2 Theories of discrimination

2.1 Statistical discrimination theory

Theoretical economic literature advanced two major employer discrimination theories to explain different average salaries for members of two presumably equally productive groups: statistical discrimination theory and taste-based discrimination theory.

Phelps (1972) developed a model which assumes that the average productivity of females is lower than males'[5]. In addition to the observable productivity characteristics of an individual, employers use the individual's association with a particular group to predict the productivity of a worker. A female may receive lower salary than a male of the same productive characteristics because employers use the average characteristics of the female group to predict the female workers' productivity. This model has been criticized by Aigner and Cain (1977) who argued that this model is not a description of discrimination. In Phelps' model, the conclusion depends on the assumption that females and males have different average productivity. Once this assumption is removed, the average male and female salary will be the same. This is because, males with higher test scores (that is, higher ability) will earn higher salaries than females with the same scores, while males with lower test scores (that is, lower ability) will earn less than females with the same scores, thus completely offsetting the gender salary differences. This criticism led to a new statistical discrimination model.

Aigner and Cain (1977) developed a model in which the average productivity of males and females is the same, but an observed variable that indicates the ability of an individual (that is, test scores) is less informative for females. By introducing the assumption that the employer is risk averse, they showed that females would receive lower wages even when male' and female' average productivity is the same. In this model, females receive lower wages because the observed variable describing productivity is less informative for them and

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[5]Throughout this section, we use 'females' synonymously with 'the disadvantaged group'.

because the risk averse employer needs to be compensated for taking the risk of employing workers whose ability is less certain.

In Arrow's model (1973), employers have prejudicial beliefs (preconceived ideas) that female workers are less productive than males. Arrow shows that, if it is costly to learn the workers' ability, prejudicial beliefs cause the average female wage to be lower than male'. Arrow further shows that such prejudicial beliefs affect workers behavior such that females invest less in human capital, thus perpetuating the beliefs.

Lundberg and Startz (1983) expanded Phelps' (1992) model by endogenizing human capital investment decision. In their model, employers only observe a test score which is a noisy indicator of a worker's marginal product. Furthermore, the test score is assumed to be less informative for females. Then, as in Phelps' (1972) model, the wage-test score profile is flatter for females, thus returns to human capital investments are lower for females. Workers invest in human capital to the point where marginal cost of investment just balances the incremental benefit from that investment. Thus, females invest less in human capital due to lower returns to human capital investments, causing the average female's wage to be less than male'.

2.2   Taste-based discrimination theory

Taste-based discrimination theory was first articulated by Becker (1957) and Arrow (1971). In this theory, discrimination arises from employer's distaste against working with a particular group of people such as females. If the employer hires those he distastes, he gains less utility. In a utility maximization framework, Becker shows that even when females and males are perfect substitutes in production, the short-run equilibrium wage for females will be lower than that of males'. This model also predicts that, in a competitive market, discriminatory firms would disappear. Non-discriminatory employers earn higher profits than discriminatory employers, since they are willing to hire workers who have been discriminated

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against and whose wages are lower. Thus, non-discriminatory firms are able to purchase discriminatory firms, indicating that there will be no discriminatory firms in the long-run.

However, due to persistent discrimination in the long-run, Becker's model became criticized. Several authors modified Becker's model to explain that discriminatory firms can in fact survive in the long run. Goldberg (1982) modified Becker's model to incorporate nepotism toward males, showing that nepotistic firms can survive in the long-run. In Goldberg's model, the nepotistic employer obtains extra non-pecuniary gains from hiring males. In a utility maximization framework, the short-run equilibrium wage is lower for females than for males. However, the price the neutral firm has to pay to purchase the nepotistic firm is not equal to nepotistic firm's profit alone, but profit plus the non-pecuniary gain the nepotistic firm enjoys. Although neutral firms have higher profits, their profits are not high enough to cover for the additional non-pecuniary gain. Therefore, nepotistic firms would survive in the long-run.

