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The Role of Connections in Academic Promotions†

By Natalia Zinovyeva and Manuel Bagues*

This paper analyzes how evaluators' private information and subjective biases affect evaluations in academia. We use evidence from centralized selection exams in Spain, where evaluators are randomly assigned to promotion committees. Candidates are significantly more likely to be promoted when they are evaluated by an acquainted evaluator, but the source of the premium depends on the nature of this relationship. Our findings suggest that, when candidates are evaluated by their PhD advisor, a colleague or a coauthor, evaluation biases dominate the potential impact of informational gains. Weaker links, on the other hand, may improve the efficiency of the selection process. (*JEL* D82, I23, J44, M51)

Science largely relies on a nonmarket reward system, based on meritocracy and credit granted by peers (Stephan 1996). Failures in this system can have important consequences for the overall quality of research. One potential threat is the existence of connections between candidates and evaluators. Evaluators may favor connected candidates either because of nepotism, or simply because they share a common view as to which academic areas are more valuable. As Joseph A. Schumpeter pointed out, "it is merely human nature that we overrate the importance of our own types of research and underrate the importance of the types that appeal to others."[1] At the same time, evaluators may be better informed about the quality of acquainted candidates in dimensions that are not easily observable by other evaluators, such as their research pipeline, their contribution in coauthored papers, or the candidates' willingness to help other colleagues (Oettl 2012). This might lead to an improvement in the quality of the selection. The net effect of this trade-off, the potential existence of an evaluation bias versus the positive informational content of connections, may vary depending on the nature of the relationship between

*Zinovyeva: Department of Economics, School of Business, Aalto University, Box 21240 FI-00076 AALTO (e-mail: natalia.zinovyeva@aalto.fi); Bagues: Department of Economics, School of Business, Aalto University, Box 21240 FI-00076 AALTO (e-mail: manuel.bagues@aalto.fi). An earlier version of this paper was circulated under the title "It's Not What You Know, but Who You Know? The Role of Connections in Academic Promotions." We are extremely grateful to Marianne Bertrand, Berta Esteve-Volart, Dan Hamermesh, Eduardo Melero, Nic Morgan, Heidi Williams, and two anonymous referees, whose suggestions greatly improved our paper. We also thank participants at presentations at the DIME-BRICK workshop, Simposio de Análisis Económico, European Society of Population Economics, Università Bocconi, Universidad Carlos III, National Bureau of Economic Research (NBER) Summer Institute, the European Economic Association, the American Economic Association, York University, the London School of Economics and the University of Chicago Booth School of Business for their valuable comments. Both authors acknowledge the support from the Spanish Ministry of Science and Innovation (grant CSO2011-29431 and Ramón y Cajal program).

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[1] Schumpeter, Joseph A., *History of Economic Analysis*, London: George Allen and Unwin (1954, 20).

candidate and evaluator, on the extent of information asymmetries, and on the institutional framework.

The empirical evidence regarding the efficiency of connections in selection processes is relatively scarce.[2] Laband and Piette (1994) and Brogaard, Engelberg, and Parsons (2014) have found that top economics journals are more likely to publish articles authored by colleagues of the editor. These articles tend to attract more future citations than other articles published in the same journal. The authors argue that this is consistent with editors taking advantage of their connections with colleagues from their own institution in order to identify and attract high-impact papers to their journal. In another case, Li (2011) has found that the presence of related reviewers, as measured by citations, was associated with an increase in the number of citations received by projects funded by the National Institute of Health.

In this paper we study the role of connections in academic promotions using the outstanding evidence provided by a large scale randomized natural experiment: centralized selection exams in Spanish academia from 2002 through 2006. During this period, all candidates for positions of Full Professor and Associate Professor first had to qualify in a centralized selection exam. Successful candidates could then apply for a position at the university level. These centralized qualification exams were set up to be highly competitive: on average, there was one position for every ten candidates. Evaluators were selected from a pool of eligible evaluators in the field using a random draw. This unique feature allows for the consistent estimation of the effect of connections on candidates' chances of success.

Our database includes information on around 30,000 candidacies from all academic disciplines. In total, these candidacies were evaluated by approximately 1,000 committees. We consider a broad range of connections between candidates and evaluators. Some connections were unusually strong. Rules regarding conflict of interest were seldom implemented and, as a result, applicants could be (randomly) assigned to an evaluation committee that included their thesis advisor, a coauthor, or a colleague. We also collect information on weaker connections. In particular, we observe whether the evaluators and the candidate have participated at some point in the same PhD thesis defense, either as author, advisor or committee member. This measure most likely reflects the existence of common research interests and some personal connection. In addition to these direct connections, we also collect information on the existence of indirect links, such as a common coauthor. The presence of connections in evaluation committees was relatively frequent. About one-third of candidates were evaluated by a strong connection, one-fifth of candidates were assigned to a committee that included a weak connection, and indirect links were present in about one out of every six evaluations.

The empirical evidence in this paper shows that direct connections in committees affect significantly the outcome of evaluations. We find that candidates are approximately 50 percent more likely to be promoted when the committee includes,

[2] A number of studies show that connected candidates tend to be more successful. For instance, evidence from Italy and France shows that, in economics, evaluators tend to prefer candidates from their own institution (Perotti 2002; Combes, Linnemer, and Visser 2008; Durante, Labartino, and Perotti 2011). This evidence is consistent both with the existence of informational asymmetries and an evaluation bias.

through luck of the draw, a strong connection. The presence of a weak connection increases candidates' chances of success by 20 percent. The presence of an indirect connection in the committee has no significant impact on candidates' chances of being promoted.

To understand the source of the premium associated to connections, we propose a simple conceptual framework that clarifies how the role of information and bias may be disentangled. In a context where many candidates compete for a few positions, information and bias yield similar empirical implications in terms of the chances of success of connected candidates. In both cases, connected candidates are expected to have better chances of being selected. Similarly, information and bias also imply that candidates selected by an acquainted evaluator are expected to be relatively weaker in dimensions that are publicly observable at the time of the evaluation. However, biased evaluators and informed evaluators differ in terms of the quality of promoted candidates in dimensions that were not publicly observable at the time of the promotion. Candidates promoted by an informed evaluator, unlike candidates promoted by a biased evaluator, are expected to excel in dimensions that only informed evaluators can observe. In our empirical analysis we proxy these dimensions using information on future research productivity and on future promotions.

We find that candidates promoted by a strong connection have a significantly worse record in dimensions that are publicly observable at the time of the evaluation, relative to other promoted candidates. They are also significantly less productive during the five-year period following their promotion. They are significantly worse in terms of the number of publications, the quality of the journals where they publish, the number of citations received, the number of PhD students supervised, and their participation in PhD thesis committees. The gap in these dimensions is approximately equal to 10 percent of a standard deviation relative to candidates in the same exam. They are also significantly less likely to qualify in future selection processes for an academic promotion. Overall, the evidence is consistent with strong connections decreasing the efficiency of the selection process.

In the case of weak connections, the evidence is consistent with the existence of informational gains that are at least as important as evaluation bias. Candidates promoted by a weak connection seem to be less productive at the time of the evaluation, but they are as productive in the future as other promoted candidates and they are significantly more likely to qualify in future selection processes. Indirect links do not seem to play any role in the evaluation process. Candidates promoted by an indirect link appear to be similar to other promoted candidates in every observable dimension, before and after the promotion.

Our paper presents evidence from a very large setting, promotions in all academic disciplines within a country during a five-year period, and exploits a transparent source of identification, the random assignment of evaluators to committees. It contributes to the current literature in several ways. First, it provides a conceptual framework that helps to disentangle the impact of information asymmetries from evaluation biases. This framework spells out the assumptions required to interpret information about the average quality of connected and nonconnected candidates that are promoted. Second, it documents the impact of a broad range of connections on promotion decisions. Third, the analysis suggests that the assessments of advisors, coauthors, and colleagues are not reliable, but that the presence of weaker links in evaluation committees might help to improve the efficiency of the selection.

The rest of the paper is organized as follows. Section I presents a simple conceptual framework that provides guidance for our empirical analysis. In Section II we explain the institutional background and Section III provides detailed information on the data we use. In Section IV we investigate how connections affect applicants' chances of being promoted as well as the efficiency of the selection process. Finally, in Section V we summarize our results and discuss possible policy implications.

