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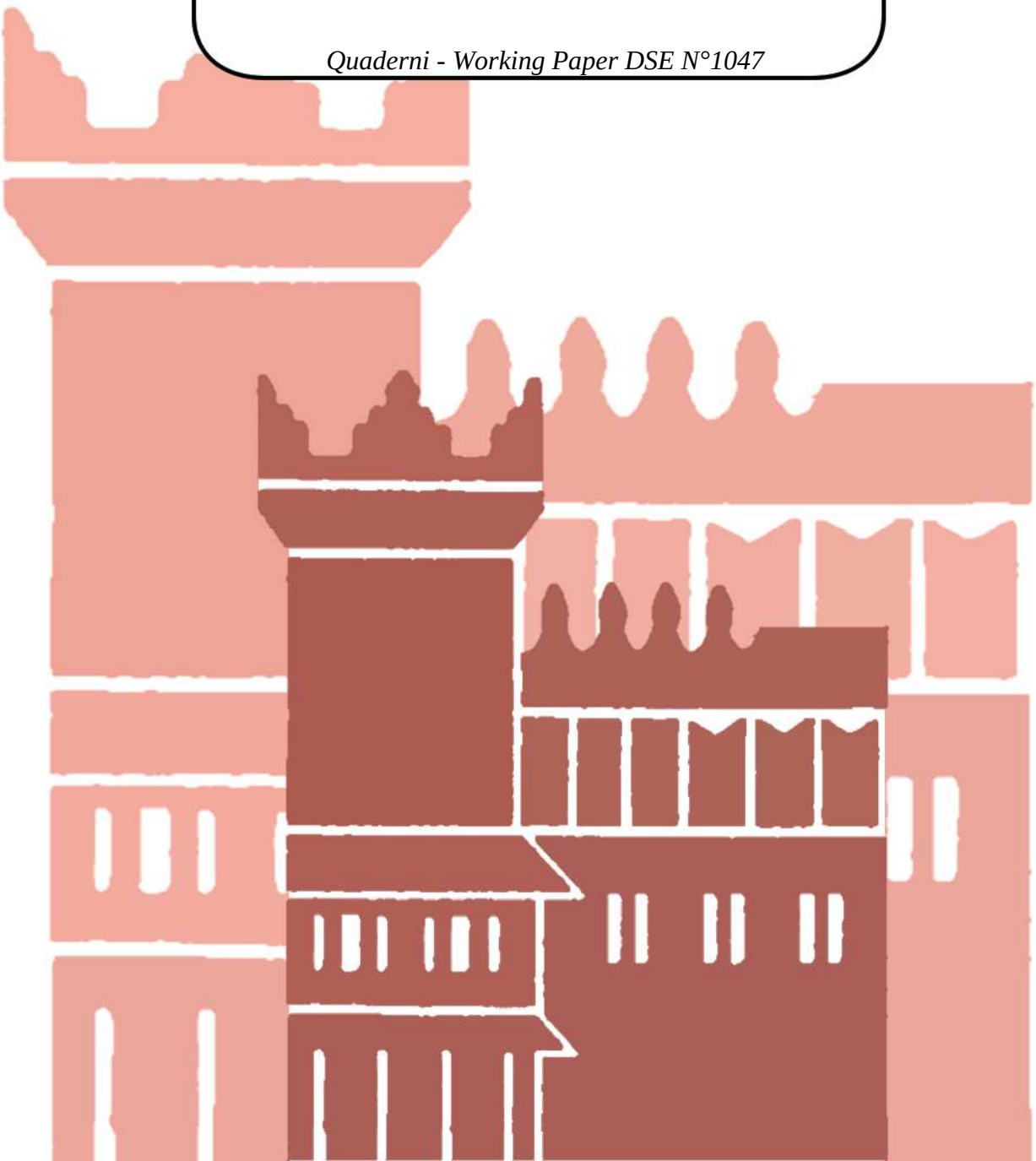

Gender quotas or girls' networks? Towards an understanding of recruitment in the research profession in Italy

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This article investigates the role of the gender composition of selection committees and networks in promoting women in research activities. We exploit a novel data set on recruitment processes at entry-level research positions in a leading Italian research centre that mainly operates in hard science. We find some evidence of discrimination against women at non-tenured entry levels, which is attenuated (or even reversed) by the presence of a woman on the selection committee. However, the most important predictor for recruitment seems to be previous connections with the research centre, which also serves as an important mechanism for women to enter the research profession. We conclude that quotas could be a solution for gender-biased preferences towards same-sex candidates in selection committees for non-tenure-track positions. Moreover, more gender-neutral networks would be another mechanism to bring more equality between men and women in research.

Keywords: Gender quotas, Discrimination, Research recruitment, Connections

JEL classification: J16, J71, J45

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1. Introduction

In 1997, a novel analysis of the evaluation criteria in Swedish academia showed the existence of various forms of favouritism when recruiting research fellows (Wenneras and Wold, 1997). The paper evaluated the peer review process in the Swedish Medical Research Council on the basis of gender parity, in the light of the greater presence of male academics. It showed that female and male applicants were not judged equally; instead, men were advantaged over women. Moreover, previous connections with peer reviewers were found to play an important role in reviewers' final decisions on fellowships. This research was conducted in one country and in one specific field – biomedicine – and for many years it has been considered a groundbreaking study on discrimination practices in academia (Brouns and Addis, 2004; Van den Brink and Benschop, 2012a).

However, over recent decades a gender imbalance in research and academic positions seems to persist everywhere in Europe. In a recent press release, the League of European Research Universities states that as of 2015 "not enough women enter or remain in the research profession and very few are in leadership positions" and that universities fail to make structural changes to facilitate the inclusion of female academics (LERU, 2015). A few years ago, the European commission reported that in 2012 women outnumbered men by 9% when they completed university, but they were under-represented compared to their male colleagues in top academic positions. More specifically, their share represented 37% of Associate Professors and 20% of Full Professors. Women were even more under-represented in the fields of science and engineering, where they constituted only 11% of full professors (Meulders and O'Dorchai, 2013). This phenomenon is commonly known as the "leaky pipeline" or "glass ceiling" effect, with both metaphors evoking the difficulty in gaining equal access

to the top for women, and applies not only to academia but also to other fields and professions (Clark Blickenstaff, 2005; Cotter et al., 2001).[1]

A recent report on gender disparities in the Italian academia (Frattini and Rossi, 2013) reflects the general European trends. The report, based on ministry data, points out that there has been some progress in the participation of women in academic positions over time, especially at the lower levels of the career ladder, leaving the percentage of women in full professorships at 35% for 2011. In other words, it is still significantly more difficult for women than for men to access, progress and pursue a career in Italian academia. The report concludes that it is not likely that the number of women will increase to a level of gender parity without a major policy intervention, such as quotas or a greater representation of women on scientific committees. Indeed, the scientific literature reports that, among other factors, gender discrimination might play a role in the current underrepresentation of women, which is also due to very few women being eligible and available to participate in committees evaluating new entrants (De Paola and Scoppa, 2015). Others show that the principal determinants of academic career advancement for Italian university professors are actually years of service and close professional connections with faculty members (Abramo et al., 2015). This implicitly means that despite first entering in smaller numbers, women could also be less connected and networked within faculties, leading to a double disadvantage (Van den Brink and Benschop, 2012a). These two dimensions also appear important in the previously mentioned article by Wenneras and Wold (1997), where the authors state that they lack data on the gender dimension of candidate connections with peer reviewers, and also information on the role that the gender of committee members plays. These

[1] See Ceci and Williams (2011) for a meta-analysis of the causes of women's under-representation in science.

features could possibly explain the result of a harsher evaluation of female candidates in the case study.

Consequently, for more than a decade affirmative action policies that "require pro-active steps"[2] have been designed in order to level the playing field between genders and to help increase the number of female academics and researchers (Sugimoto, 2013). One direct affirmative action in this direction that is currently hotly debated consists of imposing gender quotas on selection boards when filling research positions. This has already been introduced in some European countries, such as Sweden, Norway, Finland and Spain, where the compulsory minimum share of commission members for both genders is 40%. In addition, the European Commission has recently advocated this type of policy as a desirable tool to countervail the gender inequality that is still prevailing in the academic sector (Meulders and O'Dorchai, 2013, p. 7). This policy has proven useful in many instances (ibid, p.117), although imposing gender quotas on scientific selection committees does not represent a zero-cost policy since it requires a disproportionate share of senior women's time to be spent attending selection committees, thus decreasing the productive activity of female researchers.

