female evaluator decreases the relative chances of success of female candidates by approximately 2.6 percentage points ($\Delta\ Female_e$=1/5). In the Spanish committees, the effect is around 0.2 p.p. ($\Delta\ Female_e$=1/7; $\beta_2 = 0.016$).

To make these two estimates more comparable, it is useful to express them taking into account the average success rate of female candidates in each country and to consider explicitly the upper and the lower bounds of a 95% confidence interval. In Italy, an extra woman on the committee lowers the success rate of women by somewhere between 4% and 11%. In Spain, an extra woman on the committee can lower the success rate of women by at maximum 9%, but she can also increase it by up to 5%. In sum, the impact that women in committees have upon the success rate of female candidates is more negative and more precisely estimated in the Italian case, but we cannot reject that the effect is statistically similar in the two countries.

The range of variation in gender composition that we exploit in our analysis is typically between committees with no women and committees with a minority of women. In Appendix B we also show that within this range there are no significant non-linearities.

4.2 Does the presence of women in the committee affect candidates' decision to apply?

So far we have considered the sample of all initial candidates. Some of these candidates dropped from the evaluation process after committees were formed, perhaps because they anticipated that they had a small chance to qualify and they preferred to avoid the costs associated to failure, and they did not receive an evaluation from the committee.

Therefore, the above estimates may in principle capture the effect that the gender composition of a committee has upon candidates' decision to self-select into the process. To examine this issue, we use data from Italy and estimate equation (2) using as the dependent variable the indicator for those potential candidates who did not withdraw their application. While relatively fewer women decided to go ahead with the application (-2.6 p.p.), these differences are not related to the share of female evaluators (Table 6, column 4). The evidence thus suggests that impact of committees' gender composition on the chances of success of candidates can only be attributed to evaluations.

4.3 Does the presence of women in the committee affect the quality of promoted candidates?

An additional justification for increasing female representation in committees might be that female researchers help to reduce evaluation biases and select better candidates, even though not necessarily more female candidates. To shed light on this issue, we compare the observable quality of candidates who qualified in committees with different gender compositions:

$$x_{ie} = \beta_0 + \beta_1 Female_e + \beta_2 Female_e^{expected} + \epsilon_{ie} \tag{4}$$

where x_{ie} is a proxy of candidate i's quality, measured at the time of the evaluation or during the following five years. We instrument the final gender composition of the committee ($Female$) using the original one ($Female^{initial}$), and we cluster standard errors at the committee level.

We consider several proxies of quality. First, we consider the research output of successful candidates at the time of the evaluation. As shown in Table 7, candidates that were promoted by committees with a different gender composition are at the time of the evaluation statistically similar in terms of the number of papers that they have published, the quality of the journals, the number of students advised or their participation in theses committees.

Using the Spanish data, we also examine the research productivity of successful candidates during the five-year period following the evaluation. Additionally, for the candidates who qualified to positions of associate professor, we check whether they succeeded in obtaining a qualification for full professorship. Once again, we see no evidence that the quality of candidates who qualify is related to the number of women who sat on these candidates' evaluation committees. Overall, we do not observe any indication that committees with more female evaluators select better or worse candidates.

4.4 Mechanisms

The two large-scale randomized natural experiments provide a clear result: increasing the proportion of women in scientific committees does not increase the average success rate of female candidates relative to the success of male candidates. Below, we try to provide a more in-depth examination of the main theoretical arguments discussed in the literature supporting a larger presence of women in committees, and we try to understand why they are not empirically relevant.

4.4.1 Gender segregation across research networks

One of the arguments behind gender quotas is the existence of 'old-boy networks'. If professional connections with committee members help to achieve success and, at the same time, these connections are gendered, female candidates might be at a disadvantage when evaluation committees do not include women.

Previous studies suggest that the presence of strong connections in evaluation committees, as measured by co-authorships, researchers' affiliation, PhD supervisions and participation in doctoral theses committees, have a positive impact on candidates' chances of success (Zinovyeva and Bagues 2015, Bagues, Sylos-Labini and Zinovyeva 2015). The empirical evidence of the previous section shows that the presence of more women in the committee does not increase the relative success rate of female candidates. Is this because in Spain and Italy research networks are not gendered?

We consider all possible pairs between candidates and potential evaluators within a given field and we analyze whether the probability of being linked varies with their gender:

$$Link_{ij} = \beta_0 + \beta_1 Female_i + \beta_2 Female_j + \beta_3 Female_i * Female_j + \mu_{\mathbf{e}} \beta_{\mathbf{4}} + \epsilon_{ij} \quad (5)$$

where $Link_{ij}$ stands for any of the observable links between candidate i and potential evaluator j. $Female_i$ and $Female_j$ are indicators for female candidates and evaluators, and $\mu_{\mathbf{e}}$ are exam fixed effects. Coefficient β_3 in this equation reflects whether female candidates are more likely to be connected with female eligible evaluators than with male ones.

Links are gendered in every observable dimension (Table 8). There is gender segregation across institutions. In Italy, the likelihood of observing a female candidate with the same affiliation as a female professor is 0.3 p.p. (13%) larger than the likelihood of observing a similar link between a female candidate and a male professor. In

Spain, female candidates are 0.4 p.p (9%) more likely to be in the same institution as a female professor, relative to the probability of being affiliated to the same institution as a male professor. Co-authorships are also more likely when individuals share the same sex. In Italy female candidates are 0.2 p.p (19%) more likely to co-author with a female eligible evaluator than with a male one; in Spain the premium is equal to 0.1 p.p. (22%). Similarly, PhD supervisions and participation in PhD committees are also gendered. Female candidates are 0.2 p.p. (20%) more likely to have a female advisor and 1.4 p.p. (10%) more likely to have participated in the same dissertation committee as a female eligible evaluator.

We have shown that there is gender segregation across research networks. Next, we study whether candidates benefit from the presence of a connected evaluator in the committee. Specifically, we estimate the following equation:

$$\begin{aligned} Y_{ie} = \beta_0 + \beta_1 Female_i + \beta_2 Female_i * Female_e + Links_{ie}\beta_3 + \\ + \beta_5 Female_i * Female_e^{expected} + Links_{ie}^{expected}\beta_6 + \mathbf{X_i}\beta_8 + \mu_e + \epsilon_{ie} \end{aligned} \tag{6}$$

where $Links_{ie}$ is a vector including the different types of links between committee members and candidates. We also include as controls the expected proportion of links in the committee and we instrument the final composition of the committee ($Female_e$, $Links_{ie}$) using the outcome of the initial lottery draw. The vector of coefficients β_3 provides information about the causal impact of connections in the committee.

Table 9 reports the results of this analysis. Connections with evaluators are important for promotion. The presence of a colleague in the committee increases the success rate of connected candidates by 3.6 p.p. (10%) in Italy and by 4.5 p.p. (41%) in Spain.The impact of co-authors is slightly larger: 5.0 p.p. (14%) in Italy and 12.5 p.p. (113%) in Spain. Candidates with a advisor in the evaluation committee also enjoy a premium of 9.0 p.p. (82%) and when an evaluator has interacted previously with the candidate in some thesis committee the premium is around 2.5 p.p. (22%). These results are similar to the ones reported in Zinovyeva and Bagues (2015) and Bagues, Sylos-Labini and Zinovyeva (2015).

