Accepted Manuscript

Connections in Scientific Committees and Applicants' Self-Selection: Evidence from a Natural Randomized Experiment

Manuel Bagues, Mauro Sylos-Labini, Natalia Zinovyeva

PII: S0927-5371(19)30038-7
DOI: https://doi.org/10.1016/j.labeco.2019.04.005
Reference: LABECO 1726

To appear in: *Labour Economics*

Received date: 20 April 2018
Revised date: 18 February 2019
Accepted date: 5 April 2019

Please cite this article as: Manuel Bagues, Mauro Sylos-Labini, Natalia Zinovyeva, Connections in Scientific Committees and Applicants' Self-Selection: Evidence from a Natural Randomized Experiment, *Labour Economics* (2019), doi: https://doi.org/10.1016/j.labeco.2019.04.005

Highlights

- The presence of a colleague, a coauthor or a Ph.D. advisor in a scientific committee has a negative impact on application decisions.
- However, connected applicants are significantly more likely to succeed.
- Ignoring applicants' self selection would lead to an overestimation of the connection premium by 29%
- Overall, the evidence suggests that connections help to make better application decisions.

Connections in Scientific Committees and Applicants' Self-Selection: Evidence from a Natural Randomized Experiment*

Manuel Bagues † Mauro Sylos-Labini ‡ Natalia Zinovyeva §

April 16, 2019

Abstract

We investigate theoretically and empirically how connections in evaluation committees affect application decisions. Prospective candidates who are connected to a committee member may be more likely to apply if they anticipate a premium at the evaluation stage. However, when failure is costly and connections convey information to potential applicants regarding their chances of success, the impact of connections on application decisions is ambiguous. We document the relevance of this information channel using data from national evaluations in Italian academia. We find that prospective candidates are significantly less likely to apply when the committee includes, through the luck of the draw, a colleague, a coauthor or a Ph.D. advisor. At the same time, applicants tend to receive more favorable evaluations from their connections. Overall, the evidence suggests that connected individuals have access to better information at the application stage, which helps them to make better application decisions. Ignoring applicants' self-selection would lead to an overestimation of the connection premium in evaluations by 29%.

Keywords: connections, self-selection, academic labor markets

JEL Classification: J71, I23

*We would like to thank Massimiliano Coda Zabetta, Mikhail Drugov, Christian Fons-Rosen, Aldo Geuna, Chris Krestel, Marta Martinez-Troya, Myra Mohnen, Oskar Nordström Skans, Marko Terviö, Otto Toivanen and participants in presentations at Universitat Autonoma de Barcelona, the Swedish Institute for Social Research, Helsinki Center of Economic Research, CERGE-EI Prague, Humboldt University, the Trento Festival dell'Economia, Jyväskylä University, Society of Labor Economics, Nordic Summer Institute in Labor Economics, "Brucchi Luchino" Workshop, the New Economic School and the annual meeting of the American Economic Association for their useful comments.

†Aalto University and IZA, Helsinki, Finland; email: manuel.bagues@aalto.fi

‡University of Pisa, Italy; email: mauro.syloslabini@unipi.it

§Aalto University, Helsinki, Finland; email: natalia.zinovyeva@aalto.fi

1 Introduction

It is well known that academic connections are important for a successful professional career. They have a direct impact on researchers' productivity (Azoulay, Graff Zivin and Wang 2010, Azoulay, Fons-Rosen and Graff Zivin 2017, Mohnen 2017, Oettl 2012) and they may help to receive better scientific evaluations. For instance, it has been shown that the presence in a scientific committee of a coauthor, a colleague, an advisor or a mentor helps to receive better evaluations in national qualification exams in France (Combes, Linnemer and Visser 2008), in evaluations at the university level in Italy (De Paola and Scoppa 2015, Durante, Labartino and Perotti 2011, Perotti 2002), in national qualification exams in Spain (Zinovyeva and Bagues 2015) and in grant peer-review in Sweden (Sandström and Hällsten 2008). In some cases, this connection premium has been attributed to nepotism, while in other occasions, the higher success rate of connected candidates may reflect the existence of information asymmetries about applicants' quality (e.g., Zinovyeva and Bagues 2015).

In this paper, we argue that beyond their direct impact on evaluations, connections in committees may also help researchers to make better application decisions. Prospective candidates with ties to panel members are likely to have access to more accurate information about their chances of success and this information may be useful in contexts where applications are costly, including cases where there is an opportunity cost. The way in which connected candidates may benefit from their informational advantage depends on the magnitude of these application costs. When application costs are relatively high, they may take advantage of opportunities that unconnected (and uninformed) researchers would not dare to seek. Instead, when applications costs are low (but positive), they are less likely to make the mistake of applying when their chances of success are too slim.

We study empirically how connections affect application decisions using the evidence provided by the Italian system of academic qualifications. Since 2012, in order to be promoted to associate and full professor positions, researchers are required to qualify first in a national evaluation conducted annually at the field level. Successful applicants can then apply for a position at the university level. Candidates who fail to qualify have to wait for two years before they can apply again. Given the penalization faced by unsuccessful applicants, researchers who anticipate that their chances of success are slim may prefer to postpone their application until they have sufficiently strengthened their curriculum.

This set up has several features which are convenient for our analysis. In the first place, it is wide-ranging. Evaluations are conducted in every academic field and at two different stages of the career ladder, associate and full professorships. Second, committee members are randomly selected from a pool of eligible evaluators. This provides a credible and transparent empirical strategy for identifying a causal impact of committee composition on application behavior. Third, researchers need to pre-register their application before the composition of the committee is known, allowing us to observe a list of prospective candidates independently of whether they finally apply or not. The opportunity cost of pre-registering was negligible and, therefore, the list of prospective applicants helps us to focus on the group of individuals who revealed to be interested in being considered for promotion. Finally, we observe the curriculum vitae of all potential candidates and evaluators, as well as evaluators' reports, in two consecutive rounds of evaluations. We use this information to disentangle potential mechanisms underlying the impact of connections on researchers' application decisions.

Our database includes information on around 69,000 applications of researchers who pre-registered in 2012 for the first round of the national qualification evaluation. Following the announcement of the identity of panel members, around 10,000 applications were withdrawn. The remaining 59,000 applications were evaluated by a five-member evaluation committee, and 40% managed to qualify. We study the role played by three possible links between pre-registered candidates and eligible evaluators: prior co-authorship of an academic article (*coauthors*), a common current affiliation (*colleagues*), and a advisor-advisee relationship. We find that the application rate is three percentage points (p.p.) significantly lower among pre-registered researchers who, by the luck of the draw, are assigned to a committee that includes a connection. The effect is driven by connected researchers with a weak research profile. At the same time, connected researchers tend to be more successful, both conditional and unconditional on applying. Their success rate is 4.5 p.p. (13%) higher relative to other comparable researchers pre-registered for the evaluation. Information from 300,000 individual evaluations (five per applicant) also shows that, within each committee, connected candidates tend to receive more favorable evaluations from their connections, relative to the assessments they receive from other committee members. This connection premium is similar across individuals with different levels of research quality.

To interpret these findings, we propose a simple theoretical framework where (i) evaluators may be biased in favor of (or against) connected applicants, (ii) evaluators are better informed about their quality of connected applicants and (iii) applicants are better informed about their chances of success when they have a connection in the committee. In the context of Italian evaluations, this informational advantage on the applicants' side may have emerged either as a result of their ability to better observe the preferences of their connections, or perhaps through private communications between connected individuals and evaluators. In this framework, the existence of favoritism in evaluations tends to increase the probability that connected individuals apply and also their chances of success. However, information asymmetries have an ambiguous effect. The availability of better information about the quality of connected individuals may have a positive or negative impact on their application decisions and success rate, depending on their ability and how competitive is the evaluation process. Similarly, the informational advantage about their own chances of success may increase or decrease the probability that they apply, depending on the magnitude of application and failure costs.

Our preferred explanation for the lower application rate and the higher success rate of connected individuals observed in the data is that, in a context where the application costs are limited, connected candidates are better informed about their chances of success and they also benefit from a connection premium in evaluations, either due to favoritism or to the better observability of their quality. The information channel dominates at the application stage, leading to a positive selection of connected individuals among applicants.

We also examine a potential alternative explanation for why connected researchers are less likely to apply and more likely to succeed. It may be that the majority of connected researchers benefit from a positive evaluation premium, but a few expect to be penalized by their connections and thus decide not to apply. However, we do not find support for this hypothesis in the data. Connected researchers who chose not to apply in the first evaluation round are more likely to reapply and to succeed in the following round of the national assessment, which took place one year later and was carried out by the same committee members. They also tend to receive more favorable evaluations from their connections in the committee relative to the assessments that they receive from other reviewers. In sum, there is no indication that the lower application rate of connected researchers is driven by their fear of a less favorable evaluation. Instead, their informational advantage at the application stage seems to have helped connected researchers with a weak profile to optimize the timing of their applications.

Our paper contributes to the literature in several ways. While the previous literature has mostly focused on the direct impact of professional networks on productivity and on evaluations, we show that connections also help to make better application decisions. This informational advantage may be particularly valuable in contexts where applications are costly and the outcome of the evaluation is subject to uncertainty, such as applying for a grant, for a position, or selecting the outlet for submitting an academic paper. This feature of connections might also partly explain the large success of some mentoring programs (e.g., Blau et al. 2010).

A related literature has also studied whether male and female researchers have different propensities to apply for promotions in academia. Using information from scientific evaluations in France and Italy, Bosquet, Combes, and Garcia-Peñalosa (2019) and Bagues, Sylos-Labini and Zinovyeva (2017) document that female researchers have a lower probability to apply, which may affect negatively their chances of being promoted. However, the gender gap in applications does not seem to be affected by the gender composition of the committee (Bagues, Sylos-Labini and Zinovyeva 2017).

Our results also have important implications for empirical studies of evaluation biases and discrimination that rely on observational data. According to our analysis, when prospective candidates can observe the identity of evaluators and applications are costly, self-selection may be a major concern and might bias estimates. In the context considered in our paper, connected individuals are positively selected among applicants, and taking into account only information on actual applicants leads to an overestimation of the connection premium by 29%, despite the availability of an extensive set of controls which accounts for about half of the variation in evaluations. A similar problem may arise in other contexts. For instance, Fisman, Shi, Wang, and Xu (2017) examine the election of fellows of the Chinese Academies of Sciences and Engineering, and document that the success rate of applicants who share hometown ties with evaluators is 39% higher than other applicants with a similar publication record, a gap that the authors attribute to favoritism. This estimate might be biased if prospective candidates anticipate the existence of favoritism at the application stage or if connected researchers are better informed about their chances of success. The problem is not limited to the analysis of connections in academia; it might also be relevant for studies assessing evaluation biases related to gender, ethnic group, social ties or reputation whenever the identity of evaluators is known to prospective candidates and failure is costly (e.g., Fernandez and Weinberg 1997; Goldin and Rouse 2000; Petersen, Saporta and Seidel 2000, 2005, Card and DellaVigna 2017). The direction of self-selection in these studies is hard to predict and depends on the quality of connected prospective applicants, the strength of evaluation biases, the degree of information asymmetries, and the cost of failure.

Our results may also be relevant for a better understanding of the benefits of hiring through employee referrals. According to the literature, referred applicants are more likely to accept job offers, and they are also substantially less likely to quit (Simon and Warner 1992, Burks et al. 2015). The standard explanation is that employers are better informed about the quality of referred applicants. Additionally, it might also be that connected individuals are better informed not only about the existence of the vacancy but also about the quality of the match.