I. Conceptual Framework

We present a very simple model of decision making that illustrates how evaluators' information and biases affect (i) candidates' chances of success and (ii) the efficiency of the selection process. For the sake of argument, the model does not address a number of potentially relevant issues such as evaluators' reputational concerns or the strategic interactions that may arise in a committee with several members. We consider a single evaluator j, who has to decide whether to promote candidate i. Candidates' quality is an additive combination of two independent dimensions, q_{1i} and q_{2i}, which for simplicity we assume to be normally distributed with mean zero and unit variance:

$$(1a) \qquad q_i = q_{1i} + q_{2i}, \quad \begin{Bmatrix} q_{1i} \\ q_{2i} \end{Bmatrix} \sim \mathcal{N}\left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \right\}.$$

The first dimension, q_1, includes information that is publicly and perfectly observable. The second dimension, q_2, refers to information that is only partially observable. In particular, evaluator j can only observe a noisy signal of candidate i's quality in this dimension:

$$(1b) \qquad y_{ij} = q_{2i} + \epsilon_{ij}, \quad \text{where} \quad \epsilon_{ij} \sim N\left(0, \sigma_{ij}^2\right).$$

The evaluator's payoff is determined as follows. If candidate i is promoted, the evaluator's payoff is equal to the candidate's true quality q_i plus a subjective bias, B_{ij}. If the candidate is not promoted, the evaluator obtains an outside option U:

$$\text{Payoff}_j = \begin{cases} q_i + B_{ij} \text{ if candidate } i \text{ is promoted} \\ U \text{ otherwise} \end{cases}.$$

The best strategy for a risk-neutral evaluator would be to promote candidate i whenever the expected benefits of the promotion are larger than the outside option, given the available information.

$$E(q_i + B_{ij} | y_{ij}) > U \Leftrightarrow \text{candidate } i \text{ is promoted.}$$

We make two additional assumptions. First, candidate quality is assumed to be independent of the potential bias and the reliability of observable signals.

$$E(q_i|B_{ij}) = E(q_i|\sigma_{ij}) = E(q_i). \tag{2}$$

Second, in order to capture the competitive nature of a selection process where only a few exceptional candidates may succeed, let us assume that the outside option, U, is sufficiently large.

$$U - B_{ij} > 0. \tag{3}$$

Let us now examine how the evaluators' private information and potential biases affect the outcome of the evaluation process and its efficiency. We study how information and bias affect candidates' chances of being promoted (Proposition 1), the quality of promoted candidates in the publicly observable dimension (Proposition 2), their quality in the imperfectly observable dimension (Proposition 3), and their overall quality (Proposition 4).

PROPOSITION 1: *A candidate's probability of being promoted* (*i*) *increases with the evaluator's subjective bias*, *and* (*ii*) *increases with the accuracy of the signal.*

PROOF:

Given assumptions (1) and (2), it follows that:

$$\Pr(E(q_i + B_{ij}|y_{ij}) > U) = \Pr(q_{1i} + E(q_{2i}|y_{ij}) + B_{ij} > U)$$

$$= \Pr\left(q_{1i} + \frac{y_{ij}}{1+\sigma_{ij}^2} > U - B_{ij}\right) = 1 - \Phi\left((U - B_{ij})\sqrt{\frac{1+\sigma_{ij}^2}{2+\sigma_{ij}^2}}\right),$$

where $\Phi(\cdot)$ is the cumulative normal distribution function. Since $\Phi(\cdot)$ is a monotonically increasing function, the above expression is increasing in B_{ij}. Moreover, as long as assumption (3) is satisfied, it is decreasing in σ_{ij}^2.

PROPOSITION 2: *The expected quality of promoted candidates in the publicly observable dimension* $\left(\bar{q}_{1i}^{p}\right)$ (*i*) *decreases with the evaluator's subjective bias*, *and* (*ii*) *decreases with the accuracy of the signal.*

PROOF:

Given assumptions (1) and (2), it follows that:

$$\bar{q}_{1i}^{p} = E[q_{1i}|E(q_i + B_{ij}|y_{ij}) > U] = \sqrt{\frac{1+\sigma_{ij}^2}{2+\sigma_{ij}^2}}\,\lambda(x),$$

where $\lambda(\cdot) = \frac{\phi(\cdot)}{1-\Phi(\cdot)}$ is the inverse Mills ratio, and $x = (U - B_{ij})\sqrt{\frac{1+\sigma_{ij}^2}{2+\sigma_{ij}^2}}$.

Since, as it is well known, $\lambda_x'(x) > 0$,

$$\left(\bar{q}_{1i}^{p}\right)'_{B_{ij}} = \sqrt{\frac{1+\sigma_{ij}^2}{2+\sigma_{ij}^2}}\,\lambda'_x(x)x'_{B_{ij}} < 0$$

and, as long as assumption (3) holds,

$$\left(\bar{q}_{1i}^{p}\right)'_{\sigma_{ij}^2} = \left(\sqrt{\frac{1+\sigma_{ij}^2}{2+\sigma_{ij}^2}}\right)'_{\sigma_{ij}^2}\lambda(x) + \sqrt{\frac{1+\sigma_{ij}^2}{2+\sigma_{ij}^2}}\,\lambda'_x(x)x'_{\sigma_{ij}^2} > 0.$$

PROPOSITION 3: *The expected quality of promoted candidates in the imperfectly observable dimension* $\left(\bar{q}_{2i}^{p}\right)$ (*i*) *decreases with the evaluator's subjective bias*, *and* (*ii*) *increases with the accuracy of the signal.*

PROOF:

Given assumptions (1) and (2), it follows that:

$$\bar{q}_{2i}^{p} = E\left[q_{2i}|E(q_i + B_{ij}|y_{ij}) > U\right] = \frac{\lambda(x)}{\sqrt{\left(1+\sigma_{ij}^2\right)\left(2+\sigma_{ij}^2\right)}},$$

Using the properties of the inverse Mills ratio,[3]

$$\left(\bar{q}_{2i}^{p}\right)'_{B_{ij}} = \frac{\lambda'_x(x)x'_{B_{ij}}}{\sqrt{\left(1+\sigma_{ij}^2\right)\left(2+\sigma_{ij}^2\right)}} < 0,$$

and, as long as assumption (3) is satisfied,

$$\left(\bar{q}_{2i}^{p}\right)'_{\sigma_{ij}^2} = \left(\frac{1}{\sqrt{\left(1+\sigma_{ij}^2\right)\left(2+\sigma_{ij}^2\right)}}\right)'_{\sigma_{ij}^2}\lambda(x) + \frac{1}{\sqrt{\left(1+\sigma_{ij}^2\right)\left(2+\sigma_{ij}^2\right)}}\,\lambda'_x(x)x'_{\sigma_{ij}^2}$$

$$= \left(\frac{1}{\sqrt{\left(1+\sigma_{ij}^2\right)\left(2+\sigma_{ij}^2\right)}}\right)'_{\sigma_{ij}^2}\left(\lambda(x) - \lambda'_x(x)x\,\frac{1}{3+2\sigma_{ij}^2}\right) < 0.$$

PROPOSITION 4: *The expected overall quality of promoted candidates* $\left(\bar{q}_{i}^{p}\right)$ (*i*) *decreases with the evaluator's subjective bias*, *and* (*ii*) *increases with the accuracy of the signal.*

PROOF:

Assumptions (1) and (2) imply that:

$$\bar{q}_{i}^{p} = E\left[q_i|E(q_i + B_{ij}|y_{ij}) > U\right] = \sqrt{\frac{2+\sigma_{ij}^2}{1+\sigma_{ij}^2}}\,\lambda(x).$$

[3] As shown by Gordon (1941) and Birnbaum (1942), $\lambda(x) > x$ and $0 < \lambda'_x(x) < 1$.

Since $\lambda(x) > x$ and $0 < \lambda_x'(x) < 1$, it follows that:

$$\left(\bar{q}_i^p\right)_{B_{ij}}' = \sqrt{\frac{2 + \sigma_{ij}^2}{1 + \sigma_{ij}^2}}\ \lambda_x'(x) x_{B_{ij}}' < 0,$$

and, as long as assumption (3) is satisfied,

$$\left(\bar{q}_i^p\right)_{\sigma_{ij}^2}' = \left(\sqrt{\frac{2 + \sigma_{ij}^2}{1 + \sigma_{ij}^2}}\right)_{\sigma_{ij}^2}' \lambda(x) + \sqrt{\frac{2 + \sigma_{ij}^2}{1 + \sigma_{ij}^2}}\ \lambda_x'(x) x_{\sigma_{ij}^2}'$$

$$= \left(\sqrt{\frac{2 + \sigma_{ij}^2}{1 + \sigma_{ij}^2}}\right)_{\sigma_{ij}^2}' \left(\lambda(x) - \lambda_x'(x) x\right) < 0.$$

In sum, candidates have better chances of success when the evaluator is biased in their favor, or when she is better informed about their quality (Proposition 1). The positive impact of more accurate information is consistent with the findings of Cornell and Welch (1996) and Bagues and Perez-Villadoniga (2012, 2013). Moreover, relative to candidates who were promoted by an unbiased evaluator, candidates promoted by a biased evaluator tend to have lower quality in the publicly observable dimension (Proposition 2), in the *hidden* dimension (Proposition 3), and overall (Proposition 4). Similarly, relative to candidates who were promoted by an uninformed evaluator, candidates promoted by an informed evaluator tend to be relatively worse in terms of their quality in the publicly observable dimension (Proposition 2), but are of higher quality in the *hidden* dimension (Proposition 3), as well as overall (Proposition 4).

