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The Returns to College Quality in Japan:
Does Your College Choice Affect Your Earnings? ¹

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Introduction

The college advancement rate in Japan became approximately 55%, which is gradually increasing with time (see Figure 1). Parallel to this phenomenon, it became well known that the variation in earnings among college graduates had grown substantially. As shown by many economists, graduates from more selective colleges were more likely to have higher earnings than graduates from less selective colleges. For example, Iwamura (1996) employed the integral method to calculate the rate of private returns to education of some selected universities, and then showed that the returns of Hitotsubashi University, one of the top-notch national universities in the country, was approximately 10%—much higher than lower ranked national and private universities. Moreover, Kambayashi *et al* (2008) used the microdata from the *Basic Survey on Wage Structure* and proved that, while the between-group wage differentials became rather smaller, the within-group wage differentials, such as tertiary educated workers, became larger over time depending on workers' heterogeneity. A plausible explanation for why variation in earnings among college graduates became substantial is, as argued by Monk (2000) and Brewer *et al* (1999), that it may reflect the quality of education, which is often measured by expenditures on educational resources, such as faculty per student, tuition fees, and student enrollments. In other words, it is

hypothesized that this variation may account for how effectively a college has spent money on education. According to a comprehensive review conducted by Card & Krueger (1996), their conclusion is as follows: “most studies of labor market outcomes show a positive effect of school quality” (p. 135).

A notable exception to this conclusion is, however, recent studies focusing on higher education. Several empirical studies attested to the signaling effect of education, originally proposed by Spence (1973). In sharp contrast to the human capital theory, signaling assumes that education actually creates only few skills but has a substantial impact on earnings; employers use the information about the college that their prospective employee actually graduated from as a screening device to assess their innate ability or productivity that cannot be observed when hiring them. In other words, employers basically trust the rigid screening process of admission committees that are able to observe a wider range of student characteristics, even including students' motivation, ambition, and maturity reflected in their essays.

One specific type of signaling is what is called the sheepskin effect, a jump in the returns to education when degrees are completed. For instance, Jaeger & Page (1996) found that a degree receipt substantially increases the returns to college education. Chatterji, Seaman, & Singell (2003) also provided evidence of a significant,

positive, gender-specific signaling effect of education, although there are only a few studies using the data in Japan (for example, Abe, 2002). If signaling is true, it can be seen as a positive effect of college quality on earnings.

Furthermore, one methodological problem in estimating the returns to college quality is the selection bias that arises when a part of the labor market outcomes can be explained by workers' unobserved characteristics that are also correlated with their college choice. It is highly possible that the variation in earnings among college graduates may simply reflect the selection of who is admitted and who is not: students with greater ability and parental support are more likely to be admitted by more selective colleges through screening processes at the entrance examinations. In fact, Hoxby and Terry (1999) empirically showed that the reason for a substantial growth in the variation in earnings among tertiary educated workers was largely explained by an increased return to ability of an individual over time.

We now understand the effect of the nonrandom selection of students on different college quality. Some studies attempted to address the causal inference between college quality and subsequent earnings later in life, and to answer the question of whether the labor market returns to college education are significant after controlling for unobserved student and family characteristics. Monk (2000) ran wage regressions

with a wide variety of individual and family endowment variables. Brewer *et al* (1999) also ran wage regressions with a selection correction term identified by the inclusion of tuition and financial aid. Widely cited papers released by Dale & Krueger (2002) and Long (2008) employed two approaches: one compared students who were accepted and rejected by a comparable set of colleges and the other controlled for the average SAT score of each institution to which students applied. Hoekstra (2009) examined the causal effect of college selectivity on earnings by using the information on confidential admission records drawn from an anonymous flagship state university, allowing him to compare students who were barely accepted and rejected. Behrman *et al* (1996) used the sample of female twins born in Minnesota to eliminate the effect of unobserved heterogeneity of an individual. A more recent study conducted by Smith (2013) also used a larger sample of twins in the US, and that undertaken by Lindahl & Regner (2003) used a sample of siblings in Sweden. However, the conclusions drawn from previous literature did not reach a solid consensus on the effect of college quality on various education outcomes: some concluded that college quality matters (Behrman *et al*, 1996; Brewer *et al*, 1999; Monk, 2000; Long, 2008; Hoekstra, 2009; Smith, 2013), while others believed it does not (Dale & Krueger, 2002; Lindahl & Regner, 2003).

This brings us to the main questions of interest: what is the causal effect of

college quality on earnings? If college quality matters, what type of college characteristics might lead to higher labor market premiums? In particular, Behrman *et al* (1996) found a positive and significant labor market return from attending small, private, and Ph.D.-granting universities with highly rewarded, experienced faculty members. We basically follow the line of previous research conducted by Behrman *et al* (1996). In our study, the large amount of twins' data that we collected through the web-based survey in Japan is combined with the official statistics, with a wide variety of college characteristics and college selectivity.