While connections are gendered and their impact is large, their inclusion as controls in the analysis does not affect significantly our estimates of the effect of evaluators' gender on candidates' success rate (columns 1 and 5 vs. columns 2 and 6). A plausible explanation for why connections, while being gendered, do not affect significantly our estimates may be related to their scarcity in a context of evaluations at the national level. For instance, in Italy the probability that a female candidate and a male evaluator are co-authors is around 1.4%. This probability increases by 0.2 p.p. when the evaluator is also female, which would translate into an increase in the success rate of female candidates by a mere 0.01 p.p.[22] Moreover, as we show in Appendix C, evaluators' support of connected candidates does not depend on their gender.

It is also possible that weaker links between candidates and evaluators, not considered above, are also gendered (for instance, co-authors of co-authors). Nonetheless, the analysis performed by Zinovyeva and Bagues (2015) suggests that these indirect links do not affect evaluation outcomes.

4.4.2 Gender segregation across research subfields

If committee members tend to prefer candidates with similar research interests and, at the same time, men and women are segregated across research subfields, the lack of women in committees might hinder the ability of female candidates to succeed.

We check whether candidates are more likely to have the same research interests as eligible evaluators of the same gender. We estimate equation (5) using as the dependent variable the research similarity between candidates and eligible evaluators. We find gender segregation across research subfields in both countries but its magnitude is relatively small. In Italy, female candidates are 1.7 p.p. (3.5%) more likely to be in the same subfield as a female professor. In Spain, the overlap between female candidates and female eligible evaluators is 0.4 p.p. (2%) larger (Table 8, columns 3 and 8).

Research similarity with evaluators tends to increase candidates' chances of suc-

[22] A back of the envelope calculation suggests that a 0.2 p.p. increase in the probability of having a coauthor in the committee, times the premium associated to the presence of a coauthor in the committee (5.0 p.p.), is equal to 0.01 p.p.

cess, but the effect of female evaluators on female candidates' relative success rate is unchanged when we control in the estimation for research similarity (Table 9). This is consistent with the relatively small level of gender segregation observed within fields. In sum, the gender segregation across research interests is too limited for female candidates to benefit significantly from more female evaluators in the committee.

4.4.3 Stereotypes

An additional theoretical argument in favor of a higher female presence in evaluation committees is that senior male researchers might have stereotypes against female candidates. If senior female researchers do not share these stereotypes, having more women on the committee might reduce the impact of gender prejudices.

Stereotyping might be stronger when evaluators are less informed about candidates' quality. It might be particularly difficult to assess the quality of candidates who do research in subfields that lie far away from evaluators' knowledge. To investigate this issue, we divide evaluations in two groups based on the distance between evaluators' and candidates' research interests. When candidates and evaluators work in similar areas, evaluators' gender is irrelevant (Table 10, first row). However, when candidates do research in a different subfield, female candidates tend to perform relatively worse when there are relatively more women in the committee. This pattern is observed in both countries. If anything, the evidence is more consistent with stereotypes against women being more relevant in gender-mixed committees than in all-male committees.

It is also sometimes argued that stereotyping against women is stronger in sciences and mathematics-related disciplines (Reuben, Sapienza, and Zingales 2014). We compare the effect of female evaluators in STEMM and SSH disciplines, but we do not observe any significant differences between these two groups neither in Spain nor in Italy (second row of Table 10).

One might also expect prejudices against women to be stronger in disciplines that are less feminized and, therefore, offer fewer chances to interact with female researchers. We examine separately disciplines with a relatively low and a relatively high proportion of female full professors. We do not find any evidence suggesting that evaluators in these two groups differ in terms of their preference for candidates of the same sex (third row of Table 10).

4.4.4 High-level positions

The impact of committees' gender composition might also depend on the importance of the position at stake. Taste-based discrimination against women might be stronger when female candidates aspire to a high-level position. Some male evaluators might be reluctant to see a female colleague at the top of the academic career ladder. They might also hold negative stereotypes of women, for instance, regarding their leadership or other abilities specific to full professor positions.

We examine separately the effect of female presence upon the evaluation committee for candidates to full and associate professor positions (fourth row of Table 10). We do not observe any significant differences between these groups of evaluations in Italy, but we do observe a significant difference between exams for full and associate professorships in Spain. Specifically, it appears that in Spain, in committees assessing candidates to full professor positions, a higher female presence has a positive impact on female candidates' relative chances of success. However, the opposite is true in evaluations for promotion to more junior positions.

So, in the case of promotions to full professorships in Spain, but not in Italy, the result is consistent with the existence of stereotypes, or even of taste discrimination, against women by committees with low or no representation of women.

4.4.5 Analysis by disciplinary groups

Beyond these theories, it might be that the gender composition of committees matters in some specific fields. The previous empirical literature on the impact of evaluators' gender does not provide a clear pattern. Two articles conducted in Science and Economics find that evaluators tend to prefer candidates of the same sex (Casadevall and Handelsman 2013 and De Paola and Scoppa 2015) but in two other studies conducted in the same disciplines evaluators exhibit a preference for candidates of the other sex (Broder 1993, Ellemers et al. 2004). Five other articles in different fields do not find any significant relationship, but estimates are in general not precise.[23]

We consider 16 different groups of disciplines: Civil Engineering, Architecture, Geology, Social Sciences, Psychology, Veterinary, Physics, Chemistry, Mathematics, History, Medicine, Biology, Economics and Business, Law, Languages and Industrial Engineering. We estimate equation (3) separately for each group and each country. We report these estimates in Figure 1. Out of 32 coefficients, 21 are not significant, 5 are significantly positive and 6 are significantly negative. However, when we take into account in the calculation of standard errors that we are running multiple regressions using a Bonferroni correction none of the coefficients remains significant. Altogether, it is not possible to reject that the impact is similar to zero in any of the different fields and countries.

Figure 1 also illustrates that estimations on small samples tend to produce estimates of an excessive magnitude (Gelman and Weakliem 2009). In the figure groups are ordered according to their size, from smaller to larger. Estimates tend to be less precise and also larger in absolute terms in the left-hand side of the figure. As the number of available observations in the field increases, the estimate becomes more accurate and also smaller in absolute terms.

4.5 Committee decision-making

So far we have documented that mixed-gender committees are not more favorable towards female candidates than all-male committees. There are several possible explanations. It might be that female evaluators are as biased (or unbiased) as male evaluators. Alternatively, maybe female evaluators are more favorable towards female candidates but they are in a minority and they are unable to have any impact on the decision of the committee. Their presence in the committee might also induce male evaluators to be less favorable towards female candidates.

[23] See more details in Table A1.

To shed light on this issue, we compare the individual evaluations casted by male and female evaluators using the information provided by around 300,000 individual voting reports. We estimate the following equation:

$$V_{ij} = \beta_0 + \beta_1 Female_j + \beta_2 Female_i * Female_j + \mu_i + \epsilon_{ij}, \quad (7)$$

where V_{ij} is a variable that takes value one if evaluator j casted a positive vote for candidate i, while $Female_i$ and $Female_j$ are indicators that capture the gender of the candidate and the evaluator respectively. A vector of candidates' fixed effects μ_i captures any differences in candidates' characteristics that are observable to all evaluators. Female and male evaluators exhibit the same grading standards with male candidates. Female evaluators are 0.6 p.p. (1.3%) more likely to vote in favor of female candidates than male evaluators, but this difference is not statistically different from zero (Table 11, column 1).