There has also been emphasis on other mechanisms through which gender inequality and discrimination in scientific research takes place. As previously mentioned, one of these might be a gender difference in academic networking patterns. Co-optation through informal networking has traditionally been one of the principal means of recruitment in academia (Wenneras and Wold, 1997; Van Den Brink and Benschop, 2012b). Connections help improve career prospects and job opportunities, and facilitate entrance to academic jobs (Forret and Dougherty, 2004). However, women tend to be less involved in high-status professional networks and powerful coalitions

[2] For an overview of affirmative action policies, see Holzer and Neumark (2000, p.484).

(Kauffman, 1978; Husu, 2001; Van Den Brink and Benschop, 2012a), especially in male-dominated fields, and are less likely to profit from informal connections (Forret and Dougherty, 2004). These findings have initiated a larger debate at the policy level over transparency and meritocracy in academic selection and the implications for gender inequality (Van Den Brink and Benchop, 2014).

The aim of this article is to contribute to the debate on gender discrimination in the Italian research community. The paper complements and extends the already existing investigation on the determinants of entrance and progression for female academics and researchers in the Italian research context. We analyse the recruitment practices in the Bruno Kessler Foundation (FBK), an Italian hard science research institute located in the north-eastern part of the country.[3] We ask whether female and male applicants are evaluated on equal bases, and whether a higher proportion of women on selection committees raises the proportion of women selected for research jobs. We also study the role of academic connections and networking in the application process from a gender perspective. Are connections important within FBK? Are they gender-neutral? Can a potential initial disadvantage for women be compensated by strong ties with committees or with the institution under study? Does being networked help women and men differently?

The contribution of the paper is threefold. First, in contrast to previous studies, we investigate gender discrimination in non-teaching research positions, or rather a non-strictly-academic research environment. The institution we study is not related to a specific university, which allows us to shed light on the research careers of women outside university. The non-academic research environment is important, as women are disproportionately scarce in tenure-track positions, and leave academia

[3] We thank the Human Resource division of FBK for providing the data from the project "FESTA", supported by the EC under the 7th FP.

towards adjunct positions and research fellowships outside of universities (Wolfinger et al., 2009). It is important to understand whether they face the same level of discrimination as in universities, which is reported in the previously mentioned research. Second, we examine recruitment processes, not career advancement. The recruitment strategy of the institution studied here mainly operates at the lowest research levels, equivalent to post-doc or research fellowship positions at universities. To the best of our knowledge, no other study about Italy has so far investigated gender discrimination at the start of the research career. This is an extremely interesting level of the research ladder, because it may be the starting point of the scissors effect in female and male research careers. Third, we study networks as an explanation for gender imbalance in research and as a way of discriminating or favouring female researchers. In addition, in almost all cases only one candidate is selected. Therefore, the competition among candidates is more evident and explicit than in previous qualification datasets, and this allows us to use different econometric techniques that take into account the interdependent success probability of candidates applying for the same call.

The paper is organized as follows. In Section 2 we review and discuss related literature; Section 3 presents the institutional environment in which FBK operates and outlines the selection procedures adopted in this centre. In Section 4, we describe the sources of our dataset and report individual and institutional characteristics. We proceed in Section 5 with the estimation strategy and the results. Section 6 discusses and concludes.

2. Previous research

Underrepresentation of women in the research profession has triggered interest among scientists in understanding underlying reasons. Rational choice perspectives assume that individuals base their calculations on costs and benefits, and hence choose paths that are best for them in terms of success

probabilities (Breen and Goldthorpe, 1997). When it comes to research activity, several important factors play a role. Probability of success mainly depends on performance and achievements in previous stages of the career (Wolfinger et al., 2009) as less able researchers will face more difficulty in progressing and staying in research activities, particularly in academic research. However, women score highly in high school and university achievement (Buchmann and De Prete, 2006), and only later in their career does their scientific achievement seem to slow down. As many studies show, this is mostly related to their lower research productivity in terms of Ph.D. scores, scientific publications and conference participation (Long, 1992; Xie and Shauman, 1998).

The rational choice perspective also posits a role for innate attitudes towards employment or the career (Barres, 2006). A recent body of literature based on behavioural and experimental studies highlights the existence of different preferences across genders with regard to risk aversion and competitiveness: women are found to be more risk-averse, less competitive and less self-confident than men.[4] Since the competition for top positions in academia is fiercer, women could shy away from these jobs and prefer to remain at lower levels of the career ladder.

Finally, women also evaluate their success probability on the basis of the burden of childrearing, which affects women more than men (Mason and Goulden, 2004; Shen, 2013). They often choose positions that facilitate a balance between work and family (Reskin, 1993). This is also an objective factor influencing the research productivity (Bassett, 2005) of women and could be part of the explanation of the slower progress of women later in their research careers.

There are, however, explanations that go beyond individual factors in explaining the gender imbalance in research activities. Individual decisions are taken in various contexts where other factors

[4] For a detailed review of experimental studies, see Gneezy and Rustichini (2004), Croson and Gneezy (2009), De Paola et al. (2013), Flory et al. (2012), Gneezy et al. (2009), Charness and Gneezy (2012), Niederle et al. (2013), Frick (2011), Kleinjans (2009), Datta Gupta et al. (2013), Villeval (2012) and Bertrand (2011).

may have an influence over the individual career track. If the underrepresentation of women in research activities is what women want and what they aim for, then in economic terms there would be no inefficiency and no policy intervention would be required. But we cannot exclude the possibility that women are prevented from reaching (the upper levels of) an academic career because of gender discrimination. There might be a preference by male academics for male candidates, thus creating gender inequality. Some authors argue that even the work-family conflict may be regarded as a form of discrimination against women (Wolfinger et al., 2009). Others show that discrimination may also operate through definitions of academic excellence, and through academic networking, where preference for male career models career may disadvantage women both when entering or progressing further in scientific research (Van den Brink and Benschop, 2012a). Many objective measures may be influenced by these dimensions of the research process. After all, the lower productivity of female scientists might be due to a lower number of international connections and co-authorships (Sugimoto, 2013) or to a lack of role models in the upper echelons of the academic world (Blau et al., 2010) where male networks are dominant. For all these reasons, discrimination is very difficult to identify.

The economic literature often examines the discrimination that might operate through the greater (or the exclusive) presence of men on selection committees. Male evaluators could be more likely to hire or promote a male researcher instead of a female if they are subject to gender stereotypes, if they have gendered connections with male candidates, or if they share the same research interests as male candidates. Therefore, examiners' gender-biased preferences could support the gender segregation of women in research.

A few studies have recently investigated the impact of the gender composition of selection committees on the likelihood of obtaining a qualification for Associate/Full Professorships. These

studies analyse centralized selections for Associate and Full Professor positions by relying on the random assignment of evaluators to commissions (see De Paola and Scoppa, 2015; Zinovyeva and Bagues, 2011; Bagues et al., 2014).[5] The exogenous variation in the gender composition of the commission enables estimation of the causal impact of an additional female commissioner on the likelihood of a female candidate being selected. This avoids endogeneity due to the possible existence of unobservables that may be correlated with commission and candidate characteristics. Although these papers share the same methodology, the evidence is mixed. De Paola and Scoppa (2015) examine 1,000 candidates in Chemistry and Economics for the Italian qualifications for Associate and Full Professorships held in 2008 and document same-sex preferences. On the contrary, Bagues et al. (2014), analysing 66,000 applications for qualifications for Associate and Full Professorships in all academic fields in Italy in 2013 (ASN – Abilitazione Scientifica Nazionale), report the opposite: namely, each additional female commissioner decreases the success rate of female candidates by 2%. A mixed and different result is provided by Zinovyeva and Bagues (2011) on Spanish data from all academic fields: opposite-sex preferences are found in competitions for Associate Professorships, whereas female evaluators tend to prefer female candidates in competitions for Full Professorships. The authors explain their results with an internalization of the glass ceiling effect in academia by female evaluators, who may discriminate against potential future female competitors.

