The Role of Connections in Academic Promotions*

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Abstract

This paper analyzes the role of connections in academic promotions. We exploit evidence from centralized evaluations in Spain, where evaluators are randomly assigned to promotion committees. We find that prior connections between candidates and evaluators have a dramatic impact on candidates' success. For instance, the presence of a co-author or an advisor in the committee is equivalent to a standard deviation increase in candidates' research output. The effect of a weaker link, such as a member of candidate's doctoral thesis committee, is one fourth as large. The source of the premium enjoyed by connected candidates depends on the nature of their relationship with committee members. In the case of weak links, informational gains tend to dominate evaluation biases. Candidates promoted by a weak link turn out to be more productive in the future relative to other promoted candidates. However, consistently with the potential existence of favoritism, candidates promoted by a strong connection exhibit a significantly worse research record both before and after the evaluation.

Keywords: academic promotions, connections, evaluation bias, information asymmetries

JEL Classification: I23, J45

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1 Introduction

Science is largely relying on a non-market reward system, based on meritocracy and credit granted by peers (Stephan 1996). Failures in this system might have important consequences for the overall quality of research. A potential threat is the existence of previous connections between candidates and evaluators. Evaluators may favor connected candidates out of nepotism or because they share a common view on which academic areas are more valuable.[1] However, the presence of acquainted evaluators might also improve the efficiency of a selection process, as they might be better informed about candidates' quality.

The net effect of this trade-off, the positive informational effect of connections versus the potential existence of an evaluation bias, may vary depending on the nature of connections and the institutional setup. The empirical evidence is relatively scarce.[2] Laband and Piette (1994) and Brogaard et al. (2012) show that, in top Economics journals, editors take advantage of their connections with colleagues from their own institution in order to identify and 'capture' high-impact papers for publication. Li (2011) finds that the presence of related reviewers, as measured by citations, improves the quality of research supported by the National Institute of Health (NIH). Whether these results hold in other contexts or whether they apply to other types of connections remains an open question.

In this paper we study the role of connections in academic promotions using the exceptional evidence provided by the system of centralized evaluations that was in place in Spain from 2002 through 2006. During this period, candidates both to full professor and associate professor positions were evaluated by a committee at the national level.[3] Successful candidates could then apply for a position at the

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

[2]A number of studies observe that connected candidates are more likely to be promoted. For instance, evidence from France and Italy shows that promotion committees tend to prefer connected candidates, conditional on their observable research production (Perotti 2002, Combes et al. 2008, De Paola and Scoppa 2011, Durante et al. 2011). This evidence is consistent both with the existence of informational asymmetries and an evaluation bias.

[3]The position of *catedrático de universidad* at a Spanish university may be considered equivalent

university level.[4] The evidence provided by centralized competitions has several convenient features for the analysis. First, committee members were selected out of the pool of eligible professors in the discipline using a random lottery. Our empirical strategy exploits this random assignment of evaluators to committees. This approach allows for the possibility that connected candidates are better in dimensions that are observable to evaluators but not to the econometrician. Second, conflict of interest rules were seldom implemented. As a result, it is possible to study the effect of different types of connections between evaluators and candidates, including very close ones such as thesis advisors, co-authors and colleagues as well as weaker ties. Finally, the system affected a large number of researchers at every academic discipline. In total, our database includes information on thirty thousand candidacies evaluated by approximately one thousand committees. The size and the breadth of the database allow us to investigate the robustness of results along a number of dimensions.

Connections have a significant positive impact on candidates' chances of being promoted. The magnitude of the effect is increasing with the strength of the connection. Candidates have 78% more chances of being promoted if the committee includes, by luck of the draw, a strong connection such as their doctoral thesis advisor or a co-author; the presence in the committee of a colleague from the same university increases candidates' chances of success by 35%, and the presence of a weak connection, such as a professor with whom the candidate had interacted previously at some PhD thesis defense, by 19%. The importance of connections is commensurate with the relevance of observable research quality, as measured by the number of publications in ISI Web of Science, received citations, and participation in thesis committees. For instance, the presence of a strong connection in the eval-

to the position of full professor in a U.S. university. The category of *profesor titular de universidad* would be equivalent to associate professor; in Spain, the position of associate professor typically carries tenure.

[4] This procedure is relatively similar to promotion systems currently in place in other countries in continental Europe. In France, professors are recruited through a centralized examination (*concours nationaux d'agrégation*). In Italy, the Moratti Law (2005) introduced a nation-wide qualification exam for candidates to university positions (*l'idoneità nazionale*).

uation committee is equivalent to a one standard deviation increase in candidates' observable quality.

The information on candidates' research production during the five-year period following the evaluation suggests that the source of the premium enjoyed by connected candidates depends on the nature of their relationship with committee members. Information asymmetries about candidates' research quality may explain why evaluators are more likely to promote weakly connected candidates. Candidates that were promoted by a committee that included a weak tie turn out to be significantly more productive in the future relative to other promoted candidates. On the contrary, candidates who were promoted by a committee that included their thesis advisor, a co-author or a colleague exhibit a worse research record both before and after the evaluation. In this case, evaluators seem to be willing to 'sacrifice' candidates' research production in exchange for getting connected candidates promoted. There are at least two possible explanations for this behavior. Strong connections might be benefiting from cronyism. Alternatively, the larger success rate of these candidates might reflect the existence of information asymmetries in some other dimension that is only observable for strongly connected evaluators, such as candidates' willingness to help other colleagues (Oettl 2012). However, it seems unlikely that these information asymmetries can fully explain the large premium associated to connections. According to survey information, publications in journals were the most important factor for promotion decisions.[5] Overall, our analysis suggests that the balance between the positive informational effect of connections and the potential existence evaluation biases varies depending on the strength of connections.

The rest of the paper is organized as follows. Section 2 describes the institutional background. Section 3 provides details on the data and the definition of variables. In section 4 we present the empirical evidence and we investigate possible explanations for the effect of connections. Finally, in section 5 we summarize our results and discuss possible policy implications.

[5]Survey completed by 1,294 eligible evaluators (Sierra et al. 2009).

2 Institutional background

European countries are increasingly concerned with the efficiency of their universities. In an attempt to strengthen meritocracy, during the last decade several countries have reformed the organization of universities (Aghion et al. 2010). In this respect, Spain offers an insightful case.

Before 2002, Spanish public universities had a large degree of autonomy regarding hiring and promotion.[6] This system was largely associated with inbreeding, generating public concerns about the potential existence of favoritism.[7] In order to increase meritocracy, in 2002 a system of centralized competitions known as *habilitación* was introduced by the government.[8] The new system involved two stages. First, candidates to full and associate professor positions were required to qualify in a national competition held at the discipline level.[9] Successful candidates could then apply for a position at a given university. The number of positions created at the national level was very limited, and competition at the university level was largely absent. Thus, in practice, being accredited was generally equivalent to being promoted. Notably, committee members in centralized competitions were selected by random draw from the pool of all evaluators in the field. In 2006, the system of *habilitación* was replaced by a system known as *acreditación*, which is still in place. As in the system of *habilitación*, applicants are required to be accredited by a national review committee. However, under the new system, committee members are selected 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.

[6]As is generally the case in Europe, most university professors in Spain are based in public universities. In Spain, approximately 88% of university professors work in a public institution (Source: Instituto Nacional de Estadística 2010).