Finally, the endogenous self-selection of candidates may also be relevant for the interpretation of audit and correspondence studies. In these studies, fictitious applicants look identical "on paper" except for some particular characteristic such as gender or race. As pointed out by Heckman and Siegelman (1993) and Neumark (2012), an evaluator's decision to select applicants from a particular group may reflect either taste discrimination or statistical discrimination. Our analysis suggests that statistical discrimination may occur even if the two groups have an identical distribution of quality in the overall population, but one group is better informed about the evaluation process or the characteristics of the job. Evaluators may expect applicants from these two groups to differ due to self-selection.[1]

2 Theoretical framework

To guide our empirical analysis, we develop a stylized conceptual framework of the application decision process. The model aims to capture three relevant features. First, applications may involve some costs, either in the form of specific investments or opportunity costs. Second, evaluators may be biased in favor of acquainted candidates. Third, there may be information asymmetries both on the evaluators' side and on the researchers' side. Evaluators may observe the quality of candidates imperfectly and, likewise, prospective candidates may not be well informed about evaluators' standards. These information asymmetries are lower when the evaluator and the candidate are connected.

The model illustrates that the impact of connections on application decisions is ambiguous. If evaluators are positively biased towards connected researchers, these

[1]Incidentally, this might perhaps explain the results in Milkman, Akinola and Chugh (2015), who conduct an audit study in which fictional prospective students contact professors in order to discuss research opportunities before applying to a doctoral program. Faculty members are significantly less responsive to students with a foreign-sounding name even if, by construction, their messages were otherwise identical. A possible explanation, within the framework of our study, is that employers prejudge native prospective students to be better informed about their fit.

researchers will have a stronger incentive to apply. However, if connections also convey information to potential applicants on evaluation standards or if they provide information to evaluators on the quality of candidates, connections may either increase or decrease the probability of applying. As we explain below, the direction of the effect depends on the extent of information asymmetries, evaluators' priors about applicants quality, and the cost associated with the application.

2.1 Benchmark

We start with a benchmark case where there are no information asymmetries or biases. The evaluation process has the following time structure. First, an individual i (he) and an evaluator j (she) are randomly drawn from the population of prospective candidates and eligible evaluators. Second, individual i decides whether to apply for an evaluation. Let $a_i = 1$ if the candidate applies, and $a_i = 0$ otherwise. Finally, if candidate i applies, evaluator j decides whether he qualifies or not. Let $s_{ij} = 1$ if the candidate is promoted, and $s_{ij} = 0$ if he is not.

Prospective candidates differ in terms of their quality, q_i. A proportion $\alpha \in (0, 1)$ of prospective candidates have quality equal to one, while $1 - \alpha$ have quality equal to zero. Eligible evaluators differ in terms of their evaluation standards, u_j. A share $\beta \in (0, 1)$ of evaluators have high standards, u_h, and the rest have low standards, u_l, where $1 > u_h > 0 > u_l$. Candidates and evaluators are assumed to be risk-neutral.

If an individual applies and fails, he incurs a cost $C > 0$. The net gain of applying and qualifying is equal to one, and if an individual does not apply his payoff is equal to zero. The payoff of the prospective candidate can be described as follows:

$$U_i := a_i[s_{ij} - (1 - s_{ij})C].$$

The payoff of the evaluator is equal to the quality of candidate i if she promotes him, and it is equal to u_j if the candidate fails:

$$U_j := s_{ij}q_i - (1 - s_{ij})u_j.$$

When the evaluator has low standards ($u_j = u_l$), she promotes all candidates independently of their quality. When the evaluation threshold is high ($u_j = u_h$), the evaluator promotes only high-quality candidates. Consequently, prospective applicants only apply when their quality is high or when the evaluator has a low evaluation standard. Overall, the probability that a prospective candidate applies is:

$$p(a_i = 1) = \alpha + (1 - \alpha)(1 - \beta), \tag{1}$$

and the expected quality of applicants is equal to:

$$E(q_i|a_i = 1) = \frac{\alpha}{\alpha + (1 - \alpha)(1 - \beta)}. \tag{2}$$

All applicants get promoted. Therefore, unconditional on his application decision, the probability that a prospective candidate gets promoted is equal to:

$$p(s_{ij} = 1) = \alpha + (1 - \alpha)(1 - \beta), \tag{3}$$

which is also equal to his expected payoff:

$$E(U_i) = \alpha + (1 - \alpha)(1 - \beta). \tag{4}$$

2.2 Connections

Let us consider two different groups of individuals, connected and unconnected, and let us assume that these two groups are drawn from the same population. We investigate how connections affect application decisions and evaluation outcomes in three different scenarios: (i) evaluators are biased in favor of connected candidates, (ii) evaluators are better informed about the quality of connected candidates, (iii) connected candidates are better informed about evaluation standards. We discuss below each scenario and we summarize the main results in Table 1.

2.2.1 Evaluation bias in favor of connected candidates.

To formalize the existence of bias in favor of connected candidates, let us assume that the evaluator's payoff is equal to $U_j = s_{ij}(q_i + B * I_{ij}) - (1 - s_{ij})u_j$, where I_{ij} is an indicator function that takes value one if individual i has a connection with evaluator j. For simplicity, we assume that the bias in favor of connected applicants is sufficiently large to guarantee that they always succeed, independently of their own quality or whether the evaluator has high or low standards ($B > u_h$).

In this setup, connected individuals always apply and succeed. Instead, as in the benchmark case, unconnected individuals only apply if they belong to the high-quality type or if they are low-quality and the evaluator has low standards (see equation (1)). As shown in the upper panel of Table 1, connected candidates tend to be negatively selected among applicants. The expected quality of connected applicants is equal to α, which is lower than the expected quality of unconnected ones. Moreover, connected individuals are more likely to be promoted, and they have a higher payoff.

2.2.2 Information asymmetries on the evaluator side

Let us consider now the case when there are no evaluation biases, but there exist information asymmetries regarding the quality of unconnected candidates. For simplicity, we assume that evaluators observe perfectly the quality of connected candidates, but they do not observe the quality of unconnected ones.

Connected individuals behave as in the benchmark case. The application decision of unconnected individuals depends on how selective is the process. When the degree of selectivity is low ($\alpha > u_h$), all evaluators are willing to promote unconnected candidates and, anticipating that, all unconnected individuals apply and get promoted. On the contrary, when the process is selective ($u_l < \alpha \leq u_h$), only low-standard evaluators would be willing to promote unconnected candidates. Therefore, unconnected individuals only apply if the evaluator has low grading standards:

$$p(a_i = 1|I_{ij} = 0) = \begin{cases} 1 & \text{if } \alpha > u_h, \\ 1-\beta & \text{if } \alpha \leq u_h. \end{cases}$$

As in the previous case, all applicants qualify, and the probability of success and the payoffs are similar to the probability of applying.

The second panel of Table 1 compares the situation of connected and unconnected individuals. When the process is not selective, unconnected individuals benefit from the information asymmetry. They are relatively more likely to apply and also to qualify. On the contrary, when the process is selective, the information asymmetry hurts unconnected individuals. In this case, they have a lower probability to apply and to succeed.[2]

2.2.3 Information asymmetries on the candidate side

Finally, let us consider the existence of information asymmetries regarding the evaluation standards. Let us assume that while connected individuals observe the standards of the evaluator, unconnected ones cannot.

Connected individuals behave as in the benchmark case. High-quality individuals always apply, and low-quality ones only apply when they observe that evaluation standards are low. Unconnected individuals cannot condition their application on evaluation standards. They always apply if their quality is high, but the behavior of low-quality ones depends on the cost of failure. They only apply if the costs associated with failure are low enough relative to the expected benefits of winning ($C < \frac{1-\beta}{\beta}$). The *ex ante* probability that unconnected candidates apply is:

$$p(a_i = 1|I_{ij} = 0) = \begin{cases} 1 & \text{if } C < \frac{1-\beta}{\beta}, \\ \alpha & \text{if } C \geq \frac{1-\beta}{\beta}. \end{cases}$$

[2] This result is essentially similar to the findings of the seminal models of statistical discrimination by Aigner and Cain (1977) and Cornell and Welch (1996).

We compare the situation of connected and unconnected individuals in the lower panel of Table 1. When costs are low, connected individuals are relatively less likely to apply, and they tend to be positively selected among applicants. On the contrary, when costs are high, connected individuals are more likely to apply, and they tend to be negatively selected among applicants.

The expected payoff of connected individuals is always higher. They apply if and only if they qualify. Instead, unconnected individuals are hurt by the lack of information. When costs are low, some low-quality individuals apply and face high evaluation standards. Instead, when costs are high, some low-quality individuals fail to apply even if standards are low, foregoing the benefits associated with promotion.

The above model highlights that the impact of connections on candidates' application behavior depends on the underlying content of these connections. If connections imply a positive evaluation bias, connected candidates are relatively more likely to apply and to succeed, and they tend to be negatively selected into the application. However, if connections decrease information asymmetries between the candidate and the evaluator, the impact of connections on application behavior becomes ambiguous.

If there are information asymmetries about applicants' quality, the impact of connections depends on how selective is the evaluation. When evaluators are not selective, connected individuals are less likely to apply than unconnected ones, and they also have lower chances of success. However, when evaluators are selective, connected candidates benefit from the availability of better information about their own quality, and they are more likely to apply and also to succeed.

There may also be information asymmetries about evaluators' standards. In this case, application behavior depends crucially on the cost of applying and failing. When the cost is sufficiently low, connected individuals are less likely to apply than unconnected ones. On the contrary, when the cost of applying is high, connected individuals are more likely to apply.

3 Background

Most Italian universities are public, and the recruitment of full and associate professors is regulated by national laws.[3] Before 2010, recruitment procedures were managed locally by each university. In 2010, a two-stage procedure similar to those already in place in other European countries was approved (e.g., France and Spain).[4] In the first stage, candidates to associate professor and full professor positions are required to qualify in a national-level evaluation known as the National Scientific Qualification (*Abilitazione Scientifica Nazionale*). Evaluations are conducted separately in 184 scientific fields designed by the Ministry of Education. A positive assessment is valid for four years while a negative one implies a ban on participating in further national evaluations during the following two years. Qualified candidates can participate in the second stage, which is managed locally by each university.

The first National Scientific Qualification was performed between 2012 and 2014.[5] The timeline of the process is described in Figure 1. The call for eligible evaluators was published in June 2012. The deadline for professors to volunteer to be an evaluator was August 28. In the meantime, the call for candidates' applications was issued in July. Below we describe in more detail the structure of the process.

3.1 Pre-registration of candidates

Prospective candidates had to pre-register an application online by November 20 2012, before the composition of committees was known. The submission package included the CV and up to 20 selected publications. Researchers were able to pre-register to multiple fields and positions.

For most academics based in Italian universities pre-registration involved just a trivial cost of confirming the publication list already present in their accounts at the Min-

[3]According to OECD (2013), in 2011 about 92% of students in tertiary education were enrolled in 66 public universities and the remaining 8% in 29 independent private institutions.

[4]Law number 240/2010, also known as "Gelmini reform" after the name of the minister of Education.

[5]A detailed description of the process is available at `http://abilitazione.miur.it/public/index.php?lang=eng`, retrieved on February 2014.

istry webpage and submitting the application.[6] For applicants from outside academia or from abroad, pre-registration required creating a personal account on the Ministry webpage and filling in information on publications and qualifications.

3.2 Selection of committees

Once the application deadline for candidates was closed, committee members were selected by random draw from the pool of eligible evaluators in the corresponding field. These lotteries were held between late November 2012 and February 2013. The same committee had to evaluate candidates for associate and full professorships. Evaluators were in charge for two rounds of the national scientific qualification.