To sum up, some of these studies support the idea of bias due to male homophily, thus evidencing negative discrimination. Similarly, women with a stable position in the research profession may also support other women due to similarity in their profiles. On the other hand, women are often

[5] In a few European countries, such as Italy and Spain, the process to become Associate and Full Professor entails a two-step procedure. In the first step candidates must succeed at a national qualification exam in their academic scientific field. Qualification is valid for four years and it is a necessary condition for taking part in the second step of the procedure, which involves a competition at the local level, managed by each department.

specifically searched for in order to satisfy ever-more frequent policy requirements to promote gender balance in departments, given the small number of women in teaching and non-teaching positions inside and outside academia. This may add to the presence of positive discrimination. However, none of these studies has examined entry-level research positions, such as post-doc or research fellowships, which may be the starting levels of the gender imbalance in this type of profession, and thus could exhibit different patterns.[6]

Many studies instead highlight that gender inequalities are reproduced by the construct of academic excellence, where 'love of the same' models and behaviours in evaluating academic achievements often negatively affect women (Husu, 2004; Van den Brink and Benschop, 2012a). The criteria for candidate selection comprise objective standards of productivity and full-time dedication to the research profession. Although it is arguable to what extent these are really objective and gender-neutral criteria[7], there are other important dimensions influencing the evaluation of scientific merit. These are, for instance, candidates' connections with the academic elite and eminent professional networks (Johnson and Oppenheim, 2007). These may help the dissemination and citation of scientific publications (Van den Brink and Benschop, 2012a), but may also be directly responsible for the recruitment of new researchers and scientists (Zinovyeva and Bagues, 2015). It is often argued that these networks tend to be homophilous, and mostly male-dominated, so that women are less able to benefit and be promoted through them, while female networks at higher levels of the academic

[6] Another strand of the gender discrimination literature has investigated non-academic competitions. Based on 150,000 applications to enter the Spanish judiciary system, Bagues and Esteve-Volart (2010) find opposite sex preferences: commissions with relatively more females are more likely to hire a male candidate. Other studies examine the impact of the gender of evaluators on decisions such as accepting articles in a leading journal in economics (Abrevaya and Hamermesh, 2012) or approving grant proposals for the economics programme of the National Science Foundation (Broder, 1993). In the former study, no discrimination against female authors is documented, whereas in the latter there is a clear preference for opposite-sex grant applicants.

[7] Undervaluation of teaching, management or non-standard career trajectories is quite common in scientific evaluations, and disproportionally affects women who are more involved in these activities (see Van den Brink, 2010).

hierarchy are weak (Husu, 2004). Addis and Villa (2003), for instance, show that in Italy the advancement of women in academic publishing critically depends on the networking structures in the Italian economic journals, which are mostly male-dominated, with negative consequences for further promotion of female candidates. Nevertheless, the potential discrimination of this kind at initial recruitment is relatively hidden and empirically understudied.

The exact purpose of this article is to search for evidence of positive and negative discrimination of women in academic recruitment in Italy through a case study, by analysing both the direct influence of the presence of women on academic committees, and hidden dimensions of recruitment through internal networks.

3. Institutional background

3.1. The research institute

This study focuses on empirical material obtained from the Bruno Kessler Foundation (FBK) in the years 2009-2011. FBK is a private non-profit research organization based in Trento (Italy), whose core activity is research in hard science, although some research is also undertaken in humanities and social sciences. It was established in March 2007 as a conversion of the pre-existing Trentino Institute of Culture (ITC), a research institute founded in 1962 and entirely funded by the regional government (Provincia Autonoma di Trento). It currently hosts about 350 researchers, employed in eight research units.[8] Each unit is composed of several independent sub-units that run various research projects and

[8] The eight centers are: Center for Communication and Information Technology - ICT, which focuses on computer science; Center for Materials and Microsystems - CMM, concerned with microsystems and microelectronics, as well as computational physics and materials; European Center for Theoretical Studies in Nuclear Physics and Related Areas - ECT; Italian-German Historical Institute - ISIG, which deals with the historical connections between Italy and Germanic countries; Center for Religious Sciences - ISR; Research Institute for the Evaluation of Public Policies - IRVAPP, which carries out research on the impact evaluation of labor/ educational/ industrial/ development policies; International Center for Mathematics Research -CIRM, which conducts seminars and meetings on mathematics research; Explorative Projects - EP, which includes research initiatives which are in an exploratory phase.

compete for national and international funding. The institute has an excellent reputation and attracts many young researchers, not only from the local University of Trento but also from other parts of Italy and from abroad. It has a very competitive salary system compared to other European countries, which is certainly above Italian standards for equivalent positions.

The institute offers both tenure-track and non-tenure-track positions, where the first group enables researchers to progress within the institution, and the latter includes researchers with more precarious employment conditions and without a direct eligibility for higher-level positions (post-doc fellows, short-term grants and research analysts).

3.2. The selection process

The selection procedure for hiring new researchers relies on a publicly advertised call and follows the rules and stages outlined in FBK internal guidelines. The selection of researchers for both tenure-track and non-tenure-track posts consists of four stages. In the first stage, the selection committee (or its president) carries out a first screening and produces a shortlist with at most 20 candidates. These candidates are then interviewed by a committee composed of Human Resources officers and senior researchers working in the same research unit(s) that required the hiring. This second phase assesses the suitability of the candidates. The list of suitable candidates is then ranked according to their quality and adequacy for the position, mainly based on previous research and CVs. Finally, the post is offered to the highest ranked candidate(s).

Each selection committee consists of up to five members, typically with one from the Human Resources department. The remaining members are researchers from FBK (from the relevant unit or sub-unit that posts the vacancy) or from other research institutions, in Italy or abroad. The committee members are invited by the head of the unit.

Within the sluggish Italian academic labour market, a salient feature of FBK is the high turnover of researchers, leading to a large number of selection procedures each year (between 30 and 50 per year). This is mostly attributable to the fact that FBK retains only a limited number of tenure positions, while the majority of them are temporary and are (re)posted after their expiry. Given the smaller size of the research units working in the field of humanities and the absence of largely accepted bibliometric criteria, we abstract from them and focus on the science and engineering competitions posted by hard science units, which are traditionally composed by a vast majority of men (Morgan et al., 2013).

4. Data

The data used in this study were purposely collected from three main sources: candidates' CVs, FBK's administrative archives and the Scopus bibliometric database, which was used to retrieve information about the candidates' research output. Candidates applied online or via email, and their applications are kept in the institution for up to 5 years. The administrative archives hold the official final reports together with the job advertisement contained in the public call. These three sources lead to a multilevel design of the analysis, since the data relate to both the individual applicant and the call level.

The data analysed include information on 664 candidates for 111 calls posted between 2009 and 2011. The number of calls follows an irregular time profile over the years: 36 calls were posted in 2009, 47 in 2010 and 28 in 2011. The number of applications follows a similar pattern: 183 candidates were examined in 2009, 290 candidates in 2010 and 191 candidates in 2011. Some of these competitions failed to fill in the position, while a few resulted in the recruitment of more than one candidate. For 27 competitions, only one application was received. Our final sample excludes both the competitions

with only one applicant and competitions without selected winners. As a result, the dataset contains 608 applicants for 78 calls.[9] Out of the 78 calls, 72 resulted in the recruitment of one candidate, and these account for 502 candidates, whereas five calls led to two recruitments, and one led to three, with 73 and 33 applicants respectively. The calls examined are all public hence they are open to both external and internal FBK candidates.