[7]According to Cruz-Castro et al. (2006) in the nineties 93% of university tenure positions were assigned to internal candidates. Approximately 70% of these candidates had also done their PhD in the same university.

[8]This motivation for the reform was expressed, among others, by Julio Iglesias de Ussel, vice-minister for Education and Universities (newspaper El País, November 5th, 2001). Detailed information about this system of centralized competitions is available at the State Bulletin (`http://www.boe.es/boe/dias/2002/08/07/pdfs/A29254-29268.pdf`)

[9]There are nearly two hundred legally defined academic disciplines. These disciplines 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" (R.D. 1988/84).

In this paper we analyze centralized competitions in the Spanish public university system during 2002-2006. The time structure of examinations was as follows. First, universities reported the number of openings to the Ministry.[10] The centralized competition was then announced, and candidates were allowed to apply within twenty days. Once the list of applicants was settled, committee members were selected by random draw from the list of eligible evaluators. This list included those professors and researchers who were working in public institutions in Spain at the time, and who were officially recognized to have a minimum research quality in the discipline.[11] Around 80% of full professors and approximately 70% of associate professors qualified.[12] The selection was carried out by Ministry officials using a drum which contained as many balls as there were eligible evaluators.

Each committee was composed of seven members. In exams to associate professor positions, three evaluators were chosen from the list of eligible full professors (henceforth FP), and four evaluators were chosen from the list of eligible associate professors (henceforth AP). In the case of exams to FP positions, all committee members were chosen from the list of eligible FPs. The committee member with the longest tenure was appointed president, and the exam was held at the university where the president was based.

Further, seven evaluators were randomly assigned to form a *committee in reserve*. Their role was to replace evaluators in case somebody resigned from the

[10]Even though the number of available accreditations was equal to the total number of openings requested by universities, these accreditations were not directly linked to university openings. Universities that had requested a position were not forced to hire one of the candidates who were accredited in the following competition. Universities could postpone hiring decisions, or they could hire a candidate who had been accredited in the past. In fact, universities would often create a position once a local candidate had been accredited.

[11]The random assignment of evaluators to committees was subject to some minor constraints. Not more than one non-university researcher belonging to the Spanish Research Council (CSIC) was allowed to be selected as a member of the evaluation committee for a given exam. Similarly, not more than one emeritus professor was allowed to be selected as a member of a given evaluation committee. Therefore, 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 on these calculations are in Appendix B.

[12]The research quality requirement was based on the number of *sexenios* recognized to each professor. *Sexenios* are granted by the Spanish education authorities on the basis of applicants' academic research output in any non-interrupted period of a maximum of six years. Source: *Comisión Nacional Evaluadora de la Actividad Investigadora*, Memoria de los resultados de las evaluaciones realizadas de 1989 a 2005, 2005.

committee. Evaluators could only resign under a very restricted set of reasons, and resignations happened very rarely: about 2% of initially assigned evaluators were replaced. There are 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 to abstain from participating in the committee if they had a very close personal connection with one of the candidates.[13] With very few exceptions, evaluators did not report 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.

Competitions to FP positions had two qualifying stages. In the first stage each candidate presented her *résumé*. In the second stage candidates presented a piece of their research work. Additionally, exams to AP positions had an intermediate stage, in which candidates had to deliver a lecture on a topic from their syllabus. At each stage, passing decisions 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.

3 Data

We use data from three different sources. First, we have collected information on all exams to AP and FP positions that were held in Spain when the centralized system of examinations was in place (years 2002-2006). Second, we have gathered information on the research output of candidates and eligible evaluators from ISI Web of Science. Third, we use information on PhD dissertations read in Spain. This data allows us to identify individuals' PhD alma mater and their academic networks. In Appendix A we provide a detailed explanation on how this data was collected

[13] The law considers 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, retrieved on February 7th 2012 at `http://www.boe.es/aeboe/consultas/bases_datos/doc.php?id=BOE-A-1992-26318`. We thank Anxo Sánchez for providing us this reference.

and how each variable was constructed. Below we describe the final database.

3.1 Exams

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

3.2 Evaluators

In total, in the period we study there were 7,963 eligible FPs and 21,979 eligible APs. As shown in Table 2, the average eligible FP is 53 years old; eight years older than the average eligible AP. Women constitute 14% of eligible FPs and 35% of APs. As expected, eligible FPs tend to have a larger research record than APs. On average, FPs have nine (single-authored equivalent) ISI publications and APs have five.[14] Publications of both FP and AP professors receive around 8 citations each. Eligible FPs have supervised on average five doctoral students, while the average eligible AP has supervised only one student. Similarly, FPs have participated in almost five times more PhD thesis committees than APs, 25 and 5 respectively.

3.3 Candidates

During the period of study there were 13,612 applications to FP positions, and 18,138 applications to AP positions. On average, candidates applied twice, either because they failed the first time, or because they tried to simultaneously obtain a position in several related disciplines. As shown in Table 2, candidates to FP positions tend to be older, male, and to exhibit a better research record than candidates to

[14] In what follows we divide publications by the number of co-authors. For instance, two publications with two co-authors are equivalent to one single-authored publication.

AP positions. Applicants to FP positions have on average advised two students, and have participated in seven dissertation committees, whereas applicants to AP positions have not yet actively participated in the direction of doctoral students, and only a few of them have taken part in PhD committees. Given that there are relatively large differences across positions and across disciplines in the propensity to publish, cite, participate in dissertations, and time necessary to progress in the career, in what follows we normalize research indicators and age to have zero mean and unit standard deviation for candidates within each exam.

In Table 3 we report the correlation between the main characteristics of candidates, pooling together information from exams to FP and AP positions.[15] We observe that more prolific candidates tend also to have higher research quality, as measured by the number of citations received (Table 3, block B-B). Well-published candidates are also more likely to participate in students' supervision and evaluation. On average, older candidates do not have a better publication record, but they have participated more extensively in students' supervision and evaluation.

3.4 Links between evaluators and candidates

We consider several types of connections between candidates and evaluators. As Granovetter (1973) points out, the strength of an interpersonal tie should be related to "the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie". First, we focus on the strongest academic connections: advisors and co-authors. As shown in Table 4, approximately 13% of applicants to a FP positions happened to be evaluated by one of these *strong* links. In exams to AP positions, they affected 8% of candidates. Second, we investigate *institutional* connections. In exams to FP positions 28% of candidates had a colleague from their university (who was not an advisor or a co-author) sitting in the evaluation committee. In exams to AP positions, 25% of candidates were evaluated by a committee that included an evaluator who was based in candidates' alma

[15] Results are very similar if we disaggregate the table by position.

mater.[16] Third, we use information on candidates' and evaluators' participation in PhD thesis committees. We consider several types of interactions: (i) the evaluator was a member of candidate's thesis committee, (ii) the evaluator has invited the candidate to sit on the thesis committee of one of her students (or vice versa) and (iii) the evaluator and the candidate participated in the same thesis committee. We denominate these links *weak* ties. Weak ties are relatively more frequent in exams to FP positions, where approximately 34% of candidates are evaluated by a weak link. In exams to AP positions, only 7% 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 have either (i) a common advisor, (ii) a common co-author or (iii) a common thesis committee member. To stress that these links do not necessarily imply professional interaction or awareness of each other's research, we denominate them *indirect* ties. These indirect ties are also relatively frequent, affecting about a fifth of candidates.