The pool of eligible evaluators included full professors in the corresponding field who have volunteered for the task and satisfied some minimum quality requirements. In math, engineering, and natural and life sciences, evaluators were required a research production above the median of full professors in the field in at least two of the following three dimensions: (i) the number of articles published in scientific journals covered by ISI Web of Science, (ii) the number of citations, (iii) and the H-index.[7] In the social sciences and the humanities, eligible evaluators were required to have a research production above the median in at least one of the following three dimensions: (i) the number of articles published in high quality scientific journals (in what follows, A-journals), (ii) the overall number of articles published in any scientific journals and book chapters, and (iii) the number of published books.[8] Eligible evaluators could be based in Italy (hereafter 'Italian') or affiliated to a university from an OECD country (hereafter 'international'). International and Italian eligible evaluators had to satisfy the same research requirements, but their remuneration differed. While Italian evaluators worked

[6]Many Italian universities automatically feed information on publications of their researchers to individual accounts at the Ministry webpage. Previously entered information on publications is also available for the rest of researchers who had ever applied for a research grant of the Ministry or who had participated in another evaluation.

[7]More precisely, this rule applies to Mathematics and IT, Physics, Chemistry, Earth Sciences, Biology, Medicine, Agricultural and Veterinary Sciences, Civil Engineering and Architecture (with the exception of Design, Architectural and Urban design, Drawing, Architectural Restoration, and Urban and Regional Planning), Industrial and Information Engineering, and Psychology.

[8]An evaluation agency and several scientific committees determined the set of high-quality journals in each field.

pro bono, OECD evaluators received €16,000 for their participation. Italian evaluators could ask for a teaching load reduction during their service at the national committee.

Evaluation committees included five members. Four members were randomly drawn from the pool of eligible Italian evaluators, under the constraint that no university can have more than one evaluator within the committee. The fifth member was selected from the pool of eligible international evaluators.[9] The randomization procedure leaves little room for manipulation. Eligible reviewers in each field were ordered alphabetically and were assigned a number according to their position. A sequence of numbers was then randomly selected. The same sequence was applied to select committee members in a number of different fields. If an evaluator resigned, a substitute reviewer was selected randomly from the corresponding group of eligible evaluators.

3.3 General evaluation criteria

Following their appointment, each evaluation committee had to draft and to publish online a document describing the general criteria that would be used to grant positive evaluations. Committees had full autonomy on the exact criteria to be used in the evaluation. Moreover, an independent evaluation agency (ANVUR), appointed by the Ministry, collected and publicized information on the research productivity of all candidates in the previous ten years. This productivity was first measured by the same three bibliometric indicators employed to select evaluators and was then normalized by taking into account the amount of time passed since first publication and also the number of job interruptions (this last typically related to parental leave). The evaluation agency also reported the median research productivity in these bibliometric dimensions for professors in the corresponding category. Committees were not obliged, though encouraged, to use this information.[10]

To have a better understanding of how informative were the documents released by committees' describing their evaluation criteria, we have analyzed these documents.

[9]Exceptionally, whenever the pool of international professors includes less than four professors, all five committee members are drawn from the pool of eligible evaluators based in Italy.

[10]The system has slightly changed in recent years. Since 2016 candidates are required to satisfy some bibliometric criteria in order to be eligible.

The information provided by most committees was rather vague. Out of 184 committees, only 15 of them specified sufficient conditions for a positive evaluation.[11] About a third of the committees specified necessary conditions, typically related to the bibliometric indicators provided by the evaluation agency,[12] and the remaining committees simply reproduced the general instructions from the official call for applications.[13]

3.4 Final application decision

The median committee took two and a half months to prepare and publish the document with the evaluation criteria. Pre-registered candidates could withdraw their applications at any point of time between the selection of committee members and two weeks after the public announcement of the general evaluation criteria. Overall, candidates had about three months to decide whether they wanted to proceed with their application. When the list of applicants was finally closed, evaluation committees were officially informed about the identity of final applicants and the evaluation took place. Naturally, we cannot directly observe whether evaluators shared with some pre-registered candidates any private information about their chances of success, but anecdotal evidence that has been provided to us during the preparation of this study indicates that, in various occasions, such communications did indeed take place.

[11] For instance, a committee in Political Economy stated that "a sufficient condition to obtain a qualification for associate professorship is to satisfy at least one of the following requirements (based on the publications in the previous 10 years): 1) have at least 2 articles in A-journals as defined by the evaluation agency, 2) have at least 3 articles in scientific journals included in the database Web of Science, Social Science Citation Index, Economics, 3) have at least 5 articles in scientific journals included in database Scopus, Economics, Econometrics and Finance."

[12] 46 committees required that candidates' research production, as measured by bibliometric indicators, was above the median for professors in the corresponding rank, and 36 committees introduced some additional requirement.

[13] For instance, in Econometrics the committee announced that "(i)n order to assess the scientific maturity of the candidates, the Committee will give prominent weight to the evaluation of their scientific publications, especially those published in top journals. The publications will be evaluated on the basis of their originality, innovativeness, methodological rigor, international reach and impact, and relevance for the field. In order to assess journal articles, the Committee may use the classification of journals provided by ANVUR and the bibliometric indicators provided by Web of Science and Scopus. The Committee may also use information regarding the impact of each publication and the total number of citations received by the candidate."

3.5 The evaluation

The evaluations were (officially) based only on candidates' CVs and publications. There were no oral or written tests or interviews. Committee members met periodically to discuss their assessments and cast their votes. A positive assessment required a qualified majority of four positive votes (out of five committee members). Only kinship relationships between evaluators and candidates were officially subject to the conflict of interest rule. In these cases, the evaluator could not participate in the deliberation and the voting decision. Notably, Ph.D. advisors, coauthors and colleagues were not affected by the conflict of interest rules.

At the end of the process, committees provided each candidate with (i) the final outcome of the evaluation (pass or failure), (ii) a collective report explaining the criteria used by the committee and how they reached their final decision and (iii) five individual reports explaining each evaluators' position. Figure 2 provides a sample of an individual evaluation report.

Applicants who received a positive evaluation were eligible for a promotion at the university level. Those candidates who withdrew their application could participate in the qualification exam that was conducted the following year, but those who did not withdraw and failed to qualify had to skip two evaluation rounds before they could apply again.[14] Our analysis of publication data also shows that most individuals who participated in the evaluation process were still active researchers in the following years. About 97% of pre-registered candidates with a permanent university position at the time of the evaluation and 79% of those with a fixed term contract published at least one article in years 2014-2016.[15] The figure is slightly lower among researchers who failed the evaluation: 95% and 75% respectively.

[14]In practice, the system experienced several changes after the second evaluation round, and the third round was delayed for several years. The new call for candidates was announced only in the fall of 2016.

[15]We collected this information from the publication repository of Italian public universities called Institutional Research Information System (IRIS). This repository was developed by ANVUR and currently the database covers information on 60 out of 70 Italian universities.

4 Data

We consider all evaluations held within the first two rounds of the *National Scientific Qualification.* The database includes examinations for associate and full professorships in 184 academic fields. We describe below the available information on (i) the pool of eligible and actual evaluators; (ii) the pool of pre-registered and actual applicants and (iii) the evaluation outcome.[16]

4.1 Evaluators

Around six thousand professors, all based in Italy, volunteered and qualified to be in the pool of eligible evaluators. The number of professors in the pool of eligible evaluators based abroad was slightly above one thousand. In the average field, the pool of eligible evaluators includes 32 Italian professors and eight international professors.

Table 2 provides some descriptive information on eligible evaluators. The average CV includes around 131 research outputs, mostly journal articles (73), book chapters (22), and conference proceedings (20). The average CV also includes 0.42 patents. As a proxy for the quality of journal articles, we have collected information on the quality of the journals in which they were published. In social sciences and humanities, we use the official list of A-journals that was compiled by the Italian evaluation agency. This list includes approximately 7,000 academic journals. In sciences, we consider the *Article Influence Score* (AIS) of journals.[17] About 8% of Italian evaluators drawn in the initial lottery resigned and were replaced by other (randomly selected) eligible evaluators. The resignation rate was slightly higher among international reviewers (10%).

[16]We collected the CVs of prospective candidates and evaluators and the final evaluations from the webpage of the Ministry of Education. To avoid problems with homonymity, we have excluded 14 candidates that had the same name and surname as other candidates within the same field and rank.

[17]This indicator is available for all publications in the Thomson Reuters Web of Knowledge. It is related to *Impact Factor*, but it takes into account the quality of the citing journals, the propensity to cite across journals and it excludes self-citations. The average journal is normalized to have AIS equal to one.

4.2 Applications

More than 46,000 researchers pre-registered in the first round of the national scientific qualification, including approximately 28,000 applicants who held an assistant or an associate professor position in an Italian university. This accounts for around 63% of assistant professors and 60% of associate professors in Italy.[18] One-third of candidates registered in several fields (e.g.: qualification to full professorship in Political Economy and qualification to full professorship in Applied Economics) or in different categories of the same field (e.g., qualification to full and associate professorships in Political Economy). In total there were 69,020 pre-registered applications, approximately 375 per field.

In the upper panel of Table 3, columns 1 and 2 provide information on the characteristics of the initial set of pre-registered applications, and columns 3 and 4 distinguish between candidates to a position of full and associate professor. As expected, in evaluation exams for a position of full professor applicants tend to be relatively older than in associate professor evaluations (49 vs. 43 years old). Applicants to full professorships are also less likely to be female (31% vs. 41%) and they are more likely to hold a permanent position in an Italian university (74% vs. 47%). The average CV has 16 pages and, it reports 64 research outputs, mostly journal articles (37). It also includes some books (2), book chapters (7), conference proceedings (10), and patents (0.24). A typical paper is coauthored by six authors, with only 34% of papers being single authored. The candidate reports being the first author in 22% of the occasions. Not surprisingly, candidates to full professor positions have a relatively longer publication record: 89 vs. 53 publications. In social sciences and humanities, the average candidate for a position of full professor has published six articles in A-journals; applicants to associate professorships have published only three. In sciences, the average AIS of papers published by candidates for a position of full professor is around 1.31; it is similar for candidates to associate professorships. We have also constructed a proxy

[18] These figures are based on our own calculations using information from the Italian Ministry of Education on the identity of all assistant (*Ricercatori*) and associate professors (*Associati*) in Italy on December 31, 2012.

for the timing of the application. We use the application code number, which reflects the ordering of application, and we normalize this variable uniformly between 0 and 1 for applicants within the same list. This measure might potentially be correlated with candidates' quality or with their self-confidence.

Around one-seventh of applications were withdrawn by applicants when the identity of evaluators and the general evaluation criteria were revealed. For the final set of applications, the evaluation agency of the Ministry of Education constructed and published online information on candidates' research production during the ten previous years measured along three bibliometric dimensions described earlier. The evaluation agency also compared candidates research output with the median in the corresponding field and position. This information is summarized in the lower panel of Table 3. Around 38% of the final candidacies were above the median in each of the three dimensions. On the other end of the scale, 16% were below the median in every dimension.

4.3 Connections

We consider three types of links between candidates and evaluators: coauthorships, affiliation to the same institution, and Ph.D. advisor-advisee relationship. Information on coauthors and affiliation comes from the official CVs of candidates and evaluators, while information on thesis supervision is from the online public access catalogue (OPAC) of the National Library of Florence (BNCF).[19]

Approximately 12% of pre-registered candidates were assigned to a committee including a colleague, around 7% to a committee including a coauthor, and 0.8% to a committee with a Ph.D. advisor. In about a third of the cases, the coauthor also belongs to the same university. About a third of Ph.D. advisors have coauthored with their advisees. Overall, 84% of pre-registered candidates have no connections in the committee, 15.2% are connected to one committee member, and 0.8% are connected with two or more committee members.

[19]Starting from 1986, Italian public universities are obliged to deposit a copy of each doctoral thesis of their PhD students at the BNSF. A detailed description of the database can be found in Coda Zabetta and Geuna (2017).