4.1. Variables

4.1.1. Candidate-level variables

The dependent variable in our analysis is the dummy variable $success_{ij}$, which takes value 1 if the candidate *i* was eventually selected in call *j* and 0 otherwise. Our main variables are a dummy for the gender of the candidate (value 1 if the candidate is a woman), and an interaction term between the gender of the candidate and a dummy for the presence of a female examiner in the commission.[10] Other covariates included in the analysis relate to the candidates' socio-demographic characteristics (age, country of birth)[11], scientific productivity and pre-existing ties with the research institute. Several variables show the research potential of the candidates. Educational attainment consists of four categories: no degree, bachelor's degree, master's and Ph.D. Since the positions advertised at FBK are research positions, we opt to construct a dummy variable, *Ph.D.*, which takes value 1 if the candidate has a Ph.D. and zero otherwise. The field of study is recoded in three main areas, according to the very heterogeneous publication propensities across the disciplines: 1) social sciences within

[9] The final dataset comprises 171 candidates for 25 calls posted in 2009, 266 candidates for 31 calls in 2010, and 171 candidates for 22 calls referred to 2011.

[10] A detailed description of the variables categories is presented in Table A1 of appendix A.

[11] The candidate's age is missing in 47% of the CVs. When no age is reported, it is estimated from the year of graduation. Origin was coded distinguishing between Trentino-Alto Adige (local), the rest of Italy, the European Union (including Switzerland) and the rest of the world. For the econometric analysis we consider Italian origin as a dummy variable taking value 1 if the candidate is of Italian origin and 0 otherwise. Unfortunately, no information can be gathered on the marital status or the number of children of the candidates (relevant especially for female candidates).

engineering research areas; 2) hard sciences (mathematics, physics, chemistry, geography); 3) engineering, computer sciences, architecture and environmental sciences. Years of work experience (research and non-research related activities) are included in the analysis; Ph.D. activity alone is not considered as work experience, whereas lecturing and/or other types of employment, even if undertaken during the Ph.D., are taken into account.

The dataset also includes information on the candidates' scientific output. Candidates self-reported their publications on their CVs. Nevertheless, in order to standardise the comparison within and between competitions, we retrieved data regarding the number of publications and citations directly from Scopus, Elsevier's bibliographic database created in 2004.[12] In order to obtain the applicants' publication records, the Scopus Author search page was queried with the researchers' first and last names. If the author's name was not unique, the results were crosschecked with data appearing on the candidate's CV, such as age, origin and field of study, in order to refine the results and ensure a correct attribution of publications to candidates.[13] The Scopus database was accessed in August 2014. Both publications and H-index data were retrieved for the specific year of the FBK call for which the candidate applied in order to get closer to the perception of the selection committee. We opted to collect the candidates' H-index besides the number of publications because we believe that this combined measure of quality and quantity is a good proxy for the importance and significance of candidates' contributions (Hirsch, 2005).

[12] Although other bibliographic sources such as Google Scholar and Web of Science are available, many studies suggest that Scopus is superior in terms of both coverage and accuracy. According to Falagas et al. (2008, p. 338), "Scopus offers about 20% more coverage than Web of Science, whereas Google Scholar offers results of inconsistent accuracy." Moreover, "Scopus helps distinguish between the researchers in a more nuanced fashion than Web of Science." (Meho and Rogers, 2008, p. 1711).

[13] Out of 616 candidates, 50 candidates, corresponding to 40 unique individuals were not uniquely identified. In order not to lose these observations, the average value for the h-index and the number of publications of namesakes in the same field as the individual applying to FBK were entered in the data set.

Finally, candidates' pre-existing ties with FBK are captured by a dummy variable, *Ties with FBK*, which takes value 1 if the candidate had prior ties with FBK or with one member of the selection committee, either in the past or at the time of the application. Candidates are classified as having a pre-existing tie with FBK if they meet at least one of the following criteria: 1) co-authorship with a member of the selection committee; 2) being supervised at the master or Ph.D. level by one of the commission members; 3) prior work experience (including internship) at FBK; 4) current work experience (including internship) at FBK; 5) an indirect tie with a commissioner.[14] We refer to 1), 2) and 5) as commission ties and to 3) and 4) as institution ties, with the underlying hypothesis that ties with the institution may exert a stronger effect in the hiring procedures, since a candidate with prior or current work experience at FBK may have had more opportunities to show her skills and at the same time to create networks within the hiring institution. In the econometric analysis we first employ the dummy variable *Ties with FBK*, and we later decompose this variable into the sub-categories in order to have more detail on the type of connections operating at the institute. Similarly, we create a variable *Intensity of ties*, which shows the presence of multiple ties of the candidates. This is a discrete variable that counts the number of different connections outlined above (e.g. a value of 2 means an accumulation of two types of connections for the same candidate).

We consider as an indirect tie having a co-author of the Ph.D. supervisor, as well as a co-author of the candidate's co-author.

[14] We consider as an indirect tie having a co-author of the Ph.D. supervisor, as well as a co-author of the candidate's co-author.

4.1.2. Call-level variables

For each call, the characteristics of the members of the selection committee are included in the dataset, jointly with information about the vacancy advertised. For committee members, gender, age and country of origin were obtained from the administrative archives of FBK, and their bibliometric indices retrieved from Scopus for the year of the call. The latter data provide a measure of the intrinsic quality of the commission, which could be positively correlated with the use of bibliometric measures in the selection.[15] We distinguish between researchers and HR staff. The gender presence in the commissions is described by a dummy variable, *Female (no HR) in commission*$_j$, taking value 1 if the commission includes at least one female research member. At the call level, we also recorded information on the units posting the vacancies, such as the duration of the contract (in months), the salary and the type of position advertised. The positions advertised are classified into the following categories: 1) tenure-track positions (internally coded as R3-(senior)-level researchers and R4-(junior)-level researchers), 2) non-tenure-track positions (internally coded as T4-level technicians - equivalent to research assistant -, post-doc positions and fixed-term grants - called "co.co.pro." in Italian labour law).

4.2. Descriptive statistics

We observe an average of 8 applications per call. The variation in the number of candidates across calls, however, is considerable, ranging from 2 applicants to more than 30 applicants. Table 1 depicts the number of candidates and calls across the different positions included in the dataset. We distinguish the different research positions into tenure-track and non-tenure-track positions. As it can

[15] De Paola et al. (2015), working on the 2013 Italian qualifications for Associate and Full Professorships, find that a commission whose members had an H-index above the median tends to weight a candidates' publications in the selection process more than other commissions; moreover, in the lower tail of the distribution of commission quality, candidates with a weaker publication record tend to be qualified at the expense of stronger candidates.

be noted from Table 1, the vast majority of the observations refer to non-tenure-track positions (69%). Also, female candidates are equally distributed across tenured and non-tenured positions. Descriptive statistics regarding the monthly wage, the applicants' ages and the contract length across the different research positions are reported in Table B1 in Appendix B.

Table 1 – Number of candidates and calls across different positions

Position	*N. candidates*	*N. calls*	*Average N. of candidates per call*	*% of female candidates*
Tenure-track	189	26	7.27	0.20
R3	65	13	5.00	
R4	124	13	9.54	
Non-Tenure-track	419	52	8.06	0.20
T4	22	2	11.00	
Post-doc	15	2	7.50	
Co.co.pro.	382	48	7.96	
Total	608	78	7.80	0.20

Table 1 reports descriptive statistics for the candidate-level variables. The average candidate is male, around 30 years old, and with 4.6 years of work experience; he has around 6 publications and a corresponding H-index of 1.38. The proportion of women is about 20%. Almost 14% of the candidates are eventually recruited (15.7% of the female candidates and 13.5% of the male candidates) and almost 11% have pre-existing ties with FBK members or with commissioners (similar for men and women, with 12.3% of the women and 10.5% of the men).