4 Empirical analysis

Our empirical analysis is structured as follows. First, we estimate the (causal) effect of committees' composition on applicants' chances of being promoted. In order to get a better understanding of the magnitude of the effect, we also compare the effect of connections on promotions with the effect of observable research quality. Second, we explore the effect of connections across different types of disciplines, departments, candidates and evaluators. Finally, we investigate the source of the premium associated to connections. In particular, using information on candidates' future research production, we consider the possibility that evaluators might be more accurate at assessing the research potential of candidates they are acquainted with.

[16] Unfortunately we cannot observe the affiliation of candidates to AP positions at the time of the exam, we only observe the institution where they obtained their PhD. Given the low geographical mobility of Spanish professors at this stage (Cruz-Castro et al. 2006), it seems reasonable to presume that the large majority of candidates to AP positions were still based in their alma mater at the time of the evaluation.

4.1 The (causal) effect of connections on promotions

As shown in Table 4, candidates' chances of success are significantly larger when they have some connection in the evaluation committee. In exams to FP positions, candidates who are evaluated by their thesis advisor or co-author are three times more likely to be promoted than candidates who had no connections in the committee. Candidates with colleagues or weak connections among evaluators have more than twice larger chances of success relatively to unconnected candidates. Indirect connections are also associated to larger chances of success, although the premium is not as high as in the case of direct connections. The pattern is very similar in exams to AP positions.

Naturally, this descriptive evidence might be suggestive about the potential relevance of connections, but it has no causal interpretation. The larger success rate of connected candidates might simply reflect their higher quality (see Table 3, block C-B). In order to identify the causal effect of having a connection in the committee, we compare the outcomes of candidates with a similar expected committee composition but who, as a consequence of the realizations of random draws, are evaluated by committees with different composition. For instance, one may think about the case of two candidates who apply for a promotion, each one has a connection in the set of eligible evaluators, but only one of these two connected evaluators happens to be (randomly) assigned to the evaluation committee.

As pointed out in section 2, approximately 2% of evaluators drawn in the lottery where replaced. As well, according to anecdotal evidence, some professors did not attend the exam (or part of it) without a proper justification. In what follows, 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. Therefore, our estimates below provide the intention-to-treat effect.

The following equation describes the relationship between the candidates' probability of being promoted and the (random) number of connections in the evaluation committee:

$$y_{ie} = \beta_0 + \beta_1(c_{ie} - \mu_{ie}) + \epsilon_{ie} \tag{1}$$

where y_{ie} indicates whether individual i qualified in exam e and $(c_{ie} - \mu_{ie})$ is the shock to committee composition, i.e., the difference between the actual (c_{ie}) and the expected number of connections (μ_{ie}) of candidate i. Note that β_0 indicates the average success rate.

The key assumption in our identification strategy is that the selection of committee members was random. More formally,

$$E[(c_{ie} - \mu_{ie}) \cdot \epsilon_{ie}] = 0 \tag{2}$$

If this condition is satisfied, β_1 can be interpreted as the causal effect of an additional connection among evaluators on candidates' probability of success.

The empirical evidence is consistent with the assignment indeed being random. As shown in Table 3, there is no significant difference between the expected committee composition and the mean of the actual realization of the draw. As well, there is no relationship between the magnitude of the shocks to committee composition and candidates' characteristics (Table 3, blocks D-B and D-C).

Table 5 presents the estimation results for equation (1). Standard errors are clustered at the exam level, reflecting the fact that the shocks received by candidates in the same examination are not independent. We report results for the four aggregate sets of connections defined earlier: strong, institutional, weak and indirect connections.[17] Strong connections lead to a 9 percentage points increase in applicants' likelihood of success (column 1). This means about a 78% increase relative to the average success rate (about 11% of candidates are promoted). Institutional and weak connections with committee members also have a significant positive effect. They increase candidates' chances of success by 4 and 2 percentage points respec-

[17] In Appendix A we report results at a disaggregated level.

tively (approximately a 35% and a 19% increase). The effect of indirect connections is not statistically different from zero.

Weak ties are relatively more important in exams to AP positions. The importance of other connections is stable over the academic career (columns 2 and 3). Next, as a robustness check, in column 4 we control for exam fixed effects. As expected, results are unchanged. We also use an alternative identification strategy to estimate the effect of committee composition. Specifically, given that many individuals applied several times for promotion, we use a fixed-effects strategy. In other words, we compare the evaluations given to the same individual by different promotion committees. Note that this strategy is less efficient, since it does not exploit all possible variation in the data. Its internal validity is also more limited, as it considers only those individuals who participated in examinations more than once. Nevertheless, the estimates are statistically similar to the baseline estimation (column 5 vs. column 1). As an additional robustness check, we replicate the analysis for the subsample of candidates who obtained their PhD in Spain. The estimated coefficients are similar to the ones obtained for the whole sample (column 6 vs. column 1).

4.2 The role of candidates' quality

The results above suggest that connections have a strong effect on promotion decisions. In order to get a better understanding of the magnitude of these effects, we examine the relevance of a number of observable individual characteristics that proxy for candidates' quality. In particular, we estimate the effect of candidates' publications, the average number of citations per publication, the number of PhD students advised, and the number of participations in PhD thesis committees. We also control for age since, conditional on research output, younger candidates might have a larger potential. These variables are all normalized at the exam level.

The effect of observable research quality is commensurate with the effect of connections. Candidates who, conditional on age, 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 (Table 5, column 7). We also observe that, conditional on their research output, older candidates have lower chances of promotion.

Our analysis may be subject to measurement error induced by homonymity. This might create an attenuation bias in our estimates for variables based on publications data. Given that homonymity is expected to be less of a problem for individuals with less common surnames, we also perform the analysis on the subsample of individuals with surnames that are less frequent than the median surname (column 8). The estimates of some coefficients are slightly larger. In this subsample, an increase of one standard deviation in all research indicators is associated with 10 percentage points higher chances of success. The presence of an advisor or a co-author in the committee has also a slightly larger impact. It increases candidates' chances of being promoted by 12 percentage points. The effect of colleagues and weak connections remains the same.

4.3 Heterogeneity analysis

Next we analyze whether the effect of connections varies depending on the characteristics of disciplines, universities, candidates and evaluators.

4.3.1 Disciplines

The Spanish academic profession is formally divided into nearly two hundred disciplines. We divide disciplines into seven broad groups: Physics and Mathematics, Engineering, Chemistry and Biology, Medicine, Social Sciences, Humanities, and Law. The upper panel of Table 6 shows some descriptive information by disciplinary group. Candidates' propensity to publish in journals indexed by ISI Web of Science varies across groups. In Law, candidates have almost no publications, suggesting that, at least in Spanish academia, ISI journals are not a common outlet for research in this disciplinary group. Candidates in the Social Sciences and Humanities have published less than one article (adjusted by the number of co-authors), whereas candidates in the rest of disciplines have published about five to nine articles.

The lower panel provides information on the impact of candidates' observable research quality and connections on their probability of being promoted. Interestingly, indicators of research quality and connections tend to have a similar effect on candidates' chances of being promoted across all groups of disciplines. The only exception to these results is Law, where ISI publications and participation in dissertations do not seem to matter for promotion and the impact of having direct connections in the committee is twice as large as in the average discipline.