Black (1995) developed a model of employer discrimination by using a job search model in which the existence of discriminatory firms increases the search cost incurred by females. The presence of such a search cost gives firms monopsonistic power. Thus, firms by exploiting their monopsonistic power, offer lower wages for females. Rosen (2003) also uses a job search framework. Discriminatory firms pay lower wages for females as compared to neutral firms, but their hiring decision is suboptimal (non-profit maximizing). When the discrimination coefficient is not 'too high', discriminatory firms attain higher profit than neutral firms since the gains from lower wages outweigh the losses from suboptimal hiring. However, discriminatory firms have lower utility than neutral firms, indicating that discriminatory firms will disappear in the long run due to takeover. By introducing the separation between ownership and management, Rosen shows that discriminatory firms would have both higher profit and higher utility, thus they would survive in the long run.

3 Previous empirical literature

There is abundant literature that investigates the gender salary gap within academia in the US and the UK. Since the 1970s, studies on the gender salary gap in the academic labor market have been conducted by (Tuckman et al. 1977; Hasen et al. 1978; Hirsch and Leppel 1982). We summarize below more recent work. Broder (1993), by using a simultaneous equation model, estimates a salary equation using a sample of 362 male and 30 female academic economists in the US. The estimated coefficient for the female dummy indicates that females salaries are between 5% to 8% lower than males', after controlling for experience, productivity, institutional characteristics, and rank. Salary differences are more pronounced for the older cohorts. In addition, when she conducts a salary decomposition using the Oaxaca decomposition method (Oaxaca 1973), she shows that 25% of the raw salary differences could not be explained by the measured characteristics. She also finds that females are more likely to be in lower ranks; however, the difference in rank attainment is not statistically significant.

McNabb and Wass (1997) use data from all British universities for 1975, 1985 and 1992. The samples are very large; however, they lack measures for research output. In an Oaxaca decomposition, the authors obtain a gender salary gap of between 3.6 to 5.5% that could not be explained by differences in age, tenure, faculty affiliation, and rank. The unexplained salary gap would have been 7% larger if rank were not controlled for, suggesting that the under-representation of females at senior levels significantly contributed to the gender salary differences. Ward (2001) utilizes a sample of 482 male and 241 female from five Scottish universities to investigate the gender salary gap. Her results show that males have a 7.7% salary advantage over females, after controlling for numerous individual characteristics, but excluding rank. When rank is controlled for, the difference is reduced to 3.2% and is no longer statistically significant. When the Oaxaca decomposition is used, 3% of the salary difference

remains unexplained, after controlling for numerous characteristics and rank. Rank is found to be the largest contributor to the gender salary gap, accounting for 40% of the raw gender salary gap.

Ginther and Hayes (2003) uses data from the Surveys of Doctorate Recipients in the US. They find a raw gender salary gap of 11.3% in 1993. Most of this gap is explained away when they control for rank, and various personal, institutional and productivity characteristics, leaving only a negligible amount unexplained. However, they find that being female decreases the probability of being promoted to tenure by as much as 6.8%. More recently, Blackaby et al. (2005) estimate the gender pay gap in UK economics departments by using a sample of 291 male and 60 female. They find that females receive 9.4% less than males, after controlling for ethnicity, publications weighted by the quality of the journal, age, education, and various institutional characteristics, but without controlling for rank. When rank is controlled for, the gender salary gap sunstantially reduces to 5.5%, but it remains statistically significant. Thus, most of the previous studies from the US and the UK found that much of the gender salary differences in academia stems from differences in rank attainment between males and females.

4 Compensation scheme in Japanese universities

In this section we provide background information regarding the compensation scheme in Japanese universities. There are three types of universities in Japan: national, public and private. National universities are established and funded by the central government. Public universities are established by local governments, and funded by both the local and the central governments. Private universities are established by private entities and are financially self-supporting. The total annual salary of academics includes: monthly salary for 12 months, and, depending on university, bonuses and other allowances[6]. Bonuses are typically

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[6]Salary does not include research funds, travel funds for research or allowances for housing and dependants. However, it does include transportation and adjustments for the cost of living in certain cities.

provided twice a year, and the total amount can be the equivalent of 4-6 month of salary.