This conceptual framework may be helpful to investigate the role of connections in selection processes. Evaluators might be better informed about the quality of acquainted candidates, but they might also be biased in their favor. The efficiency of the selection process thus depends on the relative strength of these two features: information asymmetries and evaluation biases. According to the model, both features imply that connected candidates are expected to have better chances of being selected (Proposition 1), and candidates selected by an acquainted evaluator are expected to have a worse record in terms of observable quality (Proposition 2). Therefore, it is not possible to disentangle which of the two effects dominates, information or bias, just on the basis of candidates' success rate or on the basis of information about candidates' quality in dimensions that were observable by all evaluators. The analysis requires instead some additional information about candidates' quality beyond what was publicly available at the time of the evaluation. According to Propositions 3 and 4, when information asymmetries are sufficiently large, candidates selected by an acquainted evaluator tend to be relatively better in dimensions that were not easily observable by other evaluators, as well as in terms of overall quality.

The predictions of this conceptual framework apply under a certain set of assumptions. The model considers a very competitive selection process where candidates' quality is not related to evaluators' characteristics. In our empirical analysis we consider a context where, as we explain below, these restrictions are expected to be satisfied—the system of centralized evaluations that was in place in Spain between 2002 and 2006.

II. Institutional Background

European countries are increasingly concerned with the efficiency of their higher education and, during the last decade, several countries have reformed the organization of universities (Aghion et al. 2010). In this regard, there is much insight to be gained from the Spanish case. Before 2002, Spanish public universities had a large degree of autonomy regarding hiring and promotion of faculty members.[4] This system was largely associated with academic inbreeding, generating public concerns about the potential existence of favoritism (Cruz-Castro, Sanz-Menéndez, and Valle 2006). In order to encourage a more meritocratic selection process, in 2002 a centralized selection system known as habilitación was introduced. This selection system is relatively similar to the ones currently in place in Italy and France.

The selection process involved two stages. First, candidates for Full Professor (henceforth referred to as FP) and Associate Professor (henceforth, AP) positions were required to qualify in a national evaluation.[5] Evaluations were conducted separately in nearly 200 academic fields.[6] In the second stage, the successful candidates applied for a position at a given university. In practice, the number of qualifications at the national level was very limited, and competition at the university level was largely absent. Thus, receiving accreditation was generally equivalent to receiving a promotion. Unsuccessful candidates typically remained in the same position and could reapply for a promotion in the future.

In this paper we focus on the first stage of the process: qualification exams held at the national level. The time structure was as follows. First, the Ministry reported the number of openings and the centralized selection process was announced. Candidates were given 20 days to apply and, once the list of applicants was settled, committee members were selected by random draw. The committee member with the longest tenure was appointed president, and the exam was held at the university where the president was based. Below we explain in detail how committee members were selected and the evaluation process.

[4] As it is generally the case in Europe, most university professors in Spain are based in public universities. In 2010 this group represented 91 percent of the total amount (Ministerio de Educación, Cultura y Deporte 2013).

[5] The category of *profesor titular de universidad* at a Spanish university may be considered equivalent to the position of Associate Professor in a US university though, in Spain, it always carries tenure. The position of *catedrático de universidad* would be equivalent to Full Professor. In Spain, Full Professors earn a higher salary than Associate Professors, although they usually have a similar teaching load and they have more power in the decision-making process within departments.

[6] These fields were created in 1984 on the basis of "the homogeneity of its object of knowledge, a common historic tradition, and the existence of a community of researchers" (Real Decreto 1888/1984, Official State Bulletin, 257, 26 October 1984, p. 31051). For instance, members of an Economics Department tend to belong to the following fields: "Economic Analysis," "Applied Economics" or, less frequently, "Economic History" or "Finance and Accounting."

A. *Selection of Committee Members*

Each committee was composed of seven members who were selected by means of a random draw from the pool of eligible evaluators in the field. The random draw was itself carried out by Ministry officials who used a drum which contained as many balls as there were eligible evaluators. In exams for the position of AP, three evaluators were chosen from the list of eligible full professors, and four evaluators were chosen from the list of eligible associate professors. In the case of exams for the position of FP, all committee members were chosen from the list of eligible FPs. Furthermore, seven evaluators were assigned to form a reserve committee, whose role was to replace evaluators in case somebody resigned from the main committee.

The list of eligible evaluators included professors and researchers in the field who were working in a public institution in Spain at the time, and who were officially recognized as having a minimum research productivity.[7] The random assignment of evaluators to committees was subject to some minor constraints. Not more than one nonuniversity researcher from the Spanish Research Council (CSIC) was allowed to be selected as a member of the evaluation committee for a given exam. Similarly, no more than one emeritus professor was allowed to be selected as a member of a given evaluation committee.[8]

Evaluators could only resign under a very restricted set of circumstances, and resignations happened very rarely: about 2 percent of the initially assigned evaluators were replaced. There were two main types of resignations. Professors were allowed to decline if they were temporarily holding a high position in Spain's public administration. Also, professors were permitted to abstain from participating in the committee if they had a very close personal connection with one of the candidates.[9] However, with very few exceptions, evaluators did not decline to participate in the committee due to such connections. For instance, according to our own calculations, out of 832 professors who were assigned to evaluate their own PhD students, only 22 resigned from the committee, a proportion which is similar to the overall rate.

B. *The Evaluation*

Exams for the position of FP included two qualifying stages. In the first one, each candidate presented his résumé while in the second candidates had to present a piece of their research work. Additionally, exams for the position of AP had an

[7] The research quality requirement was based on the number of *sexenios* (six-year terms) recognized to each professor. *Sexenios* are granted by the Spanish education authorities on the basis of applicants' academic research output in any noninterrupted period of a maximum of six years. Around 80 percent of Full Professors and approximately 70 percent of Associate Professors qualified to serve in committees (Comisión Nacional Evaluadora de la Actividad Investigadora, 2005).

[8] In exams where the population of potential evaluators contained two or more researchers, or two or more emeritus professors, the expected committee composition should be computed taking into account this constraint. The details of these calculations are in the Appendix.

[9] The law covers three main cases: (i) the evaluator has a personal interest in the matter, (ii) there is some kinship relationship, (iii) there exists a well-known friendship (or enmity). Ley de Procedimiento Administrativo 30/1992, article 28, Official State Bulletin, 285, 26 November 1992, p. 40300.

intermediate stage, in which candidates had to deliver a lecture on a topic from their syllabus. Decisions to pass candidates were taken on a majority basis. At the end of the process, the number of qualified candidates could not be larger than the total number of positions.

In 2006 the system of habilitación was replaced by a system known as acreditación, which is still in place. Under the acreditación system applicants are also required to be approved by a national review committee. However, committee members are now selected in a nonrandom way from the pool of professors who volunteer for the task, and there is no limit to the number of candidates who may receive the accreditation.

III. Data

We have collected data from several sources. First, we use information on all exams for AP and FP positions that were held in Spain when the centralized system of examinations known as habilitación was in place, in the years 2002 through 2006. The data include the identity of all candidates and eligible evaluators, the outcome of the lotteries that determined committee composition, and the list of promoted candidates. Second, we have gathered information on the research output of candidates and eligible evaluators published in international (ISI Web of Science) and national (Spanish bibliographic index Dialnet) academic outlets. We also use these databases to identify coauthorships. Third, we have collected information on candidates' and evaluators' activity as PhD advisors and as members of dissertation committees. Finally, as an additional measure of performance, we use information on the outcome of centralized examinations between 2006 and 2013, under the system of examinations known as acreditación. In the Appendix we provide a detailed explanation of how this information was collected, and how each variable was constructed. Below we describe the final database.