This data set let us complement prior research, and makes several contributions to previous literature. In many studies, college quality is a combined indicator of college resources and college selectivity because in the United States, the students' choice of college is largely affected by not only college selectivity but also resources, particularly tuition and financial aid. However, in Japan, college selectivity is almost entirely determined by student performance in written exams, and admission committees do not freely choose students on the basis of any individual characteristics that are beyond their performance in entrance exam. Moreover, college quality is largely affected by government policy: the national and prefectoral public universities are competitive educational entities, sometimes more than private universities, where a substantial

amount of subsidies has been allocated. Therefore, in this context, Japan is a very suitable subject to explore the effect of college quality, separate from college selectivity conditional on individual characteristics. We also take advantage of using official statistics, providing a wide range of college characteristics and resources. Many studies just simply address whether college selectivity matters; nevertheless, the effectiveness of spending on college education is a more critical issue for public policy. This research must provide a clue on how to allocate limited resources for education to colleges.

The results drawn from empirical analyses show that there is no strong evidence for the positive returns to college quality in Japan after controlling for college selectivity and unobserved individual heterogeneity. However, in some empirical specifications, the composition of full-time faculty members, e.g., a student–faculty ratio and a full-time faculty ratio, is regarded as an important determinant of the variation in subsequent earnings among college graduates. Furthermore, although the sample is quite small, college quality has a significantly positive effect on students from low-income families.

The rest of this study is organized as follows: the next section reviews the relevant literature in this field of study; the third section introduces the empirical models to be estimated; the fourth section introduces the data used and variables defined for

empirical analyses; the fifth section presents the empirical results; and the final section provides conclusions.

Relevant Literature

In this section, we briefly summarize previous literature that dealt with potential bias to obtain consistent estimates of the effect of college quality on earnings. Monk (2000) ran wage regressions while controlling for a wide variety of student characteristics, such as family background and innate ability, measured by the Armed Forces Qualification Test. The empirical results showed that, although graduates from more selective colleges earn significantly more than those from less selective colleges, there were substantial variations across racial and gender groups in the returns to college education. Brewer *et al* (2000) employed the Heckman correction and added a selection correction term identified by an inclusion of the net costs of college attendance.

Frequently cited articles in this field of study were conducted as quasi-experiments by Dale and Krueger (2002) and Long (2008). Their proposed solution toward ability bias is to include in the traditional model of the returns to education an unrestricted set of dummy variables, indicating groups of students who received the same admissions decisions from the same set of institutions. The authors

assume that students with a similar history of acceptance and rejections will possess essentially the same average value of the observed and unobserved attributes assessed by admissions committees in making decisions. They were thus able to overcome a selection by controlling for the set of unobserved characteristics that influence college admissions and, perhaps, earnings. The conclusion drawn from Dale & Krueger (2002) was surprising for both academia and policymakers: the authors demonstrated that the effect of college quality was indistinguishable from zero, while Long (2008) took a similar strategy and concluded that college quality has a positive impact on college graduation but not on hourly wages.

The other type of literature is considered to be a natural experiment: exploiting the features of twins or siblings. In particular, identical twins (monozygotic twins, hereafter MZ twins) are produced in the same pregnancy, when a single zygote splits into two separate embryos by chance. The two are genetically identical, which thus enables us to hypothesize that a pair of MZ twins share the same innate abilities. In addition to genetic endowments, they also share the same family and neighborhood environments. The method to answer the causal question in this approach is to compare the difference in education and earnings between MZ twins and then isolate the effect of education on earnings while holding differences in genetic and family endowments

constant.

A large number of economic studies used the sample of twins to identify the causal effect of years of schooling on earnings (for example, Ashenfelter & Krueger, 1994; Ashenfelter & Rouse, 1998; Rouse, 1998); however, only a few studies focused on college quality. The prominent study was conducted by Behrman *et al* (1996). The authors use a sample of 403 female MZ twins and 306 female nonidentical twins (dizygotic twins; hereafter, DZ twins) born in Minnesota between 1936 and 1955. Lindahl & Regner (2003) also took a similar strategy to Behrman *et al* (1996) and used a sample of siblings in Sweden.

However, the conclusions drawn from previous literature did not reach a solid consensus on the effect of college quality on earnings: some concluded that college quality matters (Behrman *et al*, 1996; Brewer *et al*, 1999; Monk, 2000; Long, 2008; Hoekstra, 2009; Smith, 2013), while others did not (Dale & Krueger, 2002; Lindahl & Regner, 2003).

Empirical Models

Our empirical strategy follows the strategies of Behrman *et al* (1996) and Lindahl & Regner (2005). We outline a simple wage equation where W_{ij} is the logarithmic form of annual earnings for twins i ($i = 1, 2$) in family j , and X_{ij} is a vector of

individual characteristics, including age, squared age, gender, marital status, years of tenure at the current employment, and average working hours a day. S_{ij} represent the college selectivity measured by the deviation value, while \mathbf{C}_{ij} is a vector of college characteristics and resources. A_i is unobserved family endowments, which are common within twin-pairs and are constant over time (therefore, $A_1 = A_2 = A_j$), and random disturbance with mean zero and constant variance (e_{ij}). The mathematical expression is written as follows:

$$W_{ij} = A_i + \mathbf{X}_{ij}\alpha + \mathbf{C}_{ij}\beta + S_{ij}\gamma + e_{ij}, \quad (1)$$

If we estimate equation (1) using the conventional ordinary least squares (OLS), the result may be affected by the problem of omitted variable bias. The unobserved differences in native abilities and family backgrounds contained in the error term (e_{ij}) make the OLS estimates biased and inconsistent. To deal with this potential bias, we applied a twins' setting to the above wage equation:

$$W_{1j} = A_j + \mathbf{X}_{1j}\alpha + \mathbf{C}_{1j}\beta + S_{1j}\gamma + e_{1j}, \quad (2)$$

$$W_{2j} = A_j + \mathbf{X}_{2j}\alpha + \mathbf{C}_{2j}\beta + S_{2j}\gamma + e_{2j}, \quad (3)$$

