Women in Top Academic Positions: Is There a Trickle-down Effect?

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Abstract

We study how the promotion of a female professor affects future hiring decisions and PhD students in the department. We exploit a large-scale natural experiment which generates exogenous variation across Spanish university departments in promotions to Associate and Full Professor positions. Between 2003 to 2007, the composition of committees in national qualification exams was randomized and applicants were significantly more likely to be promoted if, by luck of the draw, they were assessed by a committee including a strong connection such as a colleague, a co-author or a former advisor. Using information from 3,700 departments in all academic disciplines and around 3,000 promotions, we find that the (exogenous) promotion of women to Associate or Full Professor does not lead to an increase in the number of women hired or promoted in the department within the following ten years or to in the share of female PhD students. However, a larger presence of female faculty is likely to affect enrolled students, as PhD students exhibit a preference for same-sex advisors.

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1 Introduction

It is well-known that women are under-represented in top positions in academia. In the European Union, women account for around 48% of PhD graduates but only 40% of associate professors and 26% of full professors (European Commission, 2021). The scarcity of women is more acute in STEM fields, where less than one-sixth of full professors are women, but women are also a minority among full professors in Social Sciences (28%) and Humanities (32%). The situation is particularly worrying in Economics. In the top 20 European and top 20 US departments, only 13% and 15% respectively of full professors are women (Lundberg and Stearns, 2019; Giraneza Birekeraho and Maniga, 2018).

The presence of women has increased in recent decades, but the situation is changing slowly. For instance, the share of female Full Professors in Spain is currently around 25 percent, despite women already representing more than 35% of new PhD graduates in the mid 80s (see Figure 1). The existence of important 'leaks in the pipeline' has been also observed in other countries, including the Economics profession in the US (Lundberg and Stearns, 2019).

In order to address the underrepresentation of women in academia, some academic institutions and universities are introducing quotas and incentive systems favoring the hiring of women. Since 2012 German universities and research institutes are subject to target quotas for new female hires, tied to the federal funding that they receive (Wissenschaftskonferenz, 2016). Other countries, like Sweden, have encouraged universities to introduce voluntary quotas for the recruitment of female full professors and, in Ireland, the government has approved 20 women-only professor positions (Freidenvall, 2018). Professorships reserved only for women have been also opened in countries such as Australia, the Netherlands, and Austria).[1]

There is often the hope that, beyond their direct impact, these policies may have a knock-on effect, helping to attract additional female faculty and students. There are several possible

1. For example, positions reserved for women have been created in Australia at the University of Adelaide (source: https://www.abc.net.au), in the Netherlands at the Eindhoven University of Technology (source:https://www.science.org), in Austria at the Vienna University of Technology (source: https://informatics.tuwien.ac.at, and in Ireland in 12 different universities (source: https://www.siliconrepublic.com.

ways in which this might happen. Many female academics report that the professional climate is hostile to women.[2] A larger presence of women at the top levels could help to create a more female-friendly environment and to tackle sexual harassment, which tends to be more prevalent in male-dominated workplaces (Folke and Rickne, 2022). More women in top positions may also help to make the academic career more family-friendly. The tenure-track system puts a strong weight on research productivity during a period that may overlap with motherhood. Women in top positions may support policies that attenuate this problem, such as stopping the tenure clock for female faculty members who give birth or increasing maternity and parental leave (Epifanio and Troeger, 2013).[3] Female professors may also become role models and mentors for young female researchers, increasing their productivity (Boustan and Langan, 2019; Holmes and O'Connell, 2007; Ginther et al., 2020) and influencing their future career choices (Porter and Serra, 2020; Bettinger and Long, 2005).[4]

Furthermore, some authors have also pointed out that men and women exhibit some differences in terms of the type of research that they value (Dolado et al., 2012; Beneito et al., 2018). In a male-dominated environment, the topics of research preferred by female authors may be underappreciated. Finally, it has been also argued that the presence of women in top positions may help to eliminate gender discrimination, although some of the existing evidence suggests otherwise (Broder, 1993; Williams and Ceci, 2015; Bagues et al., 2017; Card et al., 2020).[5] On the flip side, the hiring of a female professor might have a

2. In a survey conducted by the American Economic Association, 40% of female respondents were not satisfied with the overall climate and 44% did not feel included socially within the field AEA (2019).

3. The optimal design of these policies is non-trivial. For instance, work by (Antecol et al., 2018) suggests that gender-neutral tenure clock-stopping policies may actually reduce female tenure rates.

4. Most studies tend to find that female instructors affect positively the choices of female of students but there is also some mixed evidence. Some studies find extremely large impacts. Porter and Serra (2020) find that being exposed during 15 minutes to a successful and charismatic woman who had majored in economics at the same university increases the probability that female students choose an economics major by 8 p.p. (relative to a 9% baseline). Similarly, Carrell et al. (2010) observe that top female students at the US Air Force Academy are 26 p.p. more likely to complete a STEM major if they are taught the introductory courses by a female teacher. However, Bettinger and Long (2005) do not find a clear pattern. Using data from 54,000 students at a U.S. university, they find that female instructors increase significantly the probability that female students select their major only in one field (Sociology), but the effect is significantly negative in three other fields, including Economics. No significant effect is observed in the remaining seven fields.

5. Broder (1993) examined reviews of NSF proposals showing that female-authored proposals receive lower ratings from female reviewers. Williams and Ceci (2015) conducted five hiring experiments where

negative impact on the probability of future female hires if departments are trying to satisfy some minimum quota and stop hiring women once this target has been reached (Janys, 2022).

In this paper we study whether promoting women to top academic positions helps to attract more female faculty and PhD students using data from around 3,600 university departments in all academic fields in Spain.[6] As we explain in more detail below, both the descriptive and the causal evidence that we have analyzed suggest that the effect, if any, is small.

We provide two types of evidence. First, we report descriptive evidence using data between 2000 and 2019. We find support for some of the standard mechanisms through which a larger share of senior female faculty might help to attract more female researchers and students to a department. Within each department, female PhD graduates are significantly more likely to have a female advisor and there is substantial gender segregation across subfields of research. However, despite these gender differences observed in the choice of advisors and research topics, we observe a very low correlation between the share of women at different levels. Departments with a relatively larger number of female full professors do not have substantially more women among associate professors or among PhD students, compared to other departments within the same field. The correlation between the share of female Full Professors and the share of female Associate Professors is around 6% and with the share of female PhD students 3%. Since there might be some omitted factors that affect positively the presence of women at all levels (e.g. the supply of qualified women), these correlations are likely to be upper-bound estimates of the causal impact that female Full Professors have on the presence of women at lower levels.

Second, we obtain causal estimates exploiting the exogenous variation provided by a

faculty evaluated hypothetical female and male applicants for assistant professorships in biology, engineering, economics, and psychology. They find that female applicants receive similar assessments from male and female evaluators. Bagues et al. (2017) analyzed data from applications for qualification as Associate and Full Professor in all academic disciplines in Spain and Italy, finding that female applicants have slightly lower chances of success when they are randomly assigned to a committee with a higher share of female evaluators. Card et al. (2020) considered information from 30,000 submissions to four leading journals in Economics, and they do not observe any significant difference in the evaluations received by female authors depending on the gender of referees.

6. In Spain positions are assigned officially to 174 officially defined fields (in Spanish, 'area de conocimiento').

unique natural experiment: the system of centralized qualification exams that was in place in Spain between 2003 and 2007. During this period, all researchers seeking promotion to Associate or Full Professor had to first qualify in an evaluation conducted at the national level. Our database includes information on around 30,000 applicants belonging to approximately 3,600 departments in all disciplines who participated in these evaluations. The number of available qualifications was limited, around one for every ten candidates, and most qualified applicants were subsequently promoted by their universities. Crucially for our empirical strategy, members of these evaluation committees were selected from the pool of eligible evaluators in the field using a lottery and, as no conflict of interest rules were implemented, applicants could be randomly assigned to an evaluation committee including a co-author, a colleague or even their thesis advisor. We build on previous work by Zinovyeva and Bagues (2015), who found that the presence of these strong connections in the committee increases the chances of success of 'lucky' applicants, who accounted for 1/3 of all applicants, by around 40% (from 10% to 14%). We exploit this exogenous variation in the chances of qualifying in the national qualification examination to identify exogenous variations in the gender composition of departments. Departments with a 'lucky' female applicant have 0.5 more women 10 years after. However, this increase is fully explained by the direct effect of the initial promotion and we do not observe any additional knock-on effects. The exogenous promotion of a female faculty member has no significant impact on the gender of new hires or on the gender of new PhD students within the following 10 years.

Overall, both the descriptive evidence and the IV results suggest that the presence of more female senior faculty does not help to attract additional female junior faculty or female PhD students. However, their presence is likely to affect the situation of enrolled PhD students, as female PhD students are significantly more likely to have a female advisor and work in more feminized research fields.

2 Institutional Context

2.1 Organization of Spanish Academia

Public universities account for over 90% of faculty members and students in Spain. Within each university, faculty members are distributed across 174 officially defined fields ('areas de conocimiento'). Historically there has been a high degree of inbreeding, both among PhD students and among faculty. About two-thirds of PhD graduates obtained their undergraduate degree in the same institution and three-fourths of faculty did their PhD in the same university (Cruz Castro et al., 2006).

Before 2002, Spanish universities had large autonomy regarding hiring and promotion. In 2002 the Spanish government introduced a two-stage system of promotions, requiring applicants to associate and full professor positions to qualify first in an examination that was conducted at the national level (in Spanish, '*habilitación*'). Qualified candidates could then apply for positions at the university level. Comparable qualification systems exist in other European countries such as France ('concours national d'agrégation') or Italy ('abilitazione scientifica nazionale').

An important feature of the Spanish system of qualifications in place between 2002 and 2007 is that the number of qualifications available at the national level was limited. There was on average one qualification position for every ten applicants. Given the scarcity of qualified individuals that could apply for a promotion at the university level, ex post, most qualified applicants were automatically promoted by their own universities.

The last round of 'qualification' exams took place in 2006, and in 2007 a new system was introduced known as accreditation (in Spanish, '*acreditación*'), which is still in place. The system maintained a two-step promotion process, where candidates aspiring for promotion have to first gain eligibility at the national level. However, in the new system, there are no constraints on the number of applicants that could be considered eligible. On average, 50% of the applicants qualify. The selection system of committee members using a lottery was eliminated and evaluators were selected by an appointed chair of the committee.

2.2 Qualification exams

The timing of the qualification exams was as follows. First, the Ministry opened the call for applications from candidates aspiring to a promotion to an Associate Professor or a Full Professor position. There were at most three calls per field per year. Applicants had twenty days to submit their applications after the call was announced. Once this deadline, the committee members were chosen by a random draw from the list of all eligible professors in the corresponding field. Professors working in public universities and institutes of the National Research Council were considered eligible evaluators if they satisfied a minimum requirement of research productivity.[7] The committee member with a longer tenure was designated as the president of the committee, and the examinations took place at the university where the appointed president was based.