The size of the discipline may affect the prevalence of connections and also its impact. We divide observations in two groups according to the median number of tenured professors working in the discipline. Candidates in smaller disciplines have significantly more ties (upper panel of Table 7, columns 1-3). The expected number of strong connections in the committee is 56% larger (0.14 vs. 0.09), the number of colleagues is 40% larger (0.42 vs. 0.30) and the number of weak ties is twice as large (0.33 vs. 0.15). We also observe that strong connections are significantly more helpful in small disciplines, whereas the effect of colleagues and weak ties is statistically similar across disciplines of different size. Summing up, in small disciplines connections tend to be more abundant and more effective.

4.3.2 Department size

We explore whether the relevance of connections depends on the size of departments. The upper panel of Table 7, columns 4-6, provides information disaggregated for candidates whose expected number of colleagues in the committee was respectively below and above the median. Not surprisingly, candidates from larger departments tend to have more colleagues in the committee. They expect to have 0.65 colleagues in the evaluation committee, while the figure is eight times lower for candidates from smaller departments. Candidates from larger departments also tend to have a higher number of strong, weak and indirect ties. On the other hand, candidates from small departments benefit relatively more from the presence of colleagues in the committee. Their probability of success increases by 7 percentage points, twice as much as the effect for large departments. In total, candidates from large departments gain more from institutional connections, as their relative disadvantage in terms of the magnitude of the impact is more than compensated by their advantage in the expected number of colleagues in committees.

4.3.3 Candidates' quality

Evaluators might feel more legitimized to support their high quality connections. We measure *quality* using a factor score, which is computed as a linear combination of publications, citations per publication, average AIS, PhD theses advised, PhD committees and age, weighted by the estimated importance of each factor for promotion (Table 6). This factor score is normalized to have zero mean and unit standard deviation for all candidates in each exam.

Candidates of higher quality tend to have more professional connections but fewer institutional ones (lower panel of Table 7, columns 1-3). Better candidates benefit significantly more from their connections than candidates with a weaker research record. This is particularly true in the case of weak connections.

4.3.4 Evaluators' quality

The importance of connections might also depend on evaluators' characteristics. Evaluators of better research quality might be more committed to meritocratic evaluation. Alternative, better researchers might also be better able to impose their own evaluation criteria, being meritocratic or less so. In the latter case, better researchers might be relatively more effective in getting their connections promoted.

We split the sample of committees in two groups according to the research quality of evaluators: the ones with higher and the ones with lower than the discipline average research quality. We then analyze whether committee members have different influence on the success of their connections, depending on the average quality of evaluators in the committee. The lower panel of Table 7, columns 4-6, reports the results of this analysis. All committees tend to overrate their strong and institutional connections, independent of their research quality. However, weak ties matter more in the committees with better research quality.

In sum, connections tend to help candidates to get a promotion but there are some differences in terms of the relevance of each type of connection depending on the size of the discipline and department, and on the quality of candidates and evaluators. While the effect of strong connections is relatively larger in small disciplines, candidates from large departments benefit more from institutional connections. Interestingly, weak ties are most useful when candidates and evaluators have a stronger research profile.

4.4 Why do evaluators overrate connected candidates?

There are several possible explanations for the positive effect of connections on promotion decisions. The evidence is consistent with the existence of favoritism, where personal relationships between candidates and evaluators lead to subjective evaluations. However, this is not the only possible explanation. Professors may differ in their criteria about which dimensions are more valuable. If professors are segregated across universities or professional networks according to their tastes, this might explain why evaluators prefer candidates they are acquainted with. Information asymmetries might also mediate the effect of connections. In a tournament where only a few candidates can be promoted, evaluators will optimally tend to select candidates whose quality they can observe more accurately (Cornell and Welch 1996). Evaluators may be better informed about the quality of acquainted candidates in dimensions that are not easily observable for other evaluators. Evaluators acquainted with candidates may be better informed about candidates' research pipeline, or about their contribution in co-authored papers. This might be particularly relevant for junior authors applying for AP positions. Information asymmetries may also be relevant in other dimensions. For instance, in exams to AP positions candidates had to be explicitly evaluated on their teaching quality. Evaluators from the same institution may have better information on this dimension.

While we cannot observe candidates' teaching quality, we can observe their research production and their participation in PhD committees, not only before, but also after the public examination. We examine whether evaluators select acquainted candidates with a stronger potential in these dimensions, maybe compensating their apparent lower observable quality at the moment of the examination. Specifically, we estimate the following model:

$$q_{ie}^{post} = \beta_0 + \beta_1(c_{ie} - \mu_{ie}) + \epsilon_{ie} \tag{3}$$

where q_{ie}^{post} stands for *promoted* candidates' observable quality in the five years following the promotion. Again, quality is measured using a factor score that weighs publications, citations, participation in theses committees, and age based on the estimated contribution of each factor to promotion decisions (as reported in Table 6).

This analysis is reported in Table 8. Results differ depending on the nature of the connection. The evidence suggests that information asymmetries regarding candidates' research quality cannot justify the premium enjoyed by candidates who were evaluated by a strong professional connection or a colleague. These candidates tend to be significantly less productive, both before and after the evaluation, relative to other promoted candidates (columns 1 and 4).

However, in the case of weak ties the informational component seems to dominate any potential evaluation bias. Candidates who were promoted by a weak tie turn out to be more productive in the five-year period following the examination than other promoted candidates, although this effect is only marginally significant at standard levels. Given that information asymmetries about candidates' research potential are more likely to be present at earlier stages of the career, we analyze separately promotions to AP and FP positions. As expected, the informational contribution of weak ties is particularly large in AP exams. An additional weak tie is associated to future research quality being 0.25 standard deviations higher, an effect that is very significant both in statistical and economic terms (column 6).

5 Conclusions

The selection of evaluation committee members is subject to a well-known dilemma. Evaluators who are acquainted with candidates may have superior information about their quality. Unfortunately, their criteria might also be biased. Which of the two effects dominates may vary depending on the nature of their relationship, on the extent of information asymmetries and on the institutional framework.

In this paper we analyze 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 competitions with a random assignment of evaluators to committees was in place. We find that connections improve significantly candidates' chances of success both in exams to associate professor positions and full professor positions. Connections affect promotion decisions in all scientific disciplines, but their effect is larger in small disciplines and for relatively better candidates. Their impact is comparable to observable research quality. For instance, the presence in the committee of a thesis advisor or a co-author is equivalent to a one standard deviation increase in candidate's number of publications, citations received, PhD students advised and participations in doctoral committees.

The source of the premium associated to connections varies depending on the nature of the link. Among weak connections, the informational content of links dominates potential evaluation biases. Candidates who were promoted by a weak link, such as an evaluator who had participated in their thesis committee, turn out to be relatively more productive in the five-year period following the promotion. On the contrary, candidates promoted by a strong professional or institutional connection are relatively less productive both before and after the promotion, at least in terms of their observable research productivity. Potentially there might be information asymmetries in some other relevant dimension that is unobservable both to unconnected evaluators and to econometricians. However, the importance of this dimension and the scale of information asymmetries would have to be (perhaps unrealistically) large in order to fully explain the observed premium associated to strong and institutional connections. Alternatively, these candidates may be enjoying a preferential treatment.

