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Abstract

This paper examines the long run impacts of expanding the range of subjects in higher education admission examinations using a historical event, the reform of Japanese entrance examinations in 1979. Our results show that degree programs that are forced to increase the number of subjects increases the probability of graduates being appointed onto the board of directors of publicly traded companies despite reducing the measured average intellectual ability of students in the program. This suggests that by broadening the range of subjects, colleges can select students who can master a wide range of knowledge and transform them into future business leaders.

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1 Introduction

Evidence shows that some elite colleges produce a disproportionately large share of managers or directors (e.g., Cappelli & Hamori, 2004; Zimmerman, 2019). If educating these business leaders is one of the missions of the elite colleges, their admission policy must select appropriate candidates. How can a college's admissions policies help produce future business leaders?

We can find some clues to answer this question in the corporate governance and labor economics literature, which shows that successful managers are more likely to have a broad career (e.g., Custódio et al., 2013; Frederiksen & Kato, 2017) and students who wish to become entrepreneurs in future may take broader courses during their Master of Business Administration (MBA) degree (e.g., Lazear, 2004, 2005, 2012)[1]. This finding provides the hypothesis that people who have a high ability to learn broad topics from both their academic life and work experience are candidates for future managers. Therefore, the admission policies to produce future business leaders should include some mechanism to test this ability.

This paper examines whether expanding the range of subjects in the entrance examinations for colleges also increase the number of business leaders among the graduates from these colleges. A difficulty is that each college can choose their preferred breadth of subjects. Hence, the simple regression analysis may be biased due to the endogeneity problem: i.e., prestigious colleges attract many business leaders and require broader subjects in their admission policy without any causal relationship between the two.

We use a historical event in Japan to solve this endogeneity problem. The Japanese government introduced a nationwide standardized entrance examination, the Joint First-Stage Achievement Test (JFSAT), in 1979. As a result,

[1] How much general human capital is important for managerial tasks is one of the most important empirical questions in the literature on corporate governance because market-based views on managerial compensation explain the high chief executive officer (CEO) compensation in the United States as resulting from competition to employ scarce general managerial talent (e.g., Gabaix & Landier, 2008; Terviö, 2008).

the number of subjects in the entrance examination required for admission to public universities was increased to seven. The subjects are Japanese, Mathematics, English, two natural sciences and two social sciences. We measure the breadth of subjects by the number of subjects in the entrance examination and analyze how this exogenous change in the number of subjects affected the share of board members of listed companies from the degree program graduates, where a degree program means a faculty and university pair.

We conduct two-way fixed effect instrumental variable (IV) estimates using a sample of public universities between 1975 and 1985. Using the fact that the number of subjects exogenously increased to seven, we construct a mechanical IV, which consists of the number of subjects in the admission examinations in 1975 when the examination year is prior to 1978 and is seven after 1979. As control variables, we not only control for the degree program's fixed effect and year dummy, but also the interaction of the year dummy with several degree program characteristics.

Our analysis shows that increasing the number of subjects in a degree program's admission examination significantly increases the probability of being appointed onto the board of directors of a listed company. This result passes several robustness checks. Moreover, its magnitude is substantial. The results show that increasing the number of subjects by one in a degree program increases the likelihood of degree program graduates being appointed as directors by about 1.26 to 1.6 times for the average degree program in our sample. Hence, we can conclude that increasing the number of subjects in an entrance examination is an effective way to screen for future business leaders.

Having obtained these main results, the next step is to identify the mechanism behind the results: i.e., why does increasing the number of subjects in an entrance examination of a degree program increase the number of future business leaders among its graduates? In this paper, we try to separate two potential types of students that can be selected by increasing the number of subjects: 1) Increasing the number of subjects screens out students who have higher academic skills. 2) Increasing the number of subjects in the entrance examinations selects students who have a comparative advantage in learning a wide range of topics. Changing the type of students in a degree program not only affects the type of student directly, but it also affects the type of student by changing the type of friends that students in a degree program can interact with. Through these two effects, the type of students selected in the entrance examination surely changes the type of graduates from the degree program.

For this purpose, this paper examines the impact on the degree program's selectivity scores to investigate whether the increase in the number of subjects simply selects intellectually capable students. Selectivity scores are the scores reported by Japanese pre-University schools as an indicator of the difficulty in entering a degree program. As discussed below, the selectivity score represents the average competence of students who enter a degree program with respect to the subjects required to pass the entrance examination for the degree program. Several previous studies find that the selectivity score is the important measure of the intellectual ability of the average graduate of a degree program (Abe, 2002; Araki et al., 2016; Goodman & Oka, 2018; Ito & Nakamura, 2019). Hence, if increasing the number of subjects screens out the students with higher academic skills, the selectivity score is likely to increase.

The analysis shows that as the number of subjects in a degree program's admissions exam increases, the selectivity scores of the degree program decrease slightly but significantly. Our estimates show that with an extra entrance exam subject, the selectivity score decreases by about 0.01% for the average degree program in our sample. This result suggests that an increase in the number of subjects is unlikely to improve the average intellectual ability of degree program graduates.

In summary, the results of this study support the hypothesis that by broadening the range of subjects for entrance examinations, colleges can select people who can learn a wide range of knowledge and produce future business leaders from their graduates.

This result is consistent with the findings of existing research that managerial skills are general. Kaplan et al. (2012) investigate a proprietary dataset for executives and provide evidence that general skills are important managerial skills. Custódio et al. (2013) find a positive relationship between the index of general managerial skills and CEO pay. Custódio et al. (2019) show that S&P 1500 CEOs who acquired general management skills throughout their careers drive more innovation in their firms. Frederiksen and Kato (2017) provide evidence that the breadth of human capital is important for career success using Danish registry data. This paper contributes to this literature by showing that general skills may be rooted in innate talents and education at a young age.

This paper also discusses the relation between general skills and the ability to learn a wide range of topics. This is consistent with Lazear (2004, 2005), which insists that entrepreneurs need balanced skills. Compared to Lazear (2004, 2005), we focus more on the causal effects of admission policies, which can be used as policy instruments. Therefore, we can discuss appropriate admission policies to produce future business leaders.

Several papers examine how and why entering the elite universities influences career success (e.g., Hastings et al., 2013; Zimmerman, 2019). In particular, Zimmerman (2019) shows that admission to an elite degree program increases the number of leadership positions held by students by 44%. While investigation of the return to elite college qualifications is an important and active research area, this paper pays more attention to the allocative role of admission policy: how do changes in admission policy influence the type of students each college can educate?