Committees were composed of seven members. For Associate Professor examination panels, the draw consisted of three full professors and four associate professors from the respective lists of eligible evaluators. For Full Professor examination panels, all committee members were drawn from the eligible Full Professors. In addition, a reserve committee of seven evaluators was established should any member of the primary committee had to step down and needed to be substituted. Participation in evaluations was compulsory and only 2% of initially selected evaluators were allowed to step down and were substituted.[8]

To qualify, candidates to Full Professor positions had to pass two evaluation stages. In the first one, all candidates presented their CV to the committee. In the second one, shortlisted candidates gave a research seminar. Candidates to Associate Professor positions had to pass an additional qualifying stage consisting of a teaching demonstration.

Committee reached decisions using a majority vote. The number of candidates deemed

7. Around 80% of Full Professors and approximately 70% of Associate Professors qualified to serve in committees (*Comisión Nacional Evaluadora de la Actividad Investigadora*, Memoria de los resultados de las evaluaciones realizadas de 1989 a 2005, 2005).

8. There were two primary grounds on which professors could ask for a resignation. Firstly, professors temporarily serving in high roles within Spain's public administration were entitled to resign. Secondly, professors could ask for a resignation if a close personal relationship existed with a candidate (Ley de Procedimiento Administrativo 30/1992, article 28, accessed on February 7th, 2012 at http://www.boe.es/aeboe/consultas/bases_datos/doc.php?id=BOE-A-1992-26318). Nevertheless, resignations owing to such connections were exceedingly rare. Based on our computations, of the 832 professors tasked with evaluating their own Ph.D. students, only 22 opted out, a proportion similar to the overall rate.

qualified was restricted to not exceed the total number of available qualifications announced in the call.

3 Data

We use information from all 48 public universities in Spain and the 188 officially defined research fields (i.e. 'area de conocimiento'). In what follows, we will refer to each research field within a given university as a department.[9] Below, we describe the information that we collected on (i) faculty members, (ii) qualification exams and (iii) PhD graduates. In Appendix A, we detail the harmonization procedure in more detail.

3.1 Faculty composition

We collected information on the faculty composition of departments from several sources. First, we obtained information on all promotions to Associate and Full Professor positions between 1986 and 2020 from the Spanish State Bulletin *(BOE)*.[10] During 1986-2020, we observe about 52,612 promotions in 48 universities and 188 research areas. As shown in Figure 2, in the 1980s and 1990s there are around 1,500 promotions each year. These numbers increased significantly around 2002-2003, just before the new qualification system was introduced, presumably due to an anticipation effect. In 2004-2006 there were just a few hundred promotions yearly, as many qualification exams were still underway, and promotions recovered their previous level between 2007 and 2012. In 2013-2015 there is again a dip in the number of promotions, in this case due to the introduction of a national-level freeze in public hiring due to a public finance crisis.

Since the State Bulletin information that we gathered does not include data on faculty promoted prior to 1985, we also complement our data using the list of full professors and

9. This classification does not always match one-to-one with actual departments in Spanish universities. In some cases, departments may include more than one field. For instance, in some universities, the Business Department may include several fields, such as Management, Accounting and Marketing. On the contrary, in a few large universities, several departments may exist for the same field (e.g. there are several Economics departments at Universidad Complutense of Madrid).

10. The BOE publishes information on every promotion to Associate and Full Professor in public universities in Spain. The public announcement includes the identity of the person promoted, the university, and the research area (i.e. *area de conocimiento*)

associate professors eligible to be selected as committee members in the qualification exams which were conducted between 2003 and 2007. These lists include the date of promotion for all Full and Associate Professors who satisfied some minimum research requirements, accounting for approximately 85% and 70% of the overall number.

Using the above information, we build a longitudinal panel of departments with their compositions by role and gender. Once we observe that a researcher has been promoted or hired by a given department, we assume that they remain in the same department until they turn 65 unless we observe them being hired by another public university. Since this measure might be subject to measurement error if some individuals move abroad or to a private university, we validate its accuracy using independent information from the Ministry of Education on the gender composition of departments. We find a correlation of above 90% between these two measures, suggesting that the measurement error is likely to be small.

We restrict our analysis to units with at least one full professor and one associate professor and we focus on their composition during the period 2000-2019. Our final sample includes around 3,700 departments and in the average department there are three FPs and seven APs (see Table 1). Women represent 19% of Full Professors and 38% of Associate Professors.

3.2 National qualification exams

We exploit information from the qualification examinations conducted in Spain between 2003 and 2007 when the system known as 'habilitacion' was in place. As we explain in more detail below, this setup allows us to identify exogenous variations in promotions. We collected data on the identity of all candidates and eligible evaluators, the outcome of the lotteries that determined committee composition, and the list of qualified candidates in each field-specific exam.[11]

We have information on 967 qualification exams that took place between 2003 and 2007 in 174 research fields, with 465 exams for positions for Associate Professorships (AP) and 502 for Full Professorships (FP). As shown in Table C1, there are on average 27 candidates per FP exam and 38 candidates per AP exam. In both types of exams, the level of competition

11. Data on the centralized system of qualifications was collected by Zinovyeva and Bagues (2015) and Bagues et al. (2017) from the webpage of the Spanish Ministry of Education.

was roughly similar: on average, 11% of candidates qualify. The share of female candidates in larger exams to AP (41%), than in exams to FP (25%).

Overall there are 31,243 applications (17,799 for AP, 13,444 for FP) from 16,529 candidates. Ât'Women are slightly older when applying for FP positions and younger when applying for AP positions (Table C2). They are slightly less likely to qualify for both types of exams and also to apply.[12]

There were 21,944 Associate Professors and 7,909 Full Professors in the pool of eligible evaluators.

3.2.1 Research production

We collected information on the research production of applicants and eligible evaluators at the time of the examination from the Web of Science and Dialnet. Web of Science allows us to measure researchers' output in English-language journals, while Dialnet provides information on Spanish-language scientific publications including research articles, books, and chapters in books. We measure the quality of English-language academic articles by the Article Influence Score of the journals where these articles are published, and we use Dialnet classifications of journals and publishers to capture the quality of research output in Spanish language.

Using data from the database of doctoral theses, we also measure the number of PhD theses advised by candidates and evaluators, and their participation in theses committees.

Applications and connections between candidates and evaluators

We identify the existence of *strong ties* between applicants and eligible evaluators, such as the presence of supervisors, co-authors or colleagues. Overall, one-third of applicants had a strong connection in the committee (35% for FP positions, 29% for AP positions). Male candidates tend to have slightly more links (Table C2). As shown in Zinovyeva and Bagues (2015), the presence of these connections increases dramatically applicants' chances of success.

12. Candidates applied twice on average. Multiple applications could happen either because the candidate had failed and reapplied within the same field or because he/she applied simultaneously in several related research fields.

3.3 PhD Theses

We collected information on doctoral theses read in Spain between 1977 and 2020 from the official registry of the Spanish Ministry of Education (*Teseo* database).[13] This database provides information on the identity of PhD graduate, advisors and committee members, the date of graduation, as well as the field of research of the thesis. The research field is self-reported by Ph.D. graduates upon graduation, and it follows the UNESCO nomenclature, including around 2,000 subfields. For instance, there are approximately 100 codes in economics, including subfields such as Labor Economics, or Time Series.[14] The initial dataset contains $255,767$ theses and we restrict our analysis to $224,959$ theses with non-missing information on the research field and year of graduation.

In addition to the date of graduation, around one-third of the theses also report the date of the start of the thesis. We use this information to estimate the predicted length of every thesis, based on the university, research field, gender, and year of graduation. The interquartile range is 5-8 years.

Female students may prefer departments with a larger share of female faculty if (i) they prefer having a female advisor and (ii) if they have different research interests than men. Next we investigate whether these two mechanisms are relevant in the Spanish context.

Gender of PhD students and their advisors

The probability of being supervised by a woman has steadily increased for both female and male students during the last three decades, reflecting the increase in female representation among tenured professors (Figure 3). At the same time, female students tend to be more likely to be supervised by a female professor than male students, and this gap has been stable during this period.

Table 4 quantifies the magnitude of the gap. There is an unconditional gap of 12 p.p. (column 1), which decreases to around 8 p.p. when we compare Ph.D. graduates within the same field (column 3) and to 7 p.p. if we consider graduates within the same department.

13. This information is available at https://www.educacion.gob.es/teseo. While registration is compulsory, it has been estimated that Teseo includes information on around 90% of all theses read in Spain (Fuentes-Pujol and Arguimbau-Vivó, 2010).

14. https://skos.um.es/unesco6/00/html

Furthermore, female students are disproportionately more likely to be supervised by a female professor in departments with more women (columns 2, 4, and 6). Results are unchanged when we model the outcome variable as a Poisson (see Table C6).

Research conducted by PhD students

We now explore whether there are any differences in the research topics studied by female and male graduates. For each research topic, we calculate its degree of 'feminization' as the share of women among graduates. Figure 4 shows that in the late 80s, the average female (male) graduate worked on a research topic where 37% (30%) of graduates working on that topic were females. In the late 2010s, she (he) worked on a topic where 55% (45%) of graduates were females. The gender gap in the degree of 'feminization' of PhD theses remained constant over the 1990s and 2000s and slightly widened starting after 2010.

We quantify the magnitude of this gap in Table 5. Within the same field, female students tend to work on topics where the proportion of women is 1.9 percentage points higher (column 4). The probability of working in a more feminized field is also larger when the advisor is a woman. Male and female students with female advisors tend to work in topics where the share of female thesis is 1.2 percentage points higher. A similar gender gap is observed among students within the same department.

In sum, PhD students are significantly more likely to have a same-gender advisor and we also observe some gender segregation across subfields of research, even within the same department. This descriptive evidence provides support for the hypothesis that female PhD students may have a preference for departments with more faculty of their own gender.

4 Empirical analysis

We investigate whether the presence of women among faculty members helps to attract more women into the department. We provide two types of evidence. First, we examine the correlation between the share of female faculty and female students across departments in the same field. Taking into account that there might be unobserved factors that affect in a similar way the presence of women at every level of the department, this descriptive information is likely to provide an upper bound for the average treatment effect of a larger share of women among professors. Second, to estimate the causal impact, we exploit exogenous variation in success in qualification exams. As we explain in more detail below, our empirical strategy identifies the impact for 'compliers', in this case faculty who got promoted thanks to the presence of strong connections in the committee who assessed their application, but who would not have been promoted otherwise. This margin might be particularly relevant from a policy perspective, given that this is the group that is likely to be affected by any efforts to increase female representation.

4.1 Descriptive Evidence

We examine whether departments with more women in top positions are also more likely to have more women in lower categories. In Table 2 we examine the correlation between the share of women among associate professors and among full professors. Overall, a 10 p.p. increase in the share of female FP is associated with a 2 p.p. increase in the share of female PhD students (column 1). This correlation becomes substantially smaller when we compare departments within the same field. Within a given field, a 10% increase in the share of female FP is associated with a 0.6% increase in the share of AP.