Another question that we would like to answer is whether the voting behavior of male evaluators changes when there are more female evaluators on committee. We estimate the following equation to explicitly address this question:

$$\begin{aligned} V_{ije} = {} & \beta_0 + \beta_1 Female_i + \beta_2 Female_j + \beta_3 Female_i * Female_j + \\ & + [\gamma_1 Female_i + \gamma_2 Female_j + \gamma_3 Female_i * Female_j] * Female_e^{final} + \\ & + \mathbf{X_{ie}} \boldsymbol{\beta_4} + \epsilon_{ije}, \end{aligned} \quad (8)$$

where $Female_e^{final}$ represents the share of female evaluators in the evaluation committee. Coefficient β_1 captures whether, in all-male committees, female candidates receive fewer positive votes than male candidates of comparable quality and coefficient γ_1 shows whether this gender gap in votes casted by male evaluators changes when there are female evaluators in the committee. According to our estimates, in all-male committees, male and female evaluators receive similar evaluations ($\beta_1 = 0.004$, st. error=0.007). Each additional female evaluator in the committee decreases the probability that a female candidate receives a positive vote from a male evaluator by 1 p.p., an effect which is marginally significant ($\Delta = 1/5$, $\gamma_1 = -0.048$, st. error=0.028).

5 Conclusions

A larger presence of women in committees is frequently defended in policy discussions. In this paper we analyze how the gender composition of scientific committees affects the chances of success of female and male candidates using the exceptional evidence provided by qualification evaluations for full and associate professorships in every discipline in two different countries, Italy and Spain. These evaluations involved around 100,000 applications and 8,000 evaluators. The random assignment of evaluators to committees creates a setting of large-scale natural randomized experiments.

In general, the presence of female evaluators in the committee neither increases the success rate of female candidates nor it improves the quality of selected candidates. Strikingly, in most subsamples we observe the opposite pattern: committees with more women tend to be less favorable towards female candidates. The only exception are evaluations to full professorships in Spain, where female candidates have better chances of success when they are evaluated by a committee with more women.

We explore why the standard theoretical arguments that are usually employed in support of a higher representation of women in scientific committees do not hold in this context. We observe some gender segregation in research interests, but its magnitude is relatively small. Women are 2-4% more likely to do research in the same subfield as a female evaluator than a male evaluator. Evaluators tend to have a preference for candidates with similar research interests but overall the impact of gender segregation across research subfields on evaluation outcomes is very limited.

We also document that in Italy and in Spain there exists gender segregation across research networks. Female candidates are significantly more likely to be connected to female evaluators than to male evaluators as measured by co-authorships, affiliation, thesis advisor and participation in theses committees. This difference is large (10%-20%) but, in the context of the nation-wide evaluations that we consider in this paper, the likelihood of having a connection in the evaluation committee is small and thus the impact of gendered networks on evaluations is again limited.

Another justification for increasing the presence of women in committees is that male evaluators may hold stereotypes that have a negative effect upon female candidates. In order to explore the potential impact of gender stereotypes, we focus on cases where evaluators are not familiar with the research profile of the candidate. When information asymmetries are important, gender-mixed committees are less favorable towards women than all-male committees. One possible explanation is that female evaluators hold stronger stereotypes against women than male evaluators. Another interpretation of the evidence is that the presence of women in the committee affects male evaluators behavior. As soon as a woman colleague joins the committee, men perhaps reduce their commitment for gender equality, or it might also be that their male identity is strengthened (Akerlof and Kranton 2000). Information from individual votes within committees provides support for the later hypothesis. Female evaluators are, if anything, relatively more favorable towards female candidates, and male evaluators become less favorable towards female candidates when women are present in the committee, although this result is only significant at the 10% level.

Several countries have introduced quotas in scientific committees requiring the presence of a minimum share of male and female evaluators. There are certain features of quotas that are not captured by our analysis. Evaluators that are explicitly chosen to represent a minority might behave differently, perhaps being more inclined to take a positive view of candidates belonging to their own group. Moreover, the introduction of quotas may affect the strategic incentives of evaluators. Nonetheless, keeping in mind these limitations, our results cast doubts on a generalized implementation of gender quotas in scientific committees. According to our results, a higher representation of women in scientific committees neither increases the number of promoted female candidates nor helps to promote candidates that prove to be more productive in the future, and it might also have unintended consequences. Quotas may be detrimental for senior female researchers, who would have to spend more time sitting on committees and, in some cases, for junior ones, who may even experience a reduction in their chances of success.

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Table 1: Descriptive statistics – Eligible evaluators

	1	2	3	4	5	6	7	8	9	10	11	12
	Italy				**Spain**							
	Full professors				Full professors				Associate professors			
	All	Male	Female	p-value	All	Male	Female	p-value	All	Male	Female	p-value
Female	0.20				0.14				0.35			
Tenure in position	13	0.05	-0.24	0.000	13	0.05	-0.33	0.000	10	0.01	-0.03	0.000
Age	-				52	0.00	-0.03	0.010	45	0.01	-0.02	0.001
All Publications:	131	0.03	-0.14	0.000	34	0.02	-0.14	0.000	14	0.05	-0.09	0.000
- Articles	72	0.04	-0.18	0.000	30	0.02	-0.14	0.000	12	0.05	-0.10	0.000
- Books	5	0.04	-0.16	0.000	1	0.01	-0.06	0.000	0.44	0.01	-0.02	0.000
- Book chapters	20	0.01	-0.06	0.004	3	0.01	-0.07	0.000	1	0.01	-0.01	0.003
- Conference proceedings	23	-0.00	0.01	0.545	-				-			
- Patents	0.42	0.00	-0.01	0.527	0.10	0.00	-0.02	0.001	0.04	0.01	-0.02	0.000
- Other	11	0.02	-0.07	0.001	-				-			
Total Article Influence Score	132	0.03	-0.20	0.000	33	0.01	-0.10	0.000	12	0.03	-0.07	0.000
A-journal articles	12	0.04	-0.12	0.000	4	0.03	-0.15	0.000	2	0.04	-0.06	0.000
PhD students advised	-				5	0.03	-0.20	0.000	1	0.08	-0.15	0.000
PhD committees	-				25	0.05	-0.33	0.000	5	0.07	-0.13	0.000
Observations	5,876				49,199				61,052			

Notes: The table provides descriptive information for the pool of eligible evaluators in qualification exams in Italy and in Spain. In Italy it includes only evaluators who are based in an Italian university. *Article Influence Score* is only available for candidates in science, technology, engineering, mathematics and medicine. Information on publications in *A-journal articles* is only provided for candidates in social sciences and humanities. Columns 1, 5 and 9 report mean values for each corresponding variable and sample. In columns 2, 3, 6, 7, 10 and 11 variables have been normalized to have zero mean and unit variance for individuals within each field and rank. Columns 4, 8 and 12 report the p-value of a t-test of the difference in means between male and female eligible evaluators in the corresponding variable.