A. *Exams*

Our dataset includes information on 967 exams in 174 disciplines, of which 465 are exams for positions as AP and 502 are exams for positions as FP. Table 1 provides descriptive information on the characteristics of these exams. There are, on average, three positions available per exam in FP exams, and five positions per exam in AP exams. In both types of exams the level of competition was roughly similar and there are approximately ten candidates for every position. Practically all positions offered were filled.

B. *Candidates*

Column 1 in Table 2 provides descriptive information about the candidates' characteristics. There are 31,243 applications and, on average, candidates applied twice, either because they failed the first time, or because they applied simultaneously in several related disciplines. One-third of candidates are women and the average applicant is 41 years old.

Table 1—Descriptive Statistics—Examinations

	Mean (1)	SD (2)	Min. (3)	Max. (4)
Full professor exams				
Positions per exam	2.92	1.78	1	12
Candidates per exam	26.78	17.74	3	125
Proportion of positions filled	0.98	0.09	0	1
Associate professor exams				
Positions per exam	4.74	4.71	1	25
Candidates per exam	38.28	33.68	3	258
Proportion of positions filled	0.96	0.15	0	1

Note: The table includes information from 502 examinations for positions of Full Professor and 465 examinations for positions of Associate Professor that were held between 2002 and 2006.

Table 2—Descriptive Statistics—Candidates' Characteristics

	All (1)	FP exams (2)	AP exams (3)	Engineering (4)	Sciences (5)	Social Sciences (6)	Humanities and Law (7)	All, 5 years after exam (8)
Female	0.34	0.27	0.40	0.21	0.30	0.39	0.45	0.34
	(0.47)	(0.44)	(0.49)	(0.41)	(0.46)	(0.49)	(0.50)	(0.47)
Age	41.21	46.14	37.49	38.74	41.97	40.39	41.86	46.21
	(7.59)	(6.06)	(6.41)	(7.07)	(7.55)	(7.54)	(7.62)	(7.59)
Publications	12.84	19.09	8.12	7.76	16.99	9.22	11.45	7.58
	(18.31)	(21.18)	(14.06)	(12.88)	(24.10)	(11.61)	(11.39)	(10.15)
International	8.46	12.28	5.58	7.76	16.99	1.32	0.30	4.91
	(17.98)	(21.53)	(14.07)	(12.88)	(24.10)	(3.35)	(1.09)	(9.74)
Spanish	4.38	6.81	2.54	0	0	7.91	11.14	2.68
	(8.83)	(11.67)	(5.11)	(.)	(.)	(10.65)	(11.09)	(5.51)
Total AIS	7.28	10.36	4.96	4.80	15.38	0.88	0.30	4.36
	(19.55)	(22.19)	(16.93)	(9.70)	(27.82)	(2.72)	(1.09)	(12.31)
Citations	121.53	169.86	85.03	59.54	269.68	8.76	0.48	19.69
	(421.15)	(468.43)	(377.51)	(158.44)	(618.98)	(29.26)	(5.70)	(80.25)
PhD students	1.00	2.00	0.24	0.83	1.45	0.66	0.61	0.75
	(2.11)	(2.75)	(0.88)	(1.61)	(2.60)	(1.58)	(1.63)	(1.27)
PhD committees	3.61	7.23	0.88	2.40	4.81	2.67	3.04	1.94
	(6.76)	(8.65)	(2.55)	(4.42)	(8.21)	(4.99)	(5.99)	(2.80)
Observations	31,243	13,444	17,799	4,783	12,858	4,597	9,005	31,243
Number of individuals	16,569	6,538	10,031	2,550	6,741	2,392	5,202	16,569

Notes: Mean values. Standard deviations in parentheses. Columns 1–7 provide information on candidates' individual characteristics at the time of the examination, except citations, which refers to the number of citations to publications published before the examination by July 2012. Column 8 provides information on candidates' productivity during the five-year period following the examination. FP exams and AP exams stand for exams for Full Professor and Associate Professor positions respectively. Total AIS is the sum of the Article Influence Score of candidate's international publications.

At the time of the exam, the average candidate had around 13 publications, including 8 articles published in international journals (ISI Web of Science journals) and 4 publications in Spanish journals. We use Article Influence Score (AIS) to measure the quality of international publications.[10] We compute the variable *Total AIS* as

[10] This indicator has several advantages over other indicators of journal quality, such as journal Impact Factor or simple citation count. AIS excludes journal self-citations, it adjusts for the differences across fields in the propensity

the sum of the AIS of all the international publications of a given author. We also observe the total number of citations received by each candidate as of July 2012 in ISI Web of Science. The average candidate had received around 120 citations. The *Total AIS* and the number of citations received is twice as large among candidates to Full Professor positions than among candidates to Associate Professor positions, and it is also relatively larger in Sciences. On average, candidates had advised one doctoral student, and they had participated in four PhD thesis committees.

Columns 2 and 3 provide information disaggregated by type of exam (FP and AP). There were 13,444 applications for positions as FP, and 17,799 applications for positions as AP. Candidates for AP positions were nine years younger than candidates for FP positions and the share of women among AP candidates was significantly larger (40 percent versus 27 percent). Candidates for FP positions had published twice as many articles as candidates for AP positions. The quality of their publications was roughly similar. Applicants for FP positions had on average advised two students, and had participated in seven dissertation committees, whereas applicants to AP positions had not yet actively participated in the direction of doctoral students, and only a few of them have taken part in PhD committees.

Columns 4–7 report candidates' characteristics in four broadly defined groups of disciplines: Engineering, Sciences, Social Sciences, and Humanities and Law. Humanities and Law is the most feminized disciplinary group, with almost half of the candidates being women. The least feminized field is Engineering, where there is only one female candidate for every four male candidates. The most prolific authors are in Sciences, with a total of 17 publications, followed by Humanities and Law (11), Social Sciences (9), and Engineering (8). There are significant differences in terms of the type of research output that is produced in each field. In Sciences and Engineering articles are typically published in international journals, while in Humanities and Law and Social Sciences candidates tend to publish in Spanish journals.

C. *Links between Candidates and Evaluators*

As Granovetter (1973) points out, the strength of an interpersonal tie is related to "the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie." We consider several groups of connections between candidates and evaluators according to their strength (Table 3, column 1). First, we focus on the *strong* academic connections: those found between advisors and students, between coauthors, and between colleagues. Approximately 3 percent of applicants were evaluated by a committee that included their thesis advisor, 5 percent by coauthors, and 30 percent by colleagues (Table 3, column 1).[11]

to cite, and it weighs citations according to the importance of citing journals. Thompson Reuters does not produce journal citation reports for journals in the Art and Humanities citation index, so AIS is unavailable in these fields. Therefore, in Humanities and Law we assume the AIS of all journals to be equal to one, which is by definition the average AIS of journals included in the ISI journal citation report.

[11] Unfortunately, we are unable to observe the affiliation of candidates for AP positions at the time of the exam and thus we only observe the institution where they obtained their PhD. Given the low geographical mobility of Spanish professors at this stage, it seems reasonable to assume that the large majority of candidates for AP positions were still based in their alma mater at the time of the evaluation (Cruz-Castro, Sanz-Menéndez, and Valle 2006).

Table 3—Descriptive Statistics—Connections

	All (1)	FP exams (2)	AP exams (3)
Strong tie	32	35	29
PhD advisor	3	3	3
Coauthor	5	8	3
Colleague	30	32	28
Weak tie	19	34	7
PhD thesis committee member	7	9	5
Link by invitation	4	9	1
Same PhD thesis committee	12	25	2
Indirect tie	15	17	14
Same PhD advisor	0.3	0.3	0.2
Same coauthor	6	8	5
Same PhD thesis committee member	10	10	10
Observations	31,243	13,444	17,799

Notes: The table shows the percentage of candidates who have at least one connection of a given type in the evaluation committee. Only the strongest type of connection between an evaluator and a candidate has been considered.

Overall, one third of applicants had a strong link in the committee. The presence of coauthors and colleagues in committees is slightly larger in exams for FP positions (columns 2 and 3).

We also consider weaker links between candidates and evaluators who do not have a strong connection, based on their participation in the same PhD thesis committee. We observe several types of interactions:

- the evaluator was a member of candidate's thesis committee,
- the evaluator had invited the candidate to sit on the thesis committee of one of her students (or vice versa), and
- the evaluator and the candidate were members of the same thesis committee.

We designate these links *weak* ties. Weak links affect 19 percent of candidates and are more frequent in exams for FP positions, where approximately 34 percent of candidates are evaluated by a weak link, than in exams for AP positions, where only 7 percent of candidates have a weak tie with a committee member.