The allocative role of admission policy can be discussed in the college choices literature. Previous papers compare how centralized and decentralized mechanisms allocate talented students (e.g., Machado & Szerman, 2016; Hafalir et al., 2018; Tanaka et al., 2019), and examine how the timing of examination and admission selects talented students (e.g., Avery et al., 2014). This paper casts light on an ignored aspect of admission policy: i.e., the breadth of subjects in entrance examinations. We show that if schools wish to produce future managers, they should expand the range of subjects in the entrance examination. We believe that our analysis nicely complements other analyses.

The paper is organized as follows. Section 2 briefly discusses the institutional background and provides an overall picture of the market for Japanese higher education. Section 3 explains the data for our empirical studies and how we construct our main variables: i.e., the director share, the number of subjects and the selectivity score. Section 4 provides the descriptive analysis of our main variables. Section 5 introduces our empirical model and discusses the identification assumptions. Section 6 shows the results of our empirical studies. Section 7 concludes the paper.

2 Institutional Background

In this section, we briefly explain the Japanese education system and the institutional background behind the introduction of JFSAT. We also discuss the overall picture of the markets for Japanese higher education.

2.1 Educational System in Japan

Since 1947, the Japanese education system has consisted of nine years of compulsory education (elementary and lower secondary education, such as junior high school), three years of upper secondary education (typically high school), and higher education (ranging from two years for college and four years for university).

One of the characteristics of Japanese higher education is that only a small number of students go on to become graduate students. According to the Ministry of Education, only 7% of students who had a bachelor's degree became graduate students in 1991. Hence, most managers do not have master's degrees. According to the Japanese Institute for Labor (1998), only 1.9% of general managers or section managers had a master's or Ph.D. degree in 1996, while 61% and 11% of the corresponding managers have a master's or Ph.D. degree in the United States and Germany. As this evidence suggests, a bachelor's degree is quite important in Japan.

Undergraduate programs in Japanese universities have a four-year system. There are three types of educational establishments in Japan: i.e., national, local public and private where we refer to both national and local public universities collectively as public universities. In 1975, the breakdown of these universities is 19.3%, 8.1% and 72.6%, respectively (see Ministry of Education, Culture, Sports, Science and Technology's *Basic School Survey*). Students prepare for college or university entrance examinations and must pass them between January and March before the first semester commences in April. Each university admits students based on the score of this test until its capacity is filled. If students fail all degree programs that they apply to, they must wait one year to apply to them again.

High school students can apply to a department in a university. However, the faculty council in a university can largely influence the admission, curriculum and diploma policies of departments in the faculty. Later, we aggregate the department-level data to faculty-level data and conduct panel analysis based on faculty and university pair data. We call this faculty and university pair a degree program.

2.2 The Introduction of JFSAT

Since the current Japanese education system began in 1947, the university entrance examination system has been reformed several times. One of the most dramatic changes was the introduction of JFSAT in 1979.

Prior to 1979, university entrance examinations were decentralized and conducted by individual universities. Decisions regarding university entrance examinations were left to the discretion of each university. By law, the decision-making authority rests with the university's Faculty Council. Therefore, the setting of examination subjects at each university is left to the discretion of the university faculty. However, the Ministry of Education set guidelines for entrance examinations by issuing an "Implementation Guidelines for University Enrollment Selection" notice. The guidelines, which were updated every year, include the basic policy of university entrance examinations, acceptance policy, entrance examination method, entrance examination date, announcement of examination method, and other items. Although these guidelines were not legally binding, universities conducted individual entrance examinations in accordance with these guidelines.

The government planned to reform the entrance examination system in the context of rising demand for higher education and intensifying entrance examinations. The demand for higher education has increased with economic development in a period of high economic growth. The high school advancement rate exceeded 90% in 1975. The university entrance rate was 38.4% in 1975, compared with 10% in 1950. The benefit from graduating from college or university was likely to have been high at this point[2]. However, it was difficult for university establishments to expand college capacities at that time because the College Setting Standard strictly regulated the quantity until 1991. As the demand for higher education increased during the high-growth era, the competition for university admissions intensified. The academic ability test for selecting students for each university not only made it difficult, but also began to deviate from the standard high school curriculum.

The government has sought to introduce a common test that rationally selects students who are suitable for higher education. In 1977, the National School Establishment Law was partially revised, and the University Entrance Examination Center was established. In 1979, the JFSAT was introduced. The JFSAT is a mechanism that forces students who are interested in applying public universities to take the same examination as the first stage of the entrance examination. The examination contains five main subjects: Japanese, English[3], mathematics, science and social studies. Each main subject counts

[2] While we do not have any evidence of the perceived returns at that time, more recent research estimated that the return to higher education was around 5 to 10% in Japan (Kikuchi, 2017; Nakamuro et al., 2017).

[3] Strictly speaking, high school students can choose German or French instead of English. However, most students choose English for their examination; hence we call this subject English for this paper.

for 200 points; thus, the total score is 1000 points. Science and social studies include subfields, e.g., physics, chemistry, biology, geology, ethics, society, politics and economics, Japanese history, world history and geography. Students must choose two subfields from both science and social studies. Therefore, JFSAT requires students to study seven subjects to enter public universities. Before 1979, no university required more than seven subjects in their entrance examination.

The JFSAT was conducted in January every year from 1979 until 1989. After obtaining their JFSAT scores, applicants can decide which department of which university they choose to apply to. All public universities conduct their own entrance examination tests as a second-stage test and choose the successful candidates based on both their JFSAT score and the results of the second-stage entrance examination tests. Each university and department can choose different weights for all subjects in JFSAT and the second-stage examination tests.

Because a large number of students take the same examination, a mark sheet is used as the examination method in JFSAT. However, most universities impose written exams as their second-stage test. Nevertheless, no university department imposes new subjects that are not included among the subjects in the JFSAT on the students. As we wish to measure the breadth of subjects by the number of subjects that students must study for the public university's entrance test, we ignore the style of examination between JFSAT and the second-stage test, and count that the number of subjects is seven after the introduction of JFSAT.

The Ministry of Education stipulates that the date of the second-stage examination for public universities is the same throughout Japan. Hence, the applicants could apply to only one public university after the introduction of JFSAT. Before the introduction of JFSAT, they could choose to apply to two public universities. There were two groups of national universities before 1978, i.e., first- and second-tier universities. National universities in each group must have the same examination date. Typically, local public universities also choose the same examination date as either group of national universities. This institutional arrangement allowed applicants to apply to two public universities before 1978.