Table 2: Descriptive statistics – Applications

	1	2	3	4	5	6	7	8	9	10
	Applications to full professorships					Applications to associate professorships				
	Mean	St.Dev.	Male	Female	p-value	Mean	St.Dev.	Male	Female	p-value
					Italy					
Female	0.31	0.46				0.41	0.49			
Age	49	8	-0.01	0.01	0.205	43	7	0.02	-0.03	0.000
Based in a national university	0.96	0.19	0.96	0.98	0.000	0.96	0.18	0.96	0.97	0.000
Permanent position:	0.74	0.44	0.72	0.77	0.000	0.47	0.50	0.46	0.48	0.000
- same field	0.77	0.42	0.76	0.80	0.000	0.74	0.44	0.72	0.76	0.000
Application order	0.50	0.29	0.50	0.51	0.012	0.50	0.29	0.50	0.50	0.717
CV length (pages)	20	79	-0.01	0.03	0.006	14	60	-0.03	0.04	0.000
All Publications:	89	83	0.04	-0.09	0.000	53	54	0.04	-0.06	0.000
- Articles	52	65	0.06	-0.14	0.000	29	41	0.07	-0.10	0.000
- Books	2	4	0.04	-0.09	0.000	1	2	0.05	-0.08	0.000
- Book chapters	9	13	0.01	-0.03	0.000	5	8	0.01	-0.02	0.004
- Conference proceedings	17	32	-0.01	0.03	0.002	11	21	-0.01	0.02	0.000
- Patents	0.35	2.09	0.01	-0.03	0.000	0.19	1.39	0.03	-0.04	0.000
- Other	8	21	0.01	-0.02	0.037	6	16	0.01	-0.01	0.048
Number of coauthors per article	5	6	-0.01	0.03	0.003	5	6	-0.03	0.04	0.000
First-authored	0.22	0.19	-0.01	0.02	0.039	0.22	0.2	0.00	-0.01	0.324
Last-authored	0.15	0.17	0.02	-0.04	0.000	0.11	0.16	0.02	-0.03	0.000
Average Article Influence Score	1.28	0.93	0.03	-0.09	0.000	1.28	0.98	0.03	-0.04	0.000
A-journal articles	6	10	0.04	-0.08	0.000	4	6	0.03	-0.04	0.000
Qualified	0.36	0.48	0.37	0.34	0.000	0.37	0.48	0.38	0.35	0.000
Failure	0.48	0.50	0.48	0.46	0.013	0.50	0.50	0.5	0.5	0.969
Withdrawal	0.16	0.37	0.15	0.20	0.000	0.13	0.34	0.12	0.16	0.000
Proportion of positive votes	0.47	0.46	0.47	0.46	0.242	0.45	0.47	0.46	0.44	0.000
Number of applications	21,594					47,426				
					Spain					
Female	0.27	0.44				0.40	0.49			
Age	46	6	-0.01	0.03	0.015	37	6	0.03	-0.05	0.000
All Publications:	19	21	0.03	-0.09	0.000	8	14	0.07	-0.10	0.000
- Articles	17	21	0.04	-0.09	0.000	7	14	0.07	-0.11	0.000
- Books	0.64	1.47	0.01	-0.03	0.005	0.21	0.65	0.02	-0.02	0.000
- Book chapters	1.57	3.18	0.01	-0.02	0.086	0.54	1.41	0.01	-0.01	0.025
- Patents	0.04	0.33	0.00	0.00	0.919	0.02	0.22	0.01	-0.01	0.012
Number of coauthors per article	3	10	0.00	0.01	0.691	5	23	0.00	0.00	0.863
First-authored	0.25	0.31	0.00	0.00	0.862	0.26	0.34	0.01	-0.01	0.200
Last-authored	0.24	0.30	0.01	-0.02	0.220	0.17	0.30	0.03	-0.05	0.000
Average Article Influence Score	0.75	0.43	-0.01	0.02	0.458	0.72	0.54	0.03	-0.06	0.000
A-journal articles	3	5	0.05	-0.10	0.000	1	2	0.06	-0.06	0.000
PhD students advised	2	3	0.03	-0.09	0.000	0.24	0.88	0.03	-0.05	0.000
PhD committees	7	9	0.03	-0.08	0.000	1	3	0.05	-0.08	0.000
Qualified	0.11	0.31	0.11	0.09	0.003	0.12	0.32	0.12	0.11	0.025
Number of applications	13,444					17,799				

Notes: Article Influence Score is only available for candidates in science, technology, engineering, mathematics and medicine. Information on publications in *A-journal articles* is only provided for candidates in social sciences and humanities. Columns 1 and 6 report mean values for each corresponding variable and sample. In columns 3, 4, 8, and 9 all productivity variables have been normalized to have zero mean and unit variance for applications within each exam. Columns 5 and 10 report the p-value of a t-test of the difference in means between male and female candidates in the corresponding variable.

Table 3: Descriptive statistics – Links and Research Overlap

	1	2	3	4	5
	All		Male	Female	
Italy	N	Mean	Mean	Mean	p-value
Colleagues	2,555,839	0.028	0.027	0.030	0.000
Coauthors	2,555,839	0.014	0.015	0.014	0.000
Same subfield	1,373,790	0.598	0.597	0.599	0.022
Spain					
Colleagues	5,445,067	0.046	0.047	0.043	0.000
Coauthors	5,445,067	0.004	0.005	0.004	0.000
PhD advisor	5,445,067	0.002	0.002	0.002	0.322
PhD thesis committee	5,445,067	0.013	0.014	0.011	0.000
Overlap in research interests	4,711,621	0.201	0.189	0.221	0.000

Notes: The table provides information on links between candidates and eligible evaluators within each discipline. Information about research interests is only available for candidates with a permanent contract in an Italian university and for candidates who have defended their thesis in Spain or who have participated in a thesis committee in Spain. The variable *Same subfield* takes value one if a candidate and an eligible evaluator belong to the same subfield (*settore scientifico-disciplinare*). The variable *Overlap in research interests* measures the degree of overlap between the research interests of eligible evaluators and candidates, as measured by their participation in PhD thesis committees.

Table 4: Success rate by gender of candidates and evaluators

	1	2	3	4	5	6
	Italy			Spain		
Female	-0.028***	-0.016***	-0.006	-0.022***	-0.014***	-0.012**
	(0.006)	(0.005)	(0.007)	(0.004)	(0.004)	(0.006)
Female * Share of women in committee			-0.050**			-0.010
			(0.025)			(0.022)
Controls:						
Candidate characteristics	No	Yes	Yes	No	Yes	Yes
Adj. R-squared	0.081	0.303	0.303	0.006	0.040	0.040
Number of observations	69020	69020	69020	31243	31243	31243

Notes: OLS estimates. All regressions include exam fixed effects. *Candidate characteristics* include all individual predetermined characteristics listed in Table 2. Standard errors are clustered by exam.
* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 5: Randomization check

	1	2	3	4	5	6	7	8	9	10	11
Dependent variable:	All Publ.	Articles	Books	Chapters	Patents	Total AIS	A-journal articles	Coauthors per article	Prop. first-author	Prop. last-author	Age
	Italy										
Female*Share of women in committee	-0.035	0.009	0.071	0.082	-0.046	0.012	-0.077	-0.037	0.102*	0.037	0.153*
	(0.085)	(0.078)	(0.070)	(0.065)	(0.054)	(0.068)	(0.065)	(0.070)	(0.058)	(0.097)	(0.088)
	Spain										
Female*Share of women in committee	0.011	0.037	-0.022	-0.013	-0.073	0.173**	0.049	0.120	0.053	0.047	-0.110
	(0.090)	(0.092)	(0.064)	(0.065)	(0.046)	(0.080)	(0.066)	(0.090)	(0.093)	(0.094)	(0.102)

Notes: OLS estimates. All regressions include exam fixed effects and the interaction between the variables *Female candidate* and the *Expected share of women in committee*. Standard errors are clustered by exam.
* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 6: The causal impact of committees' gender composition

