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Information Advantage or Bias Related to Social Ties: Evidence from a Peer Review System for National Research Grants*

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Abstract

We examine how reviewer–applicant social ties (department and university affiliation, co-applicant relationships, research field similarity) influence reviewer evaluations, based on Japanese research grant application data (2005–2016). All relationships between social ties and scores are positively correlated, even after accounting for unobservable applicant characteristics and proposal quality. Regarding bias and information advantage effects, upward deviation from department match negatively correlates with applicants' future research outputs, implying bias. Upward deviation from research field or university match positively correlates with future productivity, indicating that information advantage predicts applicants' future productivity. Information advantage through social ties is stronger for younger applicants.

Keywords: Social ties; Grant peer review; Favoritism/in-group bias; Private information; Expertise
JEL classification: D82, O32, O38

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1. Introduction

Peer review systems are the de facto standard for academic research funding, and designing them carefully is considered crucial for the efficient allocation of resources in many countries (OECD 2018). In this context, the possible distortions that may occur in peer review require constant attention to ensure the continued development of science. An ethical framework for eliminating conflicts of interest (COIs) in peer review is essential to eliminate bias arising from close relationships between reviewers and applicants. Furthermore, establishing guidelines to resolve COIs will help maintain the legitimacy of public support for academia.

However, close connections may also provide useful information for identifying creative talent, which may not be fully revealed in application documents, and improving post-acceptance research productivity. In practice, social ties play an important role in mitigating information asymmetries and lowering screening costs in the labor market (Bayer et al. 2008; Gee et al. 2017; Montgomery 1991; Pallais and Sands 2017). Therefore, disentangling the effects of bias and information advantage via social ties can help determine the optimal scope of COIs and allocate research funds efficiently. This study explores how social ties between reviewers and applicants influence reviewer evaluations using a reviewer–applicant matched dataset from the national research funding application process. It demonstrates that the current definition of COIs may be suboptimal for the efficient allocation of research funding, especially for established researchers.

Beyond occasional anecdotes, the extent to which COIs inhibit professionalism with respect to fair peer review is unknown. Reviewers who are close to applicants in terms of affiliation, research connections, or expertise may benefit from successful acceptance. For example, a successful applicant's research output may enhance their organization's reputation, or a reviewer may receive private benefits from collaborating with an applicant or participating in a workshop funded by the grant awarded to the applicant. Furthermore, reviewers may be prone to in-group bias (i.e., favoring members of their own organization, academic group, or academic discipline). Social ties can also generate favoritism or rivalries; therefore,

evaluations by those in close social proximity to applicants may be highly biased. However, closeness can also mean that a reviewer has substantial private information about an applicant's abilities, which is useful in assessing how productive the proposed project will be. Hence, their assessments may predict future research productivity more precisely, especially in research fields with a limited number of eligible reviewers.

In general, it is difficult to determine whether it is bias or information advantage that has stronger effects. Arora and Gambardella (2005) examine bias in the United States (US) National Science Foundation's review process for funding in economics and find that the affiliated institution and location continue to affect award rates, even after controlling for scores in the first review and applicants' past publications. Moreover, Feinberg and Price (2004) use similar data to show that National Bureau of Economic Research (NBER) associates have significantly higher award rates than non-NBER applicants, which suggest the influence of social networks or research group memberships in the review process.[1] However, such ties may provide useful information on research ability that may not be sufficiently identified in application documents during the review process. In fact, by analyzing the US National Institutes of Health's peer review process, Li (2017) finds that reviewer scores tend to be higher if the reviewer cites the applicant's prior work; however, the quality of funding decisions is not necessarily impaired because the benefit of the reviewers' expertise more than offsets the cost of bias.[2]

Similarly, by examining the relationships between authors and editors in four of the top five economics journals (AER, ECA, JPE, and QJE), Colussi (2018) shows that the number of publications increases when an author has social ties with an editor, compared to when they do not. Social ties are defined as previously sharing

[1] Some previous studies also report positive correlations between the declaration of COI or social ties and review scores; however, the implication of the upward bias of such ties remains vague (Marsh et al. 2008; Sandström and Hällsten 2008; Tamblyn et al. 2018).

[2] Technical closeness between reviewers and applicants alone may not guarantee the benefit of reviewers' expertise for applications in scientific fields. By examining the allocation of research funds at a US research university where evaluators were randomly assigned to a set of proposals, Boudreau et al. (2016) find that evaluators tend to assign lower scores to studies that are closer to their own field and are highly novel (i.e., what percentage of keywords are used that have not been used before in the Medical Subject Headings). This pattern is consistent with a bias due to bounded rationality toward new ideas.

an affiliation or co-authorship, having been in the same PhD program as the editor, or having been in a program where the editor was on the faculty. Social ties have a statistically significant influence, especially for those who previously shared an affiliation or where the editor was a faculty member during their PhD studies, and the literature generally shows that social ties tend to produce higher evaluations. One anecdotal explanation for positive correlations between grant awards/publications and social ties with reviewers/editors is that social ties signal potential productivity (Ductor et al. 2014; Zimmermann et al. 2018). However, the extent to which this association is driven by either bias or information advantage and how the outcomes could vary depending on the nature of the ties have not been studied. This study attempts to bridge this gap.

Specifically, we examine the administrative records of the review process for KAKENHI (grants-in-aid for scientific research) applications in the field of economics during 2005–2016. KAKENHI is the largest source of national academic research funding in Japan, and most researchers rely on this fund. This funding system is suitable for our investigation because the scope of a COI is narrowly defined. For example, the COI guidelines stipulate that simply belonging to the same department or being a faculty of the same university as the applicant does not make the reviewer an interested party. Furthermore, whether social ties to applicants constitute a COI depends largely on a reviewer's own decisions. As all reviewers are appointed before the KAKENHI applications are submitted, they may sometimes encounter closely-related applicants. In such cases, reviewers choose one of three options: (1) they declare a COI and decline the application review; (2) they do not report a COI and make every effort to evaluate the application neutrally with self-regulation; or (3) they bias evaluations to assist applicants with ties to obtain grants. In fact, our dataset contains many cases in which reviewers with close social ties to the applicants did not declare a COI, which allows us to identify the impact of social ties on review scores.

Moreover, our dataset exhibits the following strengths in examining the relationship between social ties and review scores. First, our reviewer–applicant

matched dataset contains each reviewer's score for each application, thus allowing us to directly observe the variation of review scores *within* an application proposal wherein the applicant is with/without social ties. Second, because the number of reviewers is relatively small, each reviewer is responsible for many applications, which allows us to eliminate any estimation bias caused by unobservable reviewer characteristics by including reviewer fixed effects. As a result, the observed variation in social ties allows us to identify the influence of ties in several dimensions, including affiliation with the same department/university, past co-applicant relationship, and primary research field.

In our estimation, we find that four ties are positively correlated with scores: department match, university match, past co-applicant match, and research field match, even when application dummies are included to account for proposal quality/unobservable applicant ability. The correlation for department match is the highest among the four social ties. To examine whether a positive correlation is attributable to either expertise or bias, we further test whether the predictive power of a review score for an applicant's future research productivity is weaker or stronger for reviewers with strong social ties to applicants compared to the scores of other reviewers. We find strong evidence of bias only for department match and substantial evidence of information advantage for university match and research field match. In particular, such advantages of social ties are strongly observed for younger applicants. The potential distortion due to biased information is not negligible. If all reviewers who were in the same department as the applicant declined to review proposals, 6%–12% of formally awarded applicants in the same department as one of the reviewers would be replaced by formally rejected applicants with no such ties.

These results suggest that in a system that relies on voluntary declaration of COIs, reviewers from the same department as the applicant run a high risk of introducing bias, whereas in the case of other social connections, the accuracy of evaluation is likely to be enhanced. In particular, social ties may be effective in allocating research funds efficiently to younger researchers, whose research capability is less

known because of their limited publication records.

The remainder of this paper is organized as follows: Section I explains the KAKENHI system, Section II describes the dataset and construction of social tie variables, and Section III shows the estimations between social ties and review scores. Section IV presents the estimations between review scores and predicting future outputs. Section V explains the simulation of the impact of COI policy change on grant acceptance, and Section VI presents the conclusions.

2. KAKENHI

KAKENHI is the largest academic research fund in Japan, with an annual budget of 249 billion yen (2.2 billion US Dollars) in 2021. The fund is managed by the Japan Society for the Promotion of Science (JSPS) and covers all disciplines and fields, including humanities, social sciences, and natural sciences. We focus on several categories of the KAKENHI program, which differ primarily by the project budget, age limit, and numbers of reviewers, as shown in Table A1 in Appendix A.[3] The Grants-in-Aid for Scientific Research (B) and (C) (hereinafter, GSR-B/C) have different budgets but no age limit. The Grant-in-Aid for Young Scientists (S) (A) (B) and Grant-in-Aid for Young Scientists start-up (hereinafter, GYS-S/A/B and GAS, respectively) were additionally established to support independent research by young researchers and are subject to age limits. A researcher can apply for the KAKENHI only once a year as a principal investigator.

The KAKENHI application process has a two-stage review system. In the first stage, reviewers independently rate assigned applications. In the second stage, a different set of reviewers (except for GAS, which uses the same reviewers for both stages) gather to discuss and make final decisions based on the average scores provided by the first-stage reviewers. As we focus on review scores in the first stage, we describe the process in detail below. Although the influence of any potential bias

[3] We exclude the Grants-in-Aid for Scientific Research (S) and (A) categories from our analyses because applications for those categories are grouped together with applications in different disciplines and assessed by a panel of reviewers selected from multiple social science disciplines.

in the first stage on the final decision may be attenuated in the second stage, first-stage review scores are still crucial in deciding awardees because the second-stage reviewers only replace applicants around the cutoff line, given the number of awardees derived from the pre-determined KAKENHI budget.