Salary in academia is determined based on a relatively rigid payment scheme, called the salary table. The salary table is set by each university based on negotiations between the university and its own union[7]. There could be a few different salary tables depending on the types of employment contract within a university. For example, there could be one type of salary table for those hired on the typical life-time employment basis, and a different type of table for those hired on a fixed-term basis. Although all types of universities have the freedom to set their own salary table, national universities typically follow the guidelines provided by the National Personnel Authority (NPA) (*Jinjiin*)[8]. Most private universities set their own salary tables, however, there are some private universities that follow the NPA guidelines.

Table 5 presents an excerpt from a salary table guideline provided by the NPA. The salary table shows how salaries progress depending on rank. A full-time academic usually starts as a lecturer or assistant professor, and then moves up the ladder to the rank of full-professor. The salary table contains classes and divisions, where the former refers to rank. Class 5 is a full-professor, class 4 is an associate professor, class 3 is an assistant professor, and class 2 is a lecturer. Each class (rank) contains a number of divisions, or payment scales, with each academic assigned to a division. The assignment is typically decided by the university's personnel division run by non-academic staff. The precise criteria that are used to determine the initial division and how each academic progresses through divisions are not specified in the salary table. There is a common belief among academics that the initial division (that is, at hiring) is determined by age, experience, and education level only, and that, each academic progresses one division annually. If this belief is true, then salary would be a deterministic function of age, experience, and education, leaving little room for

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[7]Each university has its own union.

[8]The National Personnel Authority is a specialized, neutral, third-party organization dealing with public employee management.

gender salary differences. However, to date there has been no research investigating whether the belief is indeed true.

In April 2004 national and public universities were 'corporatized' based on the *National University Corporation Law* enacted in 2003. Prior to this, the salary tables at national and public universities were determined according to public servants' payment schemes, set by the government. Thus, salary tables were the same at every national university in the country, notwithstanding some allowances that varied by university. After the 'corporatization', national and public universities gained the freedom to set their own salary tables. However, as mentioned above, national and public universities typically follow the guidelines provided by the NPA. Their transformation into corporations meant a change in the legal status of academics, by removing their public employee status, and by allowing university management more freedom in setting compensation schemes. However, 'corporatization' did not mean a change in ownership of universities, and, national and public universities are still owned and sponsored by the government.

5 Empirical methodology

Theories of discrimination suggest that female academics may earn lower salary than male academics with comparable productive characteristics. In order to estimate gender salary differences, we control for various productivity characteristics of each academic. Two methods are typically used to empirically investigate the gender salary gap. On the one hand, there is the Oaxaca-Blinder decomposition (Oaxaca 1973; Blinder 1973), which requires running separate earning regressions for males and females. On the other hand, one can estimate a 'Mincer type' human capital earnings regression (Mincer 1974) for the pooled sample with a female dummy included.

Although the Oaxaca decomposition method has the advantage that it allows all the coefficients to be different for males and females, its application becomes difficult when the

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number of females is small, as has occurred in previous studies. For example, Blackaby et al. (2005) used the pooled regression method since their sample only contains 60 female. As will be noted in section 6, our data contains 337 academics out of which 58 are female. We, therefore, consider that the number of females is not large enough to apply the Oaxaca decomposition. Thus, we have chosen the pooled regression method for our empirical analysis.

Below is our earning equation:

$$Log(Annual\ Salary) = \alpha'Z_i + \beta_1(AssocProf)_i + \beta_2(FullProf)_i + \gamma(Female)_i + \epsilon_i \quad (1)$$

Z_i is the vector of variables that directly affect annual salary (i.e., human capital characteristics and other objective salary determinants). $(AssocProf)_i$ is a dummy variable that takes the value 1 if the academic is an associate professor, 0 otherwise. $(FullProf)_i$ is a dummy variable that takes the value 1 if the academic is a full-professor, 0 otherwise. $(Female)_i$ takes the value 1 if the academic is a female and 0 otherwise. Thus, the coefficient γ captures the gender salary gap, after controlling for human capital characteristics and other objective salary determinants.