Table 2 – Descriptive statistics - Candidates

Variable	Mean	s.d.
Female	0.20	0.40
Success	0.14	0.35
of which Females	*0.16*	*0.37*
Males	*0.14*	*0.34*
Age	30.65	5.77
of which Females	*29.94*	*4.74*
Males	*30.62*	*5.71*
Italian origin	0.48	0.50
of which Females	*0.55*	*0.50*
Males	*0.46*	*0.50*
Publications	5.58	21.05
of which Females	*3.19*	*6.28*
Males	*6.18*	*23.28*
H-index	1.39	3.19
of which Females	*0.85*	*1.55*
Males	*1.45*	*3.35*
Work experience	4.45	4.56
of which Females	*3.61*	*3.72*
Males	*4.66*	*4.72*
Field 1	0.07	0.26
of which Females	*0.22*	*0.42*
Males	*0.04*	*0.19*
Field 2	0.57	0.50
of which Females	*0.44*	*0.50*
Males	*0.60*	*0.49*
Field 3	0.36	0.48
of which Females	*0.34*	*0.48*
Males	*0.36*	*0.48*
Ties with FBK	0.11	0.31
of which Females	*0.12*	*0.33*
Males	*0.10*	*0.30*
Intensity of ties	1.35	0.65
of which Females	*1.13*	*0.35*
Males	*1.42*	*0.70*

Notes: Selected variables: The final sample amounts to 608 candidates, of which 121 are females and 487 males. The intensity of ties descriptive statistics are computed on the 65 observations with at least one tie with FBK.

Table 1 sheds a preliminary light on some marked differences between the male and female candidates: the male applicants have on average one more year of work experience than female ones; they have on average three more publications, and their H-index is higher, although the disparity

across genders is proportionally lower for the H-index. The differences in the standardized number of publications between male and female candidates are statistically significant (Wilcoxon rank-sum test, z= 4.042, p= 0.000), whereas they are not significant for the standardized H-index (Wilcoxon rank-sum test, z= 1.477, p = 0.140).[16]

By decomposing the variable representing prior ties with FBK into institution and commission ties as indicated at the end of Section 4.1.1, we note that the majority of ties are represented by ties with the institution, and that female candidates have disproportionally fewer ties with the committee than their male counterparts (Table 1).

Table 3 – Decomposition of ties with FBK

	Institution	*Commission*	*Intensity of ties (1-5)*
Females	27.08%	15.38%	1.13
Males	72.92%	84.62%	1.42
Total	100%	100%	1.35

Notes: Candidates with at least one tie amount to 65, of which 15 are females and 50 males.

In order to investigate the role of different ties, the "Intensity of ties" variable can assume values between 0 and 5, where 0 indicates that the candidate does not have any tie with FBK, and 5 stands for having all five of the five types of ties with FBK. Conditional on having at least one tie, male candidates have more ties than women. It is possible that this is a mechanism through which male candidates are favoured over female candidates.

[16] In order to compare candidates from different fields, we standardise the number of publications and the value of the candidates' H-index, according to 3 macro fields of research, which are more uniform in terms of bibliometric patterns: social sciences within engineering research areas (Field 1); maths, physics and chemistry (Field 2); environmental sciences, engineering and computer sciences (Field 3).

Table 4 – Descriptive statistics - Commission members

	Mean	*s.d.*
Female in commission	0.77	0.42
Female (no HR) in commission	0.17	0.38
Italian origin	0.64	0.48
Age	41.61	4.90
Human resources	0.87	0.59
H-index (no HR)	7.81	7.14

Notes: The sample of commissioners consists of 2042 observations, of which 93 are unique.
Descriptive statistics are computed at the call level.

Table 4 reports information about members of the selection committee at the call level; the commission members were mainly Italian, with an average age of 42 years (per commission) and an average H-index of 7.81. The commissioners' H-index was standardized following the same procedure as for the candidates' H-index.[17] About 77% of commissions included at least one female, but if we exclude HR personnel the percentage drops to 17%. Thus, all-male researcher commissions were dominant. In addition, the percentage of female researchers in the commissions varies little, as generally only one member was female. The very high percentage of all-male commissions makes discrimination against female applicants a possibility if commissioners tend to have same-sex preferences regarding candidates. This will be further examined in the econometric analysis.

5. Empirical analyses

In this section, we analyse some aspects of favouritism – gender discrimination of committee members and ties, as well as the gender nature of ties. The descriptive overview showed that women are in the minority, both in the application and the recruitment stages. Is it possible that one of the reasons for this is an under-representation of women in the selection committees?

[17] Unlike for candidates, who had to indicate their fields of research on their CVs, the commissioners' fields were retrieved from Scopus as the principal sector of their publications appearing on the Elsevier database.

We first conduct an analysis on the whole sample of candidates at FBK, and we proceed to examine hiring patterns on sub-samples of applicants, obtained by stratifying on relevant characteristics of the hiring process. We then investigate the relationship between gender and pre-existing ties.

5.1. Gender composition of committees and female success

5.1.1. Analysis on the full sample

To examine the effects of the gender composition of the commission on the probability of being hired, we estimate Equation 1 with a conditional logit model:

$$Success_{ij} = \beta_0 + \beta_1 Female_{ij} + \beta_2 Female_{ij} * Female\ (no\ HR)\ in\ commission_j + \beta_3 X_{ij} + \mu_j + \varepsilon_j \quad (1)$$

where $Success_{ij}$ is a dummy variable taking value 1 if candidate *i* won the selection for call *j* and value 0 otherwise. We control for the gender of the candidate, $Female_{ij}$, and for the interaction between the gender of the candidate and a dummy variable indicating the existence of at least one woman in the commission, $Female_{ij}$*Female (no HR) in commission$_j$. Thus, β_1 indicates the effect of being female on the probability of being selected by an all-male selection committee, whereas $\beta_1 + \beta_2$ indicates the effect of being female on the probability of being selected by a mixed-gender commission. X_{ij} is a vector of candidate attributes, such as age and country of origin, a dummy for holding a Ph.D., years of work experience, the Scopus H-index at the year of the competition, and the presence of pre-existing ties with FBK. Fixed effects of calls are captured by μ_j, which includes both the type of position and the area of specialization, as well as other factors that may influence the candidates' probability of success.

Besides estimating Equation 1 with a conditional logit model, we also estimate a linear probability model as a robustness check. The conditional logit allows us to take into account the candidates'

inter-dependent probabilities of being recruited. The likelihood of the data in a conditional logit depends on the conditional probabilities, conditional on the number of positive outcomes (in our case, success) within the group. For almost all the calls in our dataset only one candidate was selected per call and hence the group at the basis of the conditional logit is composed by candidates applying for the same call. The conditional logit fits a logistic model that explains why one candidate has a positive outcome in a certain group, conditional on one of the candidates in the group having a positive outcome. Hence, the differences across candidates are considered at the call level. Estimates for the conditional logit are displayed in Table 5 and refer to coefficients.

Table 5 – Probability of success – Conditional logit

Success	1	2	3	4	5
Female	-0.033	-0.415	-0.366	-0.356	-0.390
	(0.309)	(0.379)	(0.383)	(0.408)	(0.439)
*Female*Female (no HR) in Comm.*		1.587**	1.541**	1.402*	1.058
		(0.760)	(0.763)	(0.802)	(0.824)
H-index std.			0.243**	0.208*	0.161
			(0.105)	(0.114)	(0.126)
Age				0.046	-0.012
				(0.272)	(0.258)
Age squared				-0.003	-0.002
				(0.004)	(0.004)
Italian origins				1.144***	1.194***
				(0.348)	(0.362)
Ph.D.				0.704*	0.609
				(0.397)	(0.430)
Work experience				0.103**	0.113**
				(0.046)	(0.047)
Ties with FBK					1.552***
					(0.361)
Pseudo R^2	0.000	0.016	0.033	0.111	0.177
Observations	606	606	606	606	606

Notes: The Table reports conditional logit coefficients, computed at the call level. The dependent variable is a dummy variable for being recruited. Standard errors are reported in parenthesis. Symbols *, ** and *** indicate that coefficients

are statistically significant at the 10%, 5% and 1% levels respectively.

In the first specification reported in Table 5, column 1, we are interested in knowing whether there is an overall lower probability of female candidates being recruited. Our results reject this hypothesis. However, when examining the effect of the gender composition of the commission in column 2, it becomes apparent that commissions with a female evaluator tend to increase the chances of female candidates. This also holds true if we include a measure of the candidates' scientific productivity, the standardized H-index, as in column 3.