We observe a similar pattern when we look at PhD students. Departments in a given field with 10% more female faculty have 0.7% more female PhD students (Table 3), column 2). The correlation is close to zero and not significant if we consider the variation over time within the same department (column 3).[15]

If we assume that, if anything, selection is likely to be positive, the existence of such a low correlation would suggest that female professors have a relatively small role in attracting female PhD students. The upper bound of the OLS estimates suggests that 10% more women in the faculty can increase the share of female PhD students by no more than 1 p.p.

15. In Table C3 we consider as the share of female faculty in the three previous years. The observed pattern is unchanged.

4.2 Instrumental Variables

To estimate the causal impact of having more women in the faculty, we exploit the exogenous variation provided by the centralised qualification exam system that was in place in Spanish academia between 2003 and 2007. During this period all researchers seeking promotion to Associate or Full Professor must first qualify in a national-level evaluation. Crucially for our empirical strategy, the members of these evaluation committees were selected from the pool of eligible evaluators in the field using a random draw.

We present below two levels of analysis. First, at the individual level, we establish that the exogenous qualification has a long-term effect on the probability that an individual is promoted. Second, we switch the analysis at the department level, and we examine whether the qualification of a female member of the department translates into long-term increases in the share of women in the department, both among faculty and among PhD students. As we show below, overall we find little evidence supporting that a change in the gender composition of promotions and PhD graduates has taken place.

Individual-level analysis

First, we examine whether researchers who are lucky with the composition of their evaluation committee and get qualified are more likely to be promoted to the corresponding position. Building on previous work by Zinovyeva and Bagues (2015), we exploit the variation generated by the random lottery that selects committee members. We conduct the following two-stage least square estimation:

$$\begin{aligned}\text{Qualified}_{i,e} = \alpha_0 + \alpha_{\mathbf{1}}\, \textbf{Connections}_{\mathbf{i,e}} + \\ \alpha_{\mathbf{2}}\, \textbf{Expected\_Connections}_{\mathbf{i,e}} + \alpha_{\mathbf{3}}\, \mathbf{X}_{\mathbf{i,e}} + \nu_{i,e}\end{aligned} \tag{1}$$

$$\begin{aligned}\text{Promoted}_{i,e,t+k} = \beta_0 + \beta_1\, \widehat{\text{Qualified}}_{i,e} + \\ \beta_{\mathbf{2}}\, \textbf{Expected\_Connections}_{\mathbf{i,e}} + \beta_{\mathbf{3}}\, \mathbf{X}_{\mathbf{i,e}} + \epsilon_{i,e}\end{aligned} \tag{2}$$

where $\text{Qualified}_{i,e}$ is a dummy for whether candidate i qualified in exam e, $\mathbf{Connections_{i,e}}$ is the share of connections that applicant i had in the committee evaluating exam e, and $\mathbf{Expected\_Connections_{i,e}}$ is the expected share of connections based on the number of connections that the applicant had in the pool of eligible evaluators. To increase precision, in some specifications we also control for the research production of the candidate at the time of the exam ($X_{i,e}$). The list of controls is described in section 3.2.1. In the 2SLS estimation (equation 2), the outcome variable $\text{Promoted}_{i,e,t+k}$ measures whether the candidate had been promoted to the corresponding position (AP or FP) $t+k$ years after the qualification exam,

In the first stage estimation, α_1 captures how an additional connection in the committee increases the probability of qualifying. In equation 2, β_1 indicates the probability that applicants who qualify thanks to a connection have been promoted by year $t+k$. We cluster standard errors at the exam level.

We report the results of the first stage estimation in Table C2. As expected, individuals with more (exogenous) connections are more likely to qualify and, consistently with the committee selection being random, results are unchanged when we add controls for previous individual research productivity. To further validate the integrity of the randomization, Table C1 shows that the exogenous shocks to connections are unrelated to any of the available measures of predetermined ability.

Figure 5 shows the estimates for the impact of qualification on promotion within 10 years of the qualification exam. As expected, we observe that both in the case of qualification exams to FP (left panel) and to AP (right panel), qualification has a strong short-term impact on the probability that researchers have been promoted. Three years after the exam, exogenously qualified applicants are 70 percentage points (p.p.) more likely to have been promoted. However, the long-term effect differs across positions. In the case of qualifications to FP, the impact on promotion tends to decrease over time, indicating that the 'control' group is also being promoted. Ten years from the exam, 'lucky' candidates are only 25 p.p. more likely to have been promoted, and this difference is not statistically significant. Instead, being exogenously qualified for AP positions has a long-lasting effect: 10 years after, 'lucky' candidates are 46 p.p. more likely to have obtained a promotion, and this effect is significantly different from zero. There are at least three possible explanations for this lack of convergence. 'Unlucky' candidates may have dropped out from academia, moved abroad, or are in academia with a non-tenured contract. As shown in Figure B1, the observed patterns are similar for men and women.

Department-level analysis

In this section we examine whether the observed impact of qualifications on individual promotions translates into changes in the gender composition of departments. To capture this aggregate effect, we collapse the individual information at the department level and we consider the overall number of qualifications and promotions in each department. Similarly to the individual-level analysis, we instrument the total number of qualifications obtained by applicants from a given department using the (exogenous variation in the) average number of strong connections that these applicants had in the pool of eligible evaluators. Since we are interested in the impact of promotions obtained female and male faculty, we instrument separately these two variables. In particular, we implement the following instrumental variable estimation strategy:

$$\begin{aligned} &\text{Qualified}_{d,e}^{Females} = \theta_0 \; + \; \theta_1 \text{Connections}_{d,e}^{Females} \; + \theta_2 \; \text{Connections}_{d,e}^{Males} \; + \\ &+ \theta_3 \; \text{ExpectedConnections}_{d,e}^{Females} \; + \theta_4 \; \text{ExpectedConnections}_{d,e}^{Males} \; + X_{d,e} \; \boldsymbol{\theta_5} + \zeta_{d,e} \end{aligned} \tag{3}$$

$$\begin{aligned} &\text{Qualified}_{d,e}^{Males} = \gamma_0 \; + \; \gamma_1 \text{Connections}_{d,e}^{Females} \; + \gamma_2 \; \text{Connections}_{d,e}^{Males} \; + \\ &+ \gamma_3 \; \text{ExpectedConnections}_{d,e}^{Females} \; + \gamma_4 \; \text{ExpectedConnections}_{d,e}^{Males} \; + X_{d,e} \; \boldsymbol{\gamma_5} + \eta_{d,e} \end{aligned} \tag{4}$$

$$\begin{aligned} &\text{Y}_{d,e,t+k} = \phi_0 \; + \; \phi_1 \; \widehat{\text{Qualified}}_{d,e}^{Females} \; + \; \phi_2 \; \widehat{\text{Qualified}}_{d,e}^{Males} \; + \\ &+ \phi_3 \; \text{ExpectedConnections}_{d,e}^{Females} \; + \phi_4 \; \text{ExpectedConnections}_{d,e}^{Males} \; + X_{d,e} \boldsymbol{\phi_5} \; + \varepsilon_{d,e} \end{aligned} \tag{5}$$

where in the two first-stage equations (equations 3 and 4) $\text{Qualified}_{d,e}^{Females}$ and $\text{Qualified}_{d,e}^{Males}$, represent respectively the number of female and male qualified candidates in department d and exam e; $\text{Connections}_{d,e}^{Males}$ and $\text{Connections}_{d,e}^{Females}$ are the average number of connections that male and female applicants from the department had in the evaluation committee, and $\text{ExpectedConnections}_{d,e}^{Males}$ and $\text{ExpectedConnections}_{d,e}^{Females}$ control for the expected number of connections based on the composition of the pool of eligible evaluators. To increase precision, $X_{d,e}$ includes controls for the number of female and male faculty members one year prior to the exam, the number of female and male candidates from the department participating in the examination, and the total number of female and male candidates from the department who took part in any examination within the *habilitación* process. We cluster standard errors at the department level.[16]

In Equation 5, the second-stage of the IV strategy, we consider several different outcome variables ($\text{Y}_{d,e,t+k}$). First, we study the impact on the gender composition of the faculty by looking at the total number of women and men in the department at the FP or AP level in the next k years after the examination t, with $k \in [0, 10]$.

As shown in the left panel of Figure 6, there is a significant increase in the number of female APs after a female member of a department qualifies for an AP position. The number of APs in the department is around 0.8 higher three years after the examination, and it remains approximately at that level during the following seven years. The magnitude of this effect suggests that it captures mainly the direct impact on the 'lucky' female applicant who gets promoted, but it does not lead to any additional hires or promotions of female APs. In the upper right panel of the figure we show the impact of qualifications in the department for full professor on the number of full professors in the department in the following ten years. The observed pattern is similar to APs. There is a significant increase in the number of female full professors around three years after the examination, with an estimate close to one, and the effect remains constant during the following years. Again, the magnitude of the effect is consistent with a direct impact through the applicant who qualified, but no additional effect on other female faculty. The lower panel of the figure shows the impact of qualifications for full professor in the department on the future number of associate professors. In this

16. As a given department may participate in multiple exams, we weight our estimates using the inverse of the number of exams for a given academic role in a given year.

case we do not observe any significant effect and, if anything, the point estimate tends to be negative.

Second, we study the effect of qualifications on the number of female and male PhD graduating k years after exam e took place. As shown in Figure 8, women in the department who exogenously qualified for AP or FP have no impact on the number of female or male PhD students during the following 10 years. In Figures B2 and B4 we report the impact of exogenously qualified men on future promotions and on the number of PhD graduates, respectively. The results are similar to the ones observed in the case of women.

Overall, the IV results are consistent with the descriptive evidence presented earlier, which showed that the correlation between the presence of women at different levels tends to be low.

5 Conclusion

In order to improve the representation of women in academia, universities are increasingly reserving some positions only for women. Our results suggest that, beyond the direct impact of these quotas at the level at which they are designed, they are unlikely to trigger a trickle-down effect in other positions. The descriptive and the IV evidence provide a consistent picture: the presence of women in the upper echelons of the profession has little impact on the number of women at lower levels.

However, it is worth pointing out that a larger presence of female faculty is likely to affect enrolled female PhD students, as we observe a strong preference for same-sex advisors and also gender segregation across subfields of research. An interesting open question is how this will affect the future career of female PhD graduates, as a larger presence of female faculty might allow them to have a female advisor whose research field may be closer to their research interests.