This method of estimation faces at least three econometric challenges. First, human capital variables may be noisy and biased proxies for actual human capital accumulation. For example, education is a widely used human capital proxy. If the actual human capital is lower for females than males at a given level of education, we tend to overestimate the gender salary gap. In a study of the white-black wage gap, Neal and Johnson (1996) show that education is a biased proxy for human capital, and find that, when unbiased human capital measures such as AFQT[9] scores are used, the estimated salary gap decreases. In our paper, we tackle this problem by incorporating detailed productivity characteristics for each academic, such as publications and the amount of external grants obtained, in

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[9]Armed Forces Qualification Tests (US)

addition to traditional measures of human capital such as education and experience. In fact, one of the benefits of analyzing the academic labor market is that, besides the traditional measures of human capital, various other productivity characteristics can be controlled for, thus minimizing potential biases.

Second, rank attainment may be affected by discrimination. In such a situation, the female dummy variable does not capture the combined effect of discrimination stemming from both salary discrimination and rank attainment discrimination. One way to mitigate this problem is to estimate the earning equation without the rank variables (McNabb and Wass 1997; Ward 2001; Moore at al. 2007). When the rank variables are not included, the earning equation can be thought of as a reduced-form equation, in which case, the female dummy captures the total effect of discrimination stemming from salary and promotion discrimination combined. Another method is to estimate a salary equation and an ordered logit rank equation, separately, as below:

$$Salary\ equation: Log(AnnualSalary) = \alpha'Z_i + \beta(Rank)_i + \gamma(Female)_i + \epsilon_i \qquad (2)$$

$$Rank\ equation: y_i^* = \beta'Z_i + \theta(Female) + \mu_i \qquad (3)$$

where (Rank)=1 if associate professor, 2 if full-professor and 0 if assistant professor and below. y^* is a latent variable such that, $(Rank)_i=0$ if $y_i^* < c_1$, $(Rank)_i=1$ if $c_1 \leq y_i^* < c_2$, and $(Rank)_i=2$ if $y_i^* \geq c_2$. Therefore, the total salary gap stemming from discrimination in salary and promotion *combined* can be written as:

$$Total\ gender\ salary\ gap = \gamma + \beta[P(Rank = 2|Female) - P(Rank = 2|Male)] \qquad (4)$$

where $P(Rank = 2|Male)$ is the probability that a respondent is a full-professor given that the respondent is a male. $P(Rank = 2|Female)$ is defined in a similar manner. These probabilities can be computed at the sample average of all the explanatory variables. β is the coefficient for the rank variable in equation (2) above. Thus, if females have lower

probability of being promoted to full-professor, the second term of (4) will capture the drop in salary due to the lower rank attainment for females. This method has the advantage of being able to directly estimate the difference in promotion probability. In this study, we use both methods described above.

Third, self-selection into the academic labor market might be a potential source of bias in the female coefficient. Heckman (1998) shows that the estimated wage gap between blacks and whites reduced in the 1990s, not because discrimination disappeared, but because a considerable number of blacks, who potentially earn lower wages, dropped out of the labor force. Similarly, in our case, if female graduates whose potential salary is lower in academia decide not to enter the academic labor market, we would underestimate the potential gender salary gap. The available techniques to correct for selection bias, such as the Heckit model, require information about the graduates who did not join academia. Unfortunately, we do not have such data. Thus, direct elimination of selection bias is not possible in our case[10]. However, we investigate whether selection bias is a problem by utilizing statistics for male and female PhD graduates in Japan over the period 1969 to 2007[11].

6 Data

Data utilized in this project have been obtained from a survey we administered via a postal questionnaire[12]. Past studies used publicly available data (Broder 1993; McNab and Wass 1997; Ginther 2004; Blackby et al. 2005) or undertook independent surveys (Ward 2001). In Japan, salary information is confidential and there are no national or private statistics on academics collected regularly. Therefore, we undertook a mail survey in order to collect data. Our survey method is presented below.

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[10]Similarly, the majority of papers on gender salary differentials in academia in the US and the UK were not able to correct for sample selection bias.

[11]Unfortunately we only have statistics for PhD graduates from Japan.

[12]The questionnaire was distributed only in Japanese. A copy in Japanese (or its English translation) is available from the author upon request.

First, from the website of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) we obtained an official list of all four-year universities in Japan. The list contained 747 universities: 87 national, 76 public and 584 private universities. We accessed each university website provided in the list[13] in order to collect the names of academics in economics and economics-related departments[14]. Due to the facts that some universities do not list faculty names and some universities do not have economics departments, we were able to collect only 4353 names from only 132 universities. Many Japanese economics departments also employ faculty specializing in language education. We eliminated such faculty where possible. In addition, we excluded universities that accept only female students.