Various individual characteristics are important for success in the competitions. Being more productive in bibliometric terms has a positive impact on the probability of being appointed for the job. As reported in column 4 of Table 5, age has a negative impact, whereas Italian origin and holding a Ph.D. positively influence the probability of being recruited, as does an additional year of work experience. After including the individual characteristics, the association between the gender of the candidates and the presence of women in the commissions remains stable and in the same direction as in the previous models. Finally, if the estimation encompasses the dummy variable representing pre-existing ties, as in column 5, the interaction term between the candidates' gender and the gender composition of the commission loses significance, while the pre-existing ties variable bears a positive and highly significant coefficient.[18] In addition, by incorporating these variables the positive effect of the H-index becomes statistically insignificant. This reveals the importance of prior ties, possibly at the expense of purely meritocratic patterns of selection based on research output. Moreover, this result indicates the potential existence of female networks between candidates and commission members that could explain why more women on the committees increases the chances of female

[18] The results of the final conditional logit model are confirmed both in significance and in signs when we perform a linear probability model estimation, thus providing a robustness check.

candidates: it is not simply the number of women on the committee that makes a difference, but rather the presence of female committee members networked with the female candidates. This finding will be further explored in Section 5.2.[19]

5.1.2. Analysis on sub-samples of candidates

In this section, we analyse whether a gender gap in hiring patterns arises in sub-samples obtained by splitting the original data set according to relevant call-level variables. All the results displayed in Table 6 stem from a conditional logit model. The model is the same as the full model specification in Table 5, column 5.

First, we are interested in distinguishing between commissions in terms of a bibliometric measure as a proxy for the quality of the commission. To this end, we compute the average H-index of all the selection committees and divide the full sample of candidates into two sub-samples: those evaluated by commissions in the top quartile of the H-index distribution and those in the three lower quartiles. The estimations performed on these two sub-samples are shown in columns 1a, 1b, 2a and 2b of Table 6, with and without ties with FBK. In none of these models does a presence of female committee members seem to matter in promoting female candidates. However, the fourth quartile of commissioners in terms of research quality seems to be more responsive to candidates' research production, as highlighted by the positive and significant (at the 5% significance level) coefficient for the standardized H-index. Nevertheless, Italian origin increases the probability of recruitment and so do more years of work experience, *ceteris paribus*. However, prior connection with the institute does not significantly change the success probability of candidates, a result that indicates more

[19] All the estimations were also implemented with the standardized number of publications at the year of the competition in place of the standardized H-index of candidates, and non-significant differences were found.

meritocracy, in contrast with the general model shown above (Table 5). On the other hand, for candidates evaluated by the three lower quartiles in terms of H-index, the criteria that matter most for being recruited are being younger, having Italian origin and having pre-existing ties with FBK.[20] Thus, the less productive commissions in terms of research output are more susceptible to being influenced by networking patterns and internal connections.

Next, we examine the association of different candidate characteristics with success probability if we consider non-tenure-track and tenure-track research positions at FBK separately.[21] As pointed out in the introduction, what distinguishes our study from previous studies is the availability of data for entry-level research jobs. Within this group, a majority of 417 of the 608 applications are for non-tenure-track research jobs, whereas 189 are for tenure-track research positions. Our results suggest that females applying for non-tenure-track jobs have, *ceteris paribus*, a lower probability of being hired, although this is reverted if the commission includes a female researcher. In addition, pre-existing ties with FBK play an important and positive role in being recruited. However, when we move from the specification without ties with FBK in column 3a to the specification with ties with FBK in column 3b, the positive and significant coefficient for the interaction between female candidates and the dummy for female commission members remains, pointing to the importance of both female networks and a higher presence of female committee members for selection of the female candidates. In other words, two mechanisms for more gender equality are evident: a part of the

[20] The same estimation was performed on two sub-samples divided into above or below the median of the commissions' H-indices. No relevant differences between the two sub-samples are found in this case, meaning that a different hiring pattern emerges only for top-quality selecting committees.

[21] We split the sample into two groups with respect to the characteristics of the entry contract, and the possibility of internal promotion and a career.

influence is exerted through female networks, but an important way to promote female researchers in non-tenure track positions seems to be employing a female researcher in the selection committee.

If we look at recruitment for tenure-track research positions, being a woman becomes a second-order effect. There is no evidence of observables affecting the probability of recruitment except Italian origin and having prior ties. This means that recruiting at higher levels follows different logics: being local and well networked with the institute seems to matter more than publishing well.

Table 6 – Probability of success in different sample splits – Conditional logit

Success	1a	1b	2a	2b	3a	3b	4a	4b
	H-index commission:				Position:			
	4th quartile		1st-3rd quartiles		Non-tenure-track		Tenure-track	
Female	0.291	0.447	-0.354	-0.336	-1.103*	-1.416**	0.539	0.770
	(0.946)	(0.979)	(0.436)	(0.471)	(0.630)	(0.699)	(0.599)	(0.633)
*Female*Female (no HR) in Comm.*			1.226	0.739	2.082**	1.982*	1.021	0.455
			(0.838)	(0.872)	(1.022)	(1.067)	(1.453)	(1.677)
H-index std.	0.331**	0.382**	0.131	0.128	0.452**	0.500***	0.062	-0.021
	(0.164)	(0.193)	(0.213)	(0.236)	(0.185)	(0.186)	(0.200)	(0.207)
Age	0.887	0.967	0.038	-0.039	-0.024	-0.085	0.110	-0.042
	(1.523)	(1.529)	(0.291)	(0.276)	(0.357)	(0.351)	(0.584)	(0.513)
Age squared	-0.016	-0.018	-0.002	-0.001	-0.002	-0.001	-0.003	-0.001
	(0.024)	(0.024)	(0.004)	(0.004)	(0.006)	(0.005)	(0.009)	(0.007)
Italian origins	2.073**	2.054**	1.002***	0.998**	0.946**	0.934**	1.677**	2.119***
	(0.866)	(0.871)	(0.381)	(0.402)	(0.413)	(0.430)	(0.708)	(0.804)
Ph.D.	0.424	0.311	0.770*	0.623	0.674	0.711	0.877	0.476
	(1.235)	(1.242)	(0.424)	(0.469)	(0.564)	(0.602)	(0.566)	(0.652)
Work experience	0.322**	0.340**	0.082*	0.096*	0.127**	0.142***	0.060	0.086
	(0.159)	(0.165)	(0.049)	(0.052)	(0.054)	(0.055)	(0.099)	(0.105)
Ties with FBK		-0.833		1.699***		1.652***		2.119***
		(1.704)		(0.383)		(0.500)		(0.609)
Pseudo R^2	0.211	0.215	0.097	0.189	0.139	0.200	0.150	0.282
Observations	168	168	438	438	417	417	189	189

Notes: The Table reports conditional logit coefficients, computed at the competition level. The dependent variable is a dummy variable for being recruited. Standard errors are reported in parentheses. In models 1a - 2b the observations are divided according to the average H-index of the commissioners, whether belonging to the first three quartiles of the H-index of the commissions or to the fourth quartile; in models 3a – 4b the distinction is made according to the level of the post advertised in the competition: non-tenure-track refers to co.co.pro., post-doc and T4 levels, whereas tenure-track stands for R3 and R4 types of positions. In models 1a and 1b the interaction term is not included due to the existence of just one mixed-gender commission belonging to the 4th quartile of commissions in terms of H-index. Symbols *, ** and *** indicate that the coefficients are statistically significant at the 10%, 5% and 1% levels respectively.

5.2. Gender, ties and recruitment

The previous analyses have shown that the commissions are mostly male, and that there is little variability in the female participation in the commissions; in most cases, the presence of women equals one female researcher. Interestingly, in all the cases in which a male candidate is successful, no female is present on the evaluating committee, whereas in 36% of the cases in which a female wins the competition there is at least one female on the committee.[22] We also saw that in almost any model specification and sample split, the most important factor affecting the probability of recruitment is pre-existing ties with FBK. Table 7 reports the predicted probabilities for female and male candidates with different profiles, net of other characteristics. Male candidates have a 40% probability of success without prior networks, and 76% with prior networks. Similarly, female candidates with networks and all-male commissions have a 56% probability of winning a selection. The probability is very high, at 90%, if female candidates are both networked and there is a female researcher on the selection committee.