	1	2	3	4	5	6	7
	Italy				Spain		
Dependent variable:	Qualified			Applied	Qualified		
	OLS	OLS	IV	IV	OLS	OLS	IV
Female candidate	-0.015	0.003	0.009	-0.026***	-.022***	-0.011*	-0.011*
	(0.009)	(0.006)	(0.008)	(0.006)	(0.007)	(0.007)	(0.007)
Female candidate* Share of women in committee	-0.073**	-0.107***	-0.132***	-0.025	-0.001	-0.015	-0.016
	(0.036)	(0.026)	(0.035)	(0.026)	(0.029)	(0.028)	(0.028)
Controls:							
Candidate characteristics	No	Yes	Yes	Yes	No	Yes	Yes
Number of observations	69020	69020	69020	69020	31243	31243	31243
Mean dep. var. for female candidates	0.35	0.35	0.35	0.83	0.11	0.11	0.11

Notes: All regressions include exam fixed effects and the interaction between the variables *Female candidate* and the *Expected share of women in committee*. *Candidate characteristics* include all individual predetermined characteristics listed in Table 2. Standard errors are clustered by exam.
* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 7: Quality of qualified candidates

	1	2	3	4	5	6	7
Dep. var.:	Publications	Citations	Total AIS	A-journal articles	PhD students advised	PhD thesis committees	Success in future evaluations
	A. Italy, before the evaluation						
All	0.001	0.123	-0.117	-0.186			
	(0.060)	(0.102)	(0.134)	(0.183)			
Women	-0.017	0.148	-0.020	-0.300			
	(0.078)	(0.114)	(0.137)	(0.234)			
Men	-0.008	0.084	-0.203	-0.071			
	(0.083)	(0.129)	(0.187)	(0.186)			
	B. Spain, before the evaluation						
All	-0.004	0.068	-0.082	-0.200	0.121	-0.143	
	(0.142)	(0.216)	(0.237)	(0.244)	(0.135)	(0.131)	
Women	0.171	0.446	-0.004	-0.142	0.565**	0.052	
	(0.216)	(0.396)	(0.426)	(0.357)	(0.239)	(0.230)	
Men	-0.149	-0.225	-0.201	-0.218	-0.163	-0.291*	
	(0.191)	(0.282)	(0.292)	(0.349)	(0.175)	(0.168)	
	C. Spain, after the evaluation						
All	-0.005	-0.056	-0.092	-0.200	0.169	-0.083	0.040
	(0.131)	(0.211)	(0.219)	(0.244)	(0.133)	(0.135)	(0.052)
Women	0.248	-0.009	-0.097	-0.142	0.116	-0.114	0.001
	(0.220)	(0.380)	(0.401)	(0.357)	(0.222)	(0.243)	(0.056)
Men	-0.167	-0.131	-0.230	-0.218	0.077	-0.129	0.018
	(0.181)	(0.273)	(0.275)	(0.349)	(0.189)	(0.184)	(0.076)

Notes: OLS estimates for the sample of qualified candidates. Each coefficient corresponds to an independent regression for a given sample and dependent variable. In panels A and B the dependent variables are measured at the time of the evaluation. In panel C the dependent variables refer to the output in the five-year period following the evaluation. Success in future evaluations takes value one if a candidate who obtained a qualification for an associate professorship in our sample, qualifies in the evaluation for full professorship by year 2013. The dependent variables in columns 1-6 are normalized to have zero mean and unit variance for candidates within each exam. *Article Influence Score* is only available for candidates in science, technology, engineering, mathematics and medicine. Information on publications in *A-journal articles* is only provided for candidates in social sciences and humanities. All regressions include non-parametric controls for *expected share of women in the committee*, *disciplinary area*rank*, and *age*. Standard errors are clustered by exam.
* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 8: Gender segregation across research networks and subfields

	1	2	3	4	5	6	7	8
	Italy			Spain				
	Colleague	Coauthor	Same subfield	Colleague	Coauthor	PhD Advisor	PhD committee	Research overlap
Female candidate	0.0020***	0.0005**	0.0162***	-0.0012	-0.0003*	-0.0001	-0.0010***	0.0052*
	(0.0003)	(0.0002)	(0.0050)	(0.0014)	(0.0002)	(0.0001)	(0.0003)	(0.0027)
Female evaluator	0.0033***	-0.0004	0.0325***	0.0006	-0.0015***	-0.0013***	-0.0047***	-0.0106***
	(0.0008)	(0.0004)	(0.0123)	(0.0014)	(0.0002)	(0.0002)	(0.0006)	(0.0016)
Female candidate*	0.0030***	0.0022***	0.0167**	0.0043***	0.0010**	0.0005***	0.0013***	0.0040*
Female evaluator	(0.0007)	(0.0004)	(0.0070)	(0.0016)	(0.0002)	(0.0002)	(0.0005)	(0.0020)
Constant	0.0210***	0.0112***	0.4753***	0.0453***	0.0045***	0.0025***	0.0142***	0.2010***
	(0.0002)	(0.0001)	(0.0032)	(0.0001)	(0.0000)	(0.0000)	(0.0002)	(0.0010)
Observations	3,143,428	3,143,428	1,679,376	5,445,067	5,445,067	5,445,067	5,445,067	4,711,621

Notes: OLS estimates. The number of observations corresponds to the number of possible pairs between candidates and eligible evaluators with non-missing information in a given exam. All regressions include exam fixed effects. Standard errors are clustered by candidate.
* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 9: Connections and research similarity

	1	2	3	4	5	6	7	8
	Italy				Spain			
Female candidate	0.009	0.006	-0.007	-0.008	-0.011*	-0.011	-0.011	-0.012
	(0.008)	(0.008)	(0.009)	(0.009)	(0.007)	(0.007)	(0.008)	(0.008)
Female candidate * Share of female evaluators	-0.132***	-0.127***	-0.070	-0.069	-0.016	-0.019	-0.015	-0.020
	(0.035)	(0.034)	(0.047)	(0.046)	(0.028)	(0.028)	(0.035)	(0.035)
Connections in committee:								
Colleagues		0.180***		0.181***		0.318***		0.317***
		(0.037)		(0.044)		(0.031)		(0.031)
Coauthors		0.251***		0.221***		0.872***		0.837***
		(0.048)		(0.054)		(0.140)		(0.142)
PhD advisors						0.633***		0.570***
						(0.107)		(0.115)
PhD thesis committee						0.173***		0.162***
						(0.037)		(0.038)
Research similarity:								
Same subfield				0.049				
				(0.032)				
Overlap in research interests								0.156***
								(0.041)
Controls:								
Expected connections		Yes		Yes		Yes		Yes
Expected same subfield				Yes				
Expected overlap in research interests								Yes
Number of observations	69020	69020	35831	35831	31243	31243	27998	27998

Notes: The final share of female evaluators is instrumented by the initial share of female evaluators in the committee. All regressions include exam fixed-effects, an interaction between *Female candidate* and the *Expected share of women in committee*, and controls for all individual predetermined characteristics listed in Table 2. Connection variables are measured in shares. *PhD thesis committee* refers to candidates and evaluators who have been members of the same doctoral thesis committee. *Same subfield* is the share of evaluators who belong to the same subfield (*settore scientifico disciplinario*) as the candidate. *Overlap in research interests* is based on evaluators' and candidates' participation in doctoral thesis committees, which are classified in 2,000 different subfields (see more details in Data section). *Expected connections* is a vector including the expected share in the committee of *colleagues*, *coauthors*, *advisors* and *PhD thesis committee*. Standard errors are clustered by exam.
* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 10: Heterogeneity analysis