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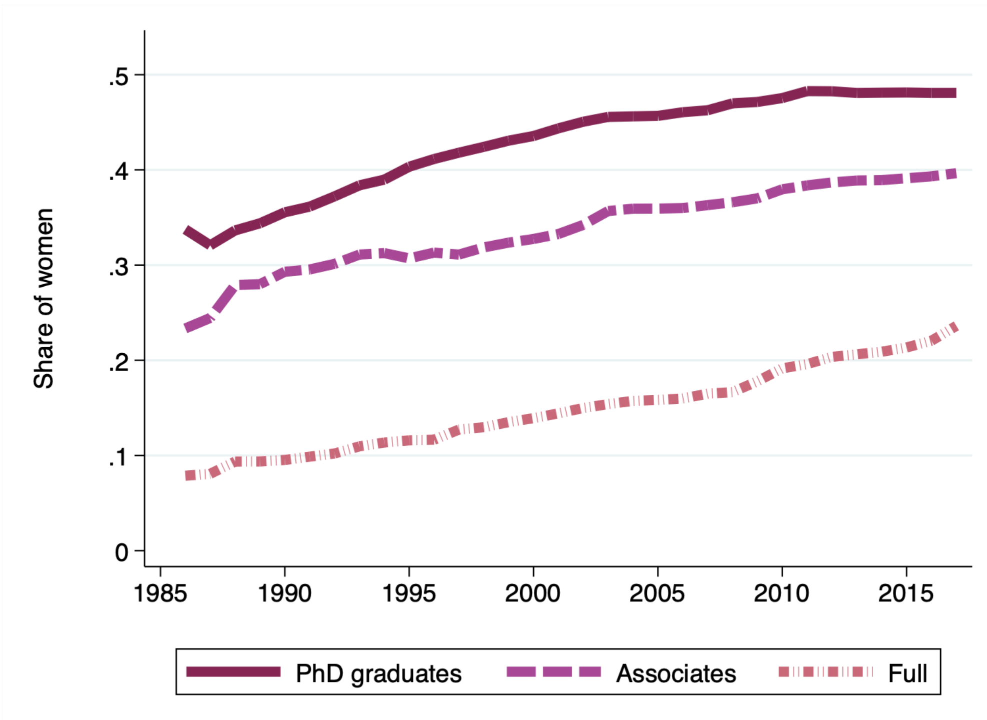
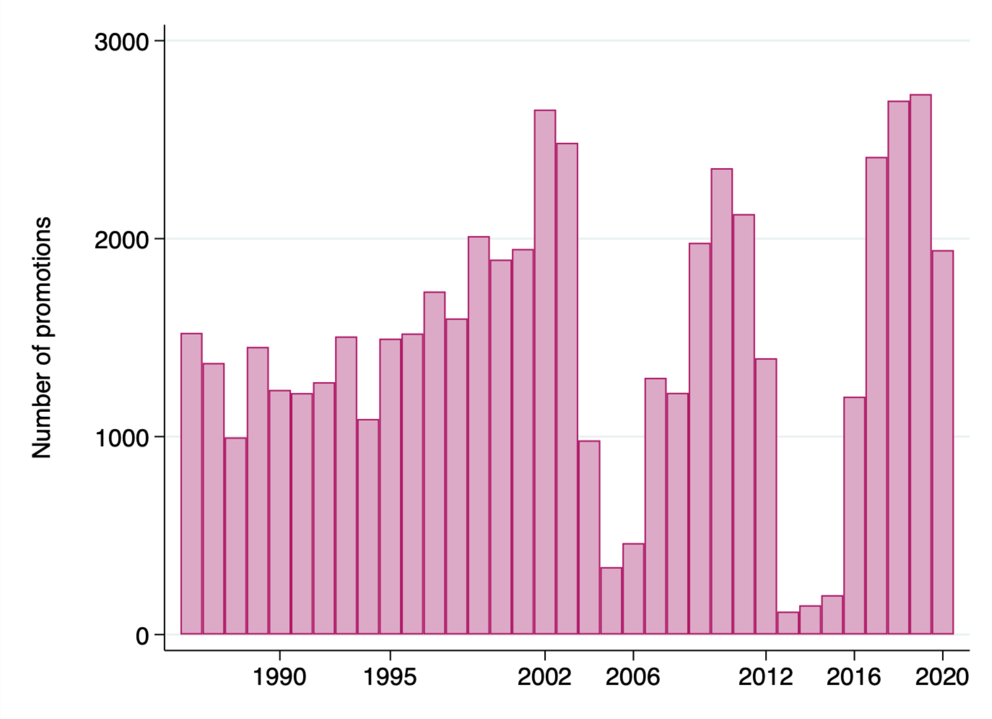
Figures

Figure 1: Trends in the share of women by academic role



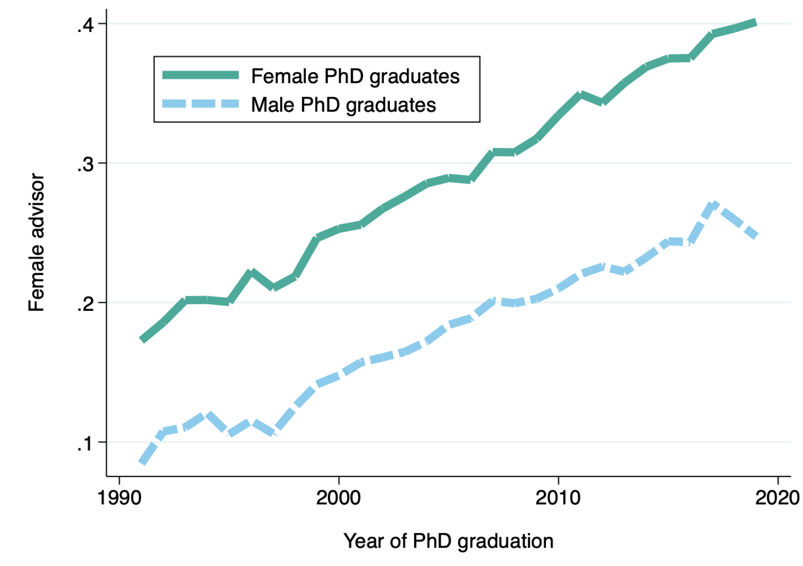
Notes: The figure shows the trends in the share of women by academic role. It highlights the existence of important 'leaks in the pipeline' in Spanish Academia. The figure is based on our own calculations using the data we collected. We validated our measures using independent information from the Ministry of Education (considering a shorter time window) and we find a correlation of 90%.

Figure 2: Promotions to Associate and Full Professor positions



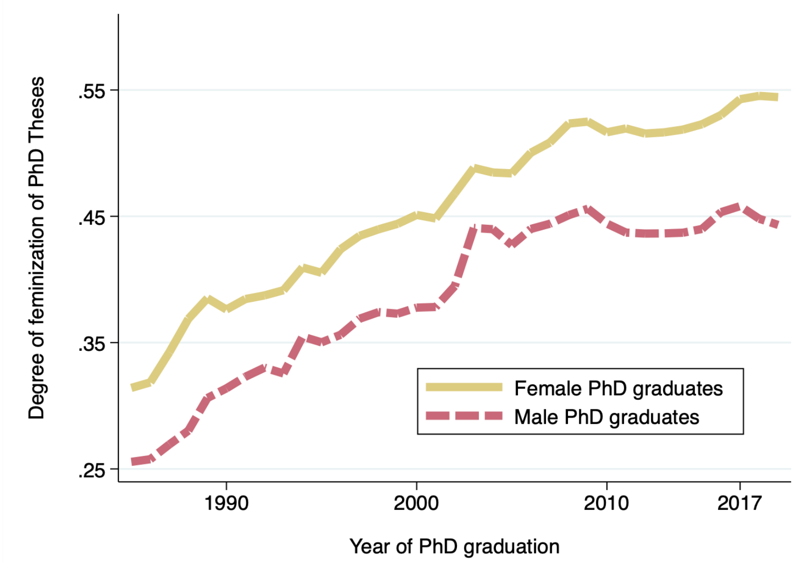
Notes: The figure shows yearly flows of promotions to Associate and Full Professors positions.

Figure 3: Probability of having a female advisor



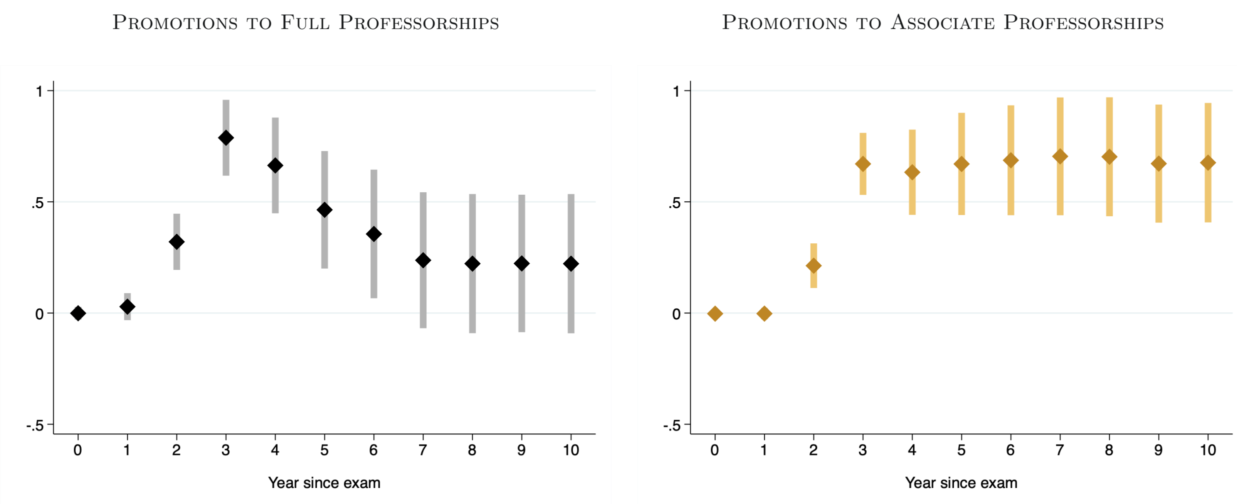
Notes: The figure shows the probability of having a female advisor, by gender of PhD graduates.