Next, from the 4353 collected names, we selected 1863 academics and mailed them questionnaires directly. Ideally, the selection method should be random. However, this could have led to a very small female sample. In order to increase the number of female observations, we selected all the female-sounding names (287 names). Nonetheless, the rest of the selected academics (1576 names) are randomly chosen. Questionnaires were sent from April to June 2008 and participants could reply either by mail or online. Two remainders were sent by mail in July and August, and an additional reminder was sent to approximately 600 academics by email. At the end of our survey period, we received 363 responses (252 by mail and 111 online). Thus, we achieved a rate of response of 19.5%. This response rate is not too high but not too low either, as compared to other previous studies that used similar mail surveys of academics; for example, Moore et al. (2007) achieved a response rate of 13%, while Ward (2001) obtained a response rate of 30%. Our sample contains 299 male and 64 female; however, due to some incomplete responses, the usable sample is 337 (of which 58 are female). Our female sample is comparable in size with female samples previously used in the literature. Broder (1993) used a sample with 30 female and 362 male; Ginther (2004)

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[13]Out of 747 listed universities only 449 had a link to a website. Missing links are mostly for private universities.

[14]Often, economics departments are combined with business departments to form a larger department. In this case, names from the business departments are also included.

had 90 female in her sample, while Blackaby et al. (2005) had a sample with 60 female and 291 male.

The percentage of females in our sample is 17.2%. Based on the statistics provided by MEXT[15] Statistics of School Education (*Gakkou Kihon Chousa*), the percentage of females in economics departments in Japan was 12.6% in 2007[16]. Thus, we over-sampled females. Over-sampling of females was purposely done in order to increase the precision of estimates. In the labor market discrimination literature, over-sampling of minority groups is not uncommon. For example, Neal and Johnson (1996) use data from the NSLY[17] which over-samples blacks. Moreover, Monk and Robinson (2000) in a study of gender and racial earning differences in academic markets over-sampled females. We thus believe that over-sampling of females does not affect the relevance of our results. Nevertheless, we advise caution when generalizing results.

One may be concerned with respondent biases. For example, if only those who identified with the purpose of analyzing gender inequalities replied, our estimates would be biased. However, we believe that such a bias does not exist in our sample, since in our cover letter, we did not emphasize that the data will be used only to analyze gender salary differences. Moreover, 96.44% of the respondents (94.83% female respondents) replied that they did not feel discriminated against in their salaries. Thus, there is no reason to believe that our sample is affected by respondent biases.

One may be also concerned with the over-representation of full-professors due to non-random responses, since in typical mail surveys of academics, such a problem is not uncommon (Ward 2001; Blackaby et al. 2005). In our sample, 63% of respondents are full-professors. However, according to MEXT Statistics of School Education (*Gakkou Kihon Chousa*) data, in 2007, 60% of academics in economics departments in Japan were full-

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[15]Ministry of Education, Sports, Science and Technology (MEXT)
[16]Based on the author's calculations.
[17]National Longitudinal Surveys of Youth (US)

professors. Thus, compared to past studies, the difference is relatively minor for our sample[18].

Finally, we under-sampled private universities because the MEXT does not provide website

links for a significant number of private universities. According to the MEXT Statistics

of School Education (*Gakkou Kihon Chousa*), 73% of academic economists work in private

universities while only 59% of our sample is in private universities.

7 Variables and descriptive statistics

Table 1 shows definitions of our variables. The dependent variable is the logarithm of the

total annual salary which includes the 12-month salary plus bonuses and allowances from the

current institution. Other sources of income, such as money earned from other institutions or

consulting fees are not included. We have a great number of control variables and classified

them according to four characteristics: personal, job, institutional and human capital.

Personal characteristics   Becker (1991) suggests that married adults posses more human

capital than unmarried adults. We include a dummy variable for married respondents in

order to control for the effect of marital status on salary. Ward (2001) finds that the presence

of young children increases salary by 8%. We, therefore, include the number of children under

age 6 in order to control for the effect of the presence of young children on salary[19].