While university applicants lost the option to make multiple applications to public universities after 1979, they received informational benefits from taking the JFSAT. Before 1978, applicants must apply to their preferred universities and departments without observing any results of the entrance examination. In contrast, after 1979, because students could apply to their preferred department and university pair after observing the JFSAT results, they can update their probability of success before making their decision.

While JFSAT continued until 1989, several major revisions began in 1987. First, students must choose one subfield, but not two subfields, out of the science and social studies choice sets. As the full score of science and social studies became 100, the total score became 800 points. As a result, the number of subjects that students must take at JFSAT fell to five. Second, the Ministry of Education allows the university to choose the date of the second examination from two candidate dates This arrangement again allows applicants to apply to two public universities.

In sum, the introduction of JFSAT made the following four big changes in entrance examinations for Japanese higher education between 1979 and 1986.

1. JFSAT prevents students from applying to multiple public universities.

2. JFSAT requires students who apply to a public university to study broader subjects.

3. JFSAT requires students who apply to a public university to take a standardized exam.

4. JFSAT allows students who apply to a public university to have partial information about their probability of success before deciding which universities to apply to.

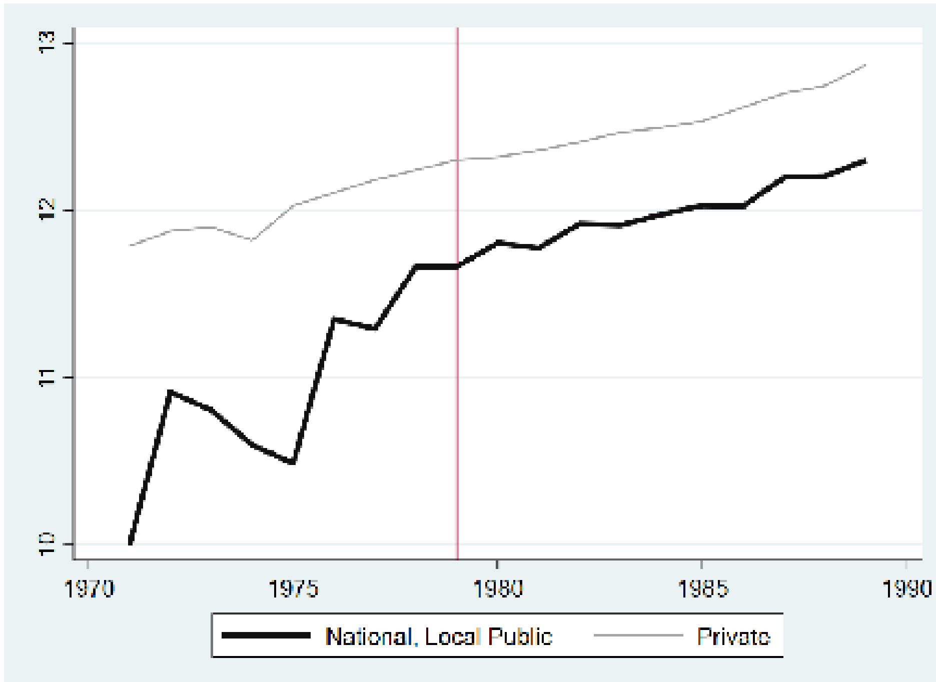

Figure 1: Changes in Tuition Fees between 1970 and 1989

We focus how changes in the number of subjects influences the selectivity score of a degree program and the director share of the graduates from the degree program in this paper.

2.3 Japanese Higher Education Market Between 1970 and 1989

To grasp the changes in the Japanese higher education market between 1970 and 1989, we examine the time series movements of tuition fees (the price of higher education), capacity (the supply of higher education) and the number of applications (the demand for higher education) in this period. Figures 1, 2 and 3 show the movements.

Figure 1 shows the time series of tuition fees by university type. Tuition fees

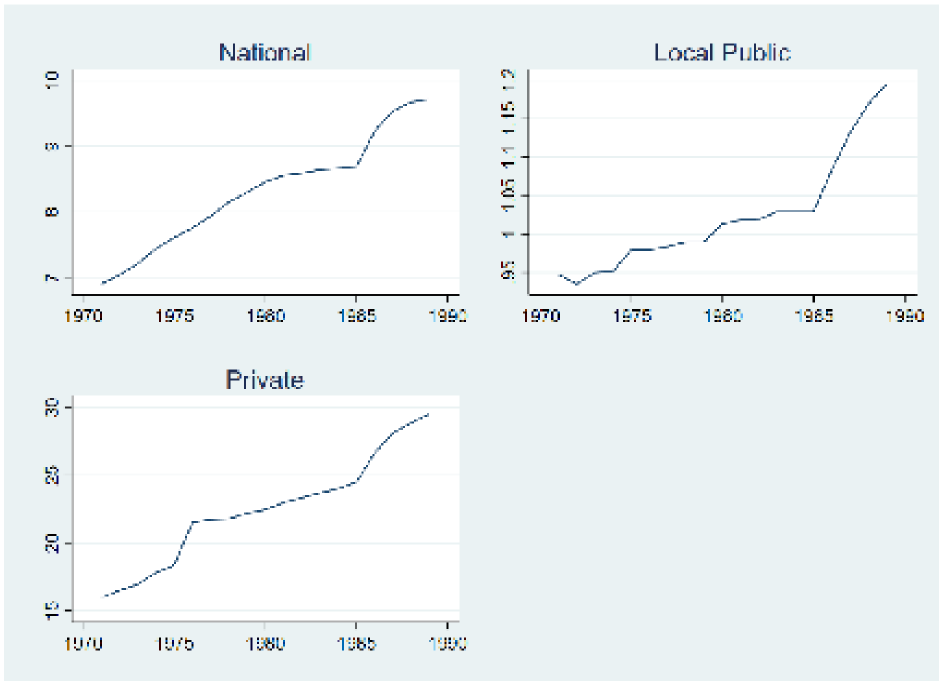

Figure 2: Changes in Capacity between 1970 and 1989

began increasing in 1975. The tuition fees of private universities are larger than those of public universities. However, the differences in tuition fees between private and public universities are roughly the same across time. There is a steady increase in tuition fees for both private and public universities after 1975. Figure 2 shows the time series of capacity by university type. It shows that private universities absorb more students than do public universities. Although both private and public universities have gradually increased their capacity in this period, the increase in capacities is much larger in private universities than in public universities.

Note that there are no significant discrete changes in tuition fees and capacity around 1979. Gradual increases in tuition fees and capacity in Figures 1 and 2 around 1979 suggest that the admission reforms of 1979 were not reforms with increases or decreases in capacity or changes in tuition.