In the first stage, three to six reviewers, who do not know each other's identities, independently score each proposal in the assigned grant applications. The number of reviewers varies depending on the KAKENHI categories mentioned above. The larger the budget category that a researcher can propose, the larger the number of reviewers (Table A1, Appendix A). Reviewers rate applications on a five-point scale: 5 indicates an excellent research proposal that should be given top priority, 4 indicates an excellent research proposal that should be prioritized, 3 indicates good research that may be adoptable, 2 indicates research that is somewhat deficient for adoption and should be given low priority, and 1 indicates a research proposal that is inadequate for adoption. All reviewers are required to match their composition of scores to a fixed distribution: 5 = 10%, 4 = 20%, 3 = 40%, 2 = 20%, and 1 = 10%.[4]

Groups of first-stage reviewers are formed within each subfield so that the reviewers' expertise matches the proposal's research area. The economics comprises seven subfields: economic theory (3801), economic doctrines/economic thought (3802), economic statistics (3803), economic policy (3804), public finance/public economy (3805), money/finance (3806), and economic history (3807). Hence, for economics proposals, at least seven reviewer groups are included in the first stage within each category.[5] However, as shown in Table A2 in Appendix A, the seven subfields are not as finely divided as the research fields commonly used in economics, indicating that, in practice, reviewers are not always

[4] To further ensure fairness in scoring, JSPS adjusts for the differences in the score distribution variance across reviewers by normalizing them using the formula: $Tscore_{ij} = \frac{(score_{ij} - \overline{score}_j) \times 0.6}{\sigma_j} + 3$, where $score_{ij}$ is the score given by reviewer j for applicant i, and σ_j is the sample standard deviation of all scores given by reviewer j. This adjusted score is called the "*T-score*." Reviewers in the second stage discuss potential awardees based on the T-score.

[5] As subcategories are sometimes changed, the subcategories shown are from 2016.

experts on the issues discussed in the proposals.[6] For example, an economist specializing in macroeconomics assigned to the economic theory reviewer group would need to assess proposals on microeconomics or behavioral economics as well as macroeconomics, whereas a labor economist assigned to the public finance/public economics group would be required to evaluate not only labor economics but also public finance or law and economics proposals.

The JSPS appoints reviewers for each subfield before the review process begins, and their term is up to three years. It uses a single-blind system in which the names of the appointed reviewers are not disclosed until the end of the term. They are selected from the JSPS reviewer candidate database, which includes past KAKENHI awardees and researchers nominated by academic associations. Potential reviewers must fulfill the following criteria: (a) understand the KAKENHI grant system, be familiar with the research field, and have fair and sufficient evaluation skills; and (b) be a university professor or an associate professor or possess equivalent knowledge in the relevant academic research field.[7] Therefore, reviewers are senior researchers (in our dataset, 89% of reviewers are professors and 9% are associate professors). Furthermore, because a reviewer group cannot have more than two reviewers affiliated with the same institution, reviewers are selected from a wide range of universities and institutes, such as private universities or research institutes as well as national universities. Thus, reviewers are not skewed toward a small number of research universities.

The review process for KAKENHI is as follows. There is a limited number of reviewers relative to the number of applicants, which results in some reviewers being burdened by considerable workloads when reviewing proposals. On average, one reviewer handles 45 proposals; however, this varies greatly, with a maximum of 150 proposals per reviewer. When a reviewer must evaluate a large number of proposals in a short period of time (approximately 40 days; as the term is from

[6] Applicants applying for GYS-B have been able to select subfields outside of their primary discipline since 2013 due to JSPS efforts to encourage interdisciplinary research. This has further increased the potential for mismatches that could result in reviewers failing to properly assess a proposal's potential value.

[7] The criteria were changed in 2018, and the JSPS actively promotes appointments of young researchers and women.

December to January, they mostly have to spend their Christmas and New Year vacations doing so), they have less time to spend on each proposal and make judgments based on "system 1" or their impressions of the application (Kahneman 2013; Tversky and Kahneman 1974).[8] This makes reviewers more susceptible to the halo effect, in which their decisions may be influenced by easily observable attributes, such as an applicant's affiliation, past publications, or co-author network.

If reviewers come across an application from a researcher that involves a vested interest, they report a COI to the JSPS and voluntarily decline to review it. A potential COI could include situations such as (1) being listed on the application as an applicant, co-investigator, or collaborator and (2) having a relationship with an applicant, co-investigator, or collaborator as follows: (a) sharing kinship or its equivalent; (b) being a close collaborator on other projects; (c) being affiliated with the same research unit; (d) having a close mentor–protege or direct employment relationship; and (e) having a conflictual or competitive relationship in which acceptance or rejection of the research proposal or its evaluation may be considered to be in the evaluator's direct interest. However, as mentioned above, the guidelines also state that a COI is not perceived too broadly, and simply belonging to the same department, faculty, or division does not constitute a COI.[9] Thus, reviewers are allowed discretion in deciding whether a relationship with an applicant constitutes a COI. As discussed below, almost two-thirds of the reviewers who are in the same department as an applicant do not report this as a COI. Reasons for low COI reporting may be that reviewers are overconfident in believing that they will not be influenced by the potential COI or that they are pursuing private interests. Finally, if a reviewer declines to score an application because of a COI, the average score is calculated based on scores provided by other reviewers.

[8] System 1 is a mode of thinking that relies on heuristics and assesses a variety of information quickly without the conscious mind being actively involved. However, various shortcuts used in this thinking mode undermine its efficiency, thereby generating biases in human judgment.

[9] This is because of the depth of the researcher pool. In Japan, the number of researchers is smaller than in the US; therefore, if colleagues are excluded, it may be difficult to find people who can appropriately review the data.

3. Data

In this study, we use administrative records on managing the KAKENHI review process provided by the JSPS.[10] The data cover all reviewer–applicant matched pairs for applications in the field of economics submitted to the KAKENHI program during 2005–2016 and include the affiliations and positions of all applicants and reviewers and their scores. We omit applicants in non-academic positions because of the considerable heterogeneity that exists in terms of experience and availability of alternative funds, and the definition of "colleague" may differ from that in a university setting.[11] Additionally, we collect the applicants' research papers and forward citations from Scopus using their names to measure their past and future outputs. In this process, it is necessary to omit some applicants with extremely common names because it is not possible to distinguish between publications by individuals with the same name. Our final sample comprises 52,591 observations of reviewer–applicant matched pairs, with 4,593 applicants and 577 reviewers, for applications during 2005–2016.

3.1. Measuring Social Ties

We focus on four social ties: same affiliation at the university level, same affiliation at the department level, past collaborative research relationships, and research field commonality. First, to measure whether reviewers and applicants are colleagues at the same institution, we use matches in their affiliations at the time of submission of the application, based on our main dataset. The dataset includes affiliated departments as well as universities; therefore, we use two social tie variables: university match and department match. Although both matches indicate collegiality, a department match would likely create a much closer relationship because colleagues in the same department work together, teach the same students,

[10] We have an agreement with the JSPS to use the data with permission from the Ministry of Education, Culture, Sports, Science and Technology.
[11] In this procedure, 3% of the sample observations are excluded; however, the main results are not affected when we use the whole sample.

attend meetings together, and typically have offices in the same building.

We expect that in-group bias or favoritism caused by department/university match may induce greater upward bias in reviewer scores, whether consciously or unconsciously. Furthermore, reviewers may directly benefit from additional resources, such as administrative support for collaboration with the awardee or more seminar talks funded by KAKENHI. Another possible concern is that reviewers may face resentment, or even retaliation, following the rejection decision because their names are disclosed at the end of their term. Conversely, professional envy or rivalry may create a downward bias in a reviewer's score, especially if the applicant and reviewer are engaged in a conflict. Nevertheless, as the applicant's colleague, a reviewer in the same department would have much more information about their research capabilities compared to reviewers from outside the department and can, therefore, more accurately judge the value of the proposal.

Second, to measure the research connection between reviewers and applicants, we use their past collaboration, as either a principal or co-investigator, on a project supported by KAKENHI funding as an indicator.[12] Researchers who have participated in the same KAKENHI project in the past are likely to have maintained close ties and know each other's research capabilities very well. When reviewers encounter proposals from past collaborators, they may provide upward-biased scores simply because they have more personal information about the applicant or because they expect to directly benefit from funding provided to a project led by someone close to them. To construct this variable, we use the publicly available KAKENHI database, which differs from our main dataset, to obtain a list of KAKENHI awardees and their co-applicants and match it to our proprietary dataset.[13] Using this database, we identify 89 reviewer–applicant pairs who have previously collaborated as either principal or co-investigators on the same KAKENHI projects. As we explain below, almost half of these 89 reviewers with past collaboration ties declined to review the relevant applications citing COIs,

[12] We also examine research connections between reviewers and applicants based on past co-authorship of academic papers; however, the number of such connections is limited partly because such reviewers often decline the review.
[13] The KAKEN database is available here: https://kaken.nii.ac.jp/en/.

further limiting the number of observed cases involving such social ties.

As mentioned above, reviewers are not always experts in the applicants' research fields because review groups are assigned various kind of research fields. Therefore, as the third dimension of social ties, we aim to measure the distance in expertise between applicants and reviewers. However, measuring the degree of expertise match between reviewers and applicants poses some challenges. We use paper presentation records from the semi-annual meetings of the Japan Economic Association (JEA), which classify paper presentations into primary categories from the Journal of Economic Literature (JEL) classification system during 1975–2009.[14] We collect all presenter and discussant JEL codes from all meetings and merge them with our reviewer–applicant dataset. We define a researcher's main field as the one in which they have presented or discussed most frequently. Then, the field match variable is constructed as an indicator of whether the reviewer's research field matches that of the applicant. Thus, the variable being equal to one indicates that a reviewer has sufficient expertise to judge a proposal's quality.[15]

A problem with using JEA participation records is that not all applicants and reviewers are JEA members or have previously been presenters or discussants at JEA meetings. Only 70% and 39% of the reviewers and applicants, respectively, are JEA members, and the data indicate that only 11% of non-JEA members previously attended JEA meetings as presenters or discussants. JEL codes cannot be assigned for non-participants. The percentage of JEA members is low because (1) economists specializing in economic history, regional studies, and Marxist economics rarely join the association; (2) applicants in GYS-B can choose a second subfield other than economics, which leads to non-economists being included as reviewers; (3) some researchers in interdisciplinary domains submit proposals in the field of economics; and (4) researchers who are not active in research activities

[14] JEA 75-year anniversary webpage (http://www.jeameetings.org/75/jea_data_open.html).

[15] Researchers for whom the presenter and discussant numbers are equal in multiple fields are considered to belong to the field that comes first in the alphabetical order of the JEL codes. To mitigate the potential bias caused by this rather arbitrary definition, we calculate *technological distance* between reviewers and applicants using the method proposed by Jaffe (1986) (i.e., the share of common fields between applicants and reviewers). The main results remain consistent in Table A5 in Appendix A.

and thus unlikely to be awarded the grant still submit proposals, as their internal research funding amount varies with the KAKENHI application. Nonetheless, using JEA participation records provides the highest coverage of applicants and reviewers compared to other methods such as using JEL codes in research papers or keywords from awarded KAKENHI projects.

Research field match is set to zero for non-participants. To adjust for missing values among non-JEA participants, a JEA participation dummy and JEA participation match (between applicants and reviewers) are included in all the estimations. These variables should also correct for any potential selection bias, in that researchers within each subfield who present or discuss papers at JEA meetings tend to be more productive than those who do not. We further repeat the main analyses excluding non-JEA participants and confirm that the results remain consistent (Table A5, Appendix A).