Figure 4: Degree of 'feminization' of PhD theses



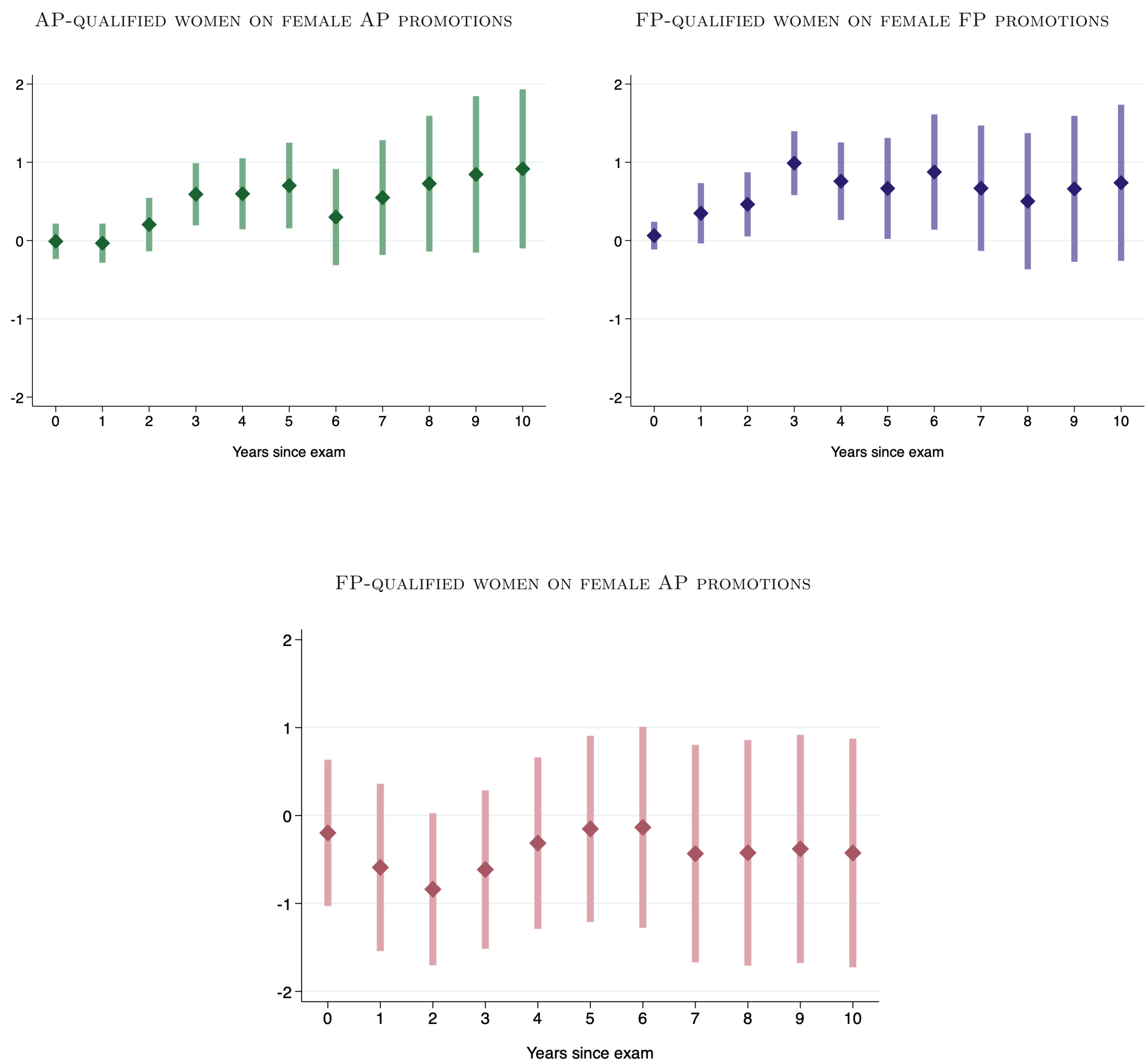
Notes: The figure shows the degree of 'feminization' of PhD theses, by gender of PhD graduates.

Figure 5: Impact of qualifications on individual promotions



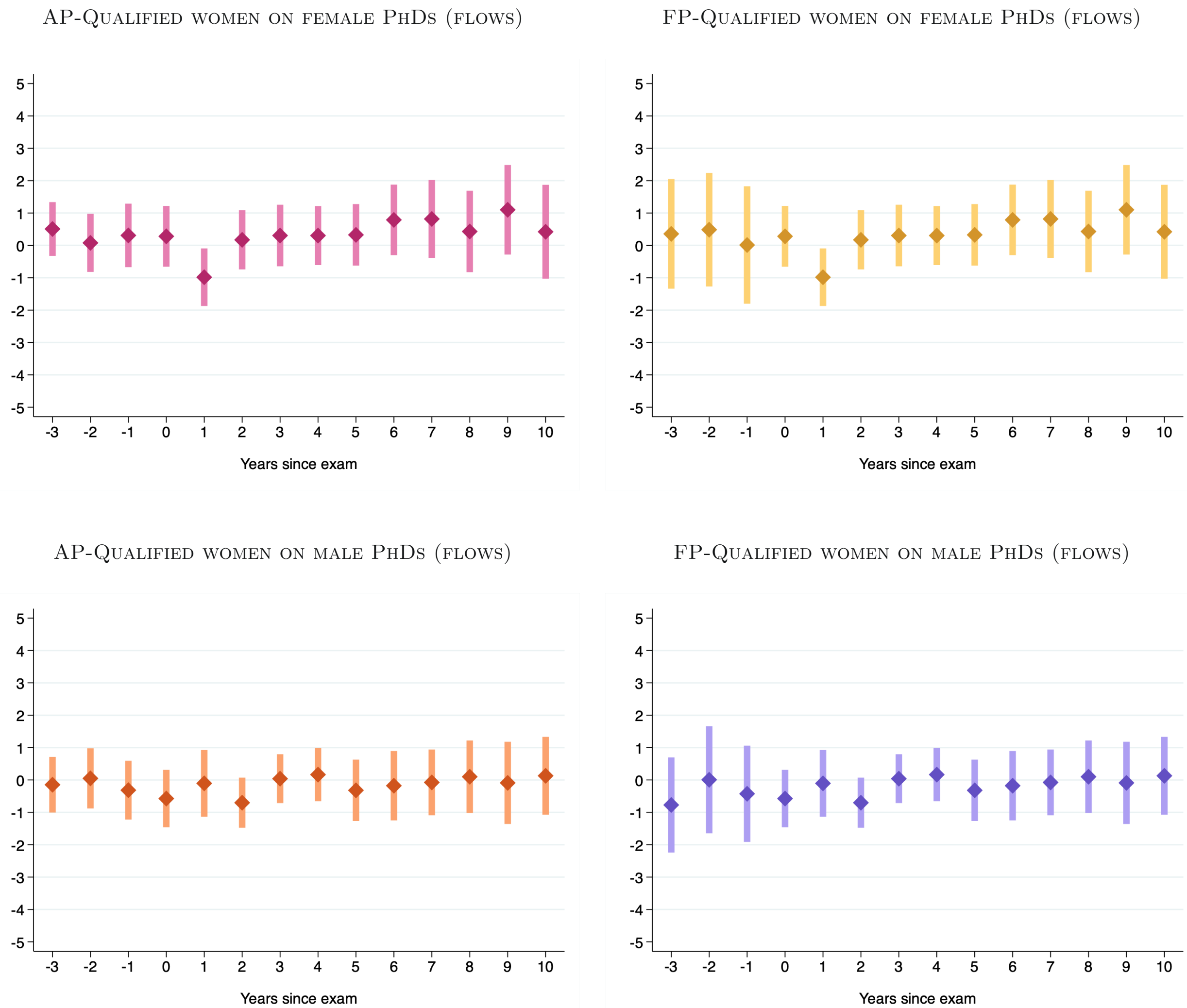
Notes: The figure shows the estimates of the impact of being exogenously qualified on the probability of being promoted $y \in [0, 10]$ years from the exam, separately by academic role. 2SLS estimates of Equation 2. The unit of analysis is individual-exam. The estimates highlights the long-lasting effect of being lucky with the evaluation committee on individual academic promotions.

Figure 6: Impact of female qualifications on future department-level female promotions



Notes: The figure shows the impact of exogenously qualified women on the cumulative number of female promotions over ten years following the qualification exam. The unit of analysis is department-exam. 2SLS estimates of Equation 5. The top two panels show that a female exogenous qualification to AP/FP does not translate into additional female promotions to the same category ten years following the exam. The bottom panel illustrates the lack of a trickle-down effect: more female Full Professors do not lead to promoting more female Associate Professors.

Figure 8: Impact of female qualifications on PhD graduates



Notes: The figure shows the impact of exogenously qualified women on the flows of female/male PhD graduates over ten years following the qualification exam. The unit of analysis is department-exam. 2SLS estimates of Equation 5. All figures illustrate that qualifying female Associate and Full Professors does not have an impact on the gender composition of PhD cohorts.

Tables

Table 1: Department Composition

	Mean	SD	p10	Median	p90	N
Full Professors						
Count	2.74	2.83	1.00	2.00	6.00	56,839
Share of women	0.19	0.32	0.00	0.00	0.67	56,839
Associate Professors						
Count	6.42	7.06	1.00	4.00	14.00	56,839
Share of women	0.38	0.32	0.00	0.33	0.88	56,839
PhDs						
Count	13.07	20.76	0.00	7.00	32.00	56,839
Share of women	0.47	0.28	0.00	0.50	0.86	50,868
N departments	3696					

Notes: The table provide descriptive statistics of departments' composition by role and gender, pooled over the period 2000-2019. We define department as the interaction between university and research field. We limit our analysis to observations with at least one AP and one FP.

Table 2: The share of women among Associate Professors

	Share of female AP	
	(1)	(2)
Share Female FP (3-year lagged)	0.176***	0.058***
	(0.016)	(0.016)
Observations	45850	45850
R^2	0.035	0.234
Year FE	✓	✓
Field FE		✓

Notes: OLS estimates. The unit of analysis is department-year. Department is defined as the interaction between university and field of research. Standard errors are clustered at the department level. The independent variables are the 3-year lagged share of female full professor (FP). The sample period is 2003-2019.

Table 3: The share of women among new PhD students

	Share of females among new PhDs		
	(1)	(2)	(3)
Share Female FP	0.109***	0.034***	0.013
	(0.011)	(0.010)	(0.023)
Share Female AP	0.186***	0.039***	0.012
	(0.012)	(0.011)	(0.028)
Observations	24397	24397	24397
R^2	0.032	0.142	0.269
Year FE	✓	✓	✓
Field FE		✓	
Department FE			✓

Notes: OLS estimates. The unit of analysis is department-year. Standard errors are clustered at the department level. The independent variables are the shares of female full professor (FP) and associate professor (AP). The sample period is 2000-2017.

Table 4: Gender segregation in supervision and department composition

	Female advisor					
	(1)	(2)	(3)	(4)	(5)	(6)
Female Student	0.123***	0.090***	0.078***	0.059***	0.067***	0.049***
	(0.004)	(0.005)	(0.003)	(0.005)	(0.003)	(0.005)
Share Female FP		0.188***		0.134***		
		(0.014)		(0.013)		
Share Female AP		0.247***		0.148***		
		(0.014)		(0.015)		
Fem Stud × Share Fem FP		0.035**		0.037***		0.030**
		(0.014)		(0.013)		(0.013)
Fem Stud × Share Fem AP		0.009		0.029**		0.037***
		(0.013)		(0.012)		(0.013)
Observations	86093	86093	86093	86093	86093	86093
Baseline	0.229	0.229	0.229	0.229	0.229	0.229
R^2	0.029	0.092	0.100	0.119	0.324	0.324
Year FE	✓	✓	✓	✓		
Field FE			✓	✓		
Department × Year FE					✓	✓

Notes: OLS estimates. The unit of analysis is PhD student starting in a given year. Department is defined as the interaction between university and field of research. The sample period is 2000-2017. Standard errors are clustered at the department level.

Table 5: Feminization of thesis topics and the gender of the advisor

	Feminization of thesis				
	(1)	(2)	(3)	(4)	(5)
Female Student	0.077***	0.055***	0.020***	0.019***	0.016***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Female Supervisor				0.012***	0.012***
				(0.001)	(0.001)
Observations	121296	121296	121296	121296	121296
Baseline	0.44	0.44	0.44	0.44	0.44
R^2	0.100	0.286	0.590	0.592	0.718
Year FE	✓	✓	✓	✓	
Broad Discipline		✓			
Field FE			✓	✓	
Year × Department FE					✓

Notes: OLS estimates. The unit of analysis is PhD graduate in a given year. The sample period is 2000-2019. Standard errors are clustered at the department level. *Feminization of thesis* measures how popular the thesis research topic is among female students, and it is computed over the previous five years. *Broad Discipline* groups research fields into four broad categories: Sciences, Medicine and Veterinary, Engineering, Social Sciences and Humanities.