Finally, we define several indicators of indirect links between candidates and evaluators: the evaluator and the candidate had either a common advisor, a common coauthor, or a common thesis committee member. To stress that these links do not necessarily imply professional interaction or awareness of each other's research, we designate them *indirect* ties. These indirect ties affect every sixth candidate.

D. *Future Performance*

We measure the future performance of candidates in two different ways. Firstly, we have gathered information on productivity indicators during the five years following the examination (Table 2, column 8). During this period the average candidate had published 8 publications, mostly in international journals, which received around 20 citations by July 2012. Candidates also advised one PhD student and participated in two PhD thesis committees. Additionally, for the sample of candidates who qualified for an AP position, we have collected information on their performance in centralized evaluations for FP positions up to September 2013. About 11 percent of these candidates managed to qualify.

IV. Empirical Analysis

The conceptual framework proposed above relies on two main assumptions. First, that only a few exceptional candidates can be promoted. This is consistent with the centralized selection exams that we study here in which there was approximately one position for every ten candidates. Second, the model assumes that connections are not related to the quality of the candidates. Below, we show how we can exploit the system of random assignment of evaluators to committees in order to identify exogenous variations in the availability of connections in committees that are orthogonal to candidates' (observable and unobservable) productivity measures. Then, we study how connections affect candidates' chances of success and, building on the testable implications provided by the conceptual framework, we investigate their overall efficiency.

A. *Random Assignment*

Connected candidates may in principle differ from other candidates in terms of their quality. We estimate empirically the relationship between the availability of connections in the committee and several productivity indicators that were predetermined at the time of the evaluation: the number of publications, the *total AIS*, the number of doctoral students advised, and participation in doctoral thesis committees. Additionally, we also consider the number of citations that candidate's publications published prior to the evaluation had received by 2012. In order to account for differences across disciplines in research output, here and in what follows we normalize research productivity measures to have mean zero and unit standard deviation for candidates in the same exam.

As shown in the upper panel of Table 4, candidates with a strong connection in the committee tend to be more cited, but they advise fewer PhD students. Candidates who are linked with an evaluator through a weak tie tend to publish more, to advise more students, and to participate in more PhD committees. Applicants with indirect links are more productive in terms of the number of publications, citations, and the quality of the journals where they publish.

Connections are associated with observable measures of productivity and, perhaps, they might also be correlated with some dimensions of quality that are unobservable to the econometrician. To avoid this problem, in what follows we consider groups of candidates that have the same number of connections in the pool of eligible evaluators. If the assignment of evaluators to committees was indeed random, there should not be any relationship between the number of connections

Table 4—Random Assignment

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

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

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

that these candidates eventually have in the evaluation committee and their predetermined characteristics.[12]

We test this hypothesis using the following equation, which describes the relationship between candidates' predetermined quality indicators and actual committee composition, conditional on the expected one:

$$x_{ie} = \alpha + \mathbf{C}_{ie}\boldsymbol{\beta} + \mathbf{D}_{ie}\boldsymbol{\gamma} + \epsilon_{ie}, \tag{4}$$

where x_{ie} represents candidate i's observable quality at the time of his participation in exam e, $\mathbf{C}_{ie}$ measures the number of connections of each type—strong, weak, and indirect ties—that candidate i has in the evaluation committee. $\mathbf{D}_{ie}$ includes three sets of dummies for the expected number of connections of each type in the committee. The Appendix provides detailed information about how the expected committee composition was computed. Overall, there are 775 dummies: 289 for

[12] Note that the number of citations received by candidate's publications published prior to the evaluation is measured in July 2012 and, therefore, it is not strictly predetermined. Unfortunately, we cannot observe the number of citations that had been received at the time of the evaluation. Potentially, it might be that due to the existence of a Matthew effect, promotion increases the number of citations received (Azoulay, Stuart, and Wang 2014). Our results suggest that this is not the case.

the expected number of strong ties, 280 for the expected number of weak ties, and 206 for the expected number of indirect ties. We measure committee composition using the outcome of the initial random draw, which might be slightly different from the committee composition that ends up evaluating candidates (2 percent of committee members resigned). Therefore, our estimates provide the intention-to-treat effect.[13]

We estimate equation (4) using the ordinary least squares (OLS) method and, as expected, we observe no significant relationship between the different types of connections that candidates have in the committee and any productivity indicator at the time of the evaluation (Table 4, lower panel, columns 1–5).

B. *Are Connected Candidates More Successful?*

In general, evaluators are expected to have better information about the quality of acquainted candidates. Added to this is the possibility that they may be biased in favor of these candidates. If connected evaluators are better informed and/or biased, the presence of a connection in the committee is expected to increase candidates' chances of success (Proposition 1).

Below we explore this implication of the model. We estimate a model analogous to equation (4), using now as dependent variable a dummy that indicates whether individual i qualified in exam e.

In this case, the vector of coefficients $\boldsymbol{\beta}$ identifies the causal effect of connections under the assumption that, conditional on the expected number of connections ($\mathbf{D}_{ie}$), variations in the actual composition of the committee ($\mathbf{C}_{ie}$) are uncorrelated with any factor that might affect promotion decisions. As shown above, this assumption is supported by the data. We compute robust standard errors clustered at the exam level in order to account for common shocks within the same exam and also for the existence of heteroskedasticity.

OLS estimates are reported in Table 5, column 1.[14] The presence of an acquainted evaluator in the committee has a significant positive effect on candidates' chances of success. This effect increases according to the strength of the connection, suggesting that strong connections (an advisor, a coauthor, or a colleague) are potentially either better informed and/or more biased. The presence of a strong connection in the committee leads to a 6 percentage points increase in the applicants' likelihood of success. This is approximately equivalent to a 50 percent increase in the candidates' chances of success (about 11 percent of candidates are promoted). Weak connections have a smaller but also significant positive effect (2 percentage points, or roughly a 20 percent increase). Indirect connections have no significant effect. In columns 2 and 3 we present estimation results separately for exams for AP positions and for FP positions. The effect of weak and strong connections is relatively stronger in exams for AP positions, suggesting that information asymmetries and/or biases are more important at earlier stages of the academic career.

[13] All results, available upon request, are essentially identical if we instrument the final composition of committees using the initial random draw.

[14] Results, available upon request, are almost identical if we use instead a probit model.

Table 5—The Effect of Connections on Candidates' Success

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

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

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

To check for the robustness of these results, we estimate the model for the subsample of candidates who obtained their PhD in Spain (column 4), and for the subsample of candidates with surnames that are less frequent than the median surname (column 5). The former check is meant to address the potential existence of unobserved connections by candidates who defended their doctoral thesis abroad. The later check deals with a potential measurement error induced by homonymity. (This might create an attenuation bias in our estimates for variables based on publications data, such as coauthors.) In both cases, the estimated coefficients are almost identical to the ones obtained for the whole sample.

In order to get a better understanding of the magnitude of the effect of connections, we examine the impact of a number of observable individual characteristics that stand as a proxy for candidates' quality. In particular, we control for the number of publications, the quality of these publications (as measured by journals' AIS), the number of PhD students advised, and the number of participations in PhD thesis committees. We also include indicators for age, participation in previous examinations, and for the number of fields where the candidate applies. As expected, there is no change in the impact of connections. The effect of observable research quality is commensurate with the effect of strong connections. Candidates who score one standard deviation more than average in each one of these four observable dimensions of research quality have approximately 7 percentage points higher chances of success (column 6).

Finally, given that many individuals participated in several examinations, we compare the evaluations given to the same individual by different promotion committees. Note that this fixed effects specification identifies the impact of connections for a specific set of candidates. It only takes into account information from individuals who participated several times in examinations, excluding relatively good candidates who managed to be promoted in their first trial, as well as candidates who failed and for some reason decided not to reapply. As a result, the sample size decreases from 31,243 observations to 22,292 observations. This empirical strategy is also less efficient, since it does not exploit all the available information. Nevertheless, the estimates are qualitatively similar to the baseline estimation.

C. *The Quality of Candidates Promoted by a Connection in Publicly Observable Dimensions*

If evaluators are better informed about the quality of acquainted candidates and/or they are biased, candidates promoted by a connected evaluator are expected to exhibit at the time of the evaluation a relatively worse record in the publicly observable dimension (Proposition 2).