4. Effects of Social Ties on Review Scores

4.1. Estimation Strategy for the Effects of Social Ties on Review Scores

We first estimate the influence of social ties between reviewers and applicants on review scores using the following equation:

$$Score_{ijt} = \beta_1 University\ Match_{ijt} + \beta_2 Department\ Match_{ijt} + \beta_3 Past\ coapplicant\ Match_{ijt} + \beta_4 Research\ field\ Match_{ijt} + X_{it}\gamma + X'_{jt}\gamma + \lambda_i + \mu_j + \nu_t + \varepsilon_{ijt}, \quad (1)$$

where the dependent variable $Score_{ijt}$ is the reviewer j's score of applicant i's research proposal in year t. Four social ties are used as independent variables to capture close relationships between reviewers and applicants. $University\ Match_{ijt}$ indicates that both applicant i and reviewer j are affiliated with the same university in year t, and $Department\ Match_{ijt}$ means that both are in the same department of the university in year t. As $Department\ Match_{ijt} = 1$ automatically implies $University\ Match_{ijt} = 1$, the coefficient of the first is the additional effect conditional on the second when

both variables are included. $Past\ coapplicant\ Match_{ijt}$ is an indicator of whether applicant i and reviewer j were previously principal or co-investigators on the same KAKENHI project and captures collaboration experience between the pair. $Research\ field\ Match_{ijt}$ equals one if both reviewer and applicant have the same JEL field; otherwise, this variable equals zero. Furthermore, to control for limited matching of the research field variable, we add JEA participants' match variables, which indicate that both the reviewer and applicant participated in a JEA meeting at least once, as explained above.

X_{it} is a vector of applicant i's characteristics, including gender, nationality (Japanese versus foreigner), publications in the past five years, dummy for KAKENHI grant awarded in the past five years, JEA membership dummy, applied subfield dummies, university dummies, and position title dummies. X'_{jt} is a vector of reviewer-related controls, including reviewer dummies and reviewer university dummies. The inclusion of university dummies is critical because reviewers are not selected at random across universities. Although multiple reviewers are never selected from the same institution, concerns may exist regarding whether reviewer selection is skewed toward a few research universities. In such cases, a university or department match may simply represent the university's quality. Thus, the university fixed effect is included to control for the quality of the universities that reviewers and applicants belong to.[16]

We also include the applicant fixed effect λ_i, reviewer fixed effect μ_j, and year fixed effect ν_t. Finally, in some specifications, we include the application fixed effect λ_{it} instead of the applicant fixed effect to fully account for research proposal quality. Table 1 shows the summary statistics for the estimation sample. The average review score is approximately 3, showing that reviewers score according to a given distribution. Of the applicants, 32% are finally awarded the

[16] Including the affiliation fixed effects may not completely correct for bias if the universities/departments where productive researchers are concentrated differ across subfields. To alleviate this concern, we examine the distribution of reviewers to demonstrate that they are not as skewed as one may assume. Even the university with the largest number of reviewers accounts for only 7% of the total. In our final sample, the percentages of reviewers from the top 7 universities, the next 19 universities, and all other universities are 39%, 34%, and 27%, respectively.

KAKENHI grant. Notably, the overall percentage of applicants having social ties with reviewers is small: university match is 1.7%, department match is 0.9%, past co-applicant relationship is 0.2%, and research field match is 6.2%.[17]

[Insert Table 1 Here]

Prior to the formal analysis, it is important to examine the extent to which these incidents of reviewer–applicant ties in the review process are self-selected because reviewers can decline offers to review applications if they perceive a COI. Table 2 shows the decline rate for each social tie—same affiliation, former research collaboration, and primary research field match—between reviewers and applicants. The probability of declining a review conditional on the presence of a social tie is the highest when the reviewers have participated in joint research with applicants in the past, at approximately 50%. When both are affiliated with the same department, reviewers decline to review in only one-third of the cases. When they are affiliated with the same university as the applicants but in different departments, reviewers declare a COI in only 10% of the cases. Where an overlap in research field is present, reviewers decline only 4% of the cases.

[Insert Table 2 Here]

We also estimate the probability of declining as a function of social ties to control for other characteristics using ordinary least squares estimation, as shown in Table 3. The marginal effects are all consistent with those in Table 2, with previous joint research being the highest (0.40–0.42), followed by department match (0.22–0.23). The other two ties are less connected in terms of COI. In particular, the low decline rate for research field match (0.02–0.03) suggests that being in the same research field alone does not lead to a relationship close enough that the reviewer and

[17] The correlation matrix for the variables is presented in Table A3 in Appendix A.

applicant must report a COI.

[Insert Table 3 Here]

Furthermore, the probability of declining is significantly correlated with past publications or other reviewers' average scores. Thus, reviewers are more likely to declare a COI when applicants' future outputs are expected to be high. In response to the concern that our estimation of Equation (1) may be biased due to self-selection of a COI declaration, we use Heckman's two-stage model with the declaration of COI as the selection equation in our main analysis as a robustness check.[18]

4.2. Results for the Effects of Social Ties on Review Scores

Figure 1 plots the distribution of scores with social ties in comparison with the pre-determined standard distribution set by the JSPS, i.e., scores from 1 to 5 are distributed with probabilities of 10%, 20%, 40%, 20%, and 10%, respectively. The distributions with social ties are significantly more skewed to the right for university match, department match, and past research collaboration compared to those for the scores without ties. The distribution is also slightly skewed to the right when reviewers and applicants share a primary research field. Such a skewed distribution may be caused by bias derived from favoritism, in-group status, or direct interest; however, social ties are not randomly assigned among the applicants. An applicant with ties may have inherently superior proposals or innate abilities because they are in popular research fields, or superior researchers may have broader social networks (Ductor et al. 2014).

[Insert Figure 1 Here]

In controlling for such possibilities, Figure 2 presents the distribution of scores

[18] The excluded variables are the reviewer's past publications and number of assigned applications.

with and without social ties, restricting the sample to applicants who have some social ties with at least one of the reviewers. For the same applicant, the scores of reviewers with social ties as well as those without social ties are skewed to the right, indicating that applicants having social ties with at least one reviewer tend to have higher quality proposals or stronger research abilities. Reviewers who have shared department/university affiliations or previous collaborations on KAKENHI projects with applicants tend to provide higher scores than do those without such ties. In contrast, a research field match does not lead to considerable differences in the review score distributions between those with and without ties. However, t-tests for the four social ties show a significant difference at the 5% level, including the research field match.

[Insert Figure 2 Here]

In the following analysis, we estimate Equation (1) to examine whether such a skewed distribution is confirmed after jointly controlling for observable applicant characteristics. The dependent variables are scores and four binary variables indicating $score = 5, score \geq 4, score \geq 3,$ and $score \geq 2$ to find the direction of skewness. Table 4 shows the results with three different error specifications that account for time-invariant unobservable application/reviewer characteristics: all fixed effects except for the applicant and application fixed effects in Column 1, all fixed effects except for the application fixed effect in Column 2, and application, reviewer, and reviewer university fixed effects in Columns 3–8. The last specification allows us to control for unobservable proposal quality; thus, the social tie coefficients capture the deviation from other reviewers' average scores, as presented in Column 3, which is the most preferred model specification. Column 4 shows the results without department match included. Columns 5–8 show the results with binary variables added.

[Insert Table 4 Here]

The university match coefficient lies between 0.12 and 0.16, which is high and significant, when controlling for department match in Columns 1–3; however, without department match, the coefficient increases to 0.24 in Column 4. Reviewers affiliated with the same university as the applicants give 0.14 higher scores on average than those without such an affiliation, according to our preferred specification shown in Column 3. Furthermore, the department match coefficient is between 0.16 and 0.17 when only controlling for applicant characteristics or applicant fixed effects but increases to 0.23 after application fixed effects are added. Column 3 shows that department-level social ties have a stronger effect on reviewer score than do those at the university level, and when the two effects are combined, reviewers from the same department as the applicants have 0.37 (= 0.14 + 0.23) higher scores than the others without any match. In addition, both affiliation match variables have the highest marginal effects between 3 and 4 points, as shown in Column 6. This implies that the affiliation effect should significantly influence the likelihood of obtaining a KAKENHI grant because the average threshold for the award is a score between 3 and 4 points.

The past joint research coefficient is between 0.23 and 0.34, which is the highest among the four social ties. The marginal effect is also the highest and only significant between 3 and 4 (Column 6). Reviewers are more likely to give scores of 4 rather than 3 to applicants with whom they have previously collaborated. The research field match coefficients are small but remain significant for all specifications in Columns 1–4. Furthermore, the marginal effect is larger between scores of 5 and 3 and most significant between scores of 4 and 5. This indicates that reviewers with expertise in the application's research field tend to give a maximum score of 5 more frequently compared to other reviewers.

Column 1 presents other notable findings. First, the score rises with an increase in past publication records and is higher for past KAKENHI grant recipients. This finding is reasonable because proposal quality is likely to be correlated with these variables. Second, scores are 0.06 points higher on average for women after

controlling for university quality and past publications. This may be the result of a shared perception that female researchers are disadvantaged and thus need to be supported. Third, scores are 0.09 points lower on average for foreigners compared to Japanese nationals. We are unsure whether this phenomenon is a sign of discrimination; however, it may be exacerbated by many foreign-born researchers submitting applications in English, which may cause some Japanese reviewers to experience difficulties in judging the quality within a limited timeframe.

Finally, in Column 9, we use Heckman's two-stage model to correct for potential selection bias because of the endogenous declaration of COI. The inverse Mills ratio has no significant coefficients, and thus, the first stage results are not included in the table. The coefficients for the four social ties remain almost identical regardless of whether Heckman's bias correction is used. This indicates that the endogeneity of COI declaration is unlikely to be a source of bias for the estimated relationship between social ties and review scores.

5. Reviewers with Social Ties: Bias Versus Information Advantage

5.1. Relationship Between Social Ties and Evaluation Quality

The above estimations show that, compared to other reviewers, reviewers who have social ties with researchers tend to provide higher ratings to the applications submitted by them. This upward deviation may reflect favoritism, in-group bias, or self-interest to obtain direct benefits or could result from these reviewers possessing better information about applicants' research capabilities. Moreover, the effects of reviewers having better information could play an especially important role for young researchers with shorter publication records and less experience in writing grant applications. If information advantage can explain most of the score variation within applications, the effect should be most pronounced for a research field match. Specifically, reviewers whose primary research field overlaps with that of the applicants should assess proposals more accurately, whereas those whose primary

research field is considerably different from that of the applicants may be unable to confidently assess applications and thus attenuate their scores toward the mean. This would explain the results in Table 4, which show that research field match is strongly associated with the maximum score dummy (i.e., score = 5) compared to other ties.