In the National Scientific Qualification, Ph.D advisors, coauthors and colleagues are not formally subject to a conflict of interest rule. Nonetheless, committees might autonomously decide to self-impose their own additional restrictions. According to our analysis of the evaluation reports, evaluators voluntarily abstained in the presence of a colleague, a coauthor or an advisee in only three fields (out of a total 184).[20]

Pre-registered candidates with a connection in the evaluation committee tend to have a significantly better research profile relative to the rest of the candidates (columns 5-7, Table 3). Connected candidates excel both in quantity and quality of research.[21]

4.4 Evaluations

Table 4 provides information on the outcome of the evaluation process. The upper panel shows information on the first round of evaluations. Out of the initial set of 69,020 pre-registered applications, approximately 14% were withdrawn and did not receive an evaluation, 49% failed the evaluation, and 37% were successful. Success is strongly correlated with candidates' observable research productivity. As shown in Figure 3, only 4% of candidates whose quality was below the median in the three bibliometric dimensions managed to succeed, compared to a 63% success rate among candidates who excelled in all three dimensions.

Each committee member writes an individual evaluation report for each application. Overall there are approximately 295,000 individual reports.[22] The average report includes around 176 words; it briefly describes the research production of the candidate and provides some discussion about its quality and its fit with the field. It also indicates the evaluator's final assessment on whether the candidate deserves qualification. We have conducted a text analysis of these reports in order to identify the final assessment. On most occasions, the final decision was reached unanimously by all five

[20] These three fields are Ecology (sector 05/C1), Pediatrics (06/G1) and Management (13/B2). As a result, 84 candidates in these fields received only four evaluation reports.

[21] We also observe that junior researchers from Italian departments that have more eligible evaluators among senior colleagues are more likely to pre-register for an evaluation before the final composition of committees is known. It may be because they anticipate a higher chance of having a connection on the evaluation panel, but it may also reflect a positive association between the quality of the senior and the junior faculty at the department level.

[22] Due to a technical problem, we are missing information on evaluation reports of 202 applications.

evaluators (86%). Overall, 45% of votes were favorable to the candidate and 55% were negative.

Those candidates who had withdrawn the application in the first round of evaluations had a chance to participate in the second round, which was conducted the following year and was evaluated by the same committees. Around 37% of these candidates chose to reapply. Out of the group of those who had reapplied, 58% managed to qualify.[23]

Candidates who qualify in the National Scientific Qualification can later apply for a promotion at the university level. Out of all researchers who pre-registered for the first round of evaluations and who qualified for the corresponding position either in the first or the second round, by December 2015 about 35% had been promoted to an associate professor position and 11% had been promoted to a full professor position.

5 Empirical analysis

Our three measures of connections - coauthors, colleagues, and thesis advisors - may capture different dimensions. Colleagues are in general expected to be close in social terms but not necessarily intellectually. They might have private information on candidates' contribution to professional service and, sometimes, they might be perhaps directly affected by the outcome of the evaluation. Coauthors and advisors are probably closer both in the social space and the ideas space. Nonetheless, in what follows, given that we find that empirically the impact of the three types of connections is statistically similar, we report the effect of all types of connections jointly.[24]

The structure of the empirical analysis is as follows. First, we estimate the causal effect of connections upon researchers' application decisions and their impact on evaluators' assessments (sections 5.1-5.3). Then, using the conceptual framework presented in section 2, we examine which of the three mechanisms considered – bias, informed

[23]In this second round, we have obtained information on the final assessment for all candidates, but we collected individual evaluation reports only in those fields that had completed evaluations by May 2015 (116 out of 184 fields).

[24]We analyze the effect of coauthors, colleagues and Ph.D. advisors separately in Table A1 in the Appendix.

evaluators or informed applicants – are consistent with the evidence (section 5.4). In section 5.5, we investigate the empirical relevance of self-selection, and we quantify the bias incurred by an analysis that estimates the impact of connections on evaluations using only information on actual applicants. Finally, we examine the longer-term effects of connections (sections 5.6 and 5.7) and discuss the external validity of our results (section 5.8).

5.1 The impact of connections on applications

According to the conceptual framework presented in section 2, if evaluators are biased in favor of connected candidates, this would encourage researchers with a connection in the committee to apply and we would expect connected candidates to be negatively selected among applicants. On the other hand, if connections reduce information asymmetries, their impact on application decisions is ambiguous and depends on how selective is the process and how large is the cost of failing relative to the gains.

In order to estimate the causal impact of connections on researchers' application decisions, we need an empirical strategy that deals with the potential endogeneity of connections. As shown in Table 3, researchers who have a connection in the evaluation committee tend to have a stronger research profile and, presumably, might also differ in some unobserved dimensions. We identify exogenous variations in the availability of a connection in the committee exploiting the random selection of its members. We compare the application behavior of pre-registered researchers who initially have similar chances of having a connection in the committee but, due to the random draw, differ in terms of the actual number of connections that they end up having in the evaluation committee:

$$y_{i,c} = \beta_0 + \beta_1 Connections_{i,c} + \mathbf{D_{i,c}}\beta_{\mathbf{2}} + \mu_c + \epsilon_{i,c}, \tag{5}$$

where $y_{i,c}$ is a dummy variable that takes value one if researcher i who pre-registered for evaluation in exam c (e.g., qualification for an associate professorship in Econometrics) applies. $\mathbf{D_{i,c}}$ represents a set of indicator variables for the number of connections that researcher i expects to have in committee c before the random selection takes place.[25] $Connections_{i,c}$ indicates the number of connected committee members selected in the initial random draw (typically none or one). Note that a few evaluators (8%) resigned and were replaced by other (randomly chosen) eligible evaluators and, as a result, the number of connections in the initial committee might differ slightly from the final composition of the committee at the time of the evaluation. Therefore, in the baseline specification coefficient β_1 captures the so-called intention-to-treat effect (ITT). Given that information on connections is only available for evaluators based in Italy (four out of the five committee members), our estimates may be subject to an attenuation bias.

To increase the accuracy of the estimation, we include in the equation a set of exam fixed effects (μ_c), accounting for possible differences in the average success rate across different fields and positions. In some specifications, we also control for the set of predetermined individual characteristics and quality indicators listed in Table 3 ($\mathbf{X_i}$), all interacted with discipline fixed effects. In all regressions, standard errors are clustered at the field level, thus reflecting that evaluations within each field are conducted by the same committee.

The key identifying assumption of the analysis is that, conditional on the number of connections that an individual has in the pool of eligible evaluators ($\mathbf{D_{i,c}}$), the outcome of the random lottery that decides committee composition is not correlated with any relevant unobservable characteristic of the researcher. The way in which the randomization was implemented suggests that there was little room for manipulation. Nonetheless, we explicitly test the randomness of the assignment. We estimate a specification similar to equation (5), but we consider as dependent variables all observable predetermined characteristics of individual i (x_i). As shown in Table 5, the results

[25] The rule of the draw limited to one the number of evaluators in the same committee from the same university. In order to take this restriction into account, we have computed the expected committee composition as an average of one million simulated draws of five committee members from the pool of eligible evaluators, substituting eventual cases of multiple evaluators from the same university with other random draws. We have then rounded the expected committee composition to two decimal places and created indicator variables for each value. All results, are practically identical if we control for the expected number of connections using a linear specification instead of a set of dummies.

from these randomization tests are consistent with the assignment being random. Researchers who obtain, through the luck of the draw, a connection in the evaluation committee are statistically similar to other researchers. They are (statistically) as likely to be female, to hold a permanent position, and they have a similar publication record and number of coauthors. Out of ten coefficients that capture the correlation between the random shock to committee composition and researchers' characteristics, only one is statistically significant at 5% level. The existence of random assignment is confirmed by the corresponding F-test for the joint significance of the estimates.[26]

The upper panel of Table 6 reports the main estimates from equation (5). Researchers are significantly less likely to apply when they are assigned, through the luck of the draw, to a committee that includes a connection. The presence of a coauthor, a colleague or an advisor in the initial committee decreases the probability of applying by 2.7 p.p. (column 1). As expected, these estimates are unchanged when we control for predetermined individual characteristics and observable productivity (column 2).

In column 3, we consider the presence of connections in the committee that conducted the evaluations. The final composition of the committee differs from the initial one due to the resignation of some evaluators. To account for the potential endogeneity of these resignations, we instrument the final composition of committees using the initial composition that was determined by the random draw. As expected, the instrumental variable (IV) estimate is slightly larger in absolute terms than ITT. The presence of a connection in the committee decreases by 2.0 p.p. the probability that the pre-registered candidate goes ahead with his application. This amounts to a 3.4% decrease in the application rate relative to a baseline application rate of 86% or, equivalently, a 22% increase in the probability of withdrawal relative to a baseline withdrawal rate of 14%.

We also analyze how application decisions vary depending on researchers' observable quality (columns 4-6). We split the sample into three groups based on researchers' publication record. In science, technology, engineering, mathematics, and medicine

[26]F-test of the null hypothesis that all ten coefficients are jointly equal to zero is 0.96 (Prob > F = 0.328).

(STEM&Med fields), we classify prospective applicants based on their total Article Influence Score and in social sciences and humanities we use the number of A-journal publications. The impact of connections on applications is driven by the decisions of researchers with weaker research profile. Connections do not have any significant impact on the application decisions of researchers in the top tercile but, for researchers in the lowest tercile, the presence of a coauthor or a colleague in the committee decreases the likelihood to apply by about 6.2 p.p (7.8%). The difference between the estimated impact of connections on applying is statistically significant at 1%.

We also explore whether our results are driven by the strategic considerations that may arise when there are several applicants from the same university. If there is an evaluator from this institution in the committee and she has a preference for one particular candidate, other researchers from this institution may decide to withdraw their application if they expect the evaluator to behave strategically, giving them a negative assessment in order to ensure that her preferred candidate faces no competition later on when he applies for a promotion at the university level. As we show in Table A3 in the Appendix, the evidence is not consistent with this explanation. The negative impact of connections on applications decisions is also observed when there are no other applicants from the same university.[27]

5.2 The impact of connections on researchers' chances of success

Next, we estimate the causal impact of connections on the success rate of researchers, unconditional on whether they applied or not. We estimate equation (5) using as dependent variable an indicator which takes value one if pre-registered candidate i qualifies in examination c and value zero if he failed or withdrew the application. As shown in the first column of panel B in Table 6, the presence of a connection in the committee increases by 3.9 p.p. the probability of success of pre-registered candi-

[27]We have also investigated how other characteristics of the relationship between evaluators and prospective applicants affect application decisions. The two dimensions that we observe – gender and subfield similarity – do not play a significant role. These results are available upon request.

dates (11% relative to the baseline success rate of 34%). The inclusion of individual controls increases threefold the explained variation in the dependent variable – the adjusted R-squared increases from 11% to 31% – but, as expected, it does not affect the point estimates significantly (column 2). The estimates are slightly larger, around 4.6 p.p., although statistically similar, when we instrument the final composition of the committee using the initial one (column 3). We also examine how the impact of connections varies depending on researchers' observable research productivity (columns 4-6). Better-published researchers benefit more from connections. Researchers in the top (bottom) tercile experience a 5.2 p.p. (2.9 p.p.) increase in their success rate when the committee includes a coauthor or a colleague, though the difference between the impact of connections on top tercile and bottom tercile researchers is only significant at 10%.

Our analysis so far shows that connected candidates are significantly less likely to apply, but they have significantly higher unconditional success rates. By construction, these findings imply that their chances of failing an exam must be substantially lower. In fact, as shown in column 3, the probability that candidates with a connections in the committee apply and receive a negative assessment is 7.5 p.p. lower. Candidates with a weaker research profile benefit more from this decrease in failure rates. In the bottom tercile, the failure rate of connected candidates is 9.1 p.p. lower, compared to a decrease of 6.1 p.p. for connected candidates in the top tercile (columns 4-6). In sum, candidates benefit from the presence of a connection in the committee in different ways depending on the quality of these same candidates. While top candidates face a relatively larger increase in success rates, candidates with a weaker research profile experience a relatively larger decrease in application rates.