Here we restrict our sample to promoted candidates only, and we estimate equation (4) using as a dependent variable several measures of candidates' productivity, which were observable at the time of the evaluation. We include controls for candidates' age in order to account for potential differences in career length. As is shown in the upper panel of Table 6, candidates who were promoted by a strong connection tend to have lower research productivity at the time of the evaluation. They have published fewer publications than other promoted candidates (a difference of 7 percent of a standard deviation), although this difference is only marginally significant (column 1). The gap is slightly larger and is significant at the 5 percent level if we consider the quality of the journals where these articles were published, as measured by the AIS (column 2).[15] The number of doctoral students and the participation in PhD thesis committees is also lower, but the difference is not significant at standard levels (columns 3 and 4). The pattern is very similar for candidates that were promoted by a weak link, although in this case standard errors tend to be slightly larger, and estimates are not statistically significant at standard levels. We do not observe any significant difference in the quality of candidates who were promoted by a committee including an indirect tie, and promoted candidates who had no direct or indirect connections in the committee.

In column 5 we consider as dependent variable the number of citations received by candidates' publications. In this case the theoretical prediction is ambiguous, and it depends on the information that was available at the time of the evaluation.

[15] In the first stage of the exam candidates present their CVs, including a list of their publications, the number of students advised, and participation in PhD thesis committees. Information about the AIS of journals was not explicitly provided, but it is expected to be highly correlated with evaluators' prior knowledge about the quality of journals. More precise information, such as the number of citations received by each article, was not typically provided.

Table 6—Quality of Promoted Candidates

Dep. var.:	Publications (1)	Total AIS (2)	PhD students (3)	PhD committees (4)	Citations (5)	Peer review (6)
Pre-exam quality						
Strong ties	−0.068*	−0.080**	−0.012	−0.036	−0.050	
	(0.035)	(0.036)	(0.035)	(0.030)	(0.036)	
Weak ties	−0.063	−0.073*	−0.054	0.002	−0.077*	
	(0.043)	(0.043)	(0.042)	(0.044)	(0.039)	
Indirect ties	0.016	0.100	−0.009	0.032	0.046	
	(0.053)	(0.065)	(0.047)	(0.049)	(0.057)	
Post-exam quality, conditional on pre-exam quality						
Strong ties	−0.053*	−0.071**	−0.080**	−0.066*	−0.068**	−0.028**
	(0.028)	(0.030)	(0.035)	(0.036)	(0.028)	(0.014)
Weak ties	−0.003	0.048	0.033	0.047	0.011	0.058**
	(0.031)	(0.039)	(0.042)	(0.044)	(0.036)	(0.027)
Indirect ties	0.001	−0.025	−0.019	−0.021	0.011	−0.024
	(0.041)	(0.048)	(0.051)	(0.053)	(0.049)	(0.020)
Post-exam quality (unconditional)						
Strong ties	−0.097***	−0.115***	−0.093**	−0.083**	−0.102***	−0.032**
	(0.035)	(0.037)	(0.037)	(0.039)	(0.032)	(0.014)
Weak ties	−0.045	0.008	0.016	0.042	−0.022	0.052*
	(0.043)	(0.046)	(0.044)	(0.048)	(0.041)	(0.028)
Indirect ties	0.013	0.018	−0.012	−0.009	0.043	−0.018
	(0.056)	(0.061)	(0.053)	(0.058)	(0.056)	(0.020)
Observations	3,573	3,573	3,573	3,573	3,573	2,127

Notes: OLS estimates. Standard errors clustered by exam in parentheses. The sample includes all successful candidates in columns 1–5 and candidates that qualified for an AP position in column 6. *Peer review* is an indicator variable that takes value one if a candidate who qualified for an AP position between 2002 and 2006 qualifies for a Full Professor position by September 2013. In the upper panel, the dependent variables are measured at the time of the exam. In the middle and lower panels, quality measures refer to the five-year period following the exam. In the middle panel, regressions include as controls the quality indicators which were measured at the time of the examination. All regressions include indicators for candidates' age and the number of expected connections of each type. Regressions reported in column 6 include also controls for the year of promotion to AP.

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

If all evaluators were aware of the quality of candidates' past publications, as represented by citations, better informed evaluators are expected to select candidates with a relatively lower number of citations but who excel in some other dimension (for instance, their contribution to each publication). Otherwise, if it was only the connected evaluators who were able to observe the quality of candidates' past publications, then connected evaluators are expected to promote candidates with a relatively better citation record. If anything, the evidence is consistent with the former hypothesis. The relationship between citations and connections is negative, although this effect is not significant at standard levels.

D. *Are Connections Efficient?*

Connected candidates are more likely to be promoted and, compared to other promoted candidates, they tend to have a worse academic record at the time of the evaluation. This evidence is consistent both with evaluators being better informed about the quality of direct connections and evaluators being biased in their favor. Proposition 3 suggests a way to disentangle the bias from information asymmetries. An informed evaluator is expected to promote candidates who are worse in dimensions that all evaluators observe, but excel in dimensions that uninformed evaluators cannot observe accurately. On the contrary, a biased evaluator promotes candidates who are relatively worse in every dimension, observable or not.

We test Proposition 3 using information on future performance. Informed evaluators are expected to predict future performance more accurately. Naturally, some aspects of candidates' quality might not necessarily become public knowledge over time, at least in the short term. In this sense, this empirical strategy might underestimate the relevance of information asymmetries.

We measure future performance in two different ways. First, we look at indicators of research productivity during the five-year period following the exam. Second, we also analyze candidates' future performance in peer evaluations. In particular, for the subset of candidates promoted to AP positions, we consider whether they manage to qualify for a FP position in the future. Relative to productivity indicators, a potential advantage of this measure is that it might capture information asymmetries in other dimensions other than research, such as professional service. Using the sample of promoted candidates, we estimate the following model:

$$x_{ie}^{future} = \alpha + \mathbf{C}_{ie}\boldsymbol{\beta} + \mathbf{D}_{ie}\gamma + \mathbf{X}_{ie}\boldsymbol{\lambda} + \epsilon_{ie}, \tag{5}$$

where x_{ie}^{future} is a measure of candidate i's future performance and $\mathbf{X}_{ie}$ is a set of productivity indicators that were observable at the time of the exam. $\boldsymbol{\beta}$ captures the difference in the future productivity of candidates promoted by a connection relative to other promoted candidates, conditional on the information that was publicly available at the time of the exam.

An important assumption is that future performance reflects candidates' true quality, but it is not directly affected by the composition of the evaluation committee, other than through its effect on promotion. Promotions might have a direct effect on candidates' future performance, but we are assuming that this effect is similar for promoted candidates of similar initial quality, independently of the composition of the corresponding evaluation committee. For instance, this assumption would not be satisfied if candidates evaluated by an acquainted committee changed their views on the role of meritocracy in academic careers, thus affecting their future effort. Unfortunately, we cannot directly test this assumption. In what follows, we assume that candidates were aware of the random nature of committee composition and they were able to observe the role of connections independently of whether they themselves had a connection in the committee.

Conditional on their past research production, candidates promoted by a strong connection turn out to be less productive in the future in every observable dimension: number of publications, the quality of the journals where they publish, the number of students advised, their participation in PhD committees, and the number of citations received (Table 6, middle panel, columns 1–5).

We also estimate equation (6) without controlling for past research indicators. Not surprisingly, candidates promoted by a strong connection are also significantly worse in terms of their future unconditional performance (Table 6, lower panel). If anything, the negative impact of strong connections is slightly larger, reflecting the fact that candidates promoted by a strong connection already had lower research productivity at the moment of the evaluation. On average, their research production during the five years that follow the promotion is about 10 percent of a standard deviation lower in every dimension relative to other promoted candidates (columns 1–5). They are also significantly less likely to qualify in the future for a new promotion (column 6). This evidence is consistent with the existence of a subjective bias in favor of strong connections, which overshadows the potential existence of information asymmetries. Alternatively, the behavior of strong connections might be explained by the existence of information asymmetries in some unknown dimension, which is unobservable to unconnected evaluators and to the econometrician, and which does not become observable over time. However, the importance of this unknown dimension and the scale of information asymmetries would have to be (perhaps unrealistically) large in order to fully explain the observed premium associated with strong connections.

The picture is different in the case of candidates promoted by a weak tie. Their future research production is not significantly different relative to other promoted candidates and, if anything, the point estimates tend to be positive (Table 6, middle panel). Moreover, these candidates are significantly more likely to qualify for a promotion in the future (column 6). This evidence is consistent with a situation whereby evaluators take advantage of their superior information about the quality of weakly connected candidates. These candidates seem to be better in dimensions that initially were not observable by all evaluators but which, somehow, became visible to the members of future selection committees over time.

V. Conclusions

The process involved in selecting evaluators is subject to a well-known dilemma. Evaluators who are acquainted with candidates may have superior information about the quality of these candidates. Unfortunately, the criteria of these evaluators might also be biased. In this paper, we address this dilemma by analyzing the role of connections in the context of academic promotions in Spain. We focus on the period between 2002 and 2006, when a system of centralized evaluations was in place that assigned evaluators at random to committees.