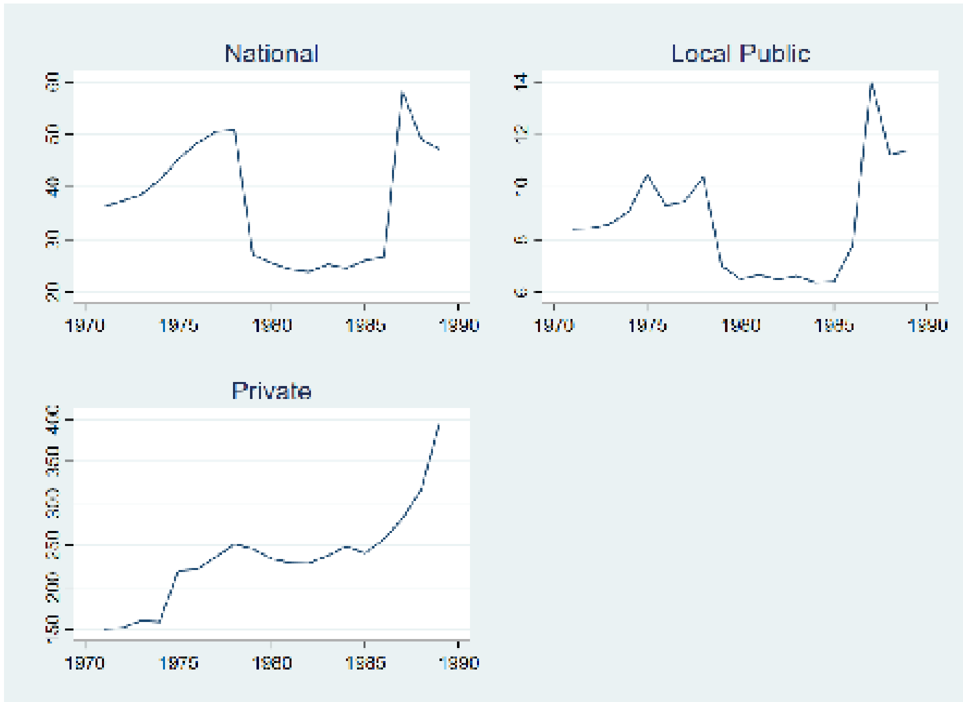

Figure 3: Changes in the number of applications between 1970 and 1989

Figure 3 shows the time series sequences of the number of applications between 1970 and 1989. Compared to Figures 1 and 2, Figure 3 displays fairly different time series patterns. The number of applications to public universities (national and local public universities) suddenly dropped in 1979 and suddenly increased in 1987. This pattern is not observed for the number of applications to private universities.

As we discussed above, while applicants could make two applications to either national or local public universities before 1978 and after 1987, they could only apply to one public university (national or local public) between 1979 and 1986. This restriction reduced the number of applications to public universities during this period. Interestingly, this restriction does not seem to increase the number of applications to private universities, as we do not observe any jump around 1979 and 1987.

Note that these sudden changes in the demand for public universities are not reflected in changes in tuition fees, which indicates that tuition fees do not adjust to equal the demand and supply in the market for higher education in Japan. The selectivity score, which is discussed below, is likely to be adjusted for the impact of supply and demand in this market.

3 Data

Our empirical analysis draws on degree program (university faculty) level panel data from 1975 to 1985. Using this data, we examine the effect of the number of subjects in degree programs on the director share in the graduates from the degree program and the selectivity score of the degree program. In this section, we explain how we construct the director share, the number of subjects and selectivity score.

3.1 Director Share

We obtain personal data on all directors of Japanese listed companies using the 1990–2017 issues of *Directors Data (Yakuin Shikiho)*, published annually by Toyo Keizai Inc. This directory contains detailed personal information, such as name, birthday, name of the degree programs, i.e., faculties and universities pairs, that directors graduated from and the year when they graduated. To identify the year when they have enrolled in their degree programs, we subtracted four years from the year of graduation. We report descriptive statistics of director-level data that is used for the construction of director share in the Appendix.

We match the degree programs listed in *Directors Data* with those in *The University Digest (Zenkoku Daigaku Ichiran)* published by the Ministry of Education. *The University Digest* contains information on the departments in universities, such as enrollment capacity, when the school was established, category of major, and location. Aggregating the capacity data in *The University Digest* by university faculty level, we calculate the capacity of the degree program. Using this calculated capacity, we construct the share of degree program graduates with experience as a board member in a Japanese listed company after 1990 relative to the capacity of the degree program for the cohort. We call this the director share, which is one of the main outcome variables in our regression analysis.

Our measure of director share has to be viewed with caution. Because of some directors' missing educational background data in the *Directors Data*, measurement errors in the director shares may potentially be a problem. As shown in Table 13 in the Appendix, the response rate increases with firm size. In particular, firms that have capital stock below the 10th percentile have significant drops in response rate. Hence, we drop the firms that have capital stock below 10%. Table 14 in the Appendix reports that this selection criterion does not change the results very much.

In addition, we use a sample of 142 degree programs that produce more than five graduates with experience as a director in Japanese listed firms after 1990 (hereafter, we refer to these degree programs as "major degree programs") for our benchmark estimation. In this way, we hope to exclude samples that contain extremely noisy information. In the Appendix, Tables 15 and 16 report the results of the same regression using the sample of all degree programs that produce at least one graduate with directorship experience in Japanese listed firms after 1990 as a robustness check.

3.2 The Number of Subjects

We measure the breadth of subjects by the number of subjects that students must study to pass the entrance examination. We obtain information on the selectivity score and exam subjects from booklets: *Eikan-wo-Mezashite* published by Kawaijuku. The booklet lists the subject patterns required for entrance exams.

The entrance examination consists of an academic test including English, mathematics, Japanese, and other subjects[4]. During the sample period, there was a change of the names of subjects due to a change in the curriculum guidelines at high school. We looked into the details of the curriculum guidelines and identified the names of subjects with similar content and treated them as the same subject.

There are compulsory and optional subjects for entrance examination. When a degree program imposes an optional subject, students must choose their preferred subjects from the proposed choice sets. Because we wish to measure the breadth of subjects by the number of subjects, we simply count the number of compulsory subjects. For the optional subjects, we assume that each subject has an equal chance of being chosen, which allows us to estimate the probability of choosing the subjects. Then, we add this probability if the same subject is not included in the compulsory subjects of entrance examination for the degree program.