Since the voting at the committee level required qualified majority of four positive votes, there may be important non-linearities in the impact of connections. We explore this issue in Table A2 in the Appendix. Around 1% of candidates were assigned two or more connections. We find that the rate of withdrawal of connected candidates does not vary significantly with the number of connections in the committee. However, candidates with two or more connections in the committee are three times more likely to succeed than candidates with just one connection.

5.2.1 Individual evaluation reports

We now turn to the information provided by evaluators' individual assessments. We compare the assessments received by the same candidate from different evaluators:

$$y_{i,j,c} = \beta_0 + \beta_1 Connection_{i,j} + \mu_i + \lambda_j + \epsilon_{i,j,c}, \tag{6}$$

where $y_{i,j,c}$ is a dummy variable that takes value one if evaluator j voted in favor of candidate i's application in qualification exam c. $Connection_{i,j}$ is a dummy variable indicating whether the candidate and the evaluator have coauthored in the past, they are based in the same institution, or the evaluator advised the candidate's doctoral thesis. A set of application fixed effects (μ_i) controls for potential differences in the characteristics of candidates. In our preferred specification, we also include evaluators' fixed effects (λ_j), which capture any potential differences in grading standards across evaluators. Coefficient β_1 captures the differences in the assessments received by each candidate from connected and unconnected evaluators, which might reflect the potential existence of differences in their evaluation criteria or the available information.

Candidates are 3.9 p.p. (9%) more likely to get a positive vote from a colleague or a coauthor, relative to the assessments they receive from other committee members (Table 7, column 1). These results are unaffected when we include evaluators' fixed effects (column 2). We also examine how the connection premium varies depending on the observable research output of candidates (columns 3-6). The premium is always positive, and it is slightly larger for candidates of lower quality. The difference between the top and bottom tercile is marginally significant.

The nature of the decision-making process may have biased down these estimates. There may be less disagreement reflected in these final verdicts than there would have been at interim stages. Despite this potential attenuation bias, the estimates are significantly positive, indicating that evaluators on average tend to be more favorable towards their coauthors, colleagues, and advisees.

5.3 Heterogeneity across fields

Figure 4 provides information on the effect of connections on application behavior and success rate across different disciplinary groups.[28] While there is some heterogeneity in terms of the magnitude of the effects, connections have a positive impact on evaluations in all fields and a negative impact of applications in all fields except one.

5.4 Mechanism

The presence of a connection on the committee decreases the probability that researchers with a weak research profile apply. At the same time, connected candidates are relatively more likely to succeed and to receive a positive vote from their connection.

According to our theoretical framework, this pattern is consistent with three possible hypotheses. First, while connected evaluators may tend in general to favor their acquaintances (e.g., Combes et al. 2008, Perotti 2002 or Zinovyeva and Bagues 2015), in some particular cases they may be negatively biased against some of their connections (*'love or hate' hypothesis*). These researchers may anticipate that the connected evaluator is biased against them and decide to withdraw the application.[29] Second, it may reflect a reduction in information asymmetries on the evaluators' side (*informed evaluators hypothesis*). Evaluators may observe more accurately the quality of connected researchers. This reduction in information asymmetries benefits high-quality connected applicants, but it decreases the chances of success of connected researchers with relatively poor quality. If these researchers anticipate their disadvantage, they may prefer not to apply. Finally, another possibility is that connected researchers

[28]In Italy, fields are officially classified in 14 disciplinary groups. Within this classification, we have also considered separately Psychology and History (group 11), and Architecture and Civil Engineering (group 8).

[29]This hypothesis is probably more plausible in the case of colleagues than in the case of coauthors or advisors. For instance, in some universities faculty members may be associated to different chairs that hold long-standing rivalries. Contrary to this intuition, we do not observe any difference between the effect of colleagues and coauthors on application behavior and success. While the impact of Ph.D. advisors on success is substantially higher than the impact of other connections, their impact on application behavior is not statistically different from the impact of colleagues or coauthors.

enjoy a connection premium in assessments but they are also better informed about the evaluation criteria of connected committees (*informed candidates hypothesis*). The availability of more accurate information might discourage some connected researchers from applying if it is costly to fail, but this cost is not too high.

The first two explanations, the *'love or hate' hypothesis* and the *informed evaluators hypothesis*, imply that connected researchers who chose not to apply would have received relatively less favorable evaluations, had they decided to apply. On the other hand, according to the *informed candidates hypothesis*, connected researchers with a weak research profile would still have benefited from connections in case they had applied. However, this advantage is not large enough to compensate the expected cost of failure, which became more certain thanks to the presence of a connection in the committee. We try to disentangle these possible explanations by using information on researchers' performance in the second round of the qualification exams, which took place the following year. In this second round, only those researchers who had not participated in the previous evaluation were allowed to apply. Most importantly, the composition of committees did not change between the first and the second round. Therefore, if connected researchers' reason to withdraw their application in the first round was that they anticipated some disadvantage in evaluations, these expectations should also play a role in the second round of evaluations.

Around 37% of researchers who withdrew their application in the first round decided to participate in the second round. The evidence seems to suggest that, at least in the case of reapplicants, the decision to withdraw the application in the first round was not driven by these candidates experiencing a disadvantage due to the better observability of their (poor) quality by evaluators or by the existence of a negative bias against them.[30] Researchers with a connection on the committee have a 4.7 p.p. (13%) higher probability of reapplying relative to other researchers who withdrew their application in the first round and, among those who reapplied, are 9.6 p.p. (17.5%) more likely to succeed (Table 8, columns 1 and 2). The analysis of individual evaluations

[30] Connected researchers are positively selected among the pool of applicants who withdrew their application in the first round, which might introduce an upward bias in the estimates.

within committees confirms this interpretation. Connected researchers who reapply tend to receive more favorable reports from their connections than from other committee members (Table 7, column 6). Overall, the evidence indicates that the withdrawal was mainly intended to improve the timing of the application.

5.5 Selection bias

The presence of a connection in a committee leads to positive selection, probably driven by connected researchers' having access to better information about their chances of success. The endogenous selection of applicants is likely to bias studies that estimate the impact of connections using only information on actual applicants. The consistency of such estimates requires that the set of observable controls fully accounts for any systematic differences in the quality of connected and unconnected candidates. This assumption is unlikely to hold in contexts where researchers can take into account the composition of committees in their application decisions.

Next, we try to quantify the size of this selection bias. Using information on final applicants, we compare the assessments received by connected and unconnected researchers using an identification strategy based on observables:

$$y_{i,c} = \beta_0 + \beta_1 Connections_{i,c} + \mathbf{D_{i,c}}\boldsymbol{\beta_2} + \mathbf{X_i}\beta_5 + \mu_c + \epsilon_{i,c}, \tag{7}$$

where the dependent variable is an indicator that takes value one if the candidate qualifies and $\mathbf{X_i}$ includes all observable predetermined characteristics, including applicants' research production.

Candidates with a connection in the committee are 6.8 p.p. (17.1%) more likely to qualify than other final candidates with comparable observable research outputs (Table 9, column 1). Results are similar if we consider instead the total number of positive votes received by the candidate (column 2): the presence of a coauthor or a colleague in the committee is associated with the increase in the number of favorable votes by 0.33 (15.8%). The premium associated with connections does not vary depending on the research quality of candidates (columns 3-5).

As expected, the estimates provided by this 'naive' identification strategy based on observables overestimate the impact of connections on candidates' chances of success. These estimates are 29% larger (17.1% vs. 13.3%) than the causal estimates that exploit the random assignment of evaluators to committees (see panel B in Table 6).

5.6 Longer-term effects of connections

One of the potential advantages of not applying when failure is likely is the possibility of applying in the following round. We investigate the overall impact of connections on the chances of success of connected candidates taking into account both the first and the second round of national qualification evaluations.

First, we examine the impact on applications. We estimate equation (5) using as left-hand variable an indicator that takes value one if candidate i applied either in the first or the second round (Table 10, panel A). On average, connections decrease application rates over the two rounds by 1.1 p.p. This is roughly one-third of the impact on applications in the first round, indicating that the effect of connections on applications is mostly explained by connected candidates postponing their application for one year.

We also examine the effect of connections on overall success rates over both evaluation rounds (panel B). The positive impact of connections is larger when we also take into account the second round. Considering both rounds, connected researchers are 6.3 p.p. (17%) more likely to qualify, compared to 4.6 p.p. (13%) in the first round. The difference between the mid- and short-term effect is particularly large for candidates with relatively modest research productivity (5.4 p.p. vs. 2.9 p.p.).

Finally, we analyze the impact on failure rates (panel C). The presence of a connection in the committee decreases the failure rate of connected candidates by 7.3 p.p. This effect is similar to the impact of connections on candidates' failure rate in the first round, and again it is larger for candidates with relatively lower research quality (8.8 p.p. vs. 5.9 p.p.).

For the subsample of re-applicants the role of connections seems to be mainly associated with the existence of a positive bias and the reduction of uncertainty regarding the evaluation standard. However, we cannot exclude that for candidates who do not re-apply in the second round connections are associated with other dominant forces, including the ones highlighted by the *love and hate* or the *informed evaluator* hypotheses.

5.7 Promotions at the university level

A possible concern with the above analysis is that qualification in the national evaluation was a necessary but not a sufficient condition to obtain a promotion. Successful candidates have still to apply for a promotion at the university level. As a result, there exists the possibility that the above evaluations have no real impact on actual promotions.

We examine whether, beyond their impact at the qualification stage, connections in the national evaluation committee have any effect on promotions at the university level. We estimate equation (5) using as the left-hand side variable an indicator that takes value one for pre-registered candidates who were promoted.[31] A connection in the national committee increases the promotion probability by 1.3 p.p. (10.6%) (Table 10, panel D). The effect is mainly driven by researchers with relatively low research productivity; for this group, the connection premium is 2.1 p.p (or 38.6%). However, the difference between these groups is not statistically significant.

We also analyze whether the above result can be explained by the difference in the assessment of qualifications by university promotion committees depending on whether the qualification committee included a connection. We address this issue by estimating equation (5) on the sample restricted to qualified candidates. As it is shown in Appendix Table A4, the promotion rate of qualified candidates does not depend on whether these candidates where promoted by a committee that included a connection.

[31] We use the official registry of tenured professors in universities as of December 2015 to identify promoted candidates. We identify changes in rank either from assistant to associate professor or from associate to full professor.

Altogether, our results indicate that committee composition and evaluation outcomes in the national evaluations do impose binding constraints on promotions at the university level.

5.8 External validity

There are several threats to the external validity of our empirical estimates. Our sample includes researchers who had pre-registered for the national evaluation. The design of the evaluation excludes the possibility that other researchers that had not pre-registered apply once they learn about the composition of the committee. While we can only speculate about the size of the latter group, the available information suggests that it cannot be substantial. As discussed in subsection 3.1, the cost of pre-registering was relatively low, and therefore it is quite likely that most researchers who had a positive chance of promotion (perhaps, in at least one possible realization of the committee draw) pre-registered. In fact, the pool of pre-registered applicants accounts for approximately 60% of researchers in Italy at the assistant and associate professor level, presumably those who are closer to the promotion stage.