To distinguish between the two effects, we examine how social ties affect the predictive power of review scores for future research outputs. We first explain the idea underlying this approach using a simple model. Let s_{ij} be reviewer j's honest score of applicant i's research proposal, which follows a normal distribution. When the first has no social ties with the second, s_{ij} has a mean of a_i and precision τ_j, where a_i is the ability of applicant *i.* When reviewer j and applicant i have social ties, the score precision changes to $\tau_j' \in [\underline{\tau}, \overline{\tau}]$, where $\underline{\tau} < \tau_j < \overline{\tau}$, and the mean score improves to $d_{ij}a_i$, when $d_{ij} \in [1, d]$. To better distinguish between the effects of bias and expertise, we parameterize τ_j' and d_{ij} as follows:

$$\tau_j' = t\underline{\tau} + (1-t)\overline{\tau} \text{ and } d_{ij} = td + 1 - t,$$

where $\mathrm{t} \in [0, 1]$. Note that t is the degree to which reviewer j's score is biased. When $t = 0$, reviewer j's score is unbiased, and their assessment is more accurate than that of reviewers without social ties to applicant i. When $t = 1$, the score can be significantly biased because reviewer *j* has a strong COI, and score accuracy is exacerbated by the uncertainty surrounding reviewer *j*'s professional ethics preventing the score from being biased. Depending on the nature of the social ties, t could take any value between 0 and 1.

Let s_{i-j} be the average of other reviewers' scores of applicant i's proposal, and s_{i-jt} is normally distributed with a mean of a_i and precision τ_{-j}. Let y_i be future research output; we assume that $y_i = \alpha + \beta a_i + \varepsilon_i$, where ε_i is the error term with a mean of zero, which is uncorrelated with s_{ij} and s_{i-j}.

When reviewer j and applicant i have no social ties, it can be seen that

$$E\left[y_i \middle| s_{ij}, s_{i-j}\right] = \alpha + \beta E\left[a_i \middle| s_{ij}, s_{i-j}\right] = \alpha + \frac{\beta\tau_j}{\tau_0+\tau_j+\tau_{-j}} s_{ij} + \frac{\beta\tau_{-j}}{\tau_0+\tau_j+\tau_{-j}} s_{i-j}. \quad (2)$$

When reviewer j and applicant i have social ties,

$$E[y_i|s_{ij}, s_{i-j}] = \alpha + \beta E[a_i|s_{ij}, s_{i-j}] = \alpha + \frac{\beta\tau_j'}{\tau_0 + \tau_j' + \tau_{-j}}\frac{s_{ij}}{d_{ij}} + \frac{\beta\tau_{-j}}{\tau_0 + \tau_j' + \tau_{-j}}s_{i-j}$$
$$= \alpha + \frac{\beta[t\underline{\tau}+(1-t)\overline{\tau}]}{\tau_0+t\underline{\tau}+(1-t)\overline{\tau}+\tau_{-j}}\frac{s_{ij}}{td+1-t} + \frac{\beta\tau_{-j}}{\tau_0+t\underline{\tau}+(1-t)\overline{\tau}+\tau_{-j}}s_{i-j}. \quad (3)$$

Note that the coefficient of s_{ij} in the second equation, $\frac{\beta[t\underline{\tau}+(1-t)\overline{\tau}]}{\tau_0+t\underline{\tau}+(1-t)\overline{\tau}+\tau_{-j}}\frac{1}{td+1-t}$, decreases in t from $\frac{\beta\overline{\tau}}{\tau_0+\overline{\tau}+\tau_{-j}}$ for $t=0$ to $\frac{\beta\underline{\tau}}{\tau_0+\underline{\tau}+\tau_{-j}}\frac{1}{d}$ for $t=1$. Similarly, the coefficient of s_{i-j} in the second equation, $\frac{\beta\tau_{-j}}{\tau_0+t\underline{\tau}+(1-t)\overline{\tau}+\tau_{-j}}$, increases from $\frac{\beta\tau_{-j}}{\tau_0+\overline{\tau}+\tau_{-j}}$ for $t=0$ to $\frac{\beta\tau_{-j}}{\tau_0+\underline{\tau}+\tau_{-j}}$ for $t=1$. By comparing the coefficients with those for the case in which reviewer j and applicant i have no social ties,

$\frac{\beta\underline{\tau}}{\tau_0+\underline{\tau}+\tau_{-j}}\frac{1}{d} < \frac{\beta\tau_j}{\tau_0+\tau_j+\tau_{-j}} < \frac{\beta\overline{\tau}}{\tau_0+\overline{\tau}+\tau_{-j}}$ and $\frac{\beta\tau_{-j}}{\tau_0+\overline{\tau}+\tau_{-j}} < \frac{\beta\tau_{-j}}{\tau_0+\tau_j+\tau_{-j}} < \frac{\beta\tau_{-j}}{\tau_0+\underline{\tau}+\tau_{-j}}$.

These results have the following implications:

a. When the applicant and reviewer have social ties that give reviewers an information advantage rather than introducing a bias (i.e., t is closer to zero), s_{ij} has stronger predictive power and s_{i-j} has weaker predictive power for the applicant's future research productivity than for those who do not have such ties.

b. When the applicant and reviewer have social ties that introduce bias rather than giving reviewers an information advantage (i.e., t is closer to one), s_{ij} has weaker predictive power and s_{i-j} has stronger predictive power for the applicant's future research productivity than those who do not have such ties.

c. When the applicant and reviewer have social ties that result in both information advantage and bias, the predictive power of s_{ij} and s_{i-j} may not significantly differ from the case wherein reviewer j and applicant i have no social ties.

Therefore, we can determine whether it is information advantage or bias that is

more responsible for a greater upward divergence in review scores by regressing future research output on the score of the focal reviewer with/without social ties and the average of other reviewers' scores for the same applicant.[19] Thus, we estimate future productivity conditional on review scores flexibly, in that the weight of the focal reviewer's score depends on four social tie variables. We precisely estimate the following equation:

$$Future\ Output_{ijt} = \beta_1 University\ Match_{ijt} \times Score_{ijt} + \beta_2 Department\ Match_{ijt} \times Score_{ijt} + \beta_3 Past\ Coapplicant\ Match_{ijt} \times Score_{ijt} + \beta_4 Research\ field\ Match_{ijt} \times Score_{ijt} + \beta_5 Score_{ijt} + \beta_6 University\ Match_{ijt} \times Other\ reviewer\ score_{ijt} + \beta_7 Department\ Match_{ijt} \times Other\ reviewer\ score_{ijt} + \beta_8 Past\ Coapplicant\ Match_{ijt} \times Other\ reviewer\ score_{ijt} + \beta_9 Research\ field\ Match_{ijt} \times Other\ reviewer\ score_{ijt} + \beta_{10} Other\ reviewer\ score_{ijt} + \beta_{11} KAKENHI + \gamma X_{it} + \mu_j + \varepsilon_{ijt}. \quad (4)$$

In Equation (4), we use two future output measures as dependent variables. One is the logarithm of the number of publications (plus one) within five years from the application year *t* as a measure of future output quantity. The other is the logarithm of the weighted number of publications (number of publications + number of citations) within five years from the application year *t* to consider future output quality. $Score_{ijt}$ is the score of applicant i is the research proposal given to reviewer j in year t. $Other\ reviewer\ score_{ijt}$ is the average of two to five reviewers' scores for applicant i in year t, excluding the score by reviewer j. Furthermore, to control for the impact of successful funding itself, we add KAKENHI, the indicator of whether a KAKENHI grant has previously been awarded. X_{it} is a vector of control variables as used in Equation (1). The positive and negative coefficients of the cross-terms, $\beta_1 - \beta_4$ and $\beta_6 - \beta_9$, respectively, imply that social ties provide reviewers with an information advantage in evaluating applications, whereas coefficients with opposite signs suggest that social ties add noise to review scores presumably because of favoritism, in-group bias, or self-interest.

[19] Academic research is inherently risky and sometimes unpredictable; thus, projects that appear strong during evaluation may not always achieve their expected outcomes. However, Li and Agha (2015) demonstrate that the average score of multiple reviewers is generally a good predictor of future outputs.

Table 5 shows our results using the total sample with the KAKENHI dummy in Columns 1 and 4, a subsample of applicants awarded KAKENHI grants in Columns 2 and 5, and a subsample of applications not awarded KAKENHI grants in Columns 3 and 6. A few notable results emerge. First, as shown in Columns 1, 2, 4, and 5, the coefficients of the cross-term for research field match with the focal reviewer are positive and strongly significant, and those with the other reviewers are negative and strongly significant for the total sample and the subsample of awardees for both quantity and quality measures, implying that reviewers in the same research field as the applicant possess better information for predicting the applicant's future outputs than do other reviewers, especially among awardees.

[Insert Table 5 Here]

Second, the coefficients of the cross-term for department match with the focal reviewer (other reviewers) are significantly negative (positive) in Columns 1, 3, 4, and 6. When reviewers are in the same department as applicants, their reviews are less informative in predicting future outputs. This negative correlation is especially high for unsuccessful applicants. These results clearly indicate that reviewers provide upward-biased scores when they are in the same department as the applicant. However, the resulting distortion in the award decision may be limited because the negative coefficient is small and insignificant among awardees. We confirm this using a counterfactual analysis in Section V.

Third, in contrast to the above, the coefficient of the cross-term for university match is positive for the total sample, implying that reviewers at the same university, but not in the same department as the applicant have better information to judge the application and less incentive to conduct a biased review. The lack of incentive is because they do not directly benefit from successful applications in a different department or because interdepartmental rivalry could reduce in-group bias.

Fourth, we find no significant results for past co-applicant match, which may be somewhat unexpected, given the highly skewed review score distribution shown in

Figure 2 for reviewers with a past co-investigator relationship with applicants. This may mean that the negative effect of bias caused by favoritism and in-group status offsets the positive effect of better information. Unlike for department match, reviewers may not enjoy positive spillover from a past co-investigator acquiring a research grant; thus, despite strong social ties, their positive aspect may be equally dominant. In fact, this variable is significant in separate regressions presented in the next section, in which we divide the sample by younger applicants' academic positions. Finally, to assess the robustness of the measurement of research field dummies, we estimate the other specification or a different sample in Tables A4 and A5, respectively. The basic results in Table 5 remain consistent.

5.2 Importance of Social Status

The relationship between social ties and review quality could depend on the social status of applicants and reviewers. Specifically, the value of additional information and benefit/cost of biased scoring may be affected by an applicant's ability as revealed in the academic community and the reviewer' status and reputation in the organization. We explore the impact of their social status using the data available.