In sum, the evidence suggests that there might be an optimal distance between evaluators and candidates. Weakly connected evaluators seem to be better informed about candidates' quality than evaluators who had no previous contact with candidates. Moreover, they appear to be less biased than strongly connected evaluators. Our results also indicate that this optimal distance may vary depending on the institutional framework. For instance, while Laband and Piette (1994) and Brogaard et al. (2012) find that editors use personal associations with colleagues in their departments in order to improve selection decisions, in Spain the presence of colleagues in promotion committees tends to decrease the research quality of promoted candidates.

Our analysis suggests that the introduction of centralized promotion examinations with random assignment of evaluators to committees *per se* does not eliminate the problem of favoritism. If anything, it introduces an element of randomness relative to who benefits from connections and who gets ultimately promoted. It also favors candidates from universities with relatively many senior researchers, which might be detrimental for the growth prospects of young departments. According to our findings, strong conflicts of interest should be prevented, and disciplines should be legally defined in such a way that they are large enough to allow for the implementation of the conflict of interest rules. At the same time, the presence of external evaluators who are weakly acquainted with the candidate may improve the quality of selection. Our work might be also interpreted as additional evidence in favor of a radical change in the way higher education is 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 an answer about which of these alternatives, more rules or incentives, would yield better outcomes. Nevertheless, it illustrates the limitations of a system of centralized competitions where evaluators (and universities) do not internalize the consequences of their decisions.

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Table 1: Descriptive statistics – Examinations

	1	2	3	4
	Mean	Std. Dev.	Min.	Max.
	Full professor exams			
Positions per exam	2.92	1.78	1	12
Candidates per exam	27.12	17.99	3	132
Proportion of positions filled	0.98	0.09	0	1
Number of exams	502			
	Associate professor exams			
Positions per exam	4.74	4.71	1	25
Candidates per exam	39.01	34.80	3	270
Proportion of positions filled	0.96	0.15	0	1
Number of exams	465			

Table 2: Descriptive statistics – Eligible evaluators and candidates

	1	2	3	4
	Eligible evaluators		**Candidates**	
	Full professor	Associate professor	Full professor	Associate professor
Female	0.14	0.35	0.27	0.40
	(0.35)	(0.48)	(0.44)	(0.49)
Age	52.91	44.98	46.39	37.45
	(6.41)	(7.82)	(6.50)	(6.55)
Tenure in position	12.94	10.36	n/a	n/a
	(8.20)	(6.59)		
Publications, weighted by co-authors	9.01	4.80	5.46	3.03
	(12.74)	(7.40)	(7.65)	(5.74)
Citations per publication	8.13	7.56	7.67	6.51
	(9.94)	(11.62)	(12.33)	(13.38)
PhD students advised	5.19	1.25	2.01	0.24
	(5.33)	(2.15)	(2.74)	(0.90)
PhD committees	25.18	5.08	7.25	0.89
	(24.48)	(7.36)	(8.66)	(2.56)
Number of observations	49199	61052	13612	18138
Number of individuals	7963	21979	6545	10039

Notes: Mean values, standard deviations in parentheses. n/a - not available.

Table 3: Correlation table

					A	B					C				D			
			Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
A	(1)	Promoted	0.11	0.32	1													
B	(2)	Publications	0.00	0.98	0.09***	1												
	(3)	Citations per publication	0.00	0.97	0.06***	0.29***	1											
	(4)	PhD theses advised	0.00	0.95	0.07***	0.07***	-0.00	1										
	(5)	PhD committees	0.00	0.98	0.08***	0.06***	0.00	0.42****	1									
	(6)	Age	0.00	0.98	-0.04	-0.02	-0.06	0.13***	0.20***	1								
C	(7)	(expected) Co-author/advisor	0.12	0.21	0.07***	0.22***	0.06***	-0.00	0.00	-0.05	1							
	(8)	(expected) Same university	0.37	0.56	0.05***	-0.01	0.00	-0.02	-0.01	0.05***	0.04**	1						
	(9)	(expected) Weak tie	0.24	0.41	0.09***	0.03***	-0.01	0.15***	0.25***	0.04***	0.17***	-0.03	1					
	(10)	(expected) Indirect tie	0.30	0.41	0.03***	0.20***	0.06***	-0.00	-0.01	-0.02	0.51***	-0.06	-0.01	1				
D	(11)	(shock) Co-author/advisor	0.00	0.29	0.08***	-0.01	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.01*	0.01	1			
	(12)	(shock) Same university	-0.01	0.51	0.06***	-0.00	-0.01	0.01	0.00	0.01	0.00	-0.06	0.01	0.01	-0.03	1		
	(13)	(shock) Weak tie	0.00	0.42	0.02***	0.00	0.00	0.01	0.00	-0.00	-0.01	0.00	0.00	0.00	-0.04	-0.04	1	
	(14)	(shock) Indirect tie	-0.00	0.44	-0.01	-0.01	-0.01	0.00	0.00	-0.01	-0.02	0.01	0.01*	-0.02	-0.06	-0.06	-0.04	1

Notes: The table includes information from candidates to full professor and associate professor positions. P-values are adjusted for clustering of standard errors for individuals in the same exam. * – p-value<0.10, ** – p-value<0.05, *** – p-value<0.01.

Table 4: Success rate, by committee composition

	1	2	4	5
	FP exams		**AP exams**	
	Proportion, %	Success rate, %	Proportion, %	Success rate, %
No connection	33	6	50	9
At least one connection:	67	13	50	15
- Co-author/PhD advisor	13	18	8	23
- Same university	28	15	25	16
- Weak tie	34	15	7	19
- Indirect tie	21	11	24	12

Notes: The average success rate is 11% in FP exams and 12% in AP exams.

Table 5: The effect of connections on candidates' success

	1	2	3	4	5	6	7	8
	All	FP exams	AP exams	All	All	Graduated in Spain	All	Less frequent surnames
Connections in committee (shock):								
- Co-author/PhD advisor	0.088***	0.082***	0.094***	0.092***	0.074***	0.087***	0.089***	0.118***
	(0.008)	(0.010)	(0.012)	(0.008)	(0.012)	(0.009)	(0.008)	(0.012)
- Same university	0.040***	0.038***	0.041***	0.043***	0.025***	0.041***	0.040***	0.040***
	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.004)	(0.004)	(0.005)
- Weak tie	0.021***	0.017***	0.041***	0.025***	0.027***	0.019***	0.021***	0.023***
	(0.005)	(0.005)	(0.011)	(0.005)	(0.008)	(0.005)	(0.005)	(0.007)
- Indirect tie	-0.001	0.004	-0.003	0.003	-0.003	-0.002	-0.001	0.000
	(0.004)	(0.006)	(0.005)	(0.005)	(0.007)	(0.005)	(0.004)	(0.006)
Quality indicators (normalized):								
- Publications							0.023***	0.044***
							(0.002)	(0.004)
- Citations per publication							0.012***	0.016***
							(0.002)	(0.003)
- PhD theses advised							0.016***	0.017***
							(0.002)	(0.003)
- PhD committees							0.021***	0.023***
							(0.002)	(0.003)
- Age							-0.019***	-0.019***
							(0.002)	(0.002)
Constant	0.113***	0.106***	0.118***	0.113***	0.113***	0.114***	0.113***	0.128***
	(0.002)	(0.003)	(0.003)	(0.000)	(0.003)	(0.002)	(0.002)	(0.003)
Exam dummies				Yes				
Individual dummies					Yes			
Adjusted R-squared	0.011	0.011	0.011	0.016	0.200	0.011	0.030	0.043
Number of observations	31750	13612	18138	31750	31750	24638	31750	16168

Notes: OLS estimates, standard errors clustered by exam are reported in parentheses. Coefficients indicate the percentage-points increase in the success rate associated to a (random) increase in the number of connected evaluators (in a seven-member committee). FP exams and AP exams stand for exams to Full and Associate Professor positions respectively. Column 6 only includes candidates who did their PhD in Spain. Quality measures are normalized for candidates in the same exam. The subsample of individuals with "less common surnames" includes individuals whose paternal and maternal surname have a frequency inferior to 100,000 (source: Spanish Statistical Institute).
* – p-value<0.10, ** – p-value<0.05, *** – p-value<0.01.