First, we took a difference between equations (1) and (2) to eliminate the unobserved family endowments shared within twin-pairs (A_j) and obtain within-fixed effects estimates of β and γ , holding other factors constant. The β and γ estimated by the

twin-fixed effect model are considered as the causal effect of college quality and selectivity conditional on individual observed and unobserved characteristics. As already explained, MZ twins are supposed to share the same genetic materials and family environments, which is the ideal situation to precisely control for unobserved family components (A_j) and to isolate the pure effect of college quality and selectivity. The estimates drawn from the sample restricted to MZ twins are more accurate than the those drawn from the entire sample of twins. Therefore, we will mainly show the results from the MZ twins' sample, thus following the previous literature.

Data

We combined three data sets to estimate the returns to higher education by each college. The first data set is the twins' data set that the authors collected through a web-based survey (see Nakamuro & Inui, 2012 and Nakamuro *et al.*, 2013 for more detailed information on the survey). This survey is designed to gather information on over 4,700 individuals in over 2,300 households. The second data set is the microdata from the *School Basic Survey* collected by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan. The *School Basic Survey* is time-series data, started in 1948, based on school characteristics, such as the numbers of applicants, enrolled students, and teaching and administrative staff in school. The third data set is

deviation values (called *hensachi* in Japanese) calculated by Kawai juku, one of the largest scale cram schools in Japan. It releases *Kawai juku's Ranking of Deviation Values* every year on its website (see <http://www.keinet.ne.jp/rank/index.html>). A series of deviation values represent college selectivity, or relative competitiveness to get an admission to each institution, for all colleges and universities in Japan. The interpretation of the deviation value is that the larger the institution, the more selective or competitive it is.

A noteworthy feature of the web-based twins' survey is to include the name of the institution and department that a respondent actually graduated from. Thus, we are able to match the name of institutions with information on the college characteristics provided in the *School Basic Survey* and college selectivity measured by the *Kawai juku's Ranking of Deviation Values*.

Our survey was implemented during the fiscal year of 2010. This survey is one of the largest twins' data sets in Japan, with a wide variety of sociodemographic characteristics. More specifically, we conducted the survey through Rakuten Research, which is affiliated with Rakuten, a major Internet shopping site (similar to Amazon.com or eBay, for example), and monitors over 2.2 million people. To analyze the effect of education on earnings, our sample targeted twins who were nonstudents between the

ages of 20 and 60.³ Through this web-based survey, one member of a twin-pair is responsible for reporting on both himself and his twin sibling at the same time. In our estimations, the information on the respondents' twin sibling is treated as though it were directly provided by that twin sibling themselves.⁴ The entire sample in this survey is 2,360 complete pairs of twins (4,720 individuals), including 1,371 pairs (2,742 individuals) of MZ twins and 882 pairs (1,764 individuals) of DZ twins. Therefore, for this study, we completely restrict the sample to MZ twin-pairs, both of whom completed four-year tertiary education.⁵ As illustrated in Table 1, the numbers of college graduates

³ Once the respondents filled out the questionnaires, they would be given a certain amount of cash-equivalent “points” that could be spent on Rakuten. To exclude “fake” twins, who pretend to be twins to collect the cash-equivalent points, we carefully developed the following data collection strategy: we did not inform respondents that the purpose of our survey was to collect data from twins. Furthermore, we started with five questions on family and siblings that were not related to twin status, and then, in the sixth question, for the first time, asked whether or not a respondent was a twin. If the respondent answered “No” in this question, they would be automatically excluded from the survey. We discovered 23 twin-pairs, each member of which was included in this survey. We then thoroughly checked the responses of both twins and randomly eliminated one of the twins from our sample.

⁴ One may question that, in our survey, there may exist substantial measurement errors in self-reported outcomes by one of the twin-pairs, instead of both. It is important to note that we have 23 twin-pairs, each member of which was included in this survey. When we checked their responses, we found that their responses reported by each other were quite accurate: the correlations between self-reported and cross-reported birthweight was 91.2%. Not only the birthweight but also other outcomes showed over 90% correlation. Furthermore, we checked whether there existed significant differences between responses on themselves and on their twin sibling; for example, one may wonder whether respondents were likely to pretend that their earnings or education were higher than those of their twin sibling. However, according to the results drawn from two sample t-tests for difference of the means, there was no difference between them. As a further robustness check, we included a respondent dummy in all specifications; however, the dummies were statistically insignificant.

⁵ We excluded graduate schools from our analysis. As Hamanaka (2013) showed, in apparent contrast to Western countries where students with a Master's degree typically earn more than ones with a Bachelor's degree, graduate students in Japan often struggle more to access better job opportunities than undergraduate students at the time of graduation. Moreover, many studies, such as Genda *et al* (2010), showed that the first job entry into the Japanese labor market has a prolonged effect on subsequent employments and earnings. Therefore, graduate students in Japan may undergo a different path to the entry of job markets and then a different path to develop their careers.

in our sample are 373 complete pairs of MZ twins (746 individuals). Out of those twins, only 61 pairs of MZ twins (122 individuals) attended the same college, indicating that a majority of twin-pairs chose different colleges to attend.