We divide the sample into two groups according to the applicant's academic position—professors versus associate professors and below—which can be a proxy for age and experience. The professors are older and more established, whereas lower-ranked researchers are younger and have shorter track records. As almost all reviewers are professors, applicant and reviewer relationships are more equal in the first sample. The results are shown in Table 6, where Panels A and B present the results for professors and associate professors and below, respectively. Notably, the impact of social ties, whether positive or negative, is significantly greater for associate professors and below in Panel B. These results are reasonable when the coefficients are positive because information revealed in a research proposal is limited for lower-ranked professors; thus, an information advantage arising from reviewers with social ties to the younger applicant leads to stronger predictive power.

[Insert Table 6 Here]

The significantly weak predictive power for review scores given to lower-ranked professors by reviewers in the same department as applicants may suggest that review scores are more subject to favoritism/in-group bias or direct interest. The effect of a past co-investigator relationship also differs depending on whether the applicant is a full or lower-ranked professor, being negative for the first and positive for the second, respectively. This explains why the coefficient of past co-applicant match is not significant in the estimations presented in Table 5. In the sample of full professors, review scores are presumably more influenced by favoritism, in-group bias, or direct interest, as they are closer in age. In contrast, reviewers accurately score applications from younger researchers with whom they have collaborated on past KAKENHI projects. This pattern is clearer when we divide the sample by whether the doctoral degree-awarding years are close for the applicant and reviewer—negative for homogeneous pairs and positive for heterogeneous ones (see Table A6 in Appendix A). Furthermore, a similar pattern is observed when the KAKENHI categories for less-established younger researchers (GYS-B and GAS) are used as a subsample (see Table A7 in Appendix A).

Collectively, the above estimations indicate that different social ties have varying predictive power for future productivity, regardless of the same upward bias observed in our evaluation across social ties. In line with this finding, while a department match in which reviewers and applicants share many interests may have a significant negative impact, other social ties, such as affiliation with the same university but different departments or sharing the same research field, may be preferable. Furthermore, this information advantage is more profitable for younger researchers.

6. Effects of COI Policy Change

Thus far, the analysis has consistently shown that assigning a reviewer from the

same department as the applicant is problematic. A question persists as to the potential impact of policy changes to prohibit such assignments on the outcome. This also provides insights on the extent to which the department match affects actual research grant allocation. To investigate this question, we conduct a counterfactual analysis on what would happen if all reviewers belonging to the same department as the applicant declined to review proposals. This is likely to be a realistic scenario because the JSPS requires this for those working on the same KAKENHI project as the applicant. In this case, only scores from other reviewers would be used to calculate the average score. To obtain the revised list of awarded applications in this counterfactual, the applications are rearranged based on the new average score, and a pre-determined number of awards are granted from the top. Then, we count the number of actual awarded applications not selected in the above counterfactual exercise. We focus on GSR-B, GSR-C, and GYS-B in the KAKENHI program, which process many applications.

Table 7 shows that 6%–12% of the successful applicants with department match would not have been selected had the reviewers affiliated with the same department as the applicant declined the review. Notably, funding for GSR-B and GYS-B is more affected by department match than that for GSR-C. As GSR-B has a larger budget and offers long-term grants, established researchers are more likely to apply for it. As colleagues who obtain this grant can bring positive publicity for their department, peer reviewers who benefit from the grant face a COI. Younger researchers applying for GYS-B may also benefit from department match because other reviewers' scores tend to be more attenuated. Many reviewers do not have much information on the applicants; thus, focal reviewers from the same department are more likely to be pivotal in determining whether a proposal is accepted.

[Insert Table 7 Here]

7. Conclusion

Review scores are generally higher when reviewers have social ties with applicants, including the same affiliation, academic organization membership, or research field, as well as past collaborating experience. Deviations from the average of other reviewers' scores should not be automatically viewed as reflective of bias because reviewers with social ties are more likely to have better information about the applicant's ability and potential. To examine whether it is information advantage or bias that better explains this deviation, we estimate whether social ties strengthen or weaken the predictive power of reviewers' scores for applicants' future performance. We find that the predictive power of review scores is lowered by department-level affiliation match but increased by university-level affiliation match and research field match. These results imply that reviewers whose primary research field overlaps with that of applicants or those who share a university-level affiliation—but do not belong to the same department—tend to provide more accurate review scores, whereas reviewers in the same department as the applicant do not, presumably because of in-group bias, favoritism, or self-interest. Furthermore, these effects of social ties, whether positive or negative, are stronger for younger applicants because they do not have a developed reputation or sufficient career experience compared to senior researchers.

Regarding the policy implications extracted from the results, our counterfactual analysis shows that 6%–12% of the successful applicants with department match would not have been selected had the reviewers affiliated with the same department as the applicant declined the review. However, the possible economic significance of a related policy change remains unclear. First, less than 1% of all reviewer–applicant pairs share a department match. This means that an acceptance or denial switch would occur for less than 0.1% of all awardees if the policy is to be implemented. Second, switching takes place between marginal applicants on the cutoff line, for whom one biased reviewer can be pivotal. Overall, such a policy change may not have an economically significant impact on awardees' average

research productivity.

Nevertheless, we still argue that the KAKENHI guidelines should be modified so that reviewers affiliated with the same department as applicants are required to decline the review. We make this recommendation for three reasons. First, the distortion is greater for GSR-B with bigger projects. This indicates that grant decisions have a large impact on applicant productivity. Second, commitment to fairness is an important principle for the JSPS. Third, the JSPS is unlikely to incur a high cost in changing the COI policy. Given that reviewer affiliations are spread across many universities and departments, this change in guidelines would not affect the required number of reviewers. However, at the very least, the possibility of review score bias related to social ties will require continued attention and efforts to accumulate further evidence.

This study faces certain limitations in terms of the external validity of the results and their generalizability for fields other than economics and in the context of other countries. This may be difficult to address because the relative magnitude of bias and information advantage owing to social ties varies across research fields and countries, presumably depending on the transparency of the application process, degree of asymmetric information, and ethical norms for fairness and professionalism. Nevertheless, future researchers should consider the appropriate definition and scope of COI and the mechanisms necessary to eliminate evaluation bias and achieve the efficient allocation of research funds.

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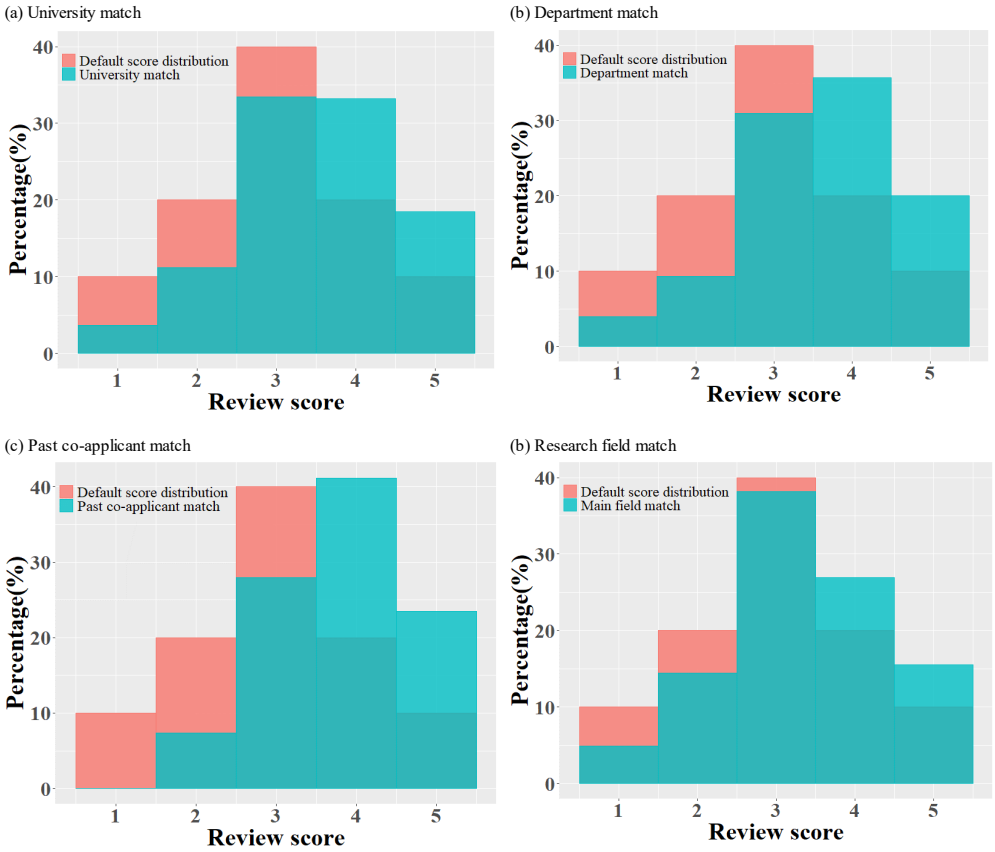