Job characteristics   (AssocProf) is a variable that takes the value 1 if the respondent

is an associate professor, 0 otherwise; (FullProf) is a variable that takes the value 1 if the

respondent is a full-professor, 0 otherwise. The excluded category includes assistant profes-

sors and lecturers. Japanese universities typically hire academics on a lifetime employment

basis (i.e., no term-specified contracts). However, since 1997, with the enactment of the

Legislation of the Fixed-Term System for Faculty Members, the fixed-term contract has been

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[18]In Blackaby et al. (2005) 28.5% of their sample is full-professor, while the representation of full-professors in the population is only 18.8% (UK). Similarly, Moore et al. (2007) have 37.3% full-professors in their sample from the UK, while the the representation of full-professors in the population is only 18.8%.

[19]We only included the number of children under age 6, since our preliminary estimates did not show a significant effect of older children.

introduced. In order to control for the effect of fixed-term employment on salary, we include a dummy variable for the fixed-term contract.

Few studies control for the effect of teaching load on salary. Taylor et al. (2006) reports that time spent on teaching has a negative effect on research productivity. In order to control for the possibility that teaching load has a direct impact on salary, we control for the total number of courses taught during the previous year. This variable can also be thought of as capturing institutional differences as well, since top universities are expected to be more research-oriented, thus requiring less teaching from their academics. We also control for the number of courses taught for the first and second time, since these courses may take longer preparation time. According to McDowell et al. (2001) and Koplin and Singell Jr. (1996), females economists usually prefer fields like labor economics as opposed to fields like theory or quantitative methods. In fact, our sample also suggests that female academics are most represented in labor economics. In order to separate the effect of field choice from the effect of being female, we include a dummy variable for labor specialization[20].

We also control for being in an administrative position (e.g., the Dean of department or the Chair of the university), since holding such positions may increase the salary. Survey participants were asked to report the percentage of their time allocated for administrative duties. The variable (Admin) takes the value 1 if the respondent spends more than 50% of his/her working time on administrative duties. This variable is a proxy for holding administrative positions. Finally, we control for cohort effects for those who entered the academic labor market in the 1980s, the 1990s, between 2000-2003 and 2004 onward. The cohort that entered academia from 2004 onward is expected to capture the possible effects of 2004 national and public university 'corporatization'. The 2000-2003 cohort dummy captures the possible effect of the 2000 *Action Plan* (see Introduction) that stipulates that national uni-

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[20] In our preliminary estimations, we included dummies for various other fields. However, this did not affect the results; only the labor field was found to be highly statistically significant.

versities should increase the number of female academics. In the 1990s there is a significant convergence in the percentage of male and female PhD graduates joining the academia (see Figure 2B). The 1990s cohort dummy captures the effects of possible changes in the labour market conditions that caused such a convergence. The cohort dummy for the 1980s capture the effects of specific labor market conditions at that time, for example, the enactment of the *1985 Law of Equal Employment Opportunity of Men and Women.*

Institutional characteristics Estimated gender salary differences could arise if females are over-represented in universities with lower remuneration. Thus, we control for various institutional characteristics. We include dummy variables for private and public universities, with national universities being the reference group. We also include a dummy variable for business department. To proxy for the quality of the department, as in other studies (Taylor et al., 2006), we use a dummy variable that takes the value 1 if the department is offering a PhD degree.

The variable (IntGrant) shows the amount of internal research grant received from the current institution in the previous academic year. According to our data, 80% of the respondents said that each academic in their department receives the same amount of internal grant. Thus, the amount of internal grant can be viewed as either showing the financial status of the university, or its research orientation. We also consider a special competitive grant called Center of Excellence grant (COE). (COE) is the variable showing the amount of research grant each respondent received from the COE grant. COE grants are provided by MEXT[21] and offer funds at the department level. According to Arimoto (2007), in 2006, 51% of selected projects belonged to the top ten national universities. Thus, we expect that this type of grant shows the quality of the department and of the university.