To identify the determinants of a within-pair variance in earnings, which is solely determined by postsecondary education, we further restrict the sample to twin-pairs who attended the same or similar ranking high schools which is defined as a difference in deviation values between two institutions of less than five (in Model V) and three (in Model VI). This setting enables us to assume that they were exposed to the same quality of primary and secondary education. Out of those twins, 139 complete pairs of MZ twins attended the same high school.

Our measure of income is the natural logarithm of annual wage earned during the fiscal year of 2009 before tax deduction. The response category in the original questionnaire ranged from one (no income or less than 0.5 million JPY) through 16 (more than 15 million JPY). We set the minimum (1 = no income and less than 0.5 million JPY) to zero and maximum (16 = more than 15 million JPY) to 15 million JPY. Then, we took the median value for categories between two (0.5 million to 0.99 million JPY) and 15 (10 million to 14.99 million JPY). The control variables deemed to affect productivity, and hence earnings are included in the models: they are age, gender (1 =

male), marital status (1 = married), hours worked per day, and number of years in current employment.

In the *School Basic Survey*, we can retrieve information on approximately 1,170 colleges and universities nationwide in Japan. According to Long (2008), college quality is classified into three general types: (i) institutional quality; (ii) quality of peers; and (iii) quality of faculty members. Therefore, we use the following information as a proxy for college quality: as a component of institutional quality, (1) a type of college (1 = private) and (2) location of college (1 = Tokyo metropolitan areas⁶ and Osaka); as a component of quality of peers, (3) the total number of undergraduate students, (4) the ratio of Ph.D. students to the total number of students, and (5) the ratio of foreign to Japanese students; and as a quality of faculty members and administrative staff, (6) the ratio of students to full-time faculty members, (7) the ratio of students to administrative staff, (8) the ratio of full-time professors to the total number of full-time faculty members, (9) the ratio of full-time to part-time faculty members, and (10) the ratio of foreign to Japanese faculty members.

The striking feature of these statistics is that there is information on school financing; the data is only available for public institutions though. It contains the

⁶ Tokyo metropolitan areas include Tokyo, Kanagawa, Chiba, and Saitama.

following: (11) the average salary of full-time faculty members; (12) tuition fees per student; and (13) the amount of subsidy received from national and local governments per student. The subsidy received from local and national governments is for operating support funds, which is different from research grants, such as Grant-in-Aid for Scientific Research, generally called “*Kaken-hi*.” It is thus appropriate to use this measurement as a proxy of college quality because this is mainly spent on school resources. The greatest drawback of this data is that we are not able to access anything before 2003. We thus take the mean value for each period between 2003 and 2010, assuming that school characteristics were relatively stable over the years. It is worth mentioning that the variables in the earliest year are highly correlated with the latest.

The descriptive statistics summarized in Table 2 show that the average age of MZ twins in our sample is 40 years, with 4.77 million JPY annual earnings, which is according to the *Basic Survey on Wage Structure* released by the Ministry of Health, Labor and Welfare, very close to the national average of 4.71 million JPY for 2009, among all employees with a college degree and engaged in their current employment of 11 years, working 8 h a day. They graduated with a major in humanities, social sciences, arts, and music from a relatively large private university. Both foreign faculty members and students are relatively small. Of the full-time faculty members, almost half may be

experienced and senior full-time professors. On an average, the student–faculty ratio is 26, and the student–administrative staff ratio is 37. Surprisingly, the salary, tuition fees, as well as subsidy received at national and municipal universities vary significantly between institutions.

Empirical Results

As already explained, the twin-fixed effect estimates drawn from the sample of MZ twins are more accurate to fully control for the unobserved family components. Therefore, we restricted our study to the sample of MZ twins and compared the results between the conventional estimates (OLS) and twin-fixed effect estimates (FE). Looking at the difference in the coefficients on college quality and its statistical significance between OLS and FE estimates, we can find whether the unobserved family component confounds the impact of college quality as well as individual characteristics on labor market outcomes.

Our analysis begins with the Model I, which is reported in the first column of Table 3-1 (OLS), along with the heteroskedasticity robust standard errors. Model I included both men and women, while Model II included only men. The conventional OLS estimate suggests that college quality does not matter, but college selectivity measured by the deviation value does. The coefficient on the respondents' major,

whether or not humanities-related, is negatively significant at a 10% level, indicating that students who majored in math, science, and engineering are more likely to obtain higher earnings in subsequent life. However, once we employed the twin-fixed effect to account for the unobserved family component, as shown in the second column of Table 3-1 (FE), it can be seen that the coefficients both on college selectivity and the major become statistically insignificant. Instead, the ratios of student to full-time faculty members, professors to the total number of teaching staff, and full- to part-time faculty members are systematically related with graduates' subsequent earnings with expected signs. In general, the full-time professors at college are more senior and experienced, and the full-time faculty members make stronger commitments to management and other duties. Therefore, this result may suggest that the quality of teaching staff plays an important role for students in effectively accumulating their skills and knowledge.