FIGURE 1. REVIEW SCORE DISTRIBUTION FOR ALL APPLICANTS WITH/WITHOUT SOCIAL TIES

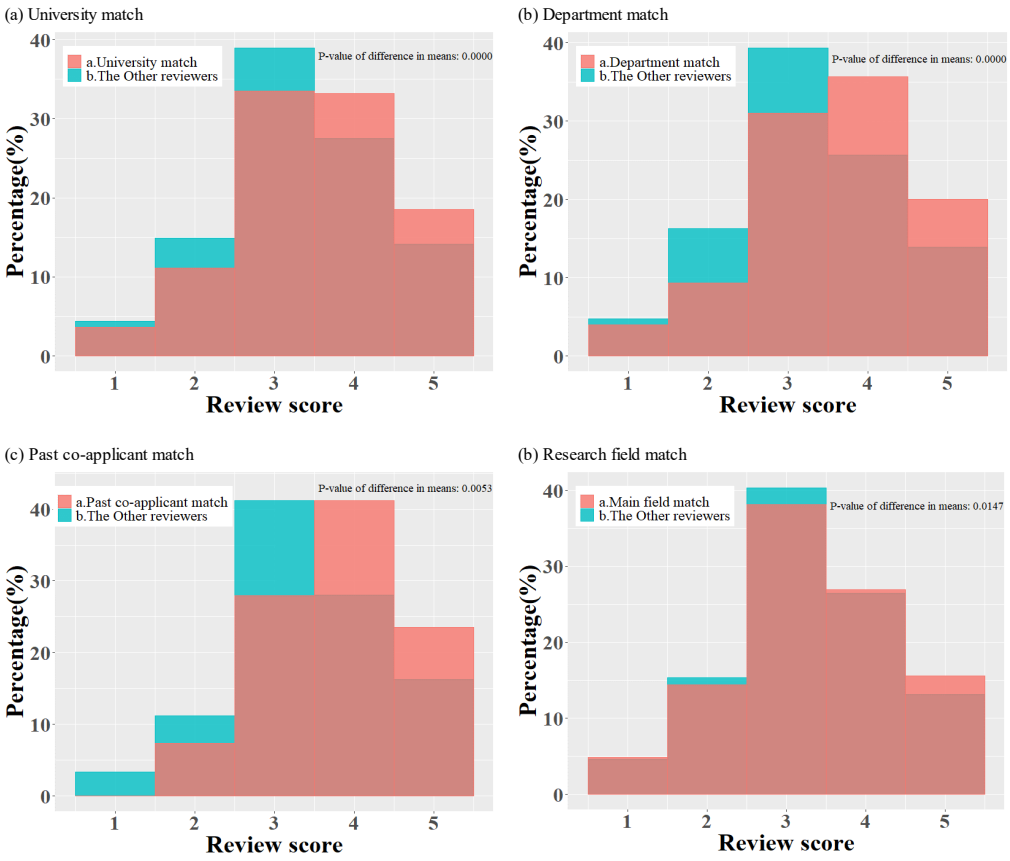

FIGURE 2. REVIEW SCORE DISTRIBUTION FOR APPLICANTS WITH SOCIAL TIES TO REVIEWERS

TABLE 1—SUMMARY STATISTICS FOR VARIABLES

Variables	Mean	Std. dev.	Min	Max
Review scores	2.97	1.06	1	5
KAKENHI dummy	0.32	0.47	0	1
Publications (log)	0.51	0.79	0	5.26
Publications + citations (log)	1.27	2.08	0	13.10
University match dummy	0.017	0.13	0	1
Department match dummy	0.009	0.09	0	1
Past co-applicant match dummy	0.002	0.05	0	1
Research field match dummy	0.063	0.24	0	1
KAKENHI in past five years dummy	0.36	0.65	0	4.19
Publication in past five years (log)	0.34	0.47	0	1
Female dummy	0.11	0.32	0	1
Foreigner dummy	0.06	0.24	0	1
JEA participation match dummy	0.34	0.47	0	1
JEA member dummy	0.37	0.48	0	1

TABLE 2—SOCIAL TIES AND CONFLICTS OF INTEREST

	Match	Declined reviews	Percentage of declined reviews
University match	880	199	22.61%
Department match	455	155	34.07%
University match (except department match)	425	44	10.35%
Past co-applicant match	89	43	48.31%
Research field match	3328	132	3.97%

TABLE 3—SOCIAL TIES AND DECLINED REVIEWS

	(1)	(2)	(3)
	Declined reviews		
University match	0.090***	0.090***	0.090***
	(0.015)	(0.015)	(0.015)
Department match	0.222***	0.223***	0.228***
	(0.026)	(0.026)	(0.027)
Past co-applicant match	0.417***	0.416***	0.401***
	(0.047)	(0.047)	(0.049)
Research field match	0.024***	0.024***	0.028***
	(0.003)	(0.003)	(0.004)
Other reviewers' average score		0.002***	0.004***
		(0.001)	(0.001)
Log of past publications	0.002**	0.001	
	(0.001)	(0.001)	
Past KAKENHI D	0.002**	0.002	
	(0.001)	(0.001)	
Adj.R	0.15	0.15	0.123
Observations	53119	53119	53119

Columns (1) and (2) include the female dummy, foreigner dummy, JEA dummy, JEA match dummy, university position dummies, subfield dummies, and year dummies. The column (3) includes application and year dummies. All standard errors are clustered by application proposal in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 4—SOCIAL TIES AND REVIEW SCORES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Score				Score = 5	Score >= 4	Score >= 3	Score >= 2	Heckman
University match	0.121**	0.157***	0.135***	0.238***	0.038*	0.066***	0.026	0.005	0.154***
	(0.051)	(0.050)	(0.051)	(0.038)	(0.021)	(0.025)	(0.020)	(0.010)	(0.045)
Department match	0.174**	0.155**	0.234***		0.037	0.121***	0.070**	0.007	0.151**
	(0.073)	(0.072)	(0.075)		(0.030)	(0.039)	(0.029)	(0.016)	(0.066)
Past co-applicant match	0.339***	0.226*	0.264**	0.270**	0.054	0.147**	0.038	0.025	0.239*
	(0.131)	(0.115)	(0.134)	(0.135)	(0.056)	(0.071)	(0.048)	(0.019)	(0.122)
Research field match	0.047**	0.037**	0.034*	0.034*	0.020***	0.019*	-0.002	-0.003	0.033*
	(0.020)	(0.019)	(0.020)	(0.020)	(0.008)	(0.010)	(0.009)	(0.005)	(0.018)
Log of past publications	0.279***	0.175***							0.175***
	(0.011)	(0.017)							(0.015)
Past KAKENHI awardee	0.351***	-0.056***							-0.052***
	(0.014)	(0.015)							(0.013)
Female	0.064***								
	(0.019)								
Foreigner	-0.089***								
	(0.026)								
JEA participation match	0.265***	0.255***	0.242***	0.242***	0.061***	0.099***	0.072***	0.010	0.261***
	(0.031)	(0.030)	(0.032)	(0.032)	(0.010)	(0.016)	(0.014)	(0.009)	(0.025)
Inverse Mills ratio									0.072
									(0.074)
Application fixed effect			Yes	Yes	Yes	Yes	Yes	Yes	
Applicant fixed effect		Yes							Yes
Reviewer fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Applicant University fixed effect	Yes	Yes							Yes
Reviewer University fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes							Yes
Adj.R	0.22	0.376	0.426	0.425	0.177	0.281	0.328	0.283	
Observations	52463	52463	52463	52463	52463	52463	52463	52463	53119

The estimations include JEA dummy, university position dummies, and subfield dummies. We use Heckman selection estimation in column 9 including reviwers declaring the COI, and we use reviewer past publications and number of assigned applications as excluded variables in stage 1. All standard errors are clustered by application proposal in parentheses. * p<0.1, ** p<0.05, *** p<0.01

TABLE 5—BASELINE RESULTS OF SOCIAL TIES AND PREDICTION OF RESEARCH OUTPUTS

	(1)	(2)	(3)	(4)	(5)	(6)
	Log of number of publications			Log of number of publications + citations		
	All	Awardees	Non Awardees	All	Awardees	Non Awardees
University match * Score	0.070**	0.078	0.058	0.189**	0.118	0.230*
	(0.033)	(0.052)	(0.040)	(0.095)	(0.142)	(0.129)
Department match * Score	-0.101**	-0.059	-0.130**	-0.284**	-0.104	-0.418**
	(0.047)	(0.084)	(0.054)	(0.134)	(0.229)	(0.164)
Past co-applicant match * Score	0.005	-0.0004	0.029	0.092	0.201	0.02
	(0.053)	(0.076)	(0.058)	(0.175)	(0.257)	(0.171)
Research field match * Score	0.027**	0.037*	0.015	0.085**	0.140***	0.029
	(0.012)	(0.019)	(0.015)	(0.033)	(0.052)	(0.042)
JEA participation match * Score	-0.001	-0.009	0.004	0.004	-0.024	0.015
	(0.004)	(0.007)	(0.005)	(0.011)	(0.020)	-0.014
University match * Other reviewers' average score	-0.070**	-0.072	-0.069	-0.175*	-0.081	-0.254*
	(0.034)	(0.054)	(0.042)	(0.098)	(0.148)	(0.131)
Department match * Other reviewers' average score	0.104**	0.054	0.148**	0.293**	0.081	0.467**
	(0.051)	(0.089)	(0.059)	(0.145)	(0.245)	(0.181)
Past co-applicant match * Other reviewers' average score	-0.036	-0.016	-0.101	-0.173	-0.269	-0.165
	(0.060)	(0.083)	(0.070)	(0.202)	(0.287)	(0.223)
Research field match * Other reviewers' average score	-0.028**	-0.034*	-0.021	-0.096***	-0.141***	-0.052
	(0.013)	(0.020)	(0.016)	(0.035)	(0.054)	(0.044)
JEA participation match * Other reviewers' average score	0.004	-0.0003	0.002	0.013	-0.005	0.004
	(0.006)	(0.009)	(0.007)	(0.015)	(0.025)	(0.020)
KAKENHI awardee	0.055***			0.150***		
	(0.017)			(0.046)		
Reviewer own score	0.024***	0.043***	0.020***	0.058***	0.109***	0.051***
	(0.003)	(0.008)	(0.003)	(0.007)	(0.021)	(0.007)
Other reviewers' average scores	0.075***	0.123***	0.061***	0.188***	0.326***	0.163***
	(0.007)	(0.020)	(0.007)	(0.019)	(0.055)	(0.019)
Log of past publications	0.623***	0.637***	0.592***	1.552***	1.597***	1.481***
	(0.013)	(0.019)	(0.018)	(0.034)	(0.050)	(0.050)
Adj.R	0.507	0.487	0.435	0.483	0.469	0.409
Observations	52591	16574	36017	52591	16574	36017

The estimations include female dummy, foreigner dummy, KAKENHI in past 5 years, JEA dummy, university position dummies, subfield dummies, university dummies, and year dummies. All standard errors are clustered by application proposal in parentheses.
* p<0.1, ** p<0.05, *** p<0.01