Appendix

A Data Sources

We collected data from several sources: (i) the Spanish Ministry of Education (TESEO) for PhD theses, (ii) the Spanish State Bulletin (Boe) for academic promotions, and (iii) the Ministry of Science and Innovation for the centralized qualification exams.[17] First, we disambiguated the researchers within each database to avoid assigning two distinct identifiers to the same person. All databases come with unique identifiers of researchers in most occurrences. For cases that come with no identifier, we implemented a series of string matching procedures, taking into account specific characteristics of Spanish names. Additionally, we exploited observable researcher attributes, such as discipline, to make the merge strategy more precise. Second, we performed a merge procedure, linking the profiles of individuals across the databases. The large majority of individuals are merged on their full name, however we recover further matches by augmenting the exact string matching, taking into account initials and that some frequent names are not always used in self-reported data. We disregard matches with conflicting disciplines or based on very frequent names. Table A1 below shows the share of researchers matched across different databases.

Table A1: Identified researchers across databases

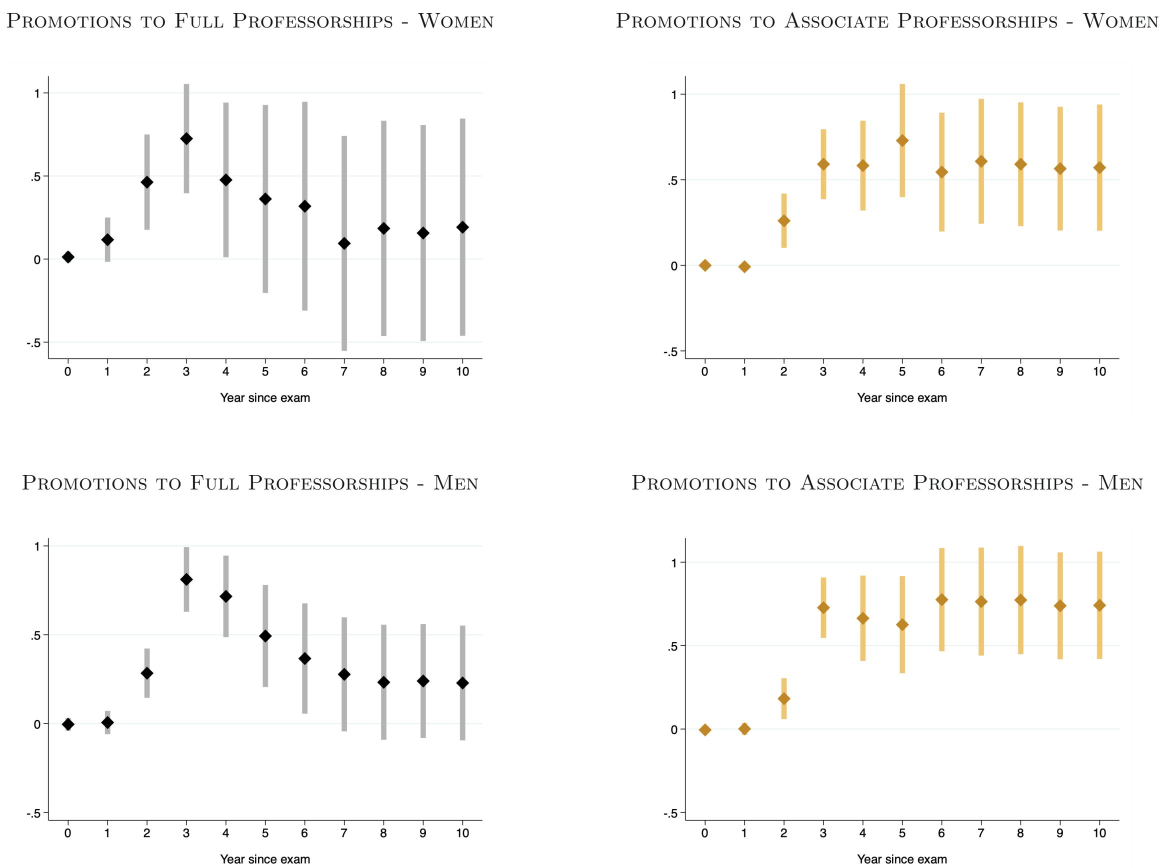
	PhD	Candidates	Promotions	Supervisors	PhD Committees	Exam Evaluators
PhD	100%	5%	15%	22%	33%	8%
Candidates	81%	100%	69%	77%	89%	37%
Promotions	72%	22%	100%	66%	79%	39%
Supervisors	64%	15%	40%	100%	81%	28%
PhD Committees	43%	8%	21%	36%	100%	14%
Exam Evaluators	64%	21%	69%	84%	95%	100%

Notes: The table reports the share of researchers identified across databases. To be read by row. For example, 81% of candidates are found in the TESEO as PhD graduates, 77% of them as PhD supervisors, 89% as PhD committee members.