The conceptual framework presented in section 2 also suggests that the impact of connections may differ depending on the underlying strength of evaluation biases, the extent of information asymmetries, and the cost of applications. Our empirical results are consistent with a context where there is a moderate connection premium in assessments (either due to potential biases or due to a better observability of the quality of connected candidates), with substantial information asymmetries and relatively small cost of applying and failing. In this context, having access to more accurate information about their chances of success might discourage some connected researchers from applying. This result may not apply in contexts where there is no cost of applying (all prospective applicants would apply) or where the cost of applying is sufficiently large (informed researchers would be in this case more likely to apply). Similarly, if the connection premium in evaluations is sufficiently large, the net impact of connections on application decisions may be positive.

6 Conclusions

We study how connections in evaluation committees affect application behavior. We provide a simple conceptual framework which shows that the presence of a connection in a committee may affect application decisions in a non-trivial way. Connected individuals may expect to benefit from taste or statistical discrimination at the evaluation stage, which increases the probability that they apply. On the other hand, connected individuals may also anticipate that they will receive a more accurate evaluation and, moreover, they may be better informed about their chances of success. This reduction in information asymmetries may in turn decrease the probability that they apply.

We study empirically the relevance of these channels exploiting the exceptional evidence provided by scientific evaluations in Italy. We find that researchers are less likely to apply when the evaluation committee includes a coauthor, a colleague or a Ph.D. advisor. At the same time, their chances of success tend to be higher. Evidence from a subsequent round of evaluations suggests that, by postponing their application, weak researchers with a connection in the committee benefit also from higher success rates in the future. Overall, the evidence is consistent with the existence of a connection premium in evaluations and also with connected individuals having access to better information which helps them to make better application decisions, in a context where failure is moderately costly. This information advantage is particularly useful for researchers with a weak research profile.

Our findings are relevant for the design of evaluation processes in several ways. The design of some institutions, such as the European Research Council, which do not disclose the identity of evaluators until the end of the evaluation process, may help to increase the equality of opportunities. Otherwise, when prospective applicants can observe the identity of committee members, connected individuals may take more informed application decisions and avoid costly failures. Moreover, our analysis of evaluations shows that, while the Italian system of national scientific qualifications is characterized by a large degree of transparency which is aimed at increasing meritocracy, connected candidates still benefit from a connection premium, although its magnitude seems to be much lower than in other scientific evaluations that are less transparent.[32]

Finally, our analysis has also important implications for the interpretation of the estimates of empirical studies of discrimination and evaluation biases that rely only on information on the final set of applicants. In contexts where applications are costly, candidates' self-selection may lead to biased estimates. The magnitude of the bias might be substantial. In the scientific evaluations we consider here, a naive estimation based only on applicants' observable information would overestimate the evaluation bias by 29%.

References

Aigner, Dennis J. and Glen G. Cain (1977), "Statistical Theories of Discrimination in Labor Markets," *Industrial and Labor Relations Review*, Vol. 30(2), 175-187.

Azoulay, Pierre, Joshua Graff Zivin and Jialan Wang (2010), "Superstar Extinction", *Quarterly Journal of Economics*, Vol. 125(2), 549-589.

Azoulay, Pierre, Christian Fons-Rosen and Joshua Graff Zivin (2016), "Does Science Advance One Funeral at a Time?", NBER WP 21788.

Bagues, Manuel and Maria Jose Perez-Villadoniga (2013), "Why Do I Like People Like Me?" *Journal of Economic Theory*, Vol. 148(3), 1292-1299.

Bagues, Manuel, Mauro Sylos-Labini, and Natalia Zinovyeva (2017), "Does the Gender Composition of Scientific Committees Matter?" *American Economic Review*, Vol. 107 (4), pp. 1207-1238.

Blau, Francine D., Janet M. Currie, Rachel T.A. Croson and Donna K. Ginther (2010), "Can Mentoring Help Female Assistant Professors? Interim Results

[32]We find that connected candidates are 4.6 p.p. (13%) more likely to qualify. Instead, Zinovyeva and Bagues (2015) find that in the Spanish system of national qualification evaluations, where evaluation reports are not publicized, the (exogenous) presence of a connection in the committee increases candidates' chances of qualifying by around 50%. Similarly, the work of Perotti (2002) suggests that the impact of connections was significantly higher in the evaluation system that was in place previously in Italy.

from a Randomized Trial," *American Economic Review*, Vol. 100(2), 348-352.

Bosquet, Clément, Pierre-Philippe Combes, and Cecilia García-Peñalosa (2019), "Gender and Promotions: Evidence from Academic Economists in France," *Scandinavian Journal of Economics*. Accepted Author Manuscript. doi:10.1111/sjoe.12300

Burks, Stephen V., Bo Cowgill, Mitchell Hoffman, and Michael Housman (2015), "The Value of Hiring through Employee Referrals," *Quarterly Journal of Economics*, Vol. 130(2), 805-839.

Card, David and Stefano DellaVigna (2017), "What do Editors Maximize? Evidence from Four Leading Economics Journals," NBER working paper 23282.

Coda Zabetta, Massimiliano and Aldo Geuna (2018), "Italian Doctorate Holders and Academic Career Progression in the Period 1987-2015," *unpublished manuscript*, University of Turin.

Combes, Pierre-Philippe, Laurent Linnemer and Michael Visser (2008), "Publish or peer-rich? The role of skills and networks in hiring economics professors," *Labour Economics*, Vol. 15, 423-441.

Cornell, Bradford and Ivo Welch (1996), "Culture, Information, and Screening Discrimination," *Journal of Political Economy*, Vol. 104(3), pp. 542-571.

Durante, Ruben, Giovanna Labartino, Roberto Perotti (2011), "Academic Dynasties: Decentralization and Familism in the Italian Academia," NBER WP 7572.

Fisman, Raymond, Jing Shi, Yongxiang Wang, and Rong Xu (2017), "Social Ties and Favoritism in Chinese Science," NBER working paper 23130, forthcoming in the *Journal of Political Economy*.

Fernandez, Roberto and Nancy Weinberg (1997), "Sifting and Sorting: Personal Contacts and Hiring in a Retail Bank," *American Sociological Review*, Vol. 62(6) pp. 883-902.

Goldin, Claudia and Cecilia Rouse (2000), "Orchestrating impartiality: The impact of 'blind' auditions on female musicians," *American Economic Review*, Vol. 90(4), 715-741.

Heckman, James, and Peter Siegelman (1993), "The Urban Institute Audit Studies: Their Methods and Findings," in *Clear and Convincing Evidence: Measurement of Discrimination in America*, ed. Fix and Struyk, 187-258. Washington, D.C.: The Urban Institute Press.

Merton, Robert K. (1957), "Priorities in Scientific Discovery: A Chapter in the Sociology of Science," *American Sociological Review*, Vol. 22(6), 635-659.

Milkman, Katherine L., Modupe Akinola and Dolly Chugh (2015), "What Happens Before? A Field Experiment Exploring How Pay and Representation Differentially Shape Bias on the Pathway Into Organizations," *Journal of Applied Psychology*, Vol. 100(6), 1678-1712.

Mohnen, Myra (2017), "Stars and Brokers: Knowledge Spillovers among Medical Scientists," Essex University, mimeo.

Neumark, David (2012),"Detecting Discrimination in Audit and Correspondence Studies," *Journal of Human Resources*, Vol. 47(4), 1128-1157.

OECD (2013), Education at a Glance 2013: OECD Indicators, OECD Publishing. http://dx.doi.org/10.1787/eag-2013-en.

Perotti, Roberto (2002), "The Italian University System: Rules vs. Incentives," paper presented at the First Conference on Monitoring Italy, ISAE, Rome.

Petersen, Trond, Ishak Saporta and Marc-David Seidel (2000), "Offering a job: meritocracy and social networks," *American Journal of Sociology*, Vol. 106(3), 763-816

Petersen, Trond, Ishak Saporta and Marc-David Seidel (2005) "Getting hired: sex and race," *Industrial Relations*, Vol. 44(3), 416-443.

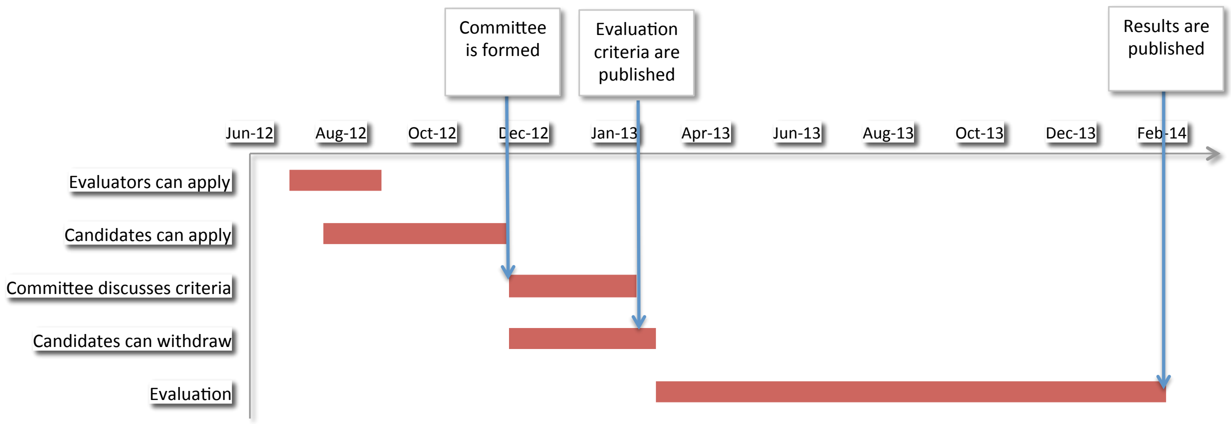
Sandström, Ulf and Martin Hällsten (2008), "Persistent nepotism in peer-review," *Scientometrics*, Vol. 74(2), 175-189.

Simon, Curtis J. and John T. Warner (1992), "Matchmaker, Matchmaker: The Effect of Old Boy Networks on Job Match Quality, Earnings, and Tenure," *Journal of Labor Economics*, Vol. 10(3), 306-330.

Stephan, Paula E. (2010), Economics of Science. In Hall, B. H. and N. Rosenberg, *Handbook of the Economics of Innovation*, pp. 217-273. Amsterdam and New York: Elsevier.

Zinovyeva, Natalia and Manuel Bagues (2015), "The Role of Connections in Academic Promotions," *American Economic Journal: Applied Economics*, Vol. 7(2), 264-92.

Figure 1: Timeline of the evaluation

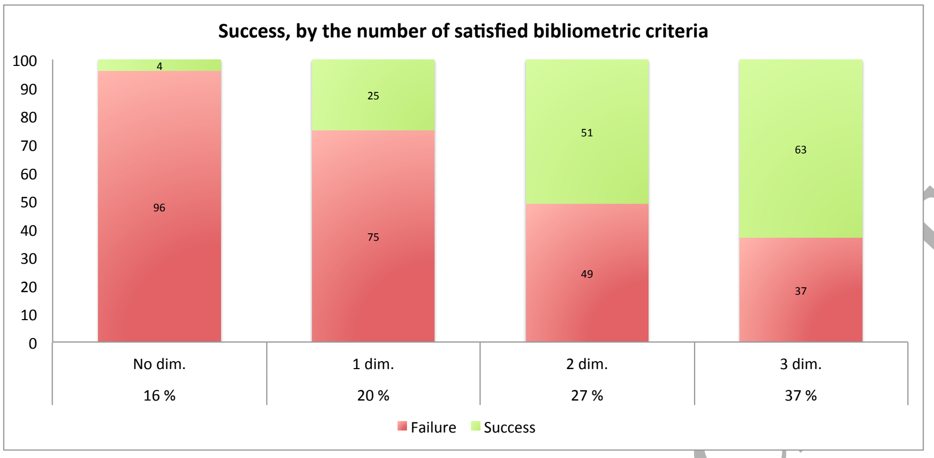


Note: As an illustration, the figure shows the timeline for Economics (discipline 13/A1).