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[21]Ministry of Education, Science, Sport and Technology

Human capital characteristics We control for standard human capital measures such as experience and education. The variable (Seniority) is the total number of years of experience at the current university; (Experience) is the total number of years of experience as an academic. We also include non-academic experience measured as the total number of years worked full-time outside academia. We also included the squared terms of (Seniority), (Experience) and non-academic experience, in order to capture that the rate of return on human capital continues at a diminishing rate. In order to control for the effect of career breaks on salary, we include a dummy variable that takes the value 1 if the academic took a leave during his/her academic career. This variable would capture the effect of human capital depreciation due to inactivity. The variable (PhD) is the dummy variable indicating that the respondent has a PhD degree. This variable captures the effect of education on salary. In order to capture the differences in the PhD programs from which the respondents graduated, we also include an additional dummy variable for a PhD degree obtained overseas.

To control for additional differences in productivity, we include the amount of competitive external grant that an academic received in the previous year[22], and the number of publications. The number of refereed articles is the most accepted measure of scholarly research output (Taylor et al., 2006). Previous literature found that the returns on salary from non-refereed publications are quite low (Oster and Hamermesh 1998; Moore et al. 2007). However, since Japanese academics in our sample produce a considerable amount of work other than refereed articles, we control for various types of publications. Publications are classified according to their types: referred single authored articles, refereed co-authored articles, working papers, single authored books, co-authored books, books edited, book chapters and textbooks. Publications are reported for the whole career. In the prior literature, the quality of research output is controlled for by distinguishing articles published in top

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[22]The amount is per individual; however the grant might have been obtained jointly. When grant was obtained jointly with other researchers, respondents were asked to report the amount based on their own contribution to the project.

journals. In our survey, however, in order to preserve the anonymity of the respondents, we did not ask the name of the journal of publication. Therefore, we cannot directly adjust for the quality of the publication. However, we asked the survey participants to report the number of publications according to the location of the publisher. Thus, each type of publication is further divided into subtypes depending on whether it was published in Japan or in the US/Europe. We expect publications in the US or Europe to be more cited than those published in Japan, since these are published mostly in Japanese. Thus, we can capture potential differences in the impact of the research output.

Descriptive statistics are presented in Table 2. The average annual salary is 10.5 million yen for males and 8.8 million yen for females. The average age is 50.7 for males and 43.3 for females. The average seniority is 13.5 years for males and 8.6 for females. The average experience is 18.3 years for males and 10.9 for females. The average non-academic experience for both males and females is about 3 years. 67% of males and 43% of females are full-professor, while 27% of males and 43% of females are associate professors. In sum, males are older on average, have more experience, and obtain higher average salary.

Only 2% of males took career breaks, while as much as 12% of the females did so. Females are more likely than males to be found in private universities (66% of females and 57% of males). It appears that there are no significant differences between males and females in terms of the highest educational achievements; 65% of males and 64% of females have PhD degrees. However, the number of males with a PhD degree from overseas is slightly higher than that of females (11% of males and 7% of females). The greatest number of females was hired after the year 2000. Figure (1) plots the salary profiles according to seniority and experience. Both females' seniority-salary profile and experience-salary profile lie below that of males'.

8 Estimation results

8.1 Salary equation

Table 3 reports the OLS results for four model specifications, each using different publication record measurements. For each model we present separate results, with rank variables included and excluded. OLS 1 includes the most detailed publication record. When rank variables are included, the coefficient for the female dummy is -0.071 and it is statistically significant at the 1% significance level, indicating that females earn 7% less than males, after controlling for detailed personal, job, institutional and human capital characteristics.

The effects of other control variables are also of interest. Age appears to be a significant determinant of salary. An increase in age by one would increase salary by 1.6% at the age of 40. Married academics earn, on average, 5% more than those not married. The number of children under 6 years old has a positive effect on salary. Salary would increase by 3% for each additional child in this age break. The past literature tends to find positive effects of children for the male sample (Bellas and Toutkoushian 1999), while insignificant effects for the female sample (Ward 2001; Barbezat 1987), suggesting that males with children might be acting as breadwinners. Our positive coefficient for children might suggest that the effect of children for the male sample is dominating the result. Indeed, when we summarize the salary by the presence of young children (under 6 years old) for respondents younger than 40 years old, males with young children earn more than males without young children (8.1 million yen and 7 million yen respectively); while females with young children earn slightly less than females without young children (7.1 million yen and 7.4 million yen respectively).