TABLE 6—RESULTS FOR SUBSAMPLE BASED ON APPLICANTS' POSITIONS

Panel A Professor

	(1)	(2)	(3)	(4)	(5)	(6)
	Log of number of publications			Log of number of publications + citations		
	All	Awardees	Non Awardees	All	Awardees	Non Awardees
University match * Score	0.054	0.067	0.041	0.14	0.056	0.196
	(0.044)	(0.072)	(0.052)	(0.126)	(0.200)	(0.158)
Department match * Score	-0.102*	-0.108	-0.089	-0.214	-0.093	-0.294
	(0.059)	(0.110)	(0.066)	(0.170)	(0.296)	(0.201)
Past co-applicant match * Score	-0.056	-0.079	-0.032	-0.115	-0.066	-0.177
	(0.043)	(0.095)	(0.049)	(0.150)	(0.298)	(0.144)
Research field match * Score	0.025	-0.001	0.046*	0.083*	0.057	0.114*
	(0.018)	(0.024)	(0.024)	(0.046)	(0.066)	(0.059)
JEA participation match * Score	-0.001	-0.009	-0.003	0.000	-0.02	(0.013)
	(0.006)	(0.010)	(0.007)	(0.015)	(0.027)	-0.018
University match * Other reviewers' average score	-0.059	-0.081	-0.043	-0.134	-0.063	-0.182
	(0.046)	(0.072)	(0.061)	(0.133)	(0.204)	(0.176)
Department match * Other reviewers' average score	0.107	0.132	0.066	0.195	0.121	0.215
	(0.066)	(0.116)	(0.082)	(0.192)	(0.320)	(0.247)
Past co-applicant match * Other reviewers' average score	0.002	0.038	-0.031	-0.022	-0.067	0.078
	(0.056)	(0.112)	(0.059)	(0.185)	(0.351)	(0.187)
Research field match * Other reviewers' average score	-0.02	0.008	-0.042*	-0.085*	-0.048	-0.124**
	(0.018)	(0.025)	(0.025)	(0.048)	(0.068)	(0.062)
JEA participation match * Other reviewers' average score	-0.003	-0.005	-0.002	0.008	0.002	0.002
	(0.008)	(0.013)	(0.011)	(0.022)	(0.033)	(0.030)
KAKENHI awardee	0.042*			0.106		
	(0.025)			(0.066)		
Reviewer own score	0.020***	0.057***	0.013***	0.047***	0.135***	0.034***
	(0.003)	(0.011)	(0.003)	(0.009)	(0.030)	(0.008)
Other reviewers' average scores	0.066***	0.161***	0.044***	0.161***	0.396***	0.116***
	(0.010)	(0.031)	(0.010)	(0.026)	(0.082)	(0.025)
Log of past publications	0.695***	0.743***	0.632***	1.711***	1.871***	1.545***
	(0.017)	(0.023)	(0.028)	(0.045)	(0.060)	(0.073)
Adj.R	0.618	0.637	0.532	0.586	0.612	0.498
Observations	23841	6907	16934	23841	6907	16934

Panel B Associate professor and lower

	(7)	(8)	(9)	(10)	(11)	(12)
University match * Score	0.092*	0.087	0.081	0.256*	0.195	0.261
	(0.047)	(0.075)	(0.062)	(0.139)	(0.203)	(0.198)
Department match * Score	-0.122*	-0.031	-0.184**	-0.411**	-0.184	-0.556**
	(0.068)	(0.116)	(0.083)	(0.192)	(0.317)	(0.248)
Past co-applicant match * Score	0.099	0.122*	0.207	0.409	0.503**	0.581
	(0.087)	(0.067)	(0.295)	(0.280)	(0.243)	(0.824)
Research field match * Score	0.032**	0.069***	0.001	0.088**	0.203***	-0.02
	(0.016)	(0.026)	(0.019)	(0.044)	(0.070)	(0.054)
JEA participation match * Score	-0.002	-0.011	0.005	0.005	-0.03	0.028
	(0.005)	(0.009)	(0.007)	(0.015)	(0.026)	-0.018
University match * Other reviewers' average score	-0.087*	-0.07	-0.097	-0.228	-0.123	-0.305
	(0.048)	(0.078)	(0.060)	(0.142)	(0.216)	(0.191)
Department match * Other reviewers' average score	0.127*	0.003	0.233***	0.446**	0.126	0.701***
	(0.071)	(0.124)	(0.086)	(0.202)	(0.341)	(0.258)
Past co-applicant match * Other reviewers' average score	-0.063	-0.063	-0.298	-0.316	-0.366	-0.818
	(0.093)	(0.073)	(0.414)	(0.315)	(0.284)	(1.170)
Research field match * Other reviewers' average score	-0.036**	-0.071***	-0.011	-0.103**	-0.217***	-0.009
	(0.017)	(0.027)	(0.021)	(0.047)	(0.074)	(0.059)
JEA participation match * Other reviewers' average score	0.01	0.007	0.009	0.017	-0.008	0.014
	(0.007)	(0.012)	(0.009)	(0.021)	(0.034)	(0.025)
KAKENHI awardee	0.065***			0.171***		
	(0.024)			(0.064)		
Reviewer own score	0.028***	0.038***	0.027***	0.072***	0.110***	0.072***
	(0.004)	(0.011)	(0.004)	(0.011)	(0.029)	(0.011)
Other reviewers' average scores	0.080***	0.111***	0.074***	0.220***	0.326***	0.211***
	(0.010)	(0.027)	(0.011)	(0.028)	(0.073)	(0.029)
Log of past publications	0.531***	0.512***	0.531***	1.357***	1.291***	1.385***
	(0.019)	(0.031)	(0.025)	(0.052)	(0.082)	(0.069)
Adj.R	0.448	0.417	0.404	0.437	0.417	0.393
Observations	28430	9576	18854	28430	9576	18854

The all estimations include female dummy, foreigner dummy, KAKENHI in past 5 years, JEA dummy, university position dummies, subfield dummies, university dummies, and year dummies. All standard errors are clustered by application proposal in parentheses.
* p<0.1, ** p<0.05, *** p<0.01

TABLE 7—COUNTERFACTUAL ANALYSIS FOR SOCIAL TIES

	KAKENHI Awardees		
	Actual(A)	Counterfactual scenario (B)	B/A*100
GSR-B	60	53	88%
GSR-C	102	96	94%
GYS-B	44	39	89%

Appendix A. Robustness Checks for Social Ties and Future Outputs

To check the robustness of our results, we estimate Equation (2) with different variables or samples. Concerns may exist regarding measurement errors for research field match variables. The primary field is defined as that with the highest number of occurrences of the JEL code assigned to the presentations in which each reviewer or applicant participated as a presenter or discussant. Instead of this definition, we can also use all information on JEL codes assigned to the JEA presentations using technological distance as proposed by Jaffe (1986). His study recommends calculating the cosine similarity of patenting areas expressed by vectors between two firms. We measure the similarity between reviewer and applicant using JEL codes assigned to their presentations. We standardize the occurrence of the same JEL code more than one times as one to control for researchers who may have presented or discussed multiple times. The results are shown in Table A5. The coefficient of technological distance is significant and positive, implying that the upward deviation owing to research area match has significant predictive power for future research productivity, which is qualitatively similar to the results in Table 5.

Next, we repeat our estimation of Equation (2) by restricting our analysis to researchers who have participated in JEA meetings as presenters or discussants. As we identify the primary research fields of the applicants and reviewers using presentation records, including those without such records may bias the estimation results. The results reported in Table A6 are quite similar to those in Table 5, indicating that they are robust to the sample restriction.

Finally, to examine whether the nature of social ties varies with reviewer and applicant status, we divide the sample into two groups using the information on the year in which reviewers and applicants received their PhD because there is no age information for reviewers and applicants. If a reviewer and an applicant obtained a PhD within 10 years of each other, both are treated as part of the same generation. If the applicant obtained a PhD more than 11 years after than

the reviewer, the reviewer is likely to treat the applicant as junior. Table A6 shows two notable results. First, the predictive power of review scores is particularly weak when the reviewer and applicant are of the same generation, implying that in-group bias or self-interest is more pronounced within the same generation. Second, past collaborative research experience seems to give the reviewer a significant information advantage when the applicant is junior to the reviewer. This relationship is completely masked in the total sample.

TABLE A1—MAIN CHARACTERISTICS OF KAKENHI CATEGORIES

Name	Maximum budget (Yen)	Period	Co-applicants	Age	# of reviewers
GSR-B Grant-in-Aid for Scientific Research (B)	More than 5 - less than 30 million	3 - 5 years	Yes	No limitation	6
GSR-C Grant-in-Aid for Scientific Research (C)	Less than 5 million	2 - 4 years	Yes	No limitation	4 (3 until 2010)
GYS-S Grant-in-Aid for Young Scientists (S)	Less than 100 million	5 years	No	Less than 42	6
GYS-A Grant-in-Aid for Young Scientists (A)	More than 5 - less than 30 million	2 - 4 years	No	Under 27 until 2008 and under 29 after 2009	6
GYS-B Grant-in-Aid for Young Scientists (B)	Less than 5 million	2 - 4 years	No	Under 27 until 2008 and under 29 after 2009	4 (3 until 2010)
GAS Grant-in-Aid for Young Scientists start-up and its continuous grant: the Grant-in-Aid for Research Activity start-up	Less than 1.5 million	Less than 2 years	No	A researcher who is entitled to apply for the KAKENHI.	4 (3 until 2010)

GYS-S was abolished in 2016.

TABLE A2—RESEARCH FIELDS ACROSS SUBFIELDS IN ECONOMICS

No.	Subfields	Keywords
3601	Economic theory	Microeconomics, Macroeconomics, Economic theory, and Game theory
3602	Economic doctrines / Economic thought	Economic doctrine, History of economics, Economic though, History of economic thought, Social thought, and History of social thought
3603	Economic statistics	Statistical system, Statistical research, History of statistics, History of statistical theory, Population statistics, Income/ Wealth distribution, National accounts, and Financial Econometrics
3604	Applied economics	International economics, Labor economics, Theory of Industry, Industrial organization, Urban economics, Environmental economics, Health economics, and Regional economics
3605	Economic policy	Economic policy, Economic affairs, Japanese economy, Social security, Economic system, Economic development, Policy simulation
3606	Public finance/ Monetary economics	Public finance, Public economics, Monetary economics, Finance, and International monetary theory
3607	Economic history	Economic history, Business history, and Industrial history
3801	Economic theory	Microeconomics, Macroeconomics, Economic theory, Game theory, Behavioral economics, Experimental economics, Evolutionary economics, and Comparative economics
3802	Economic doctrines/ Economic thought	Economic doctrine, Economic though, Social thought, and Economic Philosophy
3803	Economic statistics	Statistical system, Statistical research, Population statistics, Income/ Wealth distribution, National accounts, and Financial Econometrics
3804	Economic policy	International economics, Industrial organization, Economic development, Economic Policy, Urban economics, Transport economics, Regional economics, Environmental economics, Resource Economics, Japan economy, and Economic affairs
3805	Public finance/ Public economy	Public finance, Local government finance, Public economics, Public policy, Health Economics, Labor economics, Social security, Education economics, Law & economics, and Political economics
3806	Money/Finance	Monetary economics, Finance, International finance, Corporate finance, Insurance, and Financial engineering
3807	Economic history	Economic history, Business history, and Industrial history