Figure 2: Sample Individual Evaluation

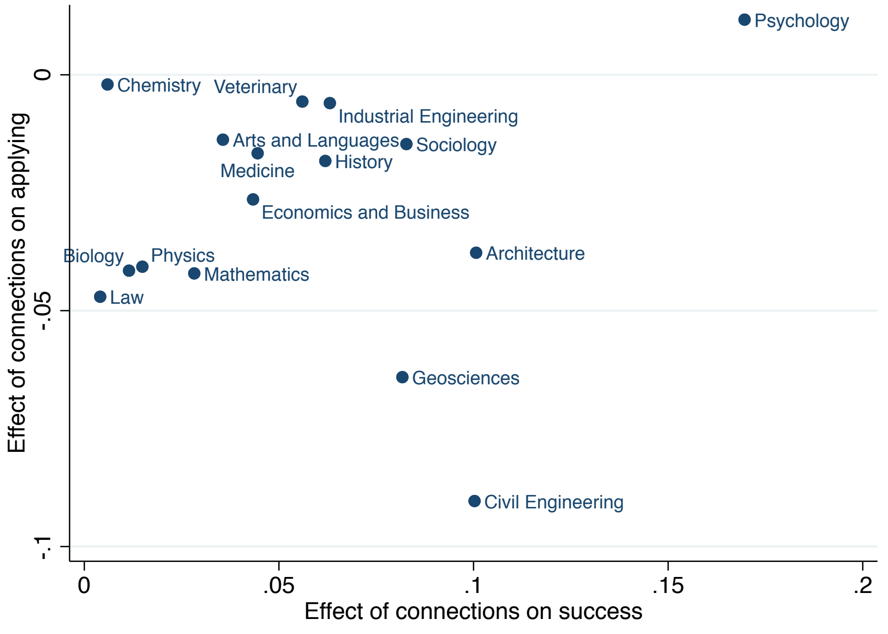
DOE John
The candidate PINCO PALLO has been Ricercatore universitario at the Università di PISA since 2006. His scientific work is concerned with the development of democracy, including a monograph on the role of public opinion in political thought and a series of contributions concerning English and Anglo-American thought and developments from the 17th through 19th centuries, with special reference to Edmund Burke. The candidate is a member of the "Re-Imagining Democracy in the Mediterranean, 1750-1860" project, based at the University of Oxford. The candidate has a significant number of international conference participations, among which those in which the English have invited him to speak about Burke are perhaps the most indicative of a strong international reputation. In terms of specific contributions, the “silent guest” metaphor is particularly significant in explaining how Burke plays out in the history of Italian political thought. The candidate scores above the median on two of the three indicators of impact and has substantial relevant teaching experience. On the basis of the application submitted, the candidate merits approval of the request for the abilitazione scientifica.

Figure 3: Success rate and bibliometric measures



Note: Candidates are classified in four groups, depending on the number of dimensions where their productivity is above the median in the corresponding category. Share of candidates in each group is indicated below.

Figure 4: Heterogeneity of the effect of connections across fields



Note: The figure shows field-level estimates of the causal impact of connections in committee on pre-registered candidates' success (x-axis) and on their probability to apply (y-axis).

Table 1: Summary of theoretical results

	Unconnected individual	**Connected individual**
Case 1: Evaluation bias in favor of connected candidates.		
$Pr(i \text{ applies})$	$\alpha + (1-\alpha)(1-\beta)$	1
$Pr(i \text{ promoted})$	$\alpha + (1-\alpha)(1-\beta)$	1
$E(q_i \mid i \text{ applied})$	$\frac{\alpha}{\alpha+(1-\alpha)(1-\beta)}$	α
$E(\text{Payoff}_i)$	$\alpha + (1-\alpha)(1-\beta)$	1
Case 2: Information asymmetries on the evaluator side.		
	Evaluation is selective: $\alpha < u_h$	
$Pr(i \text{ applies})$	$1-\beta$	$\alpha + (1-\alpha)(1-\beta)$
$Pr(i \text{ promoted})$	$1-\beta$	$\alpha + (1-\alpha)(1-\beta)$
$E(q_i \mid i \text{ applied})$	α	$\frac{\alpha}{\alpha+(1-\alpha)(1-\beta)}$
$E(\text{Payoff}_i)$	$1-\beta$	$\alpha + (1-\alpha)(1-\beta)$
	Evaluation is not selective: $\alpha > u_h$	
$Pr(i \text{ applies})$	1	$\alpha + (1-\alpha)(1-\beta)$
$Pr(i \text{ promoted})$	1	$\alpha + (1-\alpha)(1-\beta)$
$E(q_i \mid i \text{ applied})$	α	$\frac{\alpha}{\alpha+(1-\alpha)(1-\beta)}$
$E(\text{Payoff}_i)$	1	$\alpha + (1-\alpha)(1-\beta)$
Case 3: Information asymmetries on the candidate side.		
	Low application costs: $\frac{1-\beta}{\beta} > C$	
$Pr(i \text{ applies})$	1	$\alpha + (1-\alpha)(1-\beta)$
$Pr(i \text{ promoted})$	$\alpha + (1-\alpha)(1-\beta)$	$\alpha + (1-\alpha)(1-\beta)$
$E(q_i \mid i \text{ applied})$	α	$\frac{\alpha q_H + (1-\alpha)(1-\beta)q_L}{\alpha+(1-\alpha)(1-\beta)}$
$E(\text{Payoff}_i)$	$\alpha + (1-\alpha)(1-\beta) - (1-\alpha)\beta C$	$\alpha + (1-\alpha)(1-\beta)$
	High application costs: $\frac{1-\beta}{\beta} < C$	
$Pr(i \text{ applies})$	α	$\alpha + (1-\alpha)(1-\beta)$
$Pr(i \text{ promoted})$	α	$\alpha + (1-\alpha)(1-\beta)$
$E(q_i \mid i \text{ applied})$	1	$\frac{\alpha q_H + (1-\alpha)(1-\beta)q_L}{\alpha+(1-\alpha)(1-\beta)}$
$E(\text{Payoff}_i)$	α	$\alpha + (1-\alpha)(1-\beta)$

Notes: In *Case 1* evaluators are biased in favor of connected candidates, but there no information asymmetries. In *Case 2*, evaluators are (un)informed about the quality of (un)connected candidates, but evaluators do not favor connected candidates and there is perfect information about evaluators' standards. In *Case 3* prospective candidates are (un)informed about the evaluation standards of (un)connected evaluators, but there are no information asymmetries about the quality of applicants and evaluators do not favor connections. Shaded areas indicate higher values within each row.

Table 2: Descriptive statistics – Eligible evaluators

	1	2	3	4
	Mean	Std. Dev.	Min	Max
Based in Italy (N=5,876):				
Female	0.20	0.40	0	1
All publications	131	104	4	957
- Articles	73	85	0	920
- Books	8	10	0	139
- Book chapters	22	26	0	455
- Conference proceedings	20	37	0	401
- Patents	0.42	2.44	0	88
- Other	7	23	0	675
Average Article Influence Score	1.18	0.73	0.1	9.65
A-journal articles	11	16	0	207
Based abroad (N=1,365):				
Female	0.12	0.32	0	1

Notes: Article Influence Score is only available for STEM&Med fields and A-journal articles is only defined for publications by professors in the social sciences and humanities.

Table 3: Descriptive statistics – Applications

	1	2	3	4	5	6	7
Sample:	All		Position		Coauthor or colleague		
			FP	AP	Yes	No	
	Initial set of applications (N=69,020)						
	Mean	St.Dev.	Mean	Mean	Mean*	Mean*	p-value
Individual characteristics:							
Female	0.38	0.49	0.31	0.41	0.39	0.38	0.003
Age	44	8	49	43	0.05	-0.01	0.000
University affiliation	0.69	0.46	0.78	0.64	0.90	0.65	0.000
Permanent university position:	0.55	0.5	0.74	0.47	0.73	0.52	0.000
- same field	0.75	0.43	0.77	0.74	0.79	0.74	0.000
Quality indicators:							
CV length (pages)	16	67	20	14	0.08	-0.02	0.000
All Publications:	64	67	89	53	0.08	-0.02	0.000
- Articles	37	51	53	30	0.07	-0.01	0.000
- Books	2	5	3	2	0.01	-0.00	0.509
- Book chapters	7	12	10	6	0.06	-0.01	0.000
- Conference proceedings	10	20	14	8	0.07	-0.01	0.000
- Patents	0.24	1.65	0.35	0.19	0.00	-0.00	0.936
- Other	7	22	8	7	-0.03	0.00	0.003
Average number of coauthors	6	18	6	6	0.01	-0.00	0.118
First-authored	0.22	0.2	0.22	0.22	-0.02	0.00	0.079
Last-authored	0.12	0.16	0.15	0.11	0.03	-0.01	0.003
Average Article Influence Score	1.31	0.97	1.31	1.30	-0.01	0.00	0.469
A-journal articles	4	7	6	3	0.09	-0.01	0.000
Application order	0.5	0.29	0.5	0.5	0.46	0.51	0.000
	Final set of applications (N=59,150)						
Production in the previous 10 years:							
Social Sciences and Humanities:							
- Articles	20	17	25	18	0.16	-0.02	0.000
- A-journal articles	3	4	3	2	0.10	-0.01	0.000
- Books	2	3	3	2	0.02	-0.00	0.378
Sciences:							
- Articles	37	45	46	32	0.06	-0.01	0.000
- Citations	60	102	77	52	0.05	-0.01	0.000
- H-index	11	7	13	10	0.09	-0.02	0.000
Above the median in 3 indicators	0.38	0.48	0.42	0.36	0.46	0.36	0.000
Below the median in 3 indicators	0.16	0.36	0.13	0.17	0.12	0.17	0.000

Notes: Article Influence Score is defined for publications by professors in STEM&Med fields. A-journal articles are defined for publications by professors in the social sciences and humanities. Columns 5-6 provide information for the subset of applicants who had a connection in the committee and the subset who did not.

* In columns 5-6 productivity indicators and age are normalized at the exam level. Column 7 reports the p-value for the t-test of difference in means between the two groups.

Table 4: Descriptive statistics – Outcomes

	1	2	3	4	5	6	7
Sample:	All		Position		Coauthor or colleague		
			FP	AP	Yes	No	
	Mean	Std.Dev.	Mean	Mean	Mean	Mean	p-value
	Initial set of applications (N=69,020)						
Withdraws	0.14	0.35	0.16	0.13	0.17	0.14	0.000
Fails	0.49	0.50	0.48	0.50	0.34	0.52	0.000
Qualifies	0.37	0.48	0.36	0.37	0.49	0.34	0.000
	Final set of applications (N=59,150)						
Qualifies	0.43	0.49	0.43	0.43	0.59	0.40	0.000
Unanimous decision	0.86	0.35	0.84	0.86	0.86	0.86	0.813
	Individual evaluations (N=294,656)						
Length (in words)	176	277	203	164	193	175	0.000
Positive votes	0.45	.50	0.46	0.44	0.64	0.44	0.000
	Set of withdrawn applications (N=9,870)						
Reapplies in 2013	0.37	0.48	0.32	0.40	0.45	0.36	0.000
	Set of re-applicants in 2013 (N=3,684)						
Qualifies	0.58	0.49	0.59	0.57	0.67	0.55	0.000

Notes: We observe 99.7% of individual evaluations (294,656 out of 295,666 evaluations).