	1	2	3	4
	Italy		Spain	
Research overlap	*> median*	*< median*	*> median*	*< median*
	0.007	-0.193***	0.063	-0.110**
	(0.046)	(0.067)	(0.048)	(0.043)
Discipline	SSH	STEMM	SSH	STEMM
	-0.117**	-0.135***	-0.026	0.003
	(0.053)	(0.039)	(0.039)	(0.041)
Feminization of field	*> median*	*< median*	*> median*	*< median*
	-0.152***	-0.077	-0.018	-0.016
	(0.042)	(0.056)	(0.040)	(0.037)
Level of promotion	FP	AP	FP	AP
	-0.107*	-0.144***	0.121**	-0.072**
	(0.058)	(0.038)	(0.054)	(0.032)

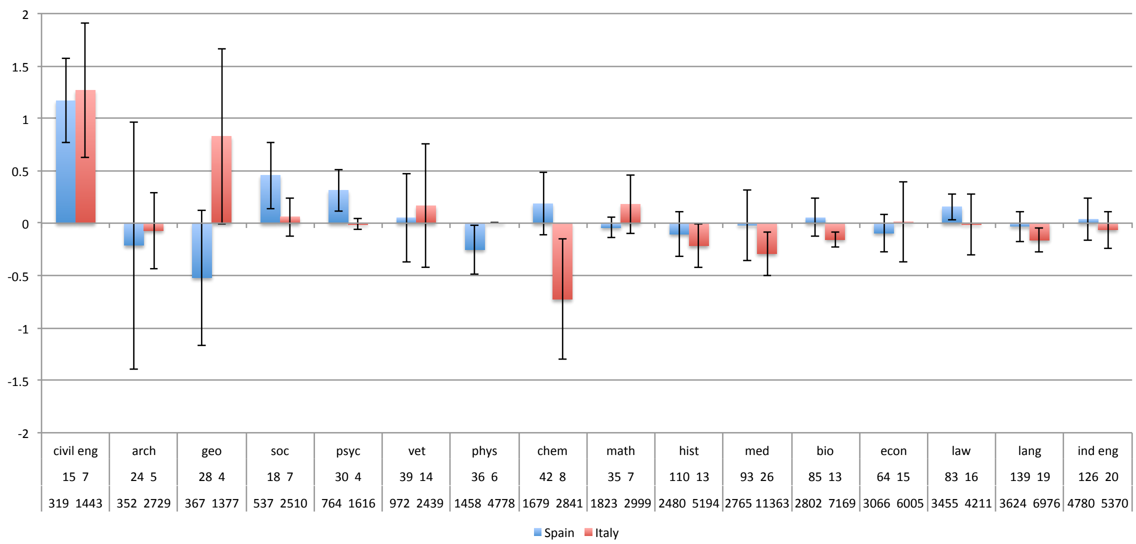
Notes: IV estimates. The dependent variable is a dummy variable that takes value one if the candidate qualified. Each coefficient corresponds to an independent regression for the corresponding sample. SSH stands for social sciences and humanities, and STEMM for science, technology, engineering, mathematics and medicine. The feminization of the field is measured by the proportion of women among full professors in the discipline. FP and AP stand, respectively, for full and associate professors. Standard errors are clustered by exam.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 11: Individual voting

	1	2
Female evaluator	0.001	-0.001
	(0.010)	(0.014)
Female candidate	-	0.004
		(0.007)
Female candidate * Female evaluator	0.006	0.003
	(0.006)	(0.013)
Female candidate * Share of women in committee		-0.048*
		(0.028)
Controls:		
Application FE	Yes	No
Adj. R-squared	0.846	0.411
N	279,427	279,427

Notes: OLS estimates. All regressions include as controls exam fixed-effects and individual predetermined characteristics listed in Table 2. The regression reported in column 2 also includes controls (non-reported) for *Female evaluator*Share of women in committee* and *Female candidate*Female evaluator*Share of women in committee*. Standard errors are clustered by exam.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 1: The causal impact of committees gender composition, by disciplinary group



Note: The figure reports the causal estimates of the effect of a higher proportion of women among evaluators on the relative success rate of female candidates in the corresponding disciplinary group and country. The confidence internals are based on committee-clustered standard errors and they are not adjusted for multiple comparisons. At the bottom of the figure, the number of committees and the number of candidates in a corresponding group are shown. The disciplinary groups are sorted according to the number of applicants in each group in Spain.

Appendix A. Data

The data on the participants in Italian evaluations, including the CV of all eligible evaluators and all candidates, was available at the website of the Italian Ministry of Higher Education and Research. We extracted all the individual characteristics that we use in the analysis from these CVs.

The data on the participants in Spanish evaluations was collected from different sources, including the Spanish Ministry of Research and Science, Thomson Reuters (ISI) Web of Knowledge, the database of publications in Spanish language Dialnet, the European Patent Office and TESEO database on doctoral dissertations.[24]

Publications indexed in above sources are matched to the list of professors in Spain based on individuals' names and field of research. This process suffers from an important problem with homonymity since there are lots of common surnames in Spain. In addition to this, bibliographic databases often incompletely record authors' names (this especially concerns the data on publications before 2010 in the Web of Knowledge). Facing the choice between minimizing the number of false positives or the number of false negatives, we generally preferred the former. This means that, on the one hand, the individuals are authors of the outcomes assigned. On the other hand, we are unable to assign research outputs that have an incomplete record of authors' names.

Below we describe in detail the process of data collection in the case of Spain.

Spanish Ministry of Research and Science The Spanish system of centralized examinations known as 'habilitación' was in place between 2002 and 2006. In total, 1,016 exams took place, around five per discipline. We restrict the sample in several ways. We exclude exams where the number of available positions was larger or equal than the number of candidates (two exams, both in Basque Philology) and disciplines where the number of potential evaluators was not large enough to form a committee (55 exams).[25] The final database includes 967 exams.

[24]The would like to thank Stéphane Maraut and Catalina Martinez for kindly sharing the data on academic inventors who have patented their inventions in the European Patent Office. See Maraut and Martínez (2014) for the description of how the patent data was collected and matched to professors.

[25]In these cases, unfilled seats in the committee were filled with professors from related disciplines.

Information on candidates' and evaluators' first name, last name, tenure and ID number was retrieved from the website of the Ministry of Research and Science in July 2009 (`http://www.micinn.es`). We used first name information in order to identify gender. In a few cases where it was not possible to assign gender based on first name, we searched online for any personal picture or document that would make it possible to assign gender.

The actual age of individuals is not observable. Instead, we exploit the fact that Spanish ID numbers contain information on their issue date to construct a proxy for the age of native individuals on the basis of his/her national ID number. In Spain, police stations are given a range of ID numbers which are assigned to individuals in a sequential manner. Since it is compulsory for all Spaniards to have an ID number by age 14, two Spaniards with similar ID numbers are likely to be of the same age (and geographical origin).[26] In order to perform the assignment, we first use registry information on the date of birth and ID numbers of 1.8 million individuals in order to create a correspondence table which assigns year of birth to the first four digits of ID number (ranges of 10,000 numbers). To test the precision of this correspondence, we apply it to a publicly available list of 3,000 court clerks, which contains both the ID number and the date of birth. In 95% of the cases the assigned age is within a three-year interval of the actual age. In order to minimize potential errors, whenever our age proxy indicated that a candidates for an associate professorship is less than 27 years old and a candidate for full professorship is less than 35 years old, we assign age a missing value. This proxy is also not defined for non-Spaniards (less than 1% of the sample). We imputed the missing age with the average age of individuals at the same discipline and rank (around 5% of the sample).