During this period, one-third of candidates were evaluated by a committee that included a strong connection such as their thesis advisor, a coauthor, or a colleague. The (random) presence of these connections in the committee increase by 50 percent the chances of success of candidates. We also find that these candidates are less productive both before and after the evaluation relative to other promoted candidates. One-fifth of candidates were evaluated by a weak link, such as an evaluator who had participated in their thesis committee. These candidates have a 20 percent higher chances of success. They turn out to be equally productive in the five-year period following the evaluation relative to other promoted candidates, and they are more likely to succeed in future peer evaluations. Finally, one in six candidates was evaluated by an evaluator with whom the candidate shared some common link, such as a common coauthor. Apparently, these links have no impact on the selection process.

Our preferred interpretation of the empirical evidence is that candidates with a strong connection may have enjoyed preferential treatment, which overshadows the potential informational advantages of strong links. An alternative interpretation is that candidates promoted by strong connections excel in dimensions that are not observable by other evaluators or by the econometrician, neither at the time of the evaluation nor in the following years. While it is impossible to rule out this hypothesis, it seems unlikely that such information asymmetries can fully explain the large premium associated with strong connections.[16] In contrast, the informational content of weak ties is at least as strong as the potential evaluation bias. In sum, the evidence suggests that the balance between the positive informational effect of connections and the existence of evaluation biases varies according to the strength of connections. Weakly connected evaluators seem to be better informed about candidates' quality than evaluators who had no previous contact with candidates or who only had some indirect tie. Moreover, they appear to be less biased than strongly connected evaluators.

According to our findings, conflict of interest rules affecting strong links should be implemented in the evaluation process. At the same time, the presence of external evaluators who are acquainted with the candidate but who are not his thesis advisor, a coauthor, or a colleague may improve the efficiency of the selection process. Our results also indicate that optimal distance may vary depending on the institutional framework. For instance, while Laband and Piette (1994) and Brogaard, Engelberg, and Parsons (2014) argue that, within the world of academic journals, editors use personal associations with colleagues in their departments in order to improve selection decisions, we show that in the setting of Spanish academia, the presence of colleagues in promotion committees tends to decrease the research quality of promoted candidates.

Finally, our work also contributes to the debate over how higher education should be organized in continental Europe. The analysis of Aghion et al. (2010) suggests that a combination of competition and autonomy would make European universities more productive. According to this view, Europe needs to move from a system of rules to one of incentives, whereby it is in the self-interest of universities to appoint and promote the most productive individuals (Perotti 2002). Our analysis does not provide a definitive answer as to which of these alternatives, more rules or incentives, would yield better outcomes. Nevertheless, it illustrates the limitations of a centralized selection system where evaluators (and universities) do not internalize the consequences of their decisions.

[16] According to a survey completed by 1,294 eligible evaluators, the most important factors for promotion decisions were research indicators such as the number of publications in journals covered by ISI Web of Science and the quality of these publications (Sierra et al. 2009).

Appendices

A. *Expected Committee Composition*

In exams for FP positions, the expected number of connections in the committee is essentially equal to the proportion of connections in the pool of eligible FPs times seven (as there are seven evaluators in the committee). The calculation procedure is slightly more complicated when the pool of eligible evaluators contains two or more researchers from the Spanish Research Council (CSIC), or two or more emeritus professor. As explained in footnote 8, the random assignment of evaluators to committees was subject to a constraint: every committee could include at most one researcher from the Spanish Research Council (CSIC) and one emeritus professor. When a second individual in one of these categories was drawn, the draw was not considered. Therefore, in these cases the expected number of connections in the committee should be computed to allow for this constraint. This affects 387 of 967 exams.

First, we compute the probability that at least one researcher is drawn from the pool, p_R, and the probability that at least one emeritus professor is drawn, p_E. For FP exams these probabilities are:

$$p_R = 1 - \frac{\binom{R}{0}\binom{P+E}{7-0}}{\binom{P+E+R}{7}}, \quad p_E = 1 - \frac{\binom{E}{0}\binom{P+R}{7-0}}{\binom{P+E+R}{7}},$$

where R is the number of researchers in the pool, E is the number of emeritus professors and P is the number of eligible professors who are not emeritus. Once these probabilities are computed, it is possible to calculate for each candidate the expected number of connections in the committee:

$$\mu = p_R p_E(c_R + c_E + 5c_P) + p_E(1 - p_R)(c_E + 6c_P)$$
$$+ p_R(1 - p_E)(c_R + 6c_P) + (1 - p_R)(1 - p_E)7c_P,$$

where c_j indicates the number of connections in group j and $j \in \{R, E, P\}$.

In AP exams, three evaluators are drawn from the pool of eligible FPs and four evaluators are drawn from the pool of eligible APs. The expected number of connections in the committee is generally equal to the proportion of connections among FPs times three plus the proportion of connections among APs times four. Again, in order to take into account the constraint on the randomization, analogously to the case of FP exams, we compute the probability that at least one researcher and at least one emeritus professor is drawn from each pool: p_R^{FP}, p_E^{FP}, p_R^{AP}, and p_E^{AP}.

Then we compute the expected number of connections in the committee using the following formula:

$$\begin{aligned}
\mu = {} & \Big[p_R^{FP} p_E^{FP}\big(c_R^{FP} + c_E^{FP} + c_P^{FP}\big) + p_E^{FP}\big(1 - p_R^{FP}\big)\big(c_E^{FP} + 2c_P^{FP}\big) \\
& \quad + p_R^{FP}\big(1 - p_E^{FP}\big)\big(c_R^{FP} + 2c_P^{FP}\big) + \big(1 - p_R^{FP}\big)\big(1 - p_E^{FP}\big)3c_P^{FP}\Big] \\
& + \Big[\big(1 - p_R^{FP}\big)\big(1 - p_E^{FP}\big)\Big[p_R^{AP} p_E^{AP}\big(c_R^{AP} + c_E^{AP} + 2c_P^{AP}\big) \\
& \qquad + p_E^{AP}\big(1 - p_R^{AP}\big)\big(c_E^{AP} + 3c_P^{AP}\big) \\
& \qquad + p_R^{AP}\big(1 - p_E^{AP}\big)\big(c_R^{AP} + 3c_P^{AP}\big) \\
& \qquad + \big(1 - p_R^{AP}\big)\big(1 - p_E^{AP}\big)4c_P^{AP}\Big] \\
& \quad + p_R^{FP}\big(1 - p_E^{FP}\big)\Big[p_E^{AP}\big(c_E^{AP} + 3c_P^{AP}\big) + \big(1 - p_E^{AP}\big)4c_P^{AP}\Big] \\
& \quad + p_E^{FP}\big(1 - p_R^{FP}\big)\Big[p_R^{AP}\big(c_R^{AP} + 3c_P^{AP}\big) + \big(1 - p_R^{AP}\big)4c_P^{AP}\Big] \\
& \quad + p_E^{FP} p_R^{FP} 4c_P^{AP}\Big],
\end{aligned}$$

where c_j^k is the proportion of connections in the pool of $k \in \{FP, AP\}$ professors in group $j \in \{R, E, P\}$.

In our empirical analysis we round these measures to the nearest second digit. For instance, if an applicant for a position of FP has one advisor within a set of 45 eligible evaluators (and there are not more than one researcher or emeritus professor), the expected number of advisors in the seven-member committee is equal to 0.16 ($7 \times 1/45$).

B. *Data*

We collected information from several different sources:

- information on the centralized selection process from the Ministry of Science and Innovation (years 2002–2006) and the Official State Bulletin (years 2006–2013),
- individual research production in international journals from ISI-Thomson Reuters Web of Science,
- information on journal and book publications in Spain from University of Rioja Dialnet database, and
- information on doctoral dissertations from the Database on Doctoral Theses (TESEO). Below we describe the process of data collection in detail.

Centralized Selection Process.—The centralized selection process known as habilitación was in place between 2002 and 2006. Information on candidates' and evaluators' first name, last name, and national ID number was retrieved from the website of the Ministry of Science and Innovation in July 2009 (http://www.micinn.es). In total, 1,016 exams took place, around 5 per discipline. We restrict the sample in several ways. We exclude exams where the number of available positions was larger than or equal to the number of candidates (2 exams in Basque Literatue and 1 exam in Textile and Paper Engineering) and disciplines where the number of potential evaluators was not big enough to form a committee (46 exams). In theses cases, unfilled seats in the committee were filled with professors from related disciplines. The final database includes 967 exams.