It is important to understand how we count the number of subjects after the introduction of JFSAT in 1979. After the introduction of the JFSAT, students who apply to public universities must take seven different subjects. While students must take the second-stage test, it does not include new subjects. Hence, the number of subjects remains at seven. This is consistent with our wish that we measure the breadth of subjects by their number. Public universities have a different number of subjects only before the introduction of the JFSAT.

We match this data with the capacity data in *The University Digest* and aggregate it by university faculty level with capacity as a weight. This procedure generates the number of subjects required in each degree program for our analysis.

[4]While some degree programs use practical tests such as an essay and practical skills for their admissions, these degree programs are few and, typically, do not significantly influence the admission system. Moreover, this does not influence the reported selectivity score. Hence, we do not consider these practical tests in this paper.

3.3 Selectivity Score

Kawaijuku, the publisher of *Eikan-wo-Mezashite*, which provides the information to construct our selectivity score, is a pre-University school that administers a series of large-scale mock examinations[5]. After conducting the mock exam, Kawaijuku provides students who took the mock exam with their deviation score (*hensachi*) calculated by the following equation:

$$H_{ks}^{n} = \frac{10\left(x_{ks}^{n} - \mu_{ks}\right)}{\sigma_{ks}} + 50$$

where H_{ks}^{n} is the deviation score on the kth subject of the nth student at the sth mock exam, x_{ks}^{n} is the exam score on the kth subject of the nth student at the sth mock exam, and μ_{ks} and σ_{ks} are the average and the standard deviation of the exam score on the kth subject at the sth mock exam. Based on the student's deviation score, Kawaijuku also provides them with estimates of their probability of being accepted to a degree program of their choice.

Kawaijuku then tracks whether the student has been accepted into the degree program of his or her choice. From this information, Kawaijuku estimates a deviation score (*hensachi*) of the degree program based on the average score of mock exams of students whose expected probability of entering the degree program of their choice is half.

Kawaijuku classifies all department and university pairs into 12 or 15 ranks according to their deviation score and reports the rank of all department and university pairs. We assign a median value in the range of the deviation score, which is represented by the rank, to the department and university pair in the rank. We match the deviation score with *The University Digest* and calculate a weighted average of the deviation score by degree program level using the weight calculated by capacity data in *The University Digest*. We call this deviation score the selectivity score of the degree program. This creates the degree program-level panel data with selectivity data.

[5] For example, in 1978, according to *Eikan-wo-Mezashite*, the total number of students who took the mock examinations was 242,383 in 1977.

It is important to note that this measure is influenced by the subjects in the entrance examination for a university department. For example, if some department and university pair includes only English and Japanese as the subjects in its entrance examination, only the English and Japanese scores in the mock exam are used to estimate the expected probability of entering the university. Nonetheless, because it is recognized in Japan that the selectivity score roughly reflects overall academic ability of an university department, many labor economists use it as a rough measure of intellectual ability (e.g., Abe, 2002; Araki et al., 2016; Goodman & Oka, 2018; Ito & Nakamura, 2019).

Adjustment of Selectivity Scores Across Years

Because our selectivity score is based on the deviation score of students who took a mock exam in a particular year, it is not comparable across years because the number of students who take the mock exam differs across years. Therefore, we must make some adjustments to ensure that the selectivity scores are comparable across years.

Suppose that a person with human capital A can obtain the score A for all subjects under a mock exam. Let $F_t(A)$ denote the ability distribution of all applicants in year t and let μ_{At} and σ_{At} denote the mean and the standard deviation of a random sample generated from $F_t(A)$. From the definition of the deviation score, a person who obtain test score A will have the deviation score "*hensachi*" H_t in year t by the following equation:

$$H_t = \frac{10\left(A - \mu_{At}\right)}{\sigma_{At}} + 50$$

Inevitably, the observed selectivity score of the degree programs, H_t, are influenced by μ_{At} and σ_{At}. To make the selectivity score comparable across years, we must convert the observed deviation score into the original ability measure using the following equation:

$$A_t^i = \frac{\sigma_{A,t}}{10}\left[H_t^i - 50\right] + \mu_{A,t} \tag{1}$$

This new measure A_t^i is the average ability of graduates from the ith degree program with a selectivity score of H_t^i in year t. To make this transformation feasible, we must estimate $\mu_{A,t}$ and $\sigma_{A,t}$ from the data.

Suppose that the ability distribution of the total population aged 18 years follows the normal distribution with a mean of 10 and standard deviation of 50, $\Phi(A)$. Assume that high school students on the higher end of the ability distribution apply to a degree program and take the mock exam. Then the ability distribution of high school students who apply to universities, $F_t^h(A)$, is written by:

$$F_t^h(A) = \frac{\int_{A_t^*}^{A} d\Phi(a)}{1 - \Phi(A_t^*)},\ 1 - \Phi(A_t^*) = \frac{N_t}{L_t}$$

where N_t is the number of applicants aged 18 years and L_t is the total population aged 18 years. Assume that a person who applied to a degree program but could not pass the exam applies to the same or another degree program the next year and that the probability of passing the entrance exam in year t is p_t. Let M_t denote the total number of applicants at year t. Then the measure of applicants who have ability less than A, $F_t(A) M_t$ must follow the following dynamics:

$$F_t(A) M_t = F_t^h(A) N_t + (1 - p_{t-1}) F_{t-1}(A) M_{t-1}$$

Because this equation must be satisfied for all A, the following equation must hold for all t:

$$M_t = N_t + (1 - p_{t-1}) M_{t-1}$$

Rearranging all equations, the dynamics of $F_t(A)$ must follow:

$$F_t(A) = \frac{N_t}{M_t} \frac{\int_{A_t^*}^{A} d\Phi(a)}{1 - \Phi(A_t^*)} + \left(1 - \frac{N_t}{M_t}\right) F_{t-1}(A) \tag{2}$$

Suppose that $F_0(A) = \frac{\int_{A_0^*}^{A} d\Phi(a)}{1-\Phi\left(A_0^*\right)}$. Because we can estimate A_t^* from $1-\Phi(A_t^*) = \frac{N_t}{L_t}$, we can estimate $F_t(A)$ from the data sequences $\left\{\frac{N_t}{M_t}, \frac{N_t}{L_t}\right\}_{t=0}$ with the recursive equation (2) and initial condition. Using the estimated $F_t(A)$, we calibrate $\mu_{A,t}$ and $\sigma_{A,t}$. Using the calibrated $\mu_{A,t}$ and $\sigma_{A,t}$, we can obtain the adjusted selectivity score of A for each degree program from equation (1). This is the selectivity score used in our estimation.