In 2006 the system of *habilitación* was replaced by a system known as *acreditación*, which is still in place. Under the *acreditación* system applicants aspiring for promotion

[26]There are a number of exceptions. For instance, this methodology will fail to identify the age of individuals who obtained their nationality when they were older than 14. Nevertheless, immigration was a rare phenomenon in Spain until the late 1990s. Additionally, some parents may have their children obtain an ID number before they are 14. This may be the case particularly after Spain entered in the mid 90s the Schengen zone and IDs became a valid documentation to travel to a number of European countries.

are also required to be approved by a national review committee. These committees evaluate candidacies on a monthly basis and their decisions are published in the Official State Bulletin. We collected information on the identity of all candidates that qualified for a FP position before September 2013.

The Ministry provides information on affiliation and on tenure in the position for eligible evaluators. Given that most candidates to full professor positions are eligible evaluators themselves in exams to associate professor positions, it is possible to obtain their affiliation by matching the list of eligible evaluators with the list of candidates. Using this procedure, we were able to obtain the information on affiliation for 93% of candidates to full professor positions. We obtained the information on affiliation for the remaining 7% of candidates from the State Official Bulletin or directly from professors' CVs that can be found online.

ISI Web of Knowledge We also collected information on the research output of eligible evaluators and candidates from the ISI Web of Knowledge.[27]

Information on scientific publications comes from the Thomson Reuters ISI Web of Knowledge (WoK). We consider publications published since 1972 by authors based in Spain, as well as the number of citations received by these publications before July 2009. The WoK database includes over 10,000 high-impact journals in the categories of Science, Engineering, Medicine and Social Sciences, as well as international proceedings coverage for over 110,000 conferences. For the purpose of this analysis, we considered all articles, reviews, notes and proceedings.

The assignment of articles to professors is non-trivial. For each publication and author, WoS provides information on his/her surname and on his/her initial. In Spain, some surnames are very common (e.g., Garcia, Fernandez, Gonzalez), and this may create problems with homonymity. Moreover, unlike most other countries, individuals are assigned two surnames (paternal and maternal) and sometimes also several first names. When Spanish authors sign a paper they may do it with only their paternal or

[27]We are grateful to the *Fundación Española para la Ciencia y la Tecnología* for providing us with access to the data.

with their maternal surname, or they may hyphenate the two surnames. Authors may also sign using their first name, their middle name, or both.

We use the following matching procedure in order to deal with the above problems. First, we assign all publications and all professors in our sample to a broad disciplinary category. In order to attribute comparable disciplinary categories for publications and individuals, we aggregate disciplines defined by the Spanish Ministry and ISI disciplinary areas into the following categories: Agriculture; Chemistry; Biology; Geology; Physics; Mathematics and Computer Science; Engineering; Medicine, Veterinary and Pharmacology; Economics and Management; Psychology, Sociology and Political Science.[28] Second, in each broad disciplinary category we match publications with individuals in our database using the information on their surnames and initials.

Specifically, the publication is assigned to a professor in the list of eligible evaluators if it is in the same disciplinary category as the professor, and the author's surname and initial, as reported by ISI, coincide (i) with the first surname and the first name's initial of the professor, (ii) with the last surname and the first initial, (iii) with the first surname hyphenated with the second surname and the first initial. We also repeat stages (i) through (iii) substituting the first initial with the middle-name initial. If a given publication can be assigned to more than one possible match, the value of this publication is divided by the number of such possible matches.

Given that the propensity to publish differs substantially across the disciplines, we normalize the number of individual's publications to have zero mean and unit standard deviation among applicants to the same exam and among eligible evaluators of a given category in a given exam. The number of citations of each publication depends on the time elapsed between the publication date and the date when the number of received citations is observed. Therefore, we first normalize the number of citations that each publication receives by subtracting the average number of citations received by Spanish-authored articles published in the corresponding ISI disciplinary

[28] In practice, apart from the case of journals *Science* and *Nature*, the ISI scientific categories are assigned to journals, not publications. In very rare cases a publication happened to be assigned to more than one broad disciplinary group.

area in the same year and then dividing by the corresponding standard deviation. Next, for each individual in our database we calculate the average number of citations per publication. For individuals who have no ISI publications, this variable takes the minimum value in the corresponding discipline. Finally, similarly to the number of publications, we normalize the number of individual's citations per publication to have zero mean and unit standard deviation among applicants to the same exam and among eligible evaluators of a given category in a given exam.

Dialnet Dialnet (`http://dialnet.unirioja.es`) is an open access bibliographic index created by the University of Rioja. It contains information on more than 8,000 journals and more than 3,5 million documents in Hispanic languages, including articles published in scientific journals, collective works and books. The database mainly covers publications in social sciences and humanities. Dialnet provides (in most cases) systematized information on individual authors' first name, paternal surname, maternal surname and affiliation, thus limiting potential concerns about homonymity.

We collected information on publications in Dialnet. Due to its lack of representativeness, we did not considered publications in Science and Engineering. We also excluded publications that appear in ISI Web of Science. We also restricted the set of journals considered to those which satisfy certain minimum research quality requirements (categories A, B or C) as established by the Integrated Scientific Journals Classification (CIRC) (Torres-Salinas et al. 2010). Similarly, we considered only books and collective volumes that are published by publishers that satisfy a minimum quality requirement. In particular, we used the EPUC-CSIC publisher list, which summarizes the names of the main publishers in social sciences and humanities in Spain and abroad (Giménez-Toledo, Tejada-Artigas and Mañana-Rodríguez 2012). Publications that have been excluded from our study are mainly publications in working paper series, non-refereed journals and volumes published by local universities (around 30%).

Teseo database on doctoral dissertations Since 1977, PhD candidates in Spanish universities have registered their dissertation in the database TESEO, which is run by the Ministry of Education. We retrieved all the information available in this database from the website https://www.educacion.gob.es/teseo in May 2011. While registration is compulsory, according to Fuentes and Arguimbau (2010) TESEO includes information on approximately 90% of all dissertations read in Spain during this period. We observe information on 151,483 dissertations. TESEO provides the identity and affiliation of dissertations' authors, advisors and committee members. Approximately 40% of dissertations are female authored. Female supervisors are scarce and represent only 18% of the total. While 58% of the students they supervise are female, in the case of male advisors, 61% of their students are male.

We match TESEO data with the list of candidates and evaluators. In exams to full professor positions we are able to find the dissertation of 71% of candidates and 41% of evaluators. In exams to associate professor positions we observe the dissertation of 83% of candidates and 70% of evaluators. Missing information may be due to the fact that individuals (i) did their PhD abroad, (ii) defended their dissertation before 1977, (iii) there are spelling mistakes, (iv) the dissertation was not included in TESEO for unknown reasons (approximately 10% of all dissertations), or (v) there was a problem with homonymity (in our dataset 0.1% of individuals share the same name, middle name, paternal surname and maternal surname).

Each thesis has been classified by its author using the Unesco International Standard Nomenclature for Fields of Science and Technology. This is a system developed by Unesco that includes more than two thousand six-digits categories.[29] 80% of dissertations provide this information. Approximately half of the authors select one six-digit category, 35% select two categories, and 15% select three or more categories. There are on average around one hundred dissertations per category. We use this information to construct a measure of individuals' research interests. In particular, we take into account every dissertation where an individual appears as an advisor, committee member or author. We were able to obtain information on the research interests of 98% candidates to full professor positions, 94% of candidates to full professor positions,

[29] Available at http://unesdoc.unesco.org/images/0008/000829/082946eb.pdf

98% of eligible full professors and 96% of eligible associate professors.