Then, we run a separate regression based on male-only samples because there is quite a gender disparity in earnings. Our results, which are presented in Model II of Table 3-1, do not show any significant differences between the male sample and the entire sample. However, one noteworthy feature of Model II is that the OLS estimates suggested that the ratio of foreign to Japanese students is negative and statistically significant, but once the twin-fixed effect model was employed, the coefficient turned

into positive and statistically significant, indicating that the more the number of foreign students relative to native Japanese students, the better are the subsequent earnings later in life. This is supporting evidence for the Government of Japan, which has strongly pushed forward and prioritized global education on the policy agenda. However, we should keep in mind that the composition of foreign students has been dramatically increased since the Government of Japan stipulated the amendment of the Immigration Control and Refugee Recognition Act of 1989. It is therefore difficult to say that the composition of foreign students in 2003 through 2010 on average is the same as that at the time when a majority of respondents in our survey attended college. As in Model I, the ratios of professors to the total number of teaching staff and full- to part-time faculty members are positive and statistically significant for the results drawn from FE. Both Models I and II suggested that the composition of full-time professors is a crucial determinant of graduates' labor market outcomes after graduation.

Dale & Krueger (2002) concluded that, although the effect of college quality is indistinguishable from zero, the effect is positive for students from low-income families. Hence, the effect may be heterogeneous across income. We thus run a separate regression restricted to twin-pairs from low-income families in spite of the sample size being quite small (see Model III of Table 3-2). In the twins' survey, we asked

respondents about their living standards when they were 15 years old, measured the responses on a five-point scale (1 = very good; 2 = good; 3 = average; 4 = bad; 5 = very bad). We ran a separate regression with the sample restricted to those who answered “bad” (4) or “very bad” (5).

While OLS estimates in Model III show that college quality does not matter, the FE estimates, coupled with the positive coefficients on college quality, clearly support Dale & Krueger (2002): we find evidence of a positive payoff from attending national or municipal colleges or universities with a larger number of Ph.D. students and greater proportion of full-time professors, while the student–faculty ratio is smaller than its counterpart. This estimation also complements the view on global education: the numbers of foreign students as well as foreign faculties have a positive impact on earnings. Most of the coefficients have sizable magnitudes.

The reason behind this finding that college quality matters, particularly for graduates from low-income families, is that the returns to investments in college quality would be higher than those for their counterparts from middle- or high-income families. Perhaps, students from low-income families were merely exposed by low-quality of secondary education before they entered college, including the opportunity to access

shadow education, in part due to the financial constraints of the household⁷. Therefore, when one of the twin pairs from the poor family was admitted by a college with high level of quality while his/her twin sibling wasn't and went to different college with low level of quality, the return to college quality between twins would become quite larger as compared with twins from rich families who received high quality of secondary education, which may reduce the difference in earnings potential between twins before entering college.

In the *School Basic Survey*, there is much financial information, such as salary, tuition fees, and subsidy. Unfortunately, this information is only available for public institutions, although we investigate the effect of these expenditures on labor market outcomes of graduates. One significance of this study is that we are able to separately analyze the effect of college quality and college selectivity. In western countries, it is apparent that college selectivity is strongly correlated with resources, and hence, much of the previous literature used the type of college, such as top private, middle private, and top public, as an indicator of college quality that combined the measure of college

⁷ Shadow education may be an important part of school quality at secondary education in Japan: the difference in access to shadow education is substantial between graduates from low- and middle- or high-income families. We asked respondents about access to shadow education, such as cramming schools, during their high-school days in preparation for college entrance examinations. According to our survey, only 16.6% of graduates from low-income families received shadow education, while 31.4% of those from middle- or high-income families received it when they were high-school students.

selectivity with resources. However, in Japan, college selectivity is not correlated with resources. In fact, in our data set, college selectivity measured by deviation value is not correlated with, or is weakly correlated with, any type of financial resource.

College selectivity is almost solely determined by performance in written exams, and admission committees do not freely choose students on the basis of individual characteristics beyond their accomplishments in the entrance exam. Moreover, resources, especially salary, tuition fees, and subsidy, are largely affected by government policy; the national and prefectural public universities are competitive educational entities, sometimes more competitive than even private universities, where a substantial amount of subsidies has been allocated. Therefore, in this context, Japan is a highly suitable subject to explore the effect of college quality, separate from college selectivity conditional on individual characteristics. Many studies just simply address whether college selectivity matters. However, the effectiveness of spending on college education is a more critical issue for public policy. This research must provide a clue on how to allocate a limited amount of public expenditure for education to colleges.

In Model IV of Table 3-2, we run a separate regression that is restricted to twin-pairs who graduated from a public university in order to look at the effects of financial resources conditional on college selectivity and individual characteristics. The

conventional OLS estimate indicates tuition has a significant positive effect on earnings, but once corrected for selection, the effect becomes indistinguishable from zero. Other variables, such as the salary of full-time faculty members and the subsidy received from national and local governments, also have no positive impact on earnings.

Finally, to identify the determinants of a within-pair variance in earnings, which is solely determined by postsecondary education, we further restrict the sample to twin-pairs who attended the same or similar ranking high schools, which is defined as a difference in deviation values between two high schools as less than five (in Model V) and three (in Model VI). In our dataset, we asked to the respondents the name of high schools from which they graduated. We matched the name of institutions with information on the deviation value at high school provided by Kanjuku, one of the large-scale cramming schools in Japan. In Model V, 194 complete pairs of MZ twins and in Model VI, 153 complete pairs of MZ twins are included while, out of those twins, 139 complete pairs of MZ twins attended the same high school. This setting enables us to assume that they were exposed to the same quality of primary and secondary education. The result is more striking than that for other models; after accounting for potential bias, almost no quality variables are statistically significant, except for the type of college in Model VI. Taken as a whole, it can be said that college quality does not

matter after controlling for college selectivity and individual characteristics. We note that the computed Variance Inflation Factor (VIF) suggests no severe collinearity among college quality measures included in Models I through VI.