TABLE A3—CORRELATION MATRIX FOR VARIABLES

		a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.
a.	Review scores	1.00													
b.	KAKENHI dummy	0.55	1.00												
c.	Publications (log)	0.29	0.33	1.00											
d.	Publications + citations (log)	0.28	0.32	0.95	1.00										
e.	University match dummy	0.06	0.05	0.05	0.05	1.00									
f.	Department match dummy	0.04	0.03	0.02	0.03	0.66	1.00								
g.	Past co-applicant match dummy	0.03	0.02	0.01	0.01	0.05	0.04	1.00							
h.	Research field match dummy	0.09	0.09	0.12	0.12	0.00	0.01	0.03	1.00						
i.	KAKENHI in past five years dummy	0.28	0.33	0.64	0.60	0.04	0.01	0.02	0.13	1.00					
j.	Publication in past five years (log)	0.27	0.29	0.21	0.19	0.01	0.01	0.02	0.10	0.31	1.00				
k.	Female dummy	0.01	0.00	-0.03	-0.02	0.00	-0.01	0.00	-0.02	-0.04	-0.04	1.00			
l.	Foreigner dummy	-0.03	-0.04	0.05	0.05	0.00	0.00	-0.01	-0.03	0.02	-0.05	0.04	1.00		
m.	JEA participation match dummy	0.20	0.22	0.31	0.31	0.03	0.02	0.01	0.36	0.30	0.21	-0.01	-0.07	1.00	
n.	JEA member dummy	0.14	0.16	0.22	0.23	0.01	0.01	0.01	0.22	0.24	0.20	0.01	-0.07	0.63	1.00

TABLE A4—THE RESULTS WITH TECHNOLOGICAL DISTANCE

	(1) All	(2) Awardees	(3) Non Awardees
University match * Score	0.188**	0.115	0.230*
	(0.095)	(0.142)	(0.129)
Department match * Score	-0.282**	-0.105	-0.417**
	(0.134)	(0.229)	(0.164)
Past co-applicant match* Score	0.083	0.206	0.01
	(0.176)	(0.261)	(0.171)
Research field match * Score	0.023*	0.035**	0.01
	(0.012)	(0.018)	(0.017)
JEA participation match * Score	-0.001	-0.033	0.014
	(0.015)	(0.025)	(0.018)
University match *	-0.173*	-0.078	-0.253*
Other reviewers' average score	(0.099)	(0.149)	(0.131)
Department match *	0.291**	0.083	0.466**
Other reviewers' average score	(0.145)	(0.246)	(0.182)
Past co-applicant match *	-0.164	-0.27	-0.153
Other reviewers' average score	(0.202)	(0.290)	(0.222)
Research field match *	-0.026*	-0.039**	-0.014
Other reviewers' average score	(0.014)	(0.020)	(0.019)
JEA participation match *	0.019	0.007	0.005
Other reviewers' average score	(0.018)	(0.029)	(0.023)
KAKENHI awardee	0.150***		
	(0.046)		
Reviewer own score	0.058***	0.110***	0.051***
	(0.007)	(0.021)	(0.007)
Other reviewers' average scores	0.188***	0.328***	0.164***
	(0.019)	(0.055)	(0.019)
Log of past publications	1.553***	1.597***	1.481***
	(0.034)	(0.050)	(0.050)
Adj.R	0.482	0.469	0.409
Observations	52591	16574	36017

The dependent variable is log of number of publications + citations. Technological distance shows the closeness of reseach fields between reviewers and applicants by Jaffe (1986). The all estimations include female dummy, foreigner dummy, KAKENHI in past 5 years, JEA dummy, university position dummies, subfield dummies, university dummies, year dummies, and reviewer dummies. All standard errors are clustered by application proposal in parentheses. * p<0.1, ** p<0.05, *** p<0.01

TABLE A5—THE RESULTS WITH JEA PARTICIPATION OF RESEARCHERS

	(1) All	(2) Awardees	(3) Non Awardees
University match * Score	0.269*	0.064	0.312
	(0.154)	(0.218)	(0.216)
Department match * Score	-0.454**	-0.079	-0.710**
	(0.209)	(0.305)	(0.281)
Past co-applicant match * Score	0.062	0.429	-0.306
	(0.236)	(0.345)	(0.208)
Research field match * Score	0.090***	0.142***	0.044
	(0.032)	(0.051)	(0.040)
University match *	-0.216	0.04	-0.377*
Other reviewers' average score	(0.155)	(0.217)	(0.220)
Department match *	0.424*	-0.047	0.927***
Other reviewers' average score	(0.224)	(0.321)	(0.311)
Past co-applicant match *	-0.171	-0.532	0.141
Other reviewers' average score	(0.262)	(0.383)	(0.255)
Research field match *	-0.090***	-0.134**	-0.049
Other reviewers' average score	(0.034)	(0.054)	(0.043)
KAKENHI awardee	0.080		
	(0.082)		
Reviewer own score	0.079***	0.096***	0.081***
	(0.016)	(0.030)	(0.019)
Other reviewers' average scores	0.267***	0.359***	0.232***
	(0.040)	(0.078)	(0.045)
Log of past publications	1.566***	1.604***	1.524***
	(0.047)	(0.066)	(0.071)
Adj.R	0.473	0.415	0.466
Observations	17815	8208	9601

The estimation sample comprises those who matched JEA participation. The dependent variable is log of number of publications + citations. The all estimations include female dummy, foreigner dummy, KAKENHI in past 5 years, university position dummies, subfield dummies, university dummies, year dummies, and reviewer dummies. All standard errors are clustered by application proposal in parentheses. * p<0.1, ** p<0.05, *** p<0.01

TABLE A6—YEAR OF OBTAINING A PHD BEING SIMILAR FOR REVIEWERS AND APPLICANTS

	The year(s) of obtaining a PhD being similar for reviewers and applicants (within 10 years)			The applicants' year of obtaining a PhD being more than 11 years after that of the reviewers		
	(1) All	(2) Awardees	(3) Non Awardees	(4) All	(5) Awardees	(6) Non Awardees
University match * Score	0.274	0.494**	-0.029	-0.211	-0.349	-0.12
	(0.192)	(0.249)	(0.206)	(0.231)	(0.431)	(0.184)
Department match * Score	-0.607**	-0.564	-0.363	-0.06	-0.769	-0.003
	(0.253)	(0.441)	(0.307)	(0.364)	(1.391)	(0.253)
Past co-applicant match * Score	-0.186	-0.874	-0.471	0.841***	0.194*	-0.443
	(0.361)	(0.876)	(0.769)	(0.304)	(0.104)	(0.347)
Research field match * Score	0.115	0.242*	0.068	0.190*	0.206	0.169
	(0.090)	(0.141)	(0.114)	(0.111)	(0.167)	(0.142)
JEA participation match * Score	-0.092**	-0.168**	-0.102*	-0.013	(0.085)	0.022
	(0.042)	(0.067)	(0.053)	(0.046)	-0.073	-0.054
University match * Other reviewers' average score	-0.247	-0.452*	0.003	0.173	0.336	0.079
	(0.186)	(0.244)	(0.216)	(0.232)	(0.432)	(0.204)
Department match * Other reviewers' average score	0.658**	0.645	0.442	0.037	0.967	-0.228
	(0.281)	(0.465)	(0.396)	(0.450)	(1.636)	(0.280)
Past co-applicant match * Other reviewers' average score	-0.13	0.442	0.366	-0.681***		
	(0.420)	(0.835)	(1.076)	(0.237)		
Research field match * Other reviewers' average score	-0.131	-0.228	-0.124	-0.235*	-0.266	-0.183
	(0.092)	(0.146)	(0.115)	(0.121)	(0.180)	(0.158)
JEA participation match * Other reviewers' average score	0.064	0.089	0.078	-0.033	0.057	-0.079
	(0.047)	(0.072)	(0.064)	(0.056)	(0.084)	(0.067)
KAKENHI awardee	0.118			0.069		
	(0.081)			(0.112)		
Reviewer own score	0.052**	0.174***	0.010	0.080***	0.116**	0.081***
	(0.022)	(0.049)	(0.023)	(0.025)	(0.056)	(0.025)
Other reviewers' average scores	0.181***	0.253***	0.181***	0.194***	0.296**	0.182***
	(0.041)	(0.097)	(0.044)	(0.051)	(0.133)	(0.051)
Log of past publications	1.621***	1.665***	1.559***	1.712***	1.882***	1.544***
	(0.053)	(0.075)	(0.082)	(0.073)	(0.095)	(0.120)
Adj.R	0.587	0.587	0.577	0.473	0.415	0.466
Observations	4681	1705	2951	17815	8208	9601

The dependent variable is log of number of publications + citations. The all estimations includes reviewer's own score, other reviewers' average score, female dummy, foreigner dummy, past five year publications, KAKENHI in past 5 years, JEA dummy, university position dummies, subfield dummies, affiliation dummies, and year dummies. All standard errors are clustered by application proposal in parentheses. * p<0.1, ** p<0.05, *** p<0.01

TABLE A7—THE RESULTS WITH APPLICANTS for GYS-B AND GAS

	GYS-B and GAS		
	(1)	(2)	(3)
	All	Awardees	Non Awardees
University match * Score	0.153	-0.165	0.322
	(0.158)	(0.212)	(0.223)
Department match * Score	-0.258	0.517	-0.654**
	(0.221)	(0.375)	(0.278)
Past co-applicant match * Score	0.563**	0.225	-0.309
	(0.254)	(0.259)	(0.671)
Research field match * Score	0.113**	0.281***	-0.053
	(0.056)	(0.086)	(0.069)
JEA participation match * Score	0.003	-0.051*	0.042*
	(0.019)	(0.030)	(0.024)
University match * Other reviewers' average score	-0.105	0.286	-0.380*
	(0.163)	(0.226)	(0.217)
Department match * Other reviewers' average score	0.283	-0.620	0.772***
	(0.234)	(0.418)	(0.287)
Past co-applicant match * Other reviewers' average score	-0.470	-0.087	
	(0.337)	(0.319)	
Research field match * Other reviewers' average score	-0.140**	-0.315***	0.038
	(0.059)	(0.089)	(0.073)
JEA participation match * Other reviewers' average score	0.038	0.067*	0.008
	(0.025)	(0.037)	(0.032)
KAKENHI awardee	0.153*		
	(0.084)		
Reviewer own score	0.090***	0.140***	0.084***
	(0.015)	(0.039)	(0.016)
Other reviewers' average scores	0.255***	0.354***	0.242***
	(0.037)	(0.098)	(0.040)
Log of past publications	1.307***	1.263***	1.272***
	(0.066)	(0.099)	(0.093)
Adj.R	0.428	0.434	0.382
Observations	16949	5557	11392

The estimation sample comprises GYS-B and GAS. The dependent variable is log of number of publications + citations. The all estimations include female dummy, foreigner dummy, KAKENHI in past 5 years, university position dummies, subfield dummies, university dummies, year dummies, and reviewer dummies. All standard errors are clustered by application proposal in parentheses. * p<0.1, ** p<0.05, *** p<0.01