Appendix B. Nonlinearities

The effect of the gender composition of committee on the relative success rate of females may be non-linear for a number of reasons. First, the presence of a woman in the committee may affect the voting behavior of male evaluators (see section 4.5). If this is the case, the transition from zero to one female evaluator in the committee may have a different effect than the transition from one to two female evaluators, or from two to three female evaluators. Second, decisions in the committee are taken on a (qualified) majority basis. Therefore, having a committee where the (qualifying) majority of members are female might have a particularly strong effect.

In order to correctly identify the potential existence of nonlinear effects, it is necessary to control for the probability that a given number of women is assigned to the committee. We consider the following model:

$$y_{ie} = \beta_0 + \beta_1 Female_i + \sum_k \gamma_k Female_i D_{ke}$$
$$+ \sum_k \delta_k Female_i D_{ke}^{expected} + \mathbf{X_i}\beta_2 + \mathbf{Z_i}\beta_3 + \mu_e + \epsilon_{ie}$$

where D_{ke} is a dummy variable that takes value one if the number of female evaluators in committee e is equal to k and $D_{ke}^{expected}$ is the probability that exactly k female evaluators are assigned to a given committee. For Spanish evaluations, we directly compute these probabilities using information on the gender mix of the pool of eligible evaluators. For the Italian case, the direct computation is more complicated, since the assignment procedure required no more than one committee member from each university. Instead, we compute these probabilities using the outcomes of 1000 simulated random draws, which account for the restrictions on the randomization.

Committees rarely included more then three women. Therefore, we only analyze the effect of having one, two, and three or more female evaluators. The estimation results are presented in Table A3. Overall, the linearity of the effect of committees' gender composition cannot be rejected by the data.

Appendix C. The effect of connections, by gender of evaluators and candidates

As we have seen in section 4.4.2, there is significant gender segregation across networks but it is not strong enough to manifest itself as apparent preference for candidates of the same sex as evaluators. One might be interested whether this is in part due to the differential impact of same-sex and opposite-sex connections upon female and male candidates. In Table A4, we explore this issue in more detail. We do not observe any differential effect of strong connections (coauthors, colleagues and, in the case of Spain, advisors) for female and male candidates. We also do not observe that the female and male connections have a differential effect on candidates' success.

Appendix Tables

Table A1: Literature review

Paper	Type of evaluation	Field	Empirical method	Applications	Results
Broder (1993)	Grant applications	Economics	Application fixed effects	1,479	Opposite-sex preference
Steinpreis, Anders and Ritzke (1999)	Job applicants and tenure candidates	Psychology	Randomized field experiment	238	No significant difference
Jayasinghe, Marsh and Bond (2003)	Grant applications	Several	Application fixed effects	2331	No significant difference
Ellemers et al. (2004)	Work commitment of students	Several	Identification based on observables	212	Opposite-sex preference
Moss-Racusin et al. (2012)	Laboratory manager position	Life Sciences	Randomized field experiment	127	No significant difference
Abrevaya and Hamermesh (2012)	Paper submitted for publication	Economics	Application fixed effects	2,940	No significant difference
Casadevall and Handelsman (2013)	Selection of conference speakers	Microbiology	Identification based on observables	1,845	Same-sex preference
De Paola and Scoppa (2015)	Job applicants	Economics and Chemistry	Identification based on observables	2,279	Same-sex preference
Williams and Ceci (2015)	Job applicants	Several	Randomized field experiment	873	No significant difference

Table A2: Main features of the evaluation systems in Italy and Spain

	Italy, Abilitazione Scientifica Nazionale, 2012-2014	Spain, Habilitación, 2002-2006
Eligibility requirement for candidates	None	None
Size of evaluation committees	5 evaluators	7 evaluators
Assignment to committees	Based on a random draw	Based on a random draw
Composition of committees	4 full professors based in Italian universities, 1 professor based abroad	In full professor exams, 7 full professors based in Spanish universities or public research centers. In associate professor exams, 3 full professors and 4 associate professors.
Constraints on randomization	No university can have more than one evaluator within a single committee.	Only one non-university researcher is allowed to be selected as a member of the committee for a given exam. Similarly, only one emeritus professor is allowed to be selected as a member of a given committee.
Minimum research quality requirement for evaluators	In STEMM disciplines, eligible professors should be above the median in their category and field in at least two of the following dimensions: (i) the number of articles published in scientific journals, (ii) the number of citations, (iii) and the H-index. In SSH disciplines, they should be above the median in at least one of the following dimensions: (i) the number of articles published in high quality scientific journals (so-called A-journals), (ii) the overall number of articles published in any scientific journals and book chapters, and (iii) the number of published books.	Eligible associate professors should have one *sexenio* and eligible full professors should have two *sexenios*. *Sexenios* are granted by the Spanish education authority on the basis of applicants' research output in any non-interrupted period of a maximum of six years.
Inclusion in the pool of eligible evaluators	Voluntary	Compulsory
Substitution of resigned evaluators	Based on a random draw	Based on a random draw
Voting rule	Qualified majority of 4	Simple majority
Number of qualifications granted by the committee	Unlimited	Limited by the number of available positions at the university level
Validity of a positive qualification	4 years (later extended to 6 years)	Unlimited
Penalization for a negative evaluation	2 years application ban	None
Application withdrawal	Up until two weeks after the evaluation criteria are publicized	Candidates can drop out from the process at any time
Evaluation	Evaluations are based solely on the material provided in candidates' application packages, consisting of CVs and selected publications.	Oral exams to full professor positions have two qualifying stages. In the first stage, candidates present their CVs. In the second stage, candidates present a piece of their research work. Exams to associate professor, in addition to these two stages, have an intermediate stage where candidates give a lecture on a topic randomly chosen from a syllabus proposed by the candidate.
Degree of transparency	The lists of potential and actual evaluators and candidates, as well as the lists of qualified candidates, are published online. Furthermore, the CVs of all participants and individual evaluation reports are published online. The evaluation agency also collects and publicizes information on the bibliometric indicators of candidates.	The lists of potential and actual evaluators and candidates, as well as the lists of qualified candidates, are published online.

Table A3: Nonlinearities

	1	2
	Italy	Spain
Female	0.001	-0.012
	(0.007)	(0.007)
Female * 1 female evaluator	-0.018	-0.001
	(0.012)	(0.011)
Female * 2 female evaluators	-0.037***	-0.006
	(0.012)	(0.013)
Female * 3 or more female evaluators	-0.080***	-0.004
	(0.021)	(0.014)
Number of observations	69020	31243

Notes: IV estimates. All regressions include as controls exams fixed-effects, the number of female evaluators in the committee, individual predetermined characteristics, and the expected probabilities to have 1, 2, and 3 or more female evaluators. Standard errors are clustered by exam.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: The effect of strong connections, by candidate and evaluator gender

	1	2
	Italy	Spain
Female candidate	0.007	-0.012*
	(0.008)	(0.007)
Female candidate * Share of female evaluators	-0.134***	-0.011
	(0.035)	(0.028)
Share of connections in committee	0.216***	0.429***
	(0.041)	(0.038)
Female candidate * Share of connections in committee	-0.002	0.017
	(0.066)	(0.060)
Share of female connections in committee	-0.031	-0.039
	(0.084)	(0.101)
Female candidate * Share of female connections in committee	0.164	-0.077
	(0.124)	(0.145)
Number of observations	69020	31243

Notes: IV estimates. All regressions include exam fixed-effects, individual predetermined characteristics, *Female candidate* Expected share of women in committee*, *Expected connections in committee*, *Female candidate* Expected connections in committee*, *Expected female connections in committee* and *Female candidate* Expected female connections in committee*. Standard errors are clustered by exam.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.