17. See Zinovyeva and Bagues (2015) for details about the collection procedure.

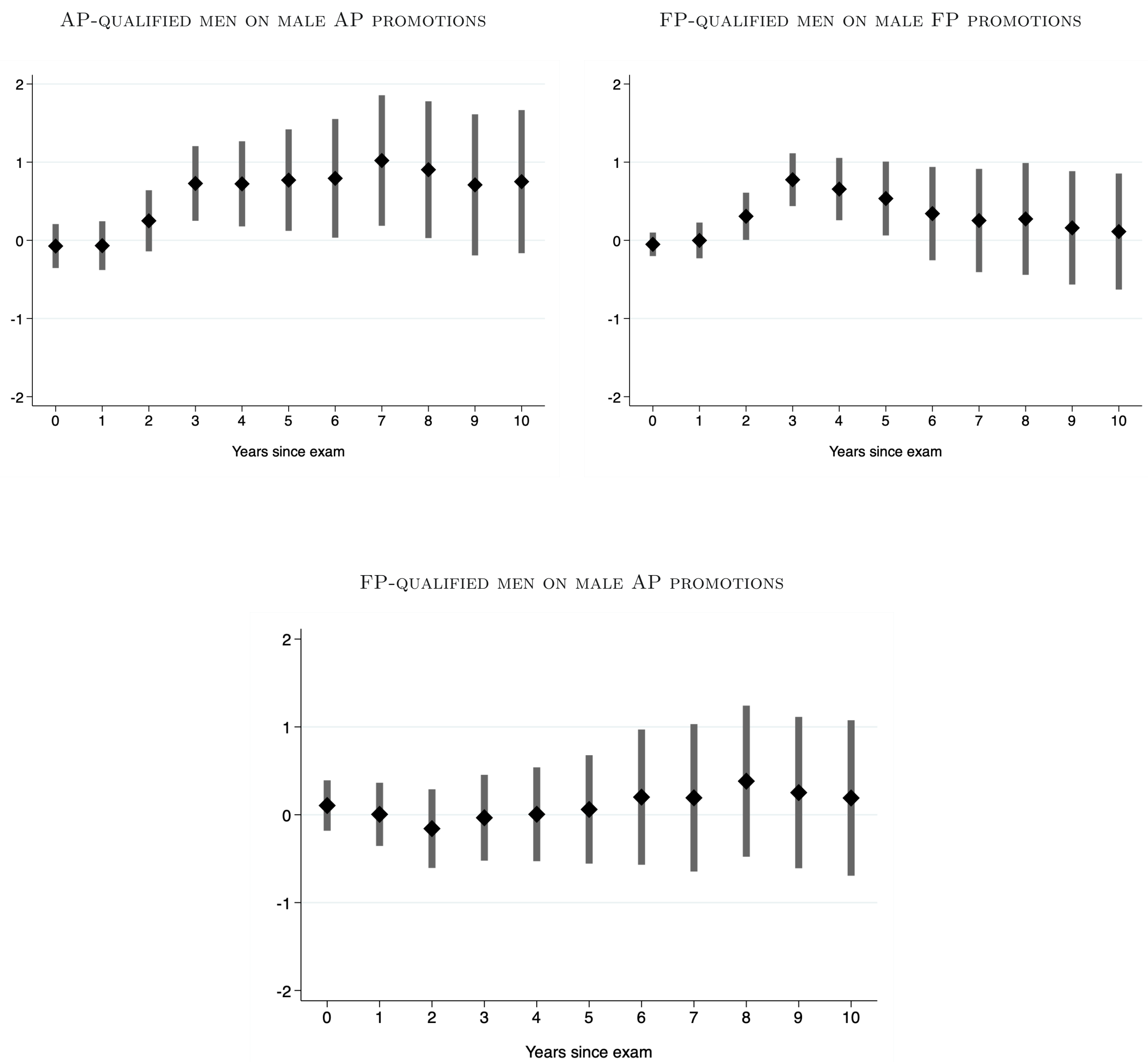
B Additional Figures

Figure B1: Individual-level analysis - Impact of qualifications on promotions



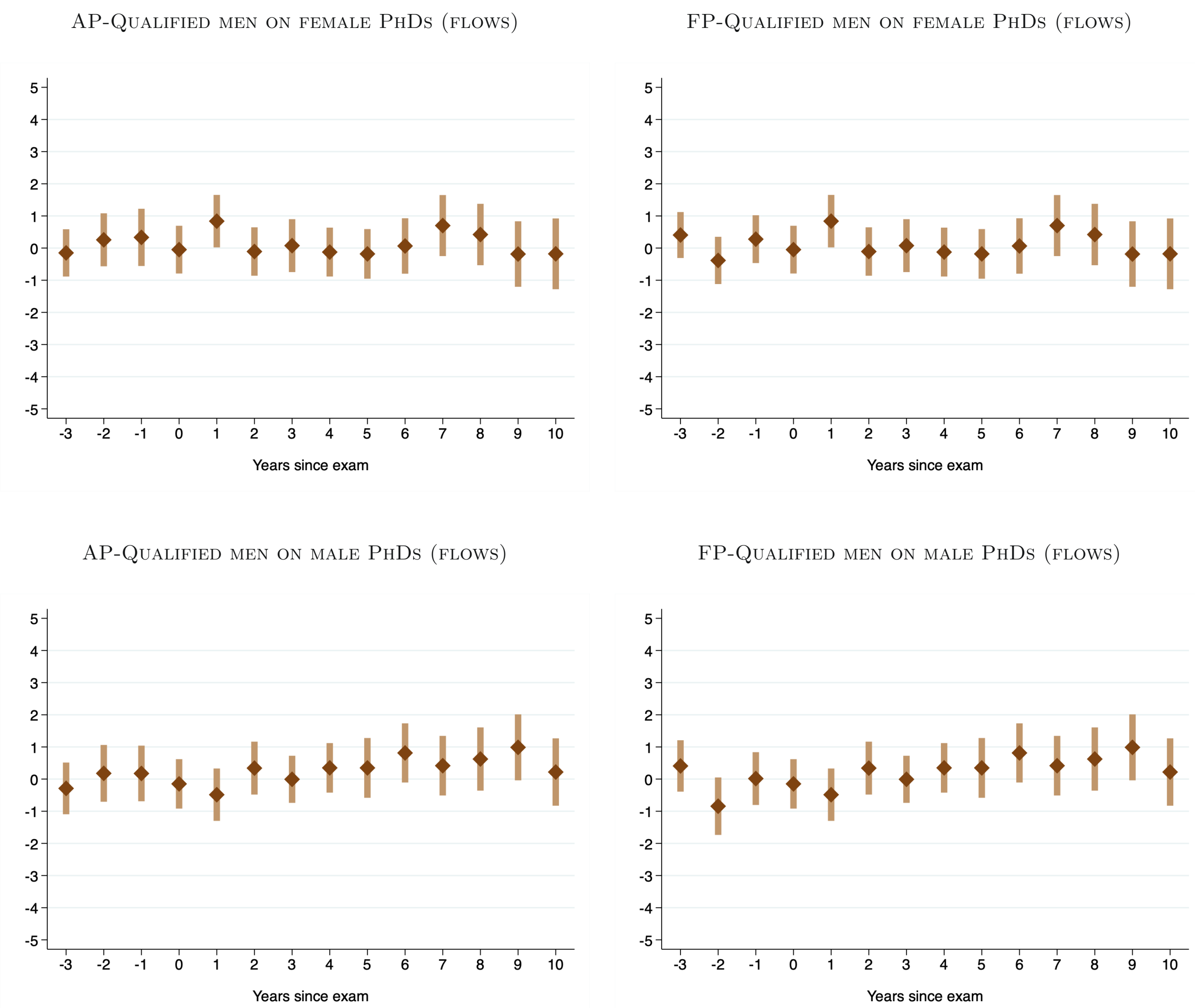
Notes: The figure shows the estimates of the impact of being exogenously qualified on the probability of being promoted $y \in [0, 10]$ years from the exam. 2SLS estimates of Equation 2. The unit of analysis is individual-exam. Figures in the left column show the short-term impact of being exogenously qualified to Full Professor on the probability of being promoted, separately by women (top) and men (bottom). Figures in the right column show the long-term impact of being exogenously qualified to Associate Professor on the probability of being promoted, separately by women (top) and men (bottom).

Figure B2: Impact of male qualifications on future department-level male promotions



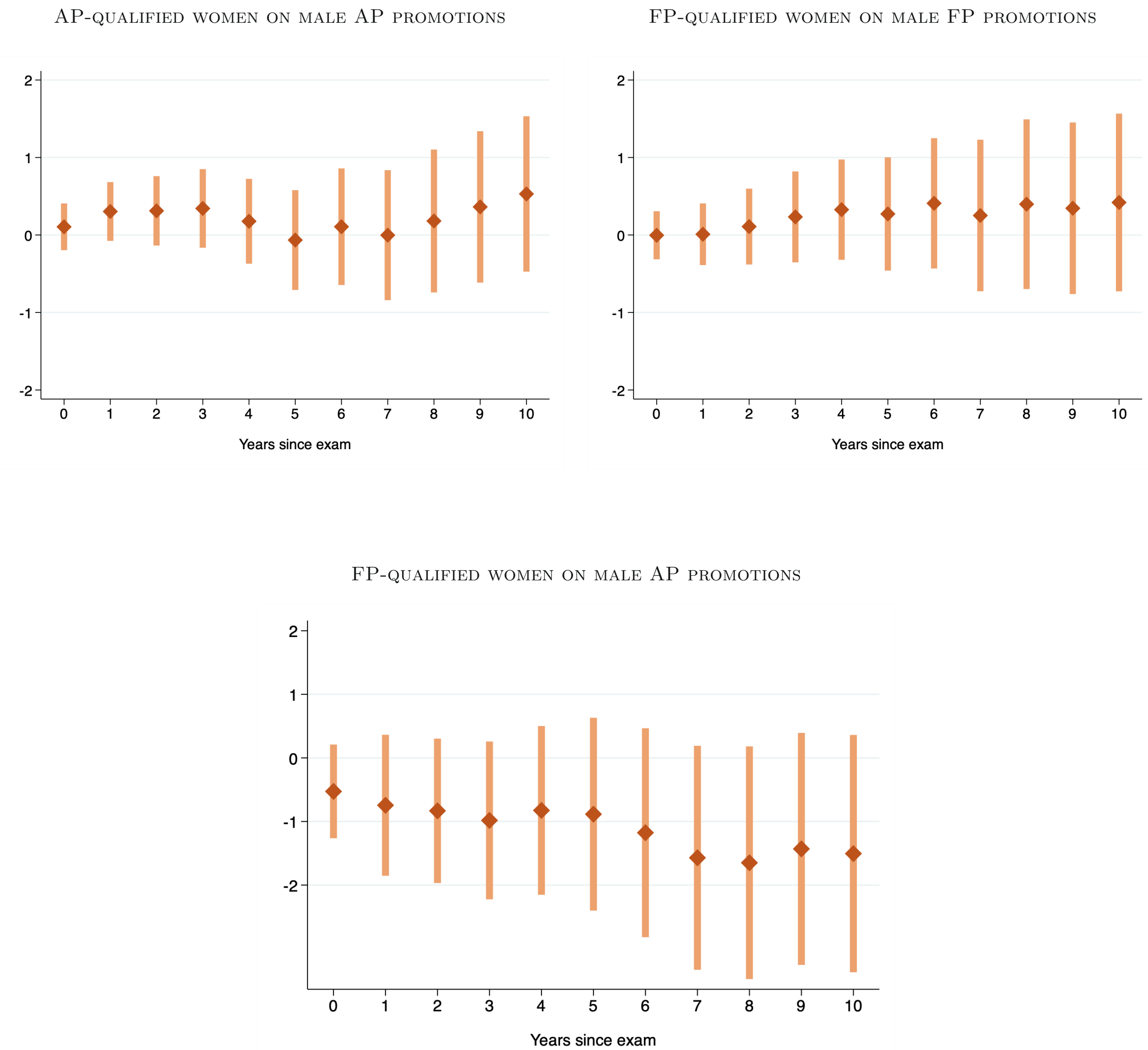
Notes: The figure shows the impact of exogenously qualified men on the cumulative number of male promotions over ten years following the qualification exam. The unit of analysis is department-exam. 2SLS estimates of Equation 5. All panels show that an exogenous male qualification to AP/FP does not translate into additional male promotions to the same category ten years following the exam.

Figure B4: Impact of male qualifications on PhD graduates



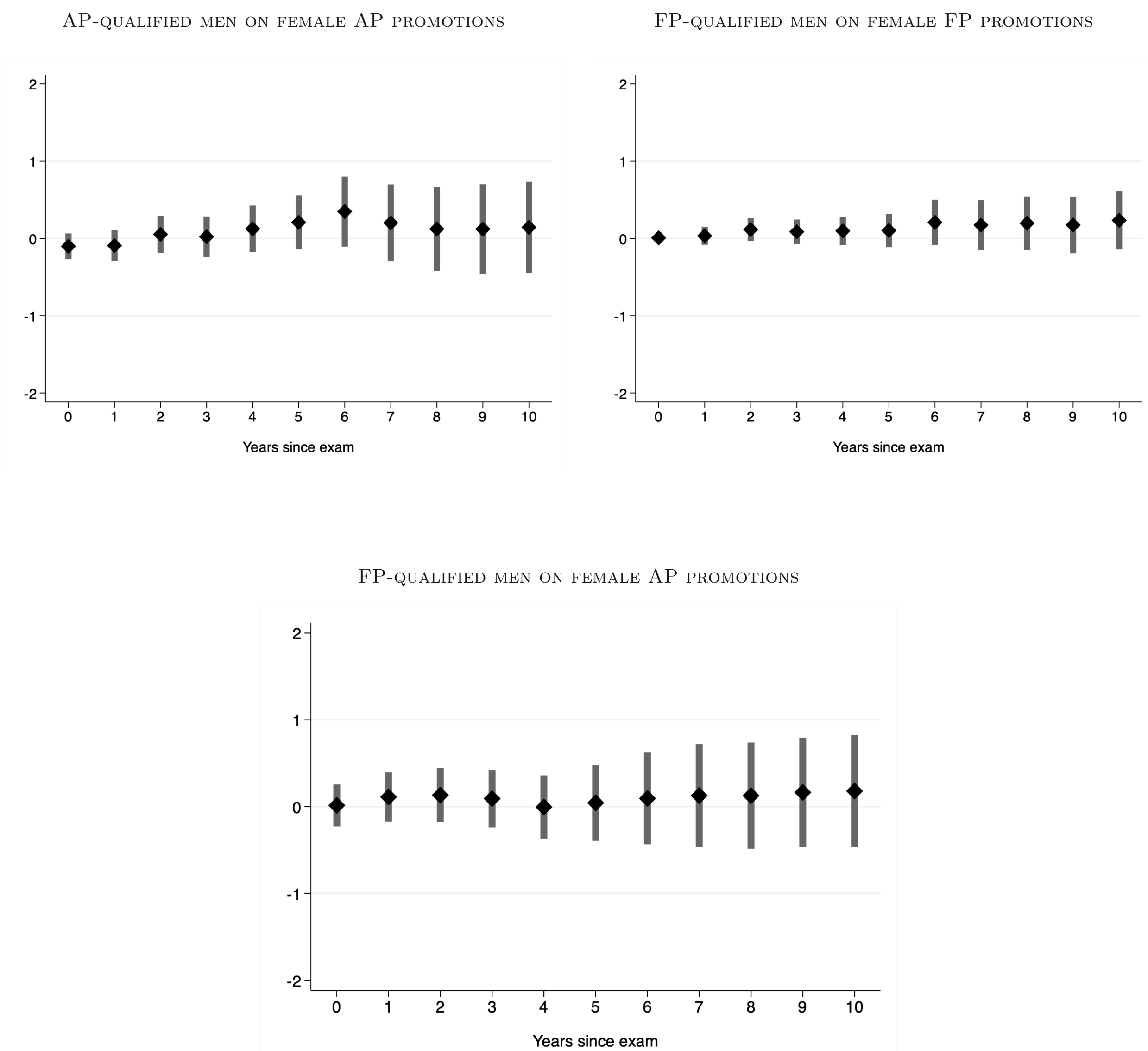
Notes: The figure shows the impact of exogenously qualified men on the flows of female/male PhD graduates over ten years following the qualification exam. The unit of analysis is department-exam. 2SLS estimates of Equation 5. All figures illustrate that qualifying male Associate and Full Professors does not have an impact on the gender composition of PhD cohorts.

Figure B5: Impact of female qualifications on male faculties



Notes: The figure shows the impact of exogenously qualified women on the cumulative number of male promotions over ten years following the qualification exam. The unit of analysis is department-exam. 2SLS estimates of Equation 5. All panels show that an exogenous female qualification to AP/FP does not translate into additional male promotions ten years following the exam.