Full-professor rank has a positive and statistically significant influence on salary. The coefficient of 0.18 suggests that there is an 18% salary gap between assistant professors and full-professors. The coefficient for (AssocProf) is positive, indicating a 6% salary gap between associate professors and assistant professors; however, the coefficient is not statistically

significant. The coefficient for (FixTerm) is statistically significant at the 1% significance level. The result indicates that the salary would be 24% lower if the contract is of limited duration. The effect of the total number of courses is negative and marginally significant. Past literature found a negative impact of teaching on research productivity (Taylor et al. 2006). Our results suggest that teaching load may have a direct and negative impact on salary. Alternatively, we can interpret the result as showing that teaching-oriented universities are paying less. Academics who are specialized in labor economics have a salary premium of about 7%. As mentioned before, in our sample, the highest concentration of females is in the labor field. One may expect that females might be concentrated in a lower paying specialization, however, in our sample, the labor field enjoys a higher salary. We observe no significant cohort effects.

The coefficient for (PrivUniv) is positive and highly significant, showing a salary premium of 16% for those working in private universities. There is also a salary premium of 7% for those who work in PhD-granting departments. This premium could stem from greater outside funding for PhD-granting departments as suggested by Koplin and Singell Jr. (1996), or due to unobserved differences in the quality of academics who work in such departments. The amount of internal grant and the COE grant do not have statistically significant effects on salary.

Now let us turn our attention to the effects of human capital characteristics on salary. The coefficients for (Seniority) and its square are small and statistically insignificant. The estimated coefficients suggest that an increase in seniority of one year would increase salary by only 0.3%, evaluated at seniority equals to 10. The small effect of seniority is similar to Ransom's (1993) findings[23] that assert that the small effect of seniority on salary is the result of monopsonistic power universities have in the academic labor market. The effects

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[23]In Ransom's study the effect of seniority is negative. A more detailed analysis of this issue is beyond the purpose of this study.

of both academic and non-academic experience are insignificant. Career break variable has a negative coefficient, but it is statistically insignificant. Nonetheless, this variable has a significant impact on the estimated coefficient for females. Although not reported here, exclusion of this variable would increase the gender salary gap from 7.1% to 7.8%.

The coefficient for (PhD) is positive (0.023), but statistically insignificant. In Japan, until recently, a PhD was granted as a life-time work achievement rather than at the completion of a doctoral dissertation. Therefore, not having a PhD does not indicate lower human capital. However, a PhD obtained abroad seems to have a sizable effect on salary. There is a salary premium of about 5.6% for a doctorate obtained outside Japan. The amount of external grant has a significant coefficient[24]. The estimated coefficient indicates that earning a one million yen grant is associated with an increase in salary of 1% or about 100 thousand yen evaluated at the mean salary[25].

All the publication variables have insignificant effects on salary, except for book chapters published in the US and Europe. In virtually all of the previous studies, the number of publications, especially refereed articles, is found to be a significant determinant of salary. In our paper, the results are different and appear to confirm the common belief among Japanese academic economists that publications are not determinants of salary, since salary is determined by the rigid salary table[26]. However, there could be other factors that influenced our results for the publication variables. For example, there could be error-in-variables endogeneity in publication measures[27].

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[24]The amount of external grant may be an endogenous variable due to unobserved ability. However, the majority of papers on salary differences in academia do not control for such biases.

[25]We would like to note here that, in Japan, external research grants do not add to salary and do not provide summer salary, as in the US.

[26]Although not reported here, we experimented with other measures of publications. We use the publication rates defined as the number of publications divided by total experience as an academic. We found that the effects of these measures of publications are insignificant and the coefficient for female was unaffected by the choice of such a specification.

[27]In a preliminary estimation we controlled for error-in-variables endogeneity in the refereed articles by applying a 2SLS stage procedure to OLS 4. Given concerns related to the choice of instruments, we do not fully report the results here. We used as instruments parents' education and their interaction terms and spouse's education. Hansen's J-statistics did not reject the overidentifying restrictions (p-value=0.60). The C-statistics test rejected the exogeneity of refereed articles (p-value=0.01). We obtained a small statistically