Table 5: Randomization test

	1	2	3	4	5
Dep. var.:	Female	Age	Same field	Other field	Application order
Connection in committee	0.004 (0.006)	0.028** (0.014)	0.002 (0.008)	0.001 (0.005)	-0.001 (0.004)
	6	7	8	9	10
Dep. var.:	CV length	Publications	A-journal articles	Total AIS	Coauthors
Connection in committee	-0.025 (0.017)	-0.001 (0.019)	-0.007 (0.010)	-0.009 (0.018)	-0.012 (0.019)

Notes: OLS estimates based on the initial set of applications. All regressions include exam fixed effects and a set of dummy variables for the expected number of connections in the committee (192 dummies). Dependent variables in columns 2, 5-10 are normalized at the exam level. Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 10%.

Table 6: The effect of connections on first-round outcomes

	1	2	3	4	5	6
Sample:		All		Research productivity:		
				High	Medium	Low
	ITT	ITT	IV	IV	IV	IV
A.			Applies in the 1^{st} round			
Connection in committee	-0.027***	-0.027***	-0.029***	-0.009	-0.018**	-0.062***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.008)	(0.011)
Individual controls	No	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.045	0.118	0.119	0.146	0.121	0.138
Mean, no connections	0.862	0.862	0.862	0.934	0.869	0.799
Connection effect, %	-3.1	-3.2	-3.4	-0.9	-2.0	-7.8
p-value(Z(High vs. Low))						0.000
B.			Qualifies in the 1^{st} round			
Connection in committee	0.039***	0.042***	0.046***	0.052***	0.049***	0.029***
	(0.007)	(0.006)	(0.006)	(0.010)	(0.009)	(0.009)
Individual controls	No	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.112	0.308	0.308	0.336	0.274	0.255
Mean, no connections	0.344	0.344	0.344	0.547	0.387	0.149
Connection effect, %	11.3	12.0	13.3	9.5	12.7	19.1
p-value(Z(High vs. Low))						0.087
C.			Fails in the 1^{st} round			
Connection in committee	-0.066***	-0.069***	-0.075***	-0.061***	-0.067***	-0.091***
	(0.007)	(0.006)	(0.007)	(0.010)	(0.009)	(0.011)
Individual controls	No	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.111	0.237	0.238	0.295	0.221	0.205
Mean, no connections	0.518	0.518	0.518	0.387	0.482	0.650
Connection effect, %	-12.7	-13.2	-14.6	-15.7	-13.8	-14.0
p-value(Z(High vs. Low))						0.047
Observations	69,020	69,020	69,020	21,443	21,800	25,777

Notes: Columns 1 and 2 report results from an OLS estimation where the right-hand side variable is the initial composition of the committee determined by the random draw. Columns 3-6 report results from estimations where the final composition of the committee has been instrumented using its initial composition.
In columns 4-6, researchers are classified according to their research productivity, as measured by the total Article Influence Score in STEM&Med fields and by publications in A-journals in the social sciences and humanities.
All regressions include exam fixed effects and a set of dummy variables for the expected number of connections in committee. Columns 2-6 also include a set of dummies for position and university, and the set of individual controls listed in the upper panel of Table 3, all interacted with discipline fixed effects.
Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 10%.
p-value(Z(High vs. Low)) shows a p-value for a two-sided test of equality of coefficients for, respectively, high and low quality candidates.

Table 7: Evaluators' individual voting

	1	2	3	4	5	6
Sample:	All final candidates		Research productivity:			Re-applicants
			High	Medium	Low	in 2^{nd} round
Connection	0.039***	0.039***	0.029***	0.043***	0.046***	0.034***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.008)	(0.011)
Candidate fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Evaluator fixed-effects	No	Yes	Yes	Yes	Yes	Yes
Observations	294,656	294,656	99,747	93,969	100,940	10,125
Number of applications	58,948	58,948	19,957	18,799	20,192	2025
Mean, no connections	0.440	0.440	0.624	0.488	0.217	0.577
Connection effect, %	9.0	8.9	4.7	8.9	21.2	5.9
p-value(Z(High vs. Low))					0.072	

Notes: OLS estimates. Each observation represents evaluator j assessment of candidate i. The dependent variable is a dummy that takes value one if the evaluator votes in favor of the candidate. In columns 1-5, the vote is from the first evaluation round. In column 6, the vote is from the second round, and the sample is composed of individuals who withdrew the application in the first round and reapplied again in the second round. Evaluations in the second round are available for 116 out of 184 fields, in which reports were published before May 2015.
In column 6, standard errors are clustered at the committee level.
*** denotes significance at 1%, ** significance at 5% and * significance at 10%.
p-value(Z(High vs. Low)) shows a p-value for a two-sided test of equality of coefficients for, respectively, high and low quality candidates.

Table 8: The impact of connections on 2^{nd} round outcomes

	1	2
Dependent variable:	Reapplies in the 2^{nd} round	Qualifies in the 2^{nd} round
Sample:	Withdrew in the 1^{st} round	Reapplied in the 2^{nd} round
Connection in committee	0.047***	0.096***
	(0.014)	(0.025)
Observations	9,870	3,684
Adjusted R-squared	0.158	0.208
Mean, no connections	0.356	0.548
Connection effect, %	13.1	17.5

Notes: OLS estimates. All regressions include exam fixed effects and a set of dummy variables for the expected number of connections in committee. Individual controls include a set of dummies for position and university, and the set of individual controls listed in the upper panel of Table 3, all interacted with discipline fixed effects.
Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 10%.

Table 9: Identification based on observables

	1	2	3	4	5
Dependent variable:	Qualifies	Positive votes		Qualifies	
Sample:	All final candidates		Research productivity: High	Medium	Low
Connection in committee	0.068***	0.329***	0.067***	0.065***	0.065***
	(0.006)	(0.028)	(0.009)	(0.008)	(0.010)
Observations	59,150	59,150	20,028	18,855	20,267
Adjusted R-squared	0.422	0.451	0.380	0.374	0.381
Mean, no connections	0.399	2.082	0.586	0.446	0.186
Connection effect, %	17.1	15.8	11.5	14.6	34.8
p-value(Z(High vs. Low))					0.882

Notes: OLS estimates. The sample is composed of all final applicants who received evaluations. All regressions include exam fixed effects, a set of dummy variables for the expected number of connections in committee, a set of dummies for position and university, and the set of individual controls listed in the upper panel of Table 3, all interacted with discipline fixed effects. Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 10%.
p-value(Z(High vs. Low)) shows a p-value for a two-sided test of equality of coefficients for, respectively, high and low quality candidates.

Table 10: The effect of connections on two-period outcomes and promotion

	1	2	3	4
Sample:	All	Research productivity:		
		High	Medium	Low
A.	Applies in the 1^{st} or the 2^{nd} round			
Connection in committee	-0.011***	-0.000	0.002	-0.035***
	(0.004)	(0.005)	(0.006)	(0.010)
Mean, no connections	0.911	0.961	0.925	0.861
Connection effect, %	-1.2	-0.03	0.2	-4.0
p-value(Z(High vs. Low))				0.002
B.	Qualifies in the 1^{st} or the 2^{nd} round			
Connection in committee	0.063***	0.059***	0.068***	0.054***
	(0.009)	(0.010)	(0.006)	(0.010)
Mean, no connections	0.371	0.566	0.421	0.178
Connection effect, %	17.0	10.4	16.1	30.2
p-value(Z(High vs. Low))				0.724
C.	Fails in the 1^{st} or the 2^{nd} round			
Connection in committee	-0.073***	-0.059***	-0.066***	-0.088***
	(0.006)	(0.010)	(0.009)	(0.011)
Mean, no connections	0.540	0.394	0.504	0.684
Connection effect, %	-13.6	-14.9	-13.1	-12.9
p-value(Z(High vs. Low))				0.051
D.	Promoted by December 2015			
Connection in committee	0.013***	0.007	0.012	0.021***
	(0.004)	(0.010)	(0.007)	(0.006)
Mean, no connections	0.121	0.203	0.123	0.056
Connection effect, %	10.6	3.6	9.7	38.6
p-value(Z(High vs. Low))				0.230
Observations	69,020	21,443	21,800	25,777

Notes: The table reports results from instrumental variables estimations where the final composition of the committee has been instrumented using the outcome of the initial random draw.
All regressions include exam fixed effects, a set of dummy variables for the expected number of connections in committee, a set of dummies for position and university, and the set of individual controls listed in the upper panel of Table 3, all interacted with discipline fixed effects. Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 1%.
p-value(Z(High vs. Low)) shows a p-value for a two-sided test of equality of coefficients for, respectively, high and low quality candidates.

Appendix A.

Table A1: The effect of connections, by connection type

	1	2	3
A.	Outcomes of the 1^{st} round		
	Applies	Qualifies	Fails
Coauthor in committee	-0.021***	0.052***	-0.073***
	(0.007)	(0.009)	(0.010)
Colleague in committee	-0.033***	0.034***	-0.067***
	(0.007)	(0.009)	(0.008)
Ph.D. advisor in committee	-0.011	0.097***	-0.108***
	(0.018)	(0.020)	(0.018)
B.	Outcomes of the 1^{st} and 2^{nd} rounds		
	Applies	Qualifies	Fails
Coauthor in committee	-0.007	0.065***	-0.072***
	(0.005)	(0.009)	(0.010)
Colleague in committee	-0.014**	0.051***	-0.066***
	(0.006)	(0.009)	(0.008)
Ph.D. advisor in committee	-0.000	0.107***	-0.107***
	(0.016)	(0.023)	(0.018)

Notes: Each coefficient is an OLS estimate from an independent regression where the right-hand side variable is the number of initially assigned connected evaluators of corresponding type (coauthors, colleagues, or advisors). All regressions include exam fixed effects and a set of dummy variables for the expected number of connections in committee (180 dummies for coauthors, 88 dummies for colleagues, and 57 dummies for Ph.D. advisors).
Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 10%.

Table A2: Non-linear effect of connections

	1	2	3
A.	Outcomes of the 1^{st} round		
	Applies	Qualifies	Fails
One connection in committee	-0.030***	0.035***	-0.065***
	(0.006)	(0.008)	(0.007)
Two or more connections in committee	-0.027*	0.111***	-0.138***
	(0.015)	(0.024)	(0.021)
B.	Outcomes of the 1^{st} and 2^{nd} rounds		
	Applies	Qualifies	Fails
One connection in committee	-0.012***	0.051***	-0.063***
	(0.004)	(0.008)	(0.007)
Two or more connections in committee	-0.004	0.135***	-0.138***
	(0.011)	(0.024)	(0.022)

Notes: OLS estimates from regressions that include indicators for candidates who have respectively one and more than one connection assigned to the committee. All regressions include exam fixed effects and a set of dummy variables for the expected number of connections in committee.
Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 10%.

Table A3: The effect of connections when there is only one candidate from the institution

	Applies
Connection in committee	-0.058**
	(0.027)
Mean, no connections	0.802
Connection effect, %	-7.23
Observations	4769

Notes: The sample is composed of candidates who have no other competitors from the same university applying for the same evaluation. The table reports results from an IV estimation where where the final composition of the committee has been instrumented using its initial composition. All regressions include exam fixed effects, a set of dummy variables for the expected number of connections in committee, a set of dummies for position and university, and the set of individual controls listed in the upper panel of Table 3, all interacted with discipline fixed effects.
Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 10%.

Table A4: Connections in the qualification committee and promotion at the university level

	Promoted by December 2015
Connection in the qualification committee	0.001
	(0.007)
Mean, no connections	0.281
Connection effect, %	0.2
Observations	25342

Notes: The sample is restricted to candidates who received a qualification in the national qualification evaluation. The table reports results from an IV estimation where where the final composition of the committee at the qualification stage has been instrumented using its initial composition. All regressions include exam fixed effects, a set of dummy variables for the expected number of connections in committee, a set of dummies for position and university, and the set of individual controls listed in the upper panel of Table 3, all interacted with discipline fixed effects. Standard errors are clustered at the committee level. *** denotes significance at 1%, ** significance at 5% and * significance at 10%.