Variable	Obs	Mean	Std. Dev.	Min	Max
Director Share	1507	0.27	0.42	0.00	3.13
Selectivity Score	1333	61.11	3.31	52.57	69.68
# of Subjects	1352	6.43	0.85	3.00	7.00
# of Initial Subjects (# of Subjects in 1975)	1476	5.63	0.75	3.00	7.00
# of Init. Subj.<6 & Init. Slct. Score<=60	1507	0.12	0.32	0.00	1.00
# of Init. Subj.<6 & Init. Slct. Score>60	1507	0.19	0.39	0.00	1.00
# of Init. Subj.>=6 & Init. Slct. Score<=60	1507	0.19	0.39	0.00	1.00
# of Init. Subj.>=6 & Init. Slct. Score>60	1507	0.50	0.50	0.00	1.00

Table 1: Summary Statistics of Main Variables between 1975 and 1985

4 Descriptive Analysis

This section reports the descriptive analysis of our data set. First, we report the summary statistics of the main variables. Then we report time series movement of our main variables, the number of subjects, selectivity score and director share.

Summary Statistics: Table 1 reports the main variables of our analysis. The table shows that the shares of directors appointed in listed companies from the degree program graduates is 0.27%. As our main focus is the impact of changes in the number of subjects on the director share, we limit our analysis to a sample of the degree programs where more than five graduates have experience as a director in Japanese listed companies after 1990. Hence, this number can be larger than the share of the standard college graduates.

It also shows that the average selectivity score is 61, which indicates that the sample mainly contains elite universities. The number of subjects is 6.43 and the number of initial subjects is 5.63. As we discuss above, the number of subjects is seven after 1979. These numbers indicate that the sample contains the research programs with a relatively large breadth of subjects even before 1978.

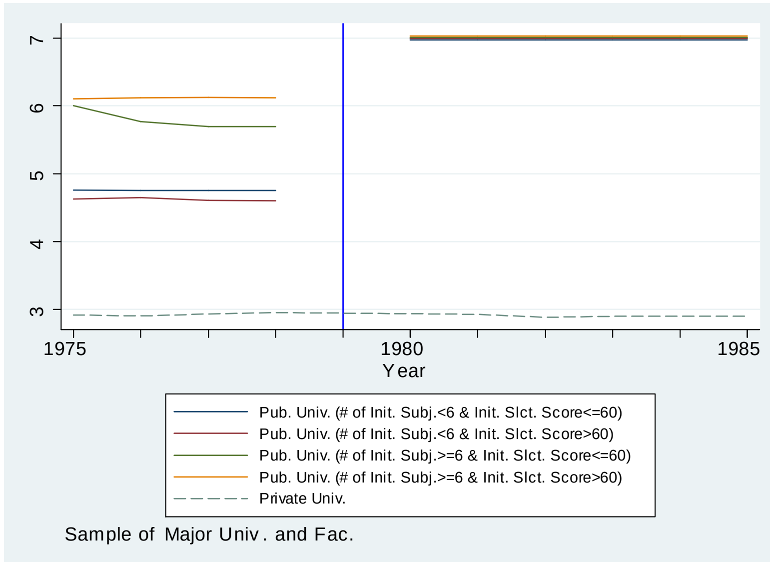

Figure 4: The Number of Subjects for Entrance Examination to Higher Education

Changes in the main variables between 1975 and 1985: Figures 4, 5 and 6 describe the changes in the number of subjects, the selectivity score and director shares of four groups in public universities. The four groups are divided by the level of selectivity score (Init. Selct. Score) and the measure of number of subjects (# of Int. Subj.) as of 1975.

Figure 4 shows that public universities with a small number of subjects in the 1975 university entrance exam significantly increase their number of subjects after the introduction of the JFSAT. It also shows that the number of subjects is roughly stable except for degree program for which the initial selectivity score is less than 60 and the initial number of subjects is more than or equal to six. This group of degree programs reduces the number of subjects before 1979, probably because they wish to maintain the selectivity score of the degree program.

Figure 5 shows that the public universities' selectivity score falls after the introduction of the JFSAT. This reduction is likely to reflect the fact that the

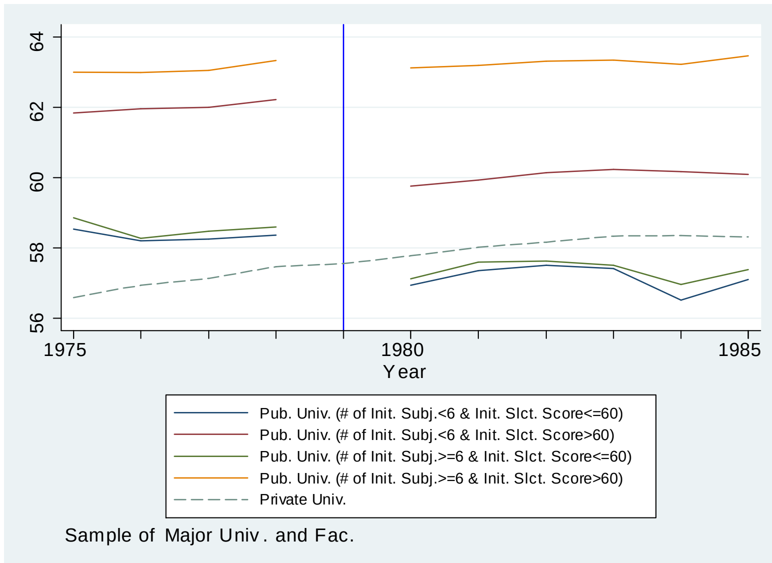

Figure 5: The Adjusted Selectivity Score

number of applications to public universities dropped in 1979 as shown in Figure 3. The magnitude of the reduction in 1979 is largest for the degree programs for which the initial selectivity score is greater than 60 and the initial number of subjects is less than six and the smallest for the degree programs for which the initial selectivity score is greater than or equal to 60 and the initial number of subjects is greater than or equal to six. Therefore, among elite degree programs, the selectivity scores of programs that initially have smaller number of subjects falls with the introduction of JFSAT more than for those that initially have a large number of subjects.