Conclusion

This study attempts to answer the question of why there is a variation in earnings among college graduates. In fact, graduates from more selective colleges are more likely to have higher earnings than graduates from less selective colleges. There are two possible explanations: first, the variation may reflect the quality of education, which is often measured by expenditure on educational resources, such as faculty per student, tuition fees, and student enrollments; second, it may be the signaling effect of education. If signaling is true, it cannot be seen as a positive effect of college quality on earnings. Furthermore, one methodological problem in estimating the returns to college quality is the selection bias arising when part of labor market outcomes can be explained by worker's unobserved characteristics that are also correlated with their college choice. Economists disagree on the causal effect of college quality on the subsequent earnings of graduates.

This study thus addresses the nonrandom selection of students on different college quality by analyzing a sample of twins to eliminate the effect of genetic makeup

and family environments. This is a unique twin data set wherein the college from which a twin pair is actually graduated is matched to the college characteristics as well as resources retrieved from official statistics, namely the *School Basic Survey*, from 2003 through 2010. In addition, in this study, we place a greater emphasis on college characteristics and resources than the college selectivity measured by the deviation values. As colleges and universities in Japan, especially public institutions, are largely supported by government funding, policymakers must be keen to know what type of college characteristics and resources lead to higher labor market premiums. Much of the policy debate in this topic hinges on the effect of college quality on graduates' subsequent earnings, leading to how effectively a college has spent money on education. In particular, Behrman *et al* (1996) found a positive and significant labor market return from attending small, private, and Ph.D.-granting universities with highly rewarded, experienced faculty members. We basically follow the line of previous research conducted by Behrman *et al* (1996) and Lindahl & Regner (2003).

The results drawn from empirical analyses show that once we control the selection on unobserved genetic and family endowments that are constant over time by using the sample of identical twins and twin-fixed effects model, in some empirical specifications, the composition of full-time faculty members, for example, student-

faculty ratio, professors–teaching staff ratio, and full-time to part-time faculty ratio, is regarded as an important determinant of the variation in subsequent earnings among college graduates. Furthermore, although the sample is quite small, college quality has a significantly positive effect on students from low-income families.

However, once we restricted our sample with twin-pairs who may be exposed by similar high school quality, the effect of college quality on earnings became indistinguishable from zero. This result is more relevant to evaluate the college quality because it is ruled out that the effect of college quality is confounded by the effect of high school quality. Therefore, college quality does not matter. This implies that outcomes measured in subsequent life, such as earnings, were more likely to be determined prior to college enrollments. The conclusion in this paper thus is that we find no strong evidence of the positive returns to college quality in Japan.

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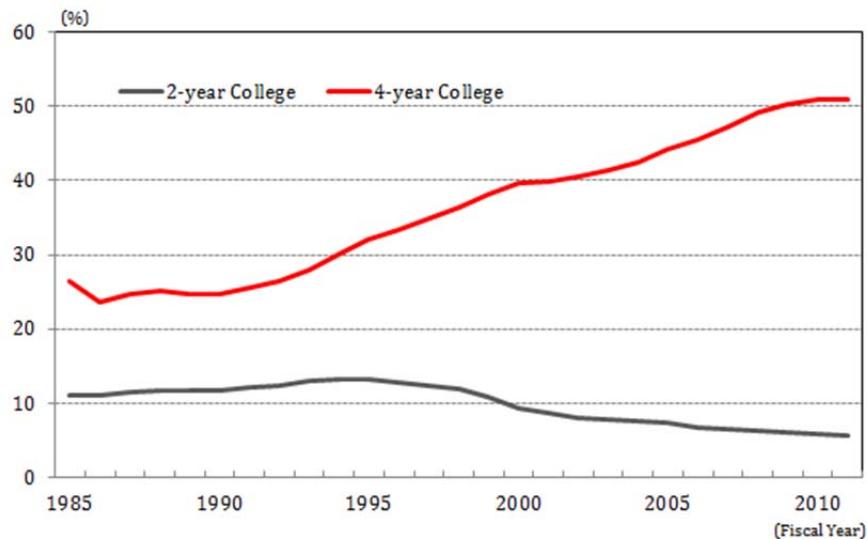
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Figure 1: The college advancement rate in Japan



(Source) School Basic Survey, Ministry of Education, Culture, Sports, Science and Technology

Table 1: The sample of twins in estimations

	MZ Twins
All educational background	2,742 (1,371)
College graduates (Men +Women)	746 (373)
Similar high school quality (within 5 deviation values at high school)	510 (255)
Similar high school quality (within 3 deviation values at high school)	306 (153)
College graduates (Men)	546 (273)
College graduate (from low-income family)	88 (44)
Public college graduates	230 (115)

(Note) Figures in parentheses represent the numbers of twin-pairs.