Table 6: The effect of connections on candidates' success, by discipline

	1	2	3	4	5	6	7
	Disciplinary group:						
	Physics and Math	Engineering	Chemistry and Biology	Medicine	Social Sciences	Humanities	Law
Means							
Connections in committee:							
- Co-author/PhD advisor	0.10	0.16	0.15	0.30	0.05	0.04	0.04
- Same university	0.28	0.60	0.25	0.32	0.36	0.47	0.19
- Weak tie	0.13	0.21	0.20	0.32	0.23	0.33	0.30
- Indirect tie	0.23	0.32	0.44	0.66	0.13	0.10	0.31
Quality indicators (non-normalized):							
- Publications	6.08	5.55	8.88	7.01	0.84	0.55	0.13
- Citations per publication	8.00	7.22	16.67	14.14	3.60	0.87	0.58
- PhD theses advised	0.71	0.79	1.57	2.28	0.69	0.79	0.27
- PhD committees	2.11	2.31	5.38	7.65	2.75	3.81	1.44
- Age	38.54	38.80	42.87	45.38	40.16	43.20	39.51
Marginal effects on success							
Connections in committee (shock):							
- Co-author/PhD advisor	0.099***	0.104***	0.047***	0.072***	0.092***	0.142***	0.213***
	(0.020)	(0.019)	(0.016)	(0.013)	(0.032)	(0.030)	(0.039)
- Same university	0.022**	0.019**	0.042***	0.042***	0.032**	0.044***	0.106***
	(0.010)	(0.009)	(0.011)	(0.011)	(0.012)	(0.008)	(0.015)
- Weak tie	0.023	0.015	0.029**	0.027*	0.007	0.027**	0.014
	(0.017)	(0.013)	(0.013)	(0.014)	(0.013)	(0.011)	(0.010)
- Indirect tie	0.001	-0.005	0.009	-0.003	-0.004	0.010	-0.012
	(0.011)	(0.010)	(0.010)	(0.009)	(0.013)	(0.018)	(0.011)
Quality indicators (normalized):							
- Publications	0.026***	0.018***	0.024***	0.026***	0.036***	0.027***	0.002
	(0.005)	(0.006)	(0.006)	(0.005)	(0.007)	(0.006)	(0.005)
- Citations per publication	0.018***	0.006	0.023***	0.018***	0.011*	0.006	-0.002
	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)
- PhD theses advised	0.016***	0.010*	0.028***	0.026***	0.005	0.018**	0.004
	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
- PhD committees	0.013***	0.017**	0.020***	0.020***	0.028***	0.031***	0.013**
	(0.005)	(0.007)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
- Age	-0.014***	-0.033***	-0.015***	-0.016***	-0.020***	-0.010**	-0.026***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
Constant	0.089***	0.118***	0.125***	0.103***	0.115***	0.141***	0.087***
	(0.005)	(0.005)	(0.007)	(0.006)	(0.006)	(0.004)	(0.006)
Adjusted R-squared	0.033	0.027	0.031	0.046	0.034	0.030	0.051
Number of observations	5227	4596	4023	4120	4073	6254	3457

Note: Marginal effects are the OLS estimates, standard errors clustered by exam are reported in parentheses. Quality measures are normalized for candidates in the same exam. * – p-value<0.10, ** – p-value<0.05, *** – p-value<0.01.

Table 7: Heterogeneity analysis

	1	2	3	4	5	6
	Discipline size:			**Department size:**		
	≤ median	>median	Difference	≤ median	>median	Difference
Means						
Connections in committee:						
- Co-author/PhD advisor	0.14	0.09	0.05***	0.08	0.15	-0.07***
- Same university	0.42	0.30	0.11***	0.08	0.65	-0.57***
- Weak tie	0.33	0.15	0.18***	0.22	0.27	-0.04***
- Indirect tie	0.29	0.31	-0.02***	0.27	0.32	-0.05***
Marginal effects on success						
Connections in committee (shock):						
- Co-author/PhD advisor	0.106***	0.062***	0.043***	0.079***	0.093***	-0.014
	(0.010)	(0.010)	(0.015)	(0.012)	(0.010)	(0.016)
- Same university	0.042***	0.036***	0.007	0.069***	0.036***	0.032***
	(0.005)	(0.006)	(0.008)	(0.011)	(0.004)	(0.011)
- Weak tie	0.021***	0.022***	-0.001	0.025***	0.018***	0.008
	(0.006)	(0.008)	(0.010)	(0.007)	(0.007)	(0.010)
- Indirect tie	-0.003	-0.000	0.003	0.000	-0.001	-0.002
	(0.006)	(0.006)	(0.008)	(0.006)	(0.006)	(0.008)
Constant	0.129***	0.096***	0.032***	0.096***	0.130***	-0.034***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Adjusted R-squared	0.014	0.007		0.009	0.013	
Number of observations	16153	15597		15876	15874	

	Quality of candidates:			**Quality of evaluators:**		
	≤median	≥median	Difference	≤expected	≥expected	Difference
Means						
Connections in committee:						
- Co-author/PhD advisor	0.09	0.14	-0.05***	0.10	0.13	-0.03***
- Same university	0.38	0.34	0.04***	0.35	0.38	-0.04***
- Weak tie	0.19	0.30	-0.11***	0.22	0.28	-0.07***
- Indirect tie	0.25	0.34	-0.09***	0.29	0.30	-0.01*
Marginal effects on success						
Connections in committee (shock):						
- Co-author/PhD advisor	0.073***	0.101***	-0.027*	0.086***	0.092***	-0.006
	(0.011)	(0.011)	(0.015)	(0.011)	(0.011)	(0.015)
- Same university	0.034***	0.049***	-0.015*	0.039***	0.041***	-0.002
	(0.005)	(0.007)	(0.008)	(0.005)	(0.006)	(0.008)
- Weak tie	0.011*	0.028***	-0.017*	0.013*	0.032***	-0.019*
	(0.006)	(0.007)	(0.009)	(0.007)	(0.007)	(0.010)
- Indirect tie	-0.004	0.002	-0.006	-0.008	0.008	-0.016*
	(0.005)	(0.006)	(0.008)	(0.006)	(0.006)	(0.009)
Constant	0.077***	0.151***	-0.074***	0.115***	0.109***	0.006
	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Adjusted R-squared	0.009	0.013		0.009	0.013	
Number of observations	16220	15530		17616	14134	

Notes: Marginal effects are the OLS estimates, standard errors clustered by exam are reported in parentheses. "Quality" is a factor score computed as a linear combination of (normalized) publications, citations per publication, PhD theses advised, participation in PhD committees and age, weighted by the estimated importance of each factor for promotion in the corresponding disciplinary group, as reported in Table 6. By construction, the mean of candidates' "quality" is zero; variance is normalized to one.
* – p-value<0.10, ** – p-value<0.05, *** – p-value<0.01.