Figure 6 shows that the director share declines throughout the period. Note that in the capacity of a degree programs for each cohort, we define director share by the share of degree program graduates with experience on a Japanese listed company board after 1990. By this definition of director share, the older the cohort, the larger number of graduates are likely to have such experience. Hence, the declining tendency of director share is not surprising. Compared

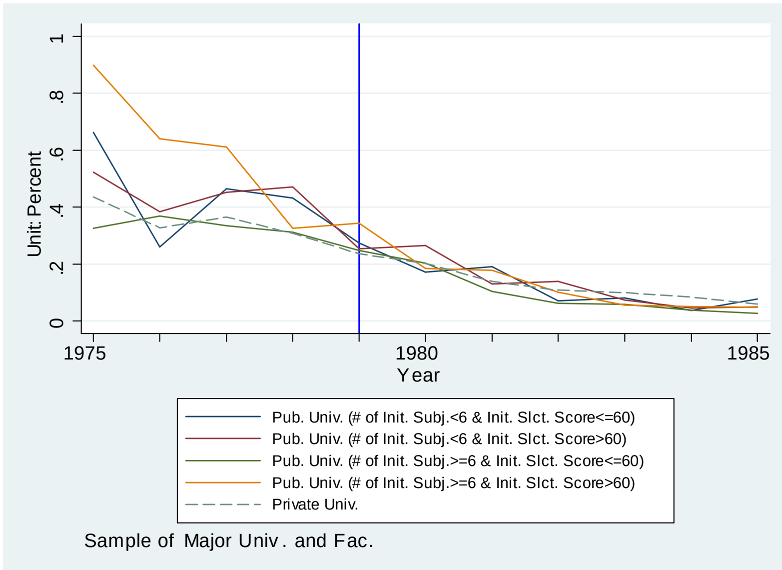

Figure 6: Director Share

with Figures 4 and 5, we do not observe a clear jump around 1979 in Figure 6. This suggests that we need appropriate covariates to identify the effects of the changes in the number of subjects on the director share.

Finally, Figures 4, 5 and 6 also report the time series movements of private universities. All figures show that private universities do not show notable change around 1979. This evidence suggests that the exclusion of private universities from our study is less likely to influence our results.

5 Empirical Model

We would like to examine the effects of changes in the number of subjects in the entrance examination. For this purpose, we use the fact that public universities were forced to increase the number of subjects in the entrance examination in 1979 due to the introduction of the JFSAT.

To estimate the impacts of changing the number of subjects on several outcomes, we conduct the following IV regression analysis:

$$Y^{j}\left(i,t\right)=\beta_{0}^{j}+\beta^{j}\left(i\right)+\beta^{j}\left(t\right)+\beta_{B}^{j}B\left(i,t\right)+\beta_{W}^{j}\left(t\right)\mathbf{W}\left(i\right)+u^{j}\left(i,t\right), \quad (3)$$

where $Y^{j}\left(i,t\right)$ is the jth outcome variables of the ith degree program, at the entrance examination year t, $B\left(i,t\right)$ is the number of subjects that students must study to pass the entrance examination of the ith degree program at the entrance examination year t, $\mathbf{W}\left(i\right)$ is the vector of predetermined variables of the ith degree program. The parameter β_{0}^{j} is the constant term, $\beta^{j}\left(i\right)$ is the ith degree program-specific fixed effect, $\beta^{j}\left(t\right)$ is the t year-specific effect, $\beta_{W}^{j}\left(t\right)$ is the t year-specific vector of parameters for $\mathbf{W}\left(i\right)$, and $u^{j}\left(i,t\right)$ is the error term of the ith degree program for the jth regression. The parameter β_{B}^{j} is our parameter of interest that captures the impacts of changing the number of subjects in the jth regression.

As outcomes, we choose the share of agents who have been a director after 1990 of the graduates who entered the ith institute in year t, $Y^{1}\left(i,t\right)$, and the selectivity score of the ith degree program in year t, $Y^{2}\left(i,t\right)$.

The standard identification assumption for the two-way fixed effect model regression (equation 3) is $E\left[B\left(i,t\right)u^{j}\left(i,t\right)\right]=0$, for all j, i and t. But note that all degree programs in public universities are forced to impose seven different subjects for the entrance examination after 1979. Because, without loss of generality, we can assume $E\left[u^{j}\left(i,t\right)\right]=0$ for all j, i and t, the identification assumption becomes:

$$E\left[B\left(i,t\right)u^{j}\left(i,t\right)\right]=0,\forall j,i,t\leq 1978 \quad (4)$$

Each degree program can decide the number of subjects for entrance examinations before 1978. In fact, Figure 4 shows that the degree programs for which the initial selectivity score is less than 60 and the initial number of subjects is more than or equal to six, reduced their number of subjects before 1978, probably because they wished to maintain the selectivity score of the degree program. This may cause an endogeneity problem. In this case, the identification assumption (equation 4) may be violated.

To deal with this possible bias, we construct a mechanical instrument $\mathbf{Z}(i,t)$ where:

$$\begin{aligned}\mathbf{Z}(i,t) &= B(i,1975)\ \ if\ \ t \leq 1978 \\ \mathbf{Z}(i,t) &= 7\ if\ \ t \geq 1979\end{aligned}$$

The standard identification assumptions are:

$$E\left[\mathbf{Z}(i,t) * u^j(i,t)\right] = 0, \forall j,i,t, \tag{5}$$

$$E\left[\mathbf{Z}(i,t) * B(i,t)\right] \neq 0, \forall i,t. \tag{6}$$

where s means sth year and j means jth degree programs.

As Figure 4 shows, equation (6) is likely to be satisfied by definition. Hence, it is less likely that this instrument is weak. The remaining concern is the exclusion restriction, which is represented by equation (5). Because all degree programs in public universities are forced to impose seven different subjects for their entrance examination after 1979, using the same argument as before, equation (5) implies that:

$$E\left[B(i,1975) * u^j(i,t)\right] = 0,\ \forall j,i,t \leq 1978 \tag{7}$$

Note that the equation (7) allows the possibility that time-varying unobserved characteristics of a degree program can affect $B(i,t)$ and $u^j(i,t)$ simultaneously. Because Figure 4 shows that $B(i,1975)$ partially influences $B(i,t)$ before 1978, equation (7) is likely a weaker assumption than equation (4). However, $B(i,1975)$ are still endogenous variables. Hence, equation (7) assumes that unobserved characteristics of a degree program that determine $B(i,1975)$ do not determine $u^j(i,t)$ before 1978.