(Source) Authors' calculations

Table 2: Descriptive statistics

Variables defined	Whole sample				MZ Twins			
	Mean	STDV	Max	Min	Mean	STDV	Max	Min
Rakuten Twin Survey								
Dependent variable: log(wage)	6.10	0.71	7.31	4.32	6.11	0.73	7.31	4.32
Independent variables:								
Age	39.39	9.44	60	21	39.69	9.29	60	21
Age ²	1,640	774	3,600	441	1,662	764	3,600	441
Gender (1=male)	0.54	0.50	1	0	0.56	0.50	1	0
Marital status (1=married)	0.66	0.47	1	0	0.68	0.47	1	0
Tenure	10.25	8.43	38	0	10.55	8.40	37	0
Working hours	8.15	3.90	16	1	8.32	3.84	24	1
Deviation value of the institution that a respondent attended	51.20	9.66	82	35	51.48	9.67	73	35
Major (1=Humanities, Social science, Arts and Music)	0.75	0.43	1	0	0.75	0.43	1	0
School Basic Survey								
(1) A type of institution (1=private)	0.59	0.49	1	0	0.56	0.50	1	0
(2) Location (1=Tokyo and Osaka)	0.48	0.50	1	0	0.48	0.50	1	0
(3) Student body	15,177	15,953	70,062	1	15,783	16,191	70,062	3
(4) Ratio of Ph.D. students and total students	0.03	0.05	0.33	0	0.03	0.05	0.33	0
(5) Ratio of foreign and Japanese students	0.03	0.03	0.45	0	0.03	0.03	0.31	0
(6) Ratio of students and full-time faculty members	25.51	15.46	374.00	0	25.05	13.13	114.00	1.03
(7) Ratio of students and full-time administrative staff	37.15	24.07	128.34	0	36.92	24.59	128.34	0.36
(8) Ratio of full professors and the total teaching staff	0.49	0.14	0.79	0	0.49	0.14	0.79	0
(9) Ratio of full-time and part-time faculty members	2.02	9.43	179.00	0	1.98	9.44	179.00	0
(10) Ratio of foreign and Japanese faculty members	0.04	0.03	0.33	0	0.04	0.04	0.33	0
(11) Salary per faculty (1,000 JPY)	7,599	1,195	11,900	5,474	7,525	1,156	11,900	5,474
(12) Tuition per student (1,000 JPY)	451	81	514	0	451	82	514	0
(13) Subsidy received per student (1,000 JPY)	40	303	5,378	0	31	171	1,775	0

(Source) Authors' calculations; Ministry of Education, Culture, Sports, Science and Technology

Table 3-1: Empirical results (Model I-II)

	Model I (Men + Women)		Model II (Men only)	
	OLS	FE	OLS	FE
Age	0.020 (0.017)	⋮	0.038** (0.018)	⋮
Age2	0.000 (0.000)	⋮	0.000 (0.000)	⋮
Gender (1=male)	0.396*** (0.050)	⋮	⋮	⋮
Marital status (1=married)	0.081* (0.043)	-0.008 (0.061)	0.157*** (0.046)	0.033 (0.053)
Tenure	0.020*** (0.003)	0.015*** (0.004)	0.016*** (0.003)	0.015*** (0.004)
Working hours	0.067*** (0.010)	0.052** (0.021)	0.043*** (0.011)	0.042* (0.021)
College Selectivity:				
Deviation value of the institution	0.017*** (0.003)	0.006 (0.005)	0.015*** (0.003)	0.003 (0.005)
College Characteristics and Resources:				
Major (1=Humanities)	-0.044* (0.045)	-0.083 (0.069)	-0.078 (0.041)	-0.090 (0.064)
A type of institution (1=private)	0.088 (0.075)	-0.025 (0.130)	0.113 (0.082)	-0.115 (0.129)
Location (1=Tokyo and Osaka)	0.027 (0.050)	-0.015 (0.045)	0.008 (0.055)	-0.003 (0.047)
Student body	0.002 (0.001)	-0.003 (0.003)	0.002 (0.001)	0.000 (0.001)
Ratio of Ph.D. students and total numbers of students	0.433 (0.594)	0.349 (0.961)	0.864 (0.631)	0.828 (1.165)
Ratio of foreign and Japanese students	-0.774 (0.639)	0.749 (1.065)	-1.236* (0.715)	1.799* (1.087)
Ratio of students and full-time faculty members	0.000 (0.004)	-0.009* (0.006)	-0.006 (0.004)	-0.007 (0.006)
Ratio of students and full-time administrative staff	0.000 (0.001)	0.000 (0.001)	0.001 (0.001)	-0.001 (0.002)
Ratio of professors and teaching staff	-0.201 (0.262)	0.681* (0.371)	-0.121 (0.255)	0.816** (0.400)
Ratio of full-time and part-time faculty members	-0.010 (0.040)	0.081* (0.045)	0.058 (0.048)	0.118** (0.055)
Ratio of foreign and Japanese faculty members	-0.484 (0.787)	0.142 (0.722)	-0.939 (0.845)	0.270 (0.709)
Constant	3.702*** (0.362)	5.151*** (0.254)	3.992*** (0.382)	5.327*** (0.271)
R-squared	0.506	0.285	0.429	0.347
Numbers of observations	746 (373)	746 (373)	546 (273)	546 (273)

(Source) Authors' calculations

Table 3-2: Empirical results (Model III-IV)