Table 8: Quality of promoted candidates

	1	2	3	4	5	6
	Pre-exam quality			**Post-exam quality**		
	All	FP exams	AP exams	All	FP exams	AP exams
Connections in committee (shock):						
- Co-author/PhD advisor	-0.070*	-0.075	-0.076	-0.088**	0.002	-0.160***
	(0.040)	(0.062)	(0.053)	(0.043)	(0.066)	(0.056)
- Same university	-0.066**	-0.072	-0.067*	-0.092***	-0.062	-0.113**
	(0.030)	(0.048)	(0.038)	(0.033)	(0.048)	(0.045)
- Weak tie	0.026	-0.021	0.141*	0.071*	0.013	0.251***
	(0.037)	(0.042)	(0.076)	(0.036)	(0.041)	(0.073)
- Indirect tie	0.022	-0.062	0.060	-0.013	-0.020	-0.009
	(0.038)	(0.064)	(0.047)	(0.038)	(0.073)	(0.044)
Constant	0.417***	0.523***	0.345***	0.458***	0.485***	0.438***
	(0.018)	(0.027)	(0.023)	(0.017)	(0.026)	(0.022)
Adjusted R-squared	0.001	-0.000	0.003	0.004	-0.001	0.011
Number of observations	3573	1446	2127	3573	1446	2127

Notes: OLS estimates, standard errors clustered by exam are reported in parentheses. "Quality" is a factor score computed as a linear combination of (normalized) publications, citations per publication, PhD theses advised, participation in PhD committees and age, weighted by the estimated importance of each factor for promotion in the corresponding disciplinary group, as reported in Table 6. By construction, the mean of candidates' "quality" is zero; variance is normalized to one. *Post-exam quality* corresponds to the five years following the examination. * – p-value<0.10, ** – p-value<0.05, *** – p-value<0.01.

Appendix A: Data Appendix

We have collected information from three different sources: (i) information on centralized competitions from the Ministry of Research and Science, (ii) individual research production from ISI Web of Science and (iii) information on doctoral dissertations from TESEO database. Below we describe the process of data collection in detail.

Ministry of Research and Science The system of centralized competitions known as 'habilitación' was in place between 2002 and 2006. Information on candidates' and evaluators' first name, last name, tenure and id number was retrieved from the website of the Ministry of Research and Science in July 2009 (`http://www.micinn.es`). In total, 1016 exams took place, around five per discipline. We restrict the sample in several ways. We exclude exams where the number of available positions was larger or equal than the number of candidates (two exams in Basque Philology and one exam in Textile and Paper Engineering) and disciplines where the number of potential evaluators was not big enough to form a committee (46 exams).[18] 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 his/her national ID number. 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).[19] In order to perform the assignment, we first use registry

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

[19]There are a number of exceptions. For instance, this methodology will fail to identify the age of those individuals who obtained their nationality when they were older than 14. This could be a case of immigrants coming to Spain. Still, immigration was a very rare phenomenon in Spain until the late 1990s. Additionally, some parents may have their kids obtain an ID number before they are 14. This may be the case particularly after Spain entered in the mid 90s the Schengen zone and IDs became a valid documentation to travel to a number of European countries. Still, individuals born around the introduction of the Schengen zone were generally too young to be participants of the public examinations during 2002-2006.

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% 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 to associate professor is less than 27 years old and a candidate to full professor is less than 35 years old, we assign age a missing value (around 5% of the sample). The choice of these thresholds is justified by the survey information, according to which the minimum age at which promotion to associate and full professor positions was granted in Spain before 2002 is respectively 27 and 35 (Cruz-Castro et al. 2006). Our proxy of age is not defined for non-Spaniards (less than 1% of the sample). We imputed the missing information on age 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 provides information on affiliation for eligible evaluators. Given that most candidates to full professor positions are themselves eligible evaluators in exams to associate professor positions, it is possible to obtain their affiliation by matching the list of eligible evaluators with the list of candidates. Using this procedure, we were able to obtain the information on affiliation for 93% of candidates to full professor positions. Information on affiliation at the time of the examination for the remaining 7% of candidates was obtained from the State Official Bulletin or directly from professors' CVs.

ISI Web of Science Information on scientific publications comes from Thompson ISI Web of Science (WoS).[20] WoS database includes over 10,000 high-impact journals in Science, Engineering, Medicine and Social Sciences, as well as international proceedings coverage for over 110,000 conferences. Out of these ten thousand journals,

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

approximately two hundred are edited in Spain. For the purpose of this analysis, we considered all articles, reviews, notes and proceedings. We collected information on publications since 1975 by authors based in Spain. As well, we consider citations received by these publications before July 2012.

The assignment of articles to professors is non trivial. For each publication and author, WoS provides information on the surname and on the initial (or, in some cases, initials). Homonymity problems may arise in the case of common surnames (i.e. Garcia, Fernandez, Gonzalez). Moreover, unlike most countries, in Spain individuals 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. As well, 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 match publications with Spanish affiliations to professors using information on surnames and initials. We select the subsample of publications that have a unique match in our list of Spanish professors. This subsample includes 250,000 publications. Second, we use this subsample to 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 Education in order to classify professors. Specifically, we assign the ISI area to a given discipline (i) if the proportion of publications in the ISI area by professors from the discipline exceeds 10% of the total number of publications in the discipline (or viceversa), or (ii) if in the ISI area appears before the 50% threshold in the cumulative distribution of publications ordered by the decreasing importance of ISI areas in the discipline (or viceversa). The resulting correspondence table, available upon request, allows matching publications in ISI areas to the scientific areas defined by the Ministry of Education. On average, we assign five 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.

If a given publication can be assigned to more than one possible match, the value of this publication is divided by the number of such possible matches. Less than 3% of publications were assigned to more than one individual. This figure is equal to 0.5% in the subsample of individuals with "less common surnames", i.e. individuals whose maternal and paternal surnames have a frequency below 100,000 according to the Spanish National Statistical Institute.

Given that propensity to publish differs substantially across disciplines, we normalize the number of individual's publications to have zero mean and unit standard deviation among applicants to the same exam and among eligible evaluators of a given category in a given exam. The number of citations of each publication depends on time elapsed between the publication date and the date when the number of received citations is observed. Therefore, we first normalize the number of citations received by each publication subtracting the average number of citations received by Spanish-authored articles published in the corresponding ISI disciplinary area in the same year and then dividing by the corresponding standard deviation. Next, for each individual in our database we calculate the average number of normalized citations per publication. Finally, similarly to the number of publications, we re-normalize the number of individual's citations per publication to have zero mean and unit standard deviation among applicants to the same exam and among eligible evaluators of a given category in a given exam. We treat individuals who have no ISI publications as if they had received zero citations.

TESEO database on doctoral dissertations Since 1977 PhD candidates in Spanish universities register their dissertation in the database TESEO, which is run by the Ministry of Education. We retrieved all the information available in this database from the website `https://www.educacion.gob.es/teseo` in May 2011. We observe 151,483 dissertations. TESEO provides the identity and affiliation of dissertations' authors, advisors and committee members.