To validate the robustness of our results, we also conduct the following reduced form estimation:

$$Y^j(i,t) = \alpha_0^j + \alpha^j(i) + \alpha^j(t) + \alpha_B^j \mathbf{Z}(i,t) + \alpha_W^j(t)\,\mathbf{W}(i) + v^j(i,t)\,. \tag{8}$$

While α_B^j is different from our parameter of interest, β_B^j, Figure 4 shows that it is likely to be similar. Hence, the results of this estimation provide important information about the validity of our research design. The identification assumption of equation (8) is similar to equation (7). Using the same argument as above, the following orthogonality condition is assumed to be satisfied:

$$E\left[B\left(i,1975\right) * v^j\left(i,t\right)\right] = 0,\ \forall j,i,t \leq 1978 \tag{9}$$

To guarantee equations (4), (7) and/or (9), the regression equations (3) and (8) control not only the ith degree program-specific fixed effect and year dummy, but also the interaction between predetermined ith degree characteristics and year dummy in, $\beta_W^j\left(t\right)\mathbf{W}\left(i\right)$. As the elements of $\mathbf{W}\left(i\right)$, we choose 1) national university dummy, and the first-tier national university dummy, 2) fields dummy which consists of Humanities and Social Sciences, Science, Engineering, Agriculture, Health, Mercantile Marine, Home Economics, Education & Teacher Training, Arts and Others, 3) region dummy: Hokkaido, North Tohoku, South Tohoku, North Kanto, South Kanto, Hokuriku, Koshin, Tokai, Kansai, Chugoku, Shikoku and Kyusyu, and 4) selectivity score of a degree program in 1975[6] and a dummy that indicates the ith degree program contained English, Mathematics and Japanese as the subjects of its entrance examination in 1975. Table 2 reports the summary statistics for these variables.

We control for the national universities and first-tier national universities dummies because we know that applications to national universities were halved after 1979. As the initial number of subjects is likely to be larger for national universities and first-tier universities, if we do not control for these variables, $\mathbf{Z}\left(i,t\right)$ may capture the differential impacts of changes in the number of applications to each group. We also control for the interaction between location (field dummies) and year dummies to capture the long-run changes in the number of applications due to urbanization and changes in industry structures. Finally,

[6]If there are no data for 1975, we choose the year that such data first appeared in our dataset as our initial value. This strategy is applied to the construction of both the initial number of subjects and the initial selectivity score.

Variable	Obs	Mean	Std. Dev	Min	Max
National Univ.	1507	0.91	0.29	0.00	1.00
1st Tier Univ.	1507	0.55	0.50	0.00	1.00
2nd Tier Univ.	1507	0.35	0.48	0.00	1.00
Initial Selectivity Score	1476	61.48	2.47	57.12	67.11
Initial English, Mathematics and Japan	1498	0.98	0.15	0.00	1.00
Located Area Dummy					
Hokkaido	1507	0.07	0.26	0.00	1.00
Kita-Tohoku	1507	0.01	0.12	0.00	1.00
Minami-Tohoku	1507	0.06	0.23	0.00	1.00
Kita-Kanto	1507	0.04	0.19	0.00	1.00
Minami-Kanto	1507	0.20	0.40	0.00	1.00
Hokuriku	1507	0.05	0.22	0.00	1.00
Koshin	1507	0.03	0.17	0.00	1.00
Tokai	1507	0.09	0.28	0.00	1.00
Kansai	1507	0.23	0.42	0.00	1.00
Chugoku	1507	0.06	0.23	0.00	1.00
Shikoku	1507	0.03	0.17	0.00	1.00
Kyusyu	1507	0.13	0.34	0.00	1.00
Field of Faculty Dummy					
Humanities	1507	0.06	0.24	0.00	1.00
Social Science	1507	0.30	0.46	0.00	1.00
Science	1507	0.05	0.22	0.00	1.00
Engineering	1507	0.35	0.48	0.00	1.00
Agriculture	1507	0.17	0.38	0.00	1.00
Health	1507	0.01	0.09	0.00	1.00
Mercantile Marine	1507	0.01	0.12	0.00	1.00
Home Economics	1507	0.00	0.00	0.00	0.00
Education & Teacher Training	1507	0.01	0.09	0.00	1.00
Arts	1507	0.00	0.00	0.00	0.00
Others	1507	0.04	0.19	0.00	1.00

Table 2: Summary Statistics of Main Covariates

we control for initial English, Mathematics and Japanese dummies to avoid the possibility that our measure of number of subjects captures the impact of language subjects.

Controlling for the interaction of year dummy with these observable degree program characteristics, we assume that equations (4), (7) and/or (9) are satisfied. To check the validity of equations (7) and/or (9), we estimate the impacts of $B(i, 1975)$ on director share and selectivity score after excluding the effect of covariates by each year. More precisely, we conduct the following regression on the residuals, $\hat{\omega}(i, t)$, using a date before 1978:

$$\hat{\omega}^j(i,t) = \gamma_0^j + \gamma^j(i) + \gamma^j(t) + \gamma_B^j(t)\, B(i, 1975) + \varepsilon^j(i,t)\,,\ t \leq 1978. \quad (10)$$

where the residual $\hat{\omega}^j(i,t)$ is defined by

$$\hat{\omega}^j(i,t) \equiv Y^j(i,t) - \hat{\alpha}_W^j(t)\,\mathbf{W}(i)\,,$$

and $\hat{\alpha}_W^j(t)$ is the estimate of $\alpha_W^j(t)$ in the following regression using the whole sample:

$$Y^j(i,t) = \alpha_0^j + \alpha^j(i) + \alpha^j(t) + \alpha_W^j(t)\,\mathbf{W}(i) + \varpi^j(i,t)\,,$$

where $\varpi^j(i,t) \equiv \alpha_B^j \mathbf{Z}(i,t) + v^j(i,t)$. Note that $\hat{\omega}(i,t) = \alpha_0^j + \alpha^j(i) + \alpha^j(t) + \left[\alpha_W^j(t) - \hat{\alpha}_W^j(t)\right]\mathbf{W}(i) + \alpha_B^j B(i, 1975) + v^j(i,t)$ before 1978. Hence, $\gamma_B^j(t)\, B(i, 1975) + \varepsilon^j(i,t)$ must reflect the movement of $\left[\alpha_W^j(t) - \hat{\alpha}_W^j(t)\right]\mathbf{W}(i) + v^j(i,t)$. Assuming that $\alpha_W^j(t) \approx \hat{\alpha}_W^j(t)$, if equation (9) is satisfied, $\gamma_B(t) \approx 0$ for all $t \leq 1978$. While equation (7) is not equivalent to equation (9), Figure 4 shows that most degree programs did not change $B(i,t)$ before 1978. Hence, we expect that if equation (7) is satisfied, it is also likely that $\gamma_B(t) \approx 0$ for all $t \leq 1978$.

Figures 7 and 8 plot the coefficients $\gamma_B(t)$ where $t = 1976$, 1977 and 1978. These figures show that we cannot reject our null hypothesis $\gamma_B(t) = 0$ for all t before 1978 at the 5% level, which provides evidence that supports our identification assumptions: i.e., equations (7) and (9).