	Model III (Low income)		Model IV (Public college)	
	OLS	FE	OLS	FE
Age	0.048 (0.090)	0.060* (0.032)		
Age2	0.000 (0.001)	-0.001 (0.000)		
Gender (1=male)	0.529* (0.302)	0.419*** (0.097)		
Marital status (1=married)	0.089 (0.147)	0.018 (0.091)	-0.142 (0.111)	
Tenure	0.015** (0.007)	0.017 (0.010)	0.013*** (0.005)	0.007 (0.008)
Working hours	0.072** (0.029)	0.141* (0.083)	0.051*** (0.015)	0.019 (0.053)
College Selectivity:				
Deviation value of the institution	0.008 (0.009)	-0.028 (0.018)	0.011 (0.011)	0.007 (0.012)
College Characteristics and Resources:				
Major (1=Humanities)	-0.195 (0.193)	-0.113 (0.109)	-0.007 (0.088)	0.090 (0.069)
A type of institution (1=private)	0.024 (0.247)	-0.829** (0.353)		
Location (1=Tokyo and Osaka)	-0.172 (0.190)	0.278 (0.197)	-0.036 (0.138)	-0.237 (0.239)
Student body	0.004 (0.004)	0.010 (0.013)	-0.008 (0.018)	0.045** (0.022)
Ratio of Ph.D. students and total numbers of students	4.159 (2.572)	4.796** (2.120)	2.994 (2.240)	0.182 (2.908)
Ratio of foreign and Japanese students	-2.123 (2.344)	8.598*** (2.697)	-0.611 (3.632)	5.343* (2.921)
Ratio of students and full-time faculty members	-0.009 (0.011)	-0.040* (0.022)	0.010 (0.017)	0.045 (0.050)
Ratio of students and full-time administrative staff	0.008* (0.004)	0.017** (0.007)	-0.003 (0.006)	0.007 (0.009)
Ratio of professors and teaching staff	0.773 (0.822)	4.335*** (1.412)	1.435 (1.024)	-0.804 (1.907)
Ratio of full-time and part-time faculty members	-0.101 (0.084)	-0.020 (0.092)	-0.094 (0.099)	-0.161 (0.124)
Ratio of foreign and Japanese faculty members	2.481 (2.056)	12.840** (5.376)	1.282 (3.940)	-4.918 (8.488)
Salary per faculty (1,000,000 JPY)			0.010 (0.073)	0.090 (0.085)
Tuition per student (1,000,000 JPY)			1.292* (0.667)	0.657 (0.715)
Subsidy received per student (1,000,000 JPY)			-0.057 (0.273)	0.078 (0.426)
Constant	2.747 (1.747)	3.404*** (0.722)	1.818 (0.992)	4.036*** (1.105)
R-squared	0.570	0.740	0.506	0.371
Numbers of observations	88 (44)	88 (44)	230 (115)	230 (115)

(Source) Authors' calculations

Table 3-3: Empirical results (Model V-VI)

	Model V (Within 5 D.V.)		Model VI (Within 3 D.V.)	
	OLS	FE	OLS	FE
Age	0.012 (0.024)		0.003 (0.027)	
Age2	0.000 (0.000)		0.000 (0.000)	
Gender (1=male)	0.427*** (0.074)		0.443*** (0.095)	
Marital status (1=married)	0.130** (0.063)	-0.011 (0.083)	0.113 (0.074)	-0.078 (0.108)
Tenure	0.020*** (0.004)	0.011*** (0.004)	0.020*** (0.005)	0.013** (0.004)
Working hours	0.084*** (0.017)	0.081*** (0.029)	0.099*** (0.021)	0.097** (0.036)
College Selectivity				
Deviation value of the institution	0.017*** (0.004)	0.009 (0.009)	0.020*** (0.005)	0.001 (0.006)
College Characteristics and Resources:				
Major (1=Humanities)	0.029 (0.061)	0.016 (0.066)	0.046 (0.073)	0.077 (0.102)
A type of institution (1=private)	-0.114 (0.111)	-0.164 (0.116)	-0.076 (0.130)	-0.264** (0.128)
Location (1=Tokyo and Osaka)	0.120 (0.073)	0.011 (0.068)	0.103 (0.088)	0.062 (0.087)
Student body	0.006*** (0.002)	-0.001 (0.002)	0.006** (0.003)	0.002 (0.003)
Ratio of Ph.D. students and total numbers of students	1.804** (0.770)	0.270 (0.889)	2.038** (0.843)	-0.380 (1.777)
Ratio of foreign and Japanese students	-0.425 (0.944)	-0.461 (1.289)	-0.294 (0.996)	1.029 (1.381)
Ratio of students and full-time faculty members	0.000 (0.005)	-0.005 (0.007)	-0.001 (0.007)	0.001 (0.007)
Ratio of students and full-time administrative staff	0.001 (0.002)	0.001 (0.002)	0.003 (0.002)	0.001 (0.002)
Ratio of professors and teaching staff	-0.061 (0.411)	0.469 (0.457)	-0.423 (0.466)	0.091 (0.460)
Ratio of full-time and part-time faculty members	0.115 (0.073)	0.077 (0.062)	0.150 (0.096)	0.046 (0.071)
Ratio of foreign and Japanese faculty members	-0.525 (1.269)	-0.735 (0.865)	-0.542 (1.495)	-0.573 (0.930)
Constant	4.147*** (0.489)	5.257*** (0.369)	4.252*** (0.569)	5.097*** (0.456)
R-squared	0.513	0.305	0.489	0.354
Numbers of observations	388 (194)	388 (194)	306 (153)	306 (153)

(Source) Authors' calculations