We are able to find the dissertation of 83% of candidates to AP exams. Missing information may be due to the fact that (i) individuals did their PhD abroad, (ii) they defended their dissertation before 1977, (iii) there are spelling mistakes, (iv) there was a homonymity problem or (v) the dissertation was not included in TESEO for unknown reasons.[21] We use dissertation information to identify candidates' alma mater.

Definition of connections We define different types of connections between candidates and evaluators. First, we consider *strong* professional connections that imply interaction on a common piece of research, c'_1: advisor-student relationship and co-authors. An additional rationale for uniting these two types of connections in a single group is that in Spain they are highly intertwined: around 50% of advisors have co-authored a paper with their students. We use information on individuals' publication record to identify whether candidates and evaluators have co-authored a paper. In the case when an author of a publication can be assigned to more than one possible match, the co-authorship tie is given a weight equal to the inverse of the number of possible matches. Second, we identify *institutional* connections, c'_2. In the case of FP exams, we consider that the evaluator and the candidate have an institutional connection if at the time of the examination they are colleagues from the same university. Unfortunately we cannot observe the affiliation of candidates to AP positions at the time of the exam, we only observe the institution where they obtained their PhD. Given the low geographical mobility of Spanish professors at this stage (Cruz-Castro et al. 2006), it seems reasonable to presume that the large majority of candidates to AP positions were still based in their alma mater at the time of the evaluation. Therefore we consider that the evaluator and the candidate have an institutional connection if the candidate obtained her PhD from the university where the evaluator is based. Third, we identify *weak* ties between candidates and evaluators, c'_3, which imply some professional interaction: the evaluator was a member of the candidate's thesis committee; the evaluator has invited the candidate

[21]In our dataset 0.1% of individuals share the same name, middle name, paternal surname and maternal surname. Moreover, while registration is compulsory, according to Fuentes and Arguimbau (2010), TESEO does not include information on approximately 10% of all dissertations read in Spain.

to sit on the thesis committee of one of her students (or vice versa); the evaluator and the candidate sat on the same thesis committee. Finally, we identify several *indirect* ties between candidates and evaluators, c_4': the evaluator and the candidate have either a common advisor or a common thesis committee member or a common co-author.

We attribute only one type of connection to a given pair of individuals, following the priority order introduced above. Specifically, given that the co-authorship link is defined probabilistically, we apply the following transformation:

$$c_1 = c_1' \qquad c_3 = (1 - c_2)c_3'$$
$$c_2 = (1 - c_1)c_2' \qquad c_4 = (1 - c_3)c_4'$$

where $c_1, ..., c_4, c_1', ..., c_4' \in [0, 1]$.

The aggregation of different connections into corresponding groups (strong professional connections, institutional connections, weak ties and indirect ties) is empirically justified, since connections within each group have generally similar effects (Table A1). There seems to exist some variation in the estimated effects of different indirect links pointing out to the mixed nature of this type of ties.

Appendix B: The Expected Committee composition

In exams to 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). However, as explained in footnote 11, 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 belonging to one of these categories was drawn, the draw was not considered. Therefore, in exams where the population of potential evaluators contains two or more researchers, or two or more emeritus professors, the expected number of connections

Table A1: The role of connections, details

	1	2	3	4	5	6	7	8	9	10	11	12
	At least one connection, %			Causal effect of connections on the probability of success			Pre-exam quality of promoted candidates			Post-exam quality of promoted candidates		
	All	FP	AP	All	FP	AP	All	FP	AP	All	FP	AP
Strong connection:												
- PhD advisor	3	3	3	0.141***	0.098***	0.173***	-0.186***	-0.190	-0.156**	-0.074	0.015	-0.102
				(0.014)	(0.020)	(0.019)	(0.065)	(0.128)	(0.074)	(0.073)	(0.153)	(0.080)
- Co-author	8	10	6	0.065***	0.077***	0.051***	-0.005	-0.036	-0.015	-0.100*	-0.009	-0.206***
				(0.009)	(0.011)	(0.013)	(0.051)	(0.069)	(0.075)	(0.052)	(0.073)	(0.073)
Institutional connection:												
- Same university	26	28	25	0.040***	0.038***	0.041***	-0.065**	-0.070	-0.069*	-0.090***	-0.062	-0.115**
				(0.004)	(0.006)	(0.006)	(0.030)	(0.048)	(0.038)	(0.033)	(0.049)	(0.044)
Weak tie:												
- PhD thesis committee member	7	9	5	0.029***	0.021**	0.042***	0.002	-0.039	0.032	0.130**	0.100	0.148*
				(0.008)	(0.010)	(0.013)	(0.059)	(0.086)	(0.081)	(0.060)	(0.085)	(0.084)
- Link by invitation	4	8	0.5	0.043***	0.045***	0.020	0.015	-0.057	0.427	0.002	-0.062	0.564**
				(0.012)	(0.013)	(0.046)	(0.076)	(0.071)	(0.324)	(0.070)	(0.068)	(0.281)
- Same PhD thesis committee	10	21	2	0.009	0.006	0.046*	0.049	0.010	0.326*	0.069	0.025	0.440***
				(0.007)	(0.007)	(0.025)	(0.054)	(0.055)	(0.172)	(0.050)	(0.053)	(0.146)
Indirect tie:												
- Same PhD advisor	0.3	0.3	0.2	0.048	0.089	0.023	-0.338	-1.291***	0.286	-0.456*	-0.673	-0.331
				(0.046)	(0.086)	(0.053)	(0.334)	(0.346)	(0.479)	(0.271)	(0.426)	(0.393)
- Same co-author	14	12	15	-0.002	0.005	-0.006	-0.007	-0.096	0.035	-0.068	-0.143	-0.032
				(0.006)	(0.009)	(0.007)	(0.052)	(0.088)	(0.065)	(0.052)	(0.103)	(0.060)
- Same PhD thesis committee member	8	8	9	0.001	0.005	-0.002	0.084	0.040	0.088	0.086	0.210**	0.032
				(0.007)	(0.011)	(0.009)	(0.054)	(0.101)	(0.063)	(0.056)	(0.104)	(0.065)
Constant				0.113***	0.106***	0.118***	0.419***	0.525***	0.347***	0.457***	0.484***	0.436***
				(0.002)	(0.003)	(0.003)	(0.018)	(0.027)	(0.023)	(0.017)	(0.026)	(0.022)
Adjusted R-squared				0.012	0.012	0.013	0.002	0.004	0.004	0.004	0.003	0.012
Number of observations				31750	13612	18138	3573	1446	2127	3573	1446	2127

Notes: OLS estimates, standard errors clustered by exam are reported in parentheses. "Quality" is a factor score computed as a linear combination of publications, citations per publication, PhD theses advised, participation in PhD committees and age, weighted by the estimated importance of each factor for promotion in the corresponding disciplinary group, as reported in Table 6. By construction, the mean of candidates' "quality" is zero; variance is normalized to one. *Post-exam quality* corresponds to the five-year period following the examination.
* – p-value<0.10, ** – p-value<0.05, *** – p-value<0.01.

in the committee should be computed taking into account 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:

$$\begin{aligned}\mu =& p_R p_E(c_R + c_E + 5c_P) + p_E(1 - p_R)(c_E + 6c_P) \\ &+ p_R(1 - p_E)(c_R + 6c_P) + (1 - p_R)(1 - p_E)7c_P\end{aligned}$$

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 then 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 probabilities 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:

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

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