Figure B7: Impact of male qualifications on female faculties



Notes: The figure shows the impact of exogenously qualified men on the cumulative number of female promotions over ten years following the qualification exam. The unit of analysis is department-exam. 2SLS estimates of Equation 5. All panels show that an exogenous male qualification to AP/FP does not translate into additional female promotions ten years following the exam.

C Additional Tables

Table C1

	All	**FP**	**AP**
Candidates per exam	32.31	26.78	38.28
	(27.22)	(17.74)	(33.68)
Qualified per exam	3.69	2.88	4.57
	(3.57)	(1.79)	(4.64)
Share of women	0.33	0.27	0.41
	(0.18)	(0.15)	(0.18)
Observations	967	502	465

Notes: The table shows descriptive statistics for the 967 qualification exams that took place between 2002 and 2006. The second and third columns provide statistics relative to exams for Full Professorships (FP) and Associate Professorships (AP), respectively.

Table C2

	Applications to Full Professorships				
	Male	Female	Diff. (Male - Female)	s.e.	obs.
Demographics					
Average Age	46.07	46.35	-0.29**	(0.12)	13444
Qualifications					
% Qualified	0.11	0.09	0.02***	(0.01)	13444
Nr Exams per candidate	2.09	2.00	0.10**	(0.04)	6538
Connections					
% with strong ties	0.353	0.349	0.004	(0.009)	13444
Strong ties	0.074	0.068	0.006**	(0.002)	13444
	Applications to Associate Professorships				
	Male	Female	Diff. (Male - Female)	s.e.	obs.
Demographics					
Average Age	37.75	37.09	0.67***	(0.10)	17799
Qualifications					
% Qualified	0.12	0.11	0.01**	(0.00)	17799
Nr Exams per candidate	1.83	1.70	0.13***	(0.03)	9991
Connections					
% with strong ties	0.293	0.287	0.006	(0.007)	17799
Strong ties	0.058	0.055	0.003**	(0.002)	17799

Notes: The table shows descriptive statistics relative to applications for Full Professorships (top Panel) and Associate Professorships (bottom Panel). We have data on 13,444 applications to FP (done by 6,538 candidates) and on 17,799 applications to AP (done by 9,991 candidates). Candidates can apply simultaneously in several related research fields, and multiple times in case of examination failure.

Table C3

	Share of females among new PhDs		
	(1)	(2)	(3)
Share Female FP (3-year lagged)	0.111***	0.036***	-0.013
	(0.013)	(0.011)	(0.029)
Share Female AP (3-year lagged)	0.190***	0.040***	0.068**
	(0.013)	(0.012)	(0.032)
Observations	18932	18932	18932
R^2	0.033	0.150	0.294
Year FE	✓	✓	✓
Field FE		✓	
Department FE			✓

Notes: OLS estimates. The unit of analysis is department-year. Department is defined as the interaction between university and field of research. Standard errors are clustered at the department level. The independent variables are the 3-year lagged shares of female full professor (FP) and associate professor (AP). The sample period is 2003-2017.

Table C4: STEM departments

	Female advisor			
	(1)	(2)	(3)	(4)
Female Student	0.095***	0.054***	0.052***	0.045***
	(0.006)	(0.005)	(0.005)	(0.005)
Share Female FP	0.189***	0.132***	0.128***	-0.007
	(0.016)	(0.015)	(0.015)	(0.020)
Share Female AP	0.247***	0.136***	0.137***	0.033*
	(0.017)	(0.018)	(0.017)	(0.019)
Fem Stud × Share Fem FP	0.039**	0.047***	0.048***	0.039***
	(0.016)	(0.015)	(0.014)	(0.014)
Fem Stud × Share Fem AP	-0.012	0.016	0.020	0.028**
	(0.014)	(0.013)	(0.013)	(0.012)
Observations	61127	61127	61127	61127
R^2	0.101	0.131	0.136	0.202
Year FE	✓	✓	✓	✓
Field FE		✓	✓	
University FE			✓	
Department FE				✓

Notes: OLS estimates. The unit of analysis is PhD student starting in a given year in **STEM departments**. The sample period is 2000-2017. Standard errors are clustered at the department level.

Table C5: No-STEM departments

	Female advisor			
	(1)	(2)	(3)	(4)
Female Student	0.074***	0.062***	0.061***	0.056***
	(0.009)	(0.009)	(0.009)	(0.009)
Share Female FP	0.186***	0.150***	0.151***	0.031
	(0.019)	(0.018)	(0.019)	(0.027)
Share Female AP	0.247***	0.198***	0.182***	0.048
	(0.019)	(0.019)	(0.019)	(0.029)
Fem Stud × Share Fem FP	0.044**	0.040**	0.041**	0.041**
	(0.020)	(0.019)	(0.019)	(0.017)
Fem Stud × Share Fem AP	0.055**	0.050**	0.051**	0.046**
	(0.022)	(0.021)	(0.021)	(0.021)
Observations	33758	33758	33758	33758
R^2	0.089	0.106	0.111	0.208
Year FE	✓	✓	✓	✓
Field FE		✓	✓	
University FE			✓	
Department FE				✓

Notes: OLS estimates. The unit of analysis is PhD student starting in a given year in **non-STEM departments**. The sample period is 2000-2017. Standard errors are clustered at the department level.

Table C6

	Female advisor				
	(1)	(2)	(3)	(4)	(5)
Female student	1.380***	1.276***	1.268***	1.275***	1.268***
	(0.040)	(0.015)	(0.014)	(0.013)	(0.014)
Observations	66271	66271	66271	80436	66271
Year FE	✓	✓	✓	✓	
Field FE		✓	✓		
University FE			✓		
Department FE				✓	
Year × Department FE					✓

Notes: Poisson estimates. We report exponentiated coefficient estimates. The unit of analysis is PhD student starting in a given year. The sample period is 2000-2017. Standard errors are clustered at the department level.

Figure C1

Dep. variable:	Publications	Total AIS	PhD students	PhD committees	Citations
	(1)	(2)	(3)	(4)	(5)
Strong ties	0.010	0.009	−0.017***	−0.013*	0.016**
	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)
Weak ties	0.044***	0.002	0.180***	0.299***	−0.010
	(0.008)	(0.007)	(0.010)	(0.011)	(0.007)
Indirect ties	0.168***	0.131***	−0.007	−0.019*	0.105***
	(0.016)	(0.015)	(0.010)	(0.011)	(0.015)
Expected ties	No	No	No	No	No
Strong ties	−0.003	−0.001	0.003	−0.003	0.002
	(0.012)	(0.010)	(0.010)	(0.011)	(0.011)
Weak ties	−0.008	−0.007	0.009	0.013	−0.005
	(0.013)	(0.012)	(0.015)	(0.016)	(0.011)
Indirect ties	−0.022	−0.006	0.002	0.004	−0.020
	(0.016)	(0.015)	(0.012)	(0.014)	(0.015)
Expected ties	Yes	Yes	Yes	Yes	Yes

Notes: The table reports OLS estimates from ten different regressions on a sample of 31,243 applications for Associate Professor and Full Professor positions. Standard errors clustered by exam in parentheses. Candidates' characteristics are measured at the time of the evaluation, except citations, which refers to the number of citations that articles authored by the candidate before the examination had received by year 2012. All dependent variables are standardized at the exam level with zero mean and unit standard deviation. Regressions in the lower panel include dummies for the expected number of connections in the committee.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Figure C2

	All (1)	FP exams (2)	AP exams (3)	Graduated in Spain (4)	Uncommon surnames (5)	All (6)	All (7)
Strong ties	0.060***	0.057***	0.068***	0.062***	0.062***	0.060***	0.041***
	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.004)	(0.005)
Weak ties	0.022***	0.017***	0.033***	0.021***	0.021***	0.021***	0.022***
	(0.005)	(0.006)	(0.011)	(0.006)	(0.007)	(0.005)	(0.006)
Indirect ties	0.003	0.002	0.008	0.001	0.005	0.003	0.009
	(0.005)	(0.008)	(0.007)	(0.005)	(0.007)	(0.005)	(0.006)
Controls:							
Publications						0.013***	0.029***
						(0.003)	(0.009)
Total AIS						0.029***	0.014*
						(0.003)	(0.007)
PhD students						0.012***	0.024***
						(0.002)	(0.007)
PhD committees						0.015***	0.010
						(0.002)	(0.007)
Individual FE							Yes
Adj. R^2	0.039	0.065	0.041	0.050	0.047	0.077	0.180
Observations	31,243	13,444	17,799	24,264	15,896	31,243	22,292

Notes: OLS estimates. Standard errors clustered by exam in parentheses. Quality controls included in columns 6 and 7 are normalized for candidates at the exam level. All columns include the number of expected connections of each type (775 indicators). Columns 6 and 7 also include indicators for candidates' age, participation in previous examinations, and the number of fields where the candidate applies.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

D First Stage Regressions

Table D1: Department-level - First Stage of the Instrumental Variable Strategy
AP Qualifications instrumented by connections

	Qualified Females (1)	Qualified Males (2)
Female Connections	1.126***	0.265***
	(0.180)	(0.096)
Male Connections	0.077	1.106***
	(0.056)	(0.158)
Female Expected Connections	0.058	-0.120
	(0.305)	(0.151)
Male Expected Connections	0.137	0.885***
	(0.108)	(0.284)
Female AP (1-year lag)	0.001	0.004
	(0.003)	(0.003)
Male AP (1-year lag)	-0.001	-0.004**
	(0.001)	(0.002)
Female candidates per department-exam	0.148***	0.044***
	(0.013)	(0.010)
Male candidates per department-exam	0.005	0.132***
	(0.007)	(0.011)
Female candidates per department	-0.019***	-0.006
	(0.005)	(0.009)
Male candidates per department	-0.002	-0.017***
	(0.002)	(0.004)
Constant	-0.033***	-0.048***
	(0.011)	(0.014)
Observations	6065	6065
KP rk Wald F-stat	27.346	27.346

Table D2: Department-level - First Stage of the Instrumental Variable Strategy
FP Qualifications instrumented by connections

	Qualified Females	Qualified Males
	(1)	(2)
Female Connections	0.918***	0.090
	(0.187)	(0.109)
Male Connections	-0.007	0.971***
	(0.031)	(0.114)
Female Expected Connections	0.251	-0.016
	(0.277)	(0.231)
Male Expected Connections	0.078	0.537***
	(0.054)	(0.192)
Female AP (1-year lag)	0.003*	0.000
	(0.002)	(0.002)
Male AP (1-year lag)	-0.002*	-0.006***
	(0.001)	(0.002)
Female candidates per department-exam	0.054***	0.011
	(0.013)	(0.018)
Male candidates per department-exam	0.006	0.091***
	(0.004)	(0.010)
Female candidates per department	0.010	0.004
	(0.009)	(0.011)
Male candidates per department	-0.003	0.003
	(0.003)	(0.006)
Constant	-0.006	-0.017
	(0.005)	(0.012)
Observations	6594	6594
KP rk Wald F-stat	18.598	18.598