Table 7. Conditional logit with 1) interaction between the gender of the candidates and prior ties, and 2) interaction between the gender of the candidates, the presence of women on the committee and prior ties. Predicted probabilities of success

Candidate gender-prior ties	Average partial effect	Std.error
Male – No ties	0.41	0.90
Male – Ties	0.76	0.69
Female – No ties	0.37	0.87
Female – Ties	0.60	0.90
Candidate gender – Women on committee – Prior ties		
Female – No women on committee – No prior ties	0.45	0.96
Female – No women on committee – With prior ties	0.56	0.95
Female – Women on committee – No prior ties	0.57	0.96
Female – Women on committee – With prior ties	0.91	0.34

Notes: The models control for individual and call characteristics.

[22] The Table is available upon request.

Networks tend to explain in part or fully the higher propensity that a female wins competition if at least one of the committee members is a woman, and male networks might be responsible for recruiting male candidates. This represents an alternative channel through which a gendered selection may take place since prior ties precede the actual selection process. In this section, we decompose the ties to analyse their composition more deeply and their gender dimension.

Table 8 – Gender composition of successful and unsuccessful candidates

	Females	*%*	*Males*	*%*
Overall				
Ties	15	12.40%	50	10.27%
No ties	106	87.60%	437	89.73%
Successful				
Ties	6	31.58%	22	33.33%
No ties	13	68.42%	44	66.67%
Unsuccessful				
Ties	9	8.82%	28	6.65%
No ties	93	91.18%	393	93.35%

Decomposition of prior ties with FBK across candidates' gender, however, shows that connections seem to be gender-neutral. Table 8 reports the percentage of candidates with and without prior ties: overall, 12.40% of the female applicants have previous ties with FBK, and the percentage for males stands at 10.27%.[23] If we look at successful and unsuccessful applicants separately, again, we do not find any statistically significant differences across genders. However, as we saw previously in Table 3, the average male candidate differs from the female one in a higher intensity of ties (1.42 vs. 1.13), and in the maximum number of ties (four types of connections vs. a maximum of two for females). In addition, women are underrepresented in the ties with commissions. To better understand the

[23] The differences in the proportions are not statistically significant; two-group test of proportions: z = -0. 599, p = 0.549.

mechanisms behind recruitment that are linked to prior connections, the previous multivariate analyses are repeated using the decomposed measures.

We examine the impact of different types of ties with FBK on the probability of being recruited in two ways: first, we estimate the conditional logit model (5) in Table 5 replacing the variable "Ties with FBK" with the two variables representing ties with the institution and ties with the commission. Second, we estimate the same model replacing the two dummy variables with the intensity of ties indicator.

Table 9 – Probability of success – Conditional logit with types and intensity of ties

Success	1	2	3
Female	-0.356	-0.581	-0.281
	(0.408)	(0.476)	(0.431)
*Female*Female (no HR) in Comm.*	1.402*	1.445	0.917
	(0.802)	(0.886)	(0.832)
H-index std.	0.208*	0.228*	0.158
	(0.114)	(0.120)	(0.126)
Age	0.046	-0.062	-0.008
	(0.272)	(0.247)	(0.255)
Age squared	-0.003	-0.001	-0.002
	(0.004)	(0.004)	(0.004)
Italian origins	1.144***	1.020***	1.079***
	(0.348)	(0.362)	(0.363)
Ph.D.	0.704*	0.504	0.604
	(0.397)	(0.441)	(0.447)
Work experience	0.103**	0.124***	0.119**
	(0.046)	(0.048)	(0.048)
Institution ties		2.248***	
		(0.447)	
Commission ties		-0.238	
		(0.699)	
Intensity of ties			1.201***
			(0.286)
Pseudo R^2	0.111	0.216	0.192
Observations	606	606	606

Notes: The Table reports conditional logit coefficients, computed at the call level. The dependent variable is a dummy variable for being recruited. Standard errors are reported in parenthesis. The symbols *, ** and *** indicate that the coefficients are statistically significant at the 10%, 5% and 1% levels respectively.

When we estimate the model specification in column 5, Table 5 exploiting the different types of ties (institution vs. commission) as in Table 9, column 2, the results show that the most effective ties in terms of probability of success in the competition are represented by ties with the institution. Hence, it seems that having worked or working at FBK is the most fruitful channel for being employed at FBK. Female networks created while working for the institute could be a mechanism that explains the relationship between female committee members and the success of female candidates.

We are also interested in investigating the role of multiple ties with FBK in recruitment, treating the different types of ties with equal weights. The results portrayed in Table 9, column 3, show that having an additional tie, either with the institution or with the commission, statistically increases the candidates' probability of success. Men are more likely to have multiple connections within the institution, and thus more chances of success due to networking.

5.3. Post-competition analysis

Having identified pre-existing ties as important determinant of candidates' success at FBK, we conduct a post-competition analysis on those candidates who won a competition, splitting them into two groups: applicants with and without pre-existing ties with the institution. We also divide the analyses by gender. The rationale for post-competition analysis is to investigate the role of ties in the candidates' ex-post research productivity, since hiring through networks can carry two opposite effects: the negative effect of an evaluation bias driven by acquaintances (pure favouritism), and the positive effect of reducing information asymmetries regarding the candidates' quality and research potential. It could hence be the case that the connections mechanism present in FBK competitions might contribute to hiring the most productive individuals and hence to making the selection more efficient.

We limit the analysis to the sub-sample of successful candidates, consisting of 85 observations, and we compare the number of publications in the two years following the competition between those individuals with prior ties and those without prior ties.[24] Table 11 shows that the number of publications in the two post-competition years for candidates recruited with prior ties is on average higher than for candidates recruited without prior ties. If we perform a Wilcoxon rank-sum test on the number of publications (levels), the difference is statistically significant at the 10% level (z= -1.723, p= 0.0850), although it is not for the standardized number of publications (z= -1.597, p= 0.1103). There is hence some evidence of a positive informational effect of ties, suggesting that networks may help select the most productive candidates in terms of scientific research. This result is driven by the male part of the sub-sample, since females recruited without ties tend to produce slightly more than females recruited with ties, although this difference is not statistically significant.

Table 11 – Post-competition productivity of successful candidates

	Ties	*No ties*	*Institution ties*	*Commission ties*
Average N. publications	4.79	3.28	4.85	8.33
Females	2.83	3.15	2.83	5.50
Males	5.32	3.32	5.43	9.14
Average N. publications (std)	*0.38*	*0.13*	*0.39*	*0.97*
Females	*0.04*	*0.05*	*0.04*	*0.50*
Males	*0.47*	*0.16*	*0.49*	*1.10*

When we decompose the post-competition productivity of successful candidates across institution and commission ties (Table 11), we notice that candidates with commission ties are on average more

[24] In this case, we opted for a comparison of the number of publications rather than of H-indexes, since in this very short time lapse of only two years gathering citations for articles published is extremely rare. Nevertheless, restricting the analysis to only two years is consistent with the short contract length at FBK, thus reducing the probability that the candidates quit working at FBK.

productive than those with institution ties, both for females and males.[25] Therefore, it emerges that having prior networks with commissioners is positively correlated with the post-competition propensity to publish, in both levels and standardized values. The higher propensity of male candidates to have connections with commission members and their higher propensity for multiple connections might partly explain the differences in the post-competition productivity of male candidates compared to female candidates with ties.

6. Discussion and conclusion

Gender disparities in many professional fields are a highly debated topic. Reducing the gender disparity in research activities is not only relevant for fairness issues, but it would enhance university-firm collaborations, in that women are more prone to cooperation and context dependency (Maietta, 2015). In this paper we have analysed the existence of potential mechanisms of discrimination against women in academic research based on data on recruitment processes in the field of hard science between 2009 and 2011 in an Italian research centre, FBK. We have investigated whether the gender composition of the selecting committees influences the selection of candidates in terms of gender. We have also analysed the role of prior ties in the recruitment process, and their relevance for gender disparities. Our dataset allows us the analysis of factors influencing recruitment at the start of a research career, for our sample includes entry-level positions (post-docs, temporary jobs and research fellowships). In order to capture the real influence of commissions and ties, we have controlled for the measures of productivity of candidates. We have made use of bibliometric data retrieved from Scopus, a reliable source of information on publications and citations, to control for research productivity.