The actual age of individuals is not observable. Instead, we exploit the fact that Spanish ID numbers contain information on their issue date to construct a proxy for the age of native individuals on the basis of their national ID numbers. In Spain, police stations are given a range of numbers that they then assign to individuals in a sequential manner. Since it is compulsory for all Spaniards to have an ID number by age 14, two Spaniards with similar ID numbers are likely to be of the same age (and geographical origin).[17] In order to perform the assignment, we first use registry information on the date of birth and ID numbers of 1.8 million individuals in order to create a correspondence table which assigns year of birth to the first four digits of ID number (ranges of 10,000 numbers). To test the precision of this correspondence, we apply it to a publicly available list of 3,000 court secretaries, which contains both the ID number and the date of birth. In 95 percent of the cases the assigned age is within a three year-interval of the actual age. In order to minimize potential errors, whenever our age proxy indicated that a candidate for a position of Associate Professor is less than 27 years old, and a candidate to Full Professor positions is less than 35 years old, we assign age a missing value (around 5 percent of the sample). The choice of these thresholds is based on survey information, according to which the minimum age for promotion to Associate Professor and Full Professor positions granted in Spain before 2002 is 27 and 35 respectively (Cruz-Castro, Sanz-Menéndez, and Valle 2006). Our proxy of age is not defined for non-Spaniards (less than 1 percent of the sample). We imputed the missing information on age by assuming that individuals, for whom the age proxy is missing, have the same age as an average individual of the same academic rank in the same discipline.

The Ministry of Science and Innovation provides information on affiliation for eligible evaluators. Given that most candidates for positions of Full Professor are themselves eligible evaluators in exams for positions of Associate Professor, it is possible to obtain their affiliation by matching the list of eligible evaluators with the list of candidates. Using this procedure, we were able to obtain the information regarding the affiliation of 93 percent of candidates to Full Professor positions. Information on affiliation at the time of the examination for the remaining 7 percent

[17] There are a number of exceptions. For instance, this methodology will fail to identify the age of individuals who obtained their nationality when they were older than 14. Still, immigration was a very rare phenomenon in Spain until the late 1990s. Additionally, some individuals may have obtained their ID number before they were 14. This may particularly be the case after Spain entered the Schengen zone in the mid-1990s, when IDs became valid travel documentation for a number of European countries. However, individuals born around the time that the Schengen zone was created were generally too young to participate in the public examinations performed during 2002–2006.

of candidates was obtained from the State Official Bulletin or directly from professors' CVs.

In 2006 the system of habilitación was replaced by a system known as acreditación, which is still in place. Under the acreditación system, applicants aspiring for promotion are also required to be approved by a national review committee. These committees evaluate candidacies on a monthly basis and their decisions are published in the Official State Bulletin. We collected information on the identity of all candidates that qualified for a FP position before September 2013.

ISI-Thomson Reuters Web of Science.—The ISI-Thomson Reuters Web of Science (WoS) database includes over 10,000 high-impact journals in Science, Engineering, Medicine, and Social Sciences, as well as international proceedings that cover over 110,000 conferences.[18] Out of these 10,000 journals, approximately 200 are edited in Spain. For the purpose of this analysis, we considered all articles, reviews, notes, and proceedings produced by Spanish-based authors since 1975.

The assignment of articles to professors is nontrivial. For each publication and author, the WoS provides information on the surname and on the initial (or, in some cases, initials). Problems with homonymity may arise in the case of common surnames (i.e., García, Fernández, or González). Moreover, unlike most countries, individuals in Spain typically use two surnames (paternal and maternal) and sometimes also a middle name. A paper authored by a Spanish author may include only the paternal or the maternal surname, or both surnames hyphenated. Further, Spanish authors may sign using their first name, their middle name, or both. We use the following matching procedure in order to identify authors. First, we create a correspondence table between the 240 scientific areas used by ISI to classify publications and the 190 scientific disciplines used by the Ministry of Science and Innovation in order to classify professors. For this purpose, we select a subsample of eligible evaluators and candidates with relatively uncommon surnames and, using information on their surnames and initials, we match them with ISI publications that have Spanish affiliations. We keep the subsample of publications that obtain a unique match in our list of Spanish professors. This subsample includes 72,000 publications. It is this subsample that we use to create a correspondence table between ISI scientific areas and Spanish scientific disciplines. Specifically, we assign the ISI area to a given discipline if the proportion of publications in the ISI area by professors from the discipline exceeds 1 percent of the total number of publications in the discipline and the proportion of publications in the discipline exceeds 1 percent of the total number of publications in the ISI area. The resulting correspondence table, available upon request, allows matching publications in ISI areas to the scientific areas defined by the Ministry of Science and Innovation. On average, we assign nine ISI areas to each discipline. Finally, using this correspondence table, we merge the ISI publication data with the full list of professors using information on surnames, initials, and discipline. We dropped observations that, given the matching criteria, were assigned to more than one possible match. Altogether, we assign 50 percent

[18] We are grateful to the Fundación Española para la Ciencia y la Tecnología (FECyT) for providing us with the access to the data.

of all ISI publications with Spanish-based authors to evaluators and candidates in our database.

Citations of publications are observed in July 2012. Some of these citations might have been received after the exams considered in this paper took place. We have also collected information of journals' Article Influence Score (AIS) from ISI journal citation reports in year 2007. AIS is not available for the Arts and Humanities Citation index. Therefore, in Humanities and Law we assume the AIS of all journals to be equal to one, which is by definition the average AIS of journals included in the ISI journal citation report.

Dialnet.—Dialnet (http://dialnet.unirioja.es) is an open access bibliographic index created by the University of Rioja. It contains information on more than 8,000 journals and more than 3.5 million documents in Hispanic languages, including articles published in scientific journals, collective works, and books. The database mainly covers publications in social sciences and humanities. Dialnet provides (in most cases) systematized information on individual authors' first name, paternal surname, maternal surname, and affiliation, thus limiting potential concerns about homonymity.

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

TESEO Database on Doctoral Dissertations.—Established by the Ministry of Education in 1977, the TESEO database is a register of all doctoral dissertations completed in Spain. TESEO provides the identity and affiliation of dissertations' authors, advisors, and committee members. We observe 151,483 such dissertations, retrieving all the information available in this database from the website https://www.educacion.gob.es/teseo in May 2011.

We have been able to locate the dissertation of 80 percent of candidates. Missing information may be due to the fact that

- individuals did their PhD abroad,
- individuals defended their dissertation before 1977,
- there are spelling mistakes,
- there was a homonymity problem (0.1 percent of individuals share the same name, middle name, paternal surname, and maternal surname), or
- the dissertation was not included in TESEO for unknown reasons.

While registration is compulsory, according to Fuentes Pujol and Arguimbau Vivó (2010), TESEO does not include information on approximately 10 percent of all dissertations read in Spain. We use dissertation information to identify the candidates' alma mater.

Connections.—We define different types of connections between candidates and evaluators. First, we consider *strong* professional connections (c_1) that imply close interaction: the relationships between advisor-student, coauthors, and colleagues. These three types of connections are closely intertwined in Spain: around 40 percent of individuals have coauthored a paper with their advisor; around 60 percent of coauthors are based in the same university as the candidate; and in 85 percent of the cases the PhD advisor is also based in the same university as the candidate. Unfortunately, we are unable to observe the affiliation of candidates to AP positions at the time of the exam, and as such we only observe the institution where they obtained their PhD. In this case we consider that the evaluator and the candidate have an institutional connection if the candidate obtained his PhD from the university where the evaluator is based. Given the low geographical mobility of Spanish professors at this stage of the careers (Cruz-Castro, Sanz-Menéndez, and Valle 2006), it seems reasonable to assume that the large majority of candidates for AP positions were still based in their alma mater at the time of the evaluation. Second, we identify a number of *weak* ties (c_2) between candidates and evaluators: where the evaluator was a member of the candidate's thesis committee; the evaluator had invited the candidate to sit on the thesis committee of one of her students (or vice versa); or the evaluator and the candidate sat on the same thesis committee. Finally, we identify several *indirect* ties (c_3) between candidates and evaluators: where the evaluator and the candidate have either a common advisor, a common thesis committee member, or a common coauthor.

We attribute only one type of connection to a given pair of individuals, following the priority order introduced above. Specifically, we apply the following transformation:

$$c_1' = c_1 \qquad c_2' = (1 - c_1')c_2 \qquad c_3' = (1 - c_2')c_3$$

where $c_1, c_2, c_3, c_1', c_2', c_3' \in \{0, 1\}$.

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