[25] The differences are all statistically significant after conducting Wilcoxon rank-sum tests.

In our results we do not find that male commissions necessarily discriminate against women on a general level though our analysis highlights the positive role of a female presence in commissions in promoting the entrance of female researchers. When we analyse tenure-track and non-tenure track positions separately, we do find that female candidates are discriminated against by all-male commissions in non-tenure track positions, even after controlling for their research productivity and education, as well as for socio-demographic variables and prior ties with the institution. But this disadvantage is more than compensated by the presence of a female researcher on the selection committee, thus lending support to the proposal of gender quotas in selection committees. The same does not hold true for tenure-track positions, for which ties with FBK and Italian origin are the main drivers for selection. The latter is in line with the research conducted by Wolfinger et al. (2009), who find that female Ph.D. candidates are more likely to occupy non-tenured positions and to leave academia even after controlling for scientific productivity. Likewise, Geuna and Sotaro (2015) find that female Japanese academics in hard science are characterized by a higher probability of leaving academic research than men, and this phenomenon is especially pervasive in the early stages of the academic career ladder.

An interesting finding in our research regards the role of networking within FBK. Ties refer to a connection when a commission member in academic selections is the Ph.D./Master supervisor of the candidate or when the candidate has worked and is currently working at FBK. Networks of candidates with the commission and the institution substantially explain the positive influence of a female presence in commissions, leading to a conclusion of the importance of female networking as a mechanism of entrance into research jobs. However, in the case of non-tenure track positions, ties with the FBK complement the positive influence of a female presence in commissions, as they are both associated with a higher chance of a woman being eventually selected.

Moreover, we have thoroughly investigated the effect of pre-existing ties on research productivity finding that winners with prior ties with FBK produce significantly more publications in the two years following the competition. This implies that there might be a possible positive role for prior ties in reducing the information gap between candidates and the selection committees about their research potential, confirming a result found by Zinovyeva and Bagues (2015).[26] The result of the post-competition analysis is, however, different for men and women, as women tend to show more stable performance independently of connections, although at a lower productivity level. This result might be due to the different character of connections in female and male networking, where institutional networks prevail in the case of women, while ties with commissions disproportionally affect men-potentially influencing their respective productivity. Finally, decomposition of the ties gives us further insight into gender differences behind the measure of connections. Women tend to have fewer multiple connections in relative and absolute terms, and are less connected with committee members. Moreover, the results seem to suggest a presence of gender-biased networks that underlie the competitions. We saw that in all the cases in which a male candidate is successful, no female is present on the evaluating committee, whereas in 36% of the cases in which a female wins the competition there is at least one female on the committee. In competitions won by male candidates the principal dimension explaining the candidate's success is prior networks with the institute. Similarly, at a general level, the success of female candidates is partly explained by a connection between the candidates and the (female) commission members.

To conclude, the present article finds a positive role for quotas in promoting female researchers in

[26] They posit the existence of an optimal distance in terms of pre-existing ties between evaluators and candidates in their analysis on academic promotions to Associate and Full Professorships in Spain. Being selected through weak ties with commissioners enhances ex-post research productivity, whereas being promoted with strong ties or without ties hinders candidates' research outcome. Strong connections are those with a Ph.D. thesis advisor or with a co-author, while weak ties are identified in same-university colleagues and to a lesser extent in Ph.D. thesis defence members.

the non-academic research environment, especially for temporary positions. Quotas could be a solution for gender-biased preferences towards same-sex candidates in selection committees, which are generally male-dominated. Previous studies have found either same-sex preferences (De Paola and Scoppa, 2015), opposite-sex preferences (Bagues et al., 2014) or mixed preferences depending on the level of the position (Zinovyeva and Bagues, 2011). However, the decision on whether to implement quotas in specific cases and the policy-relevance of these findings would need to be evaluated against evidence of negative consequences of adopting gender quotas. Some authors suggest that quotas might initially open new positions for female researchers, but may have adverse effects on the female candidates who enter due to quotas in the long run. These candidates might be subject to sabotage and backlashes in professional circles, and thus perform less well (Leibbrandt et al., 2015). Moreover, gender quotas in research jobs might have a limited importance due to the nature of academic selections and the importance of prior networks.

Our article contributes to the literature reporting the importance of networking in academia. We saw that women connect disproportionally with respect to men, while both genders tend to stay in homophilous networks. One of the implications of our study is that mixed networks in contrast to female and male networks could importantly change the selection process in academia, leading to more balanced research teams. This could be a mechanism leading to more equality between men and women in research.

Our research presents a few limitations, the main one being the non-randomness of committee members. This does not allow us to consider our results as causal effects. However, we tried to mitigate this issue by including in the empirical analysis indirect ties between committee members and candidates, which otherwise would have been relevant unobservable characteristics affecting the

probability of being recruited.

Looking at the internal organizational chart of FBK, the share of women declines with the hierarchy rank, as in most organizations. The challenge is thus to understand how to promote female researchers to top positions. (Male) networking in more senior positions penalizes women, who tend to stay at the lower hierarchical level, and tend to participate at a limited extent in the structure of important male-dominated networks.[27] Even if there is a higher representation of women in networking at the beginning of their careers, this reverses later on, and has consequences for the representation of women at the top of the career ladder in the research profession and their promotion in the internal structure. Further research should be carried out on the promotion mechanisms operating at FBK: it would probably be possible to isolate in a more explicit way contingent discrimination dynamics and the role of the gender composition of promoting commissions.

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[27] Descriptive statistics, available on request, have shown that female committee members tend to be substantially younger and in rather junior positions.

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Appendix A

Table A1 – Variable definitions

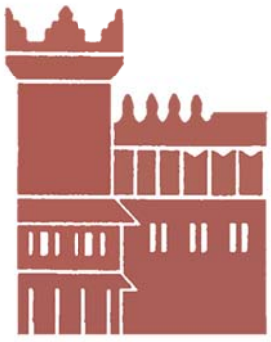
Variable	*Dummy*	*Definition*
Female	D	The candidate is female
Success	D	The candidate is recruited
Female in commission	D	The candidate is evaluated by a commission with at least one female
Female (no HR) in commission	D	The candidate is evaluated by a commission with at least one female researcher (no HR)
H-index standardized		Candidate's h-index at the year of the call, standardized by her field of research
Age		Candidate's age in years
Italian origin	D	The candidate has Italian nationality
Ph.D.	D	The candidate has earned a Ph.D.
Work experience		Candidate's work experience in years, excluding years exclusively devoted to Ph.D.
Ties with FBK	D	The candidate has at least one among the types of ties indicated at p. 18
Commission	D	The candidate has ties with FBK either of type 1), 2) or 5)
Institution	D	The candidate has ties with FBK either of type 3) or 4)
Intensity of ties		Number of candidate's types of ties with FBK (range 0-5)
Tenure-track positions		R3, R4 positions
Non tenure-track positions		T4, post-doc, or co.co.pro. positions
Human resources	D	The commissioner is from the HR division
Monthly wage		Monthly wage of the posted position expressed in Euros
Contract length		Contract length of the posted position expressed in months

Appendix B

Table B1 aims to shed light on some descriptive statistics of the various research levels at FBK.

Table B1 – Descriptive statistics of research levels

Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
Monthly wage	2687	905.23	750	7234
R3	3113	124.32	2667	3156
R4	2842	124.22	2750	3150
T4	2750	0	2750	2750
Post-doc	3156	0	3156	3156
Co.co.pro.	2394	815.45	750	4388
Applicant's age	30.65	5.77	19	60
R3	32.94	5.43	2667	3156
R4	30.65	5.30	2750	3150
T4	26.59	5.38	2750	2750
Post-doc	32.33	3.24	3156	3156
Co.co.pro.	30.17	5.54	750	4388
Contract length	21.46	11.01	3	44
R3	29.63	9.12	12	42
R4	25.58	9.41	8	36
T4	8.36	1.18	8	12
Post-doc	30.40	6.20	24	36
Co.co.pro.	18.83	10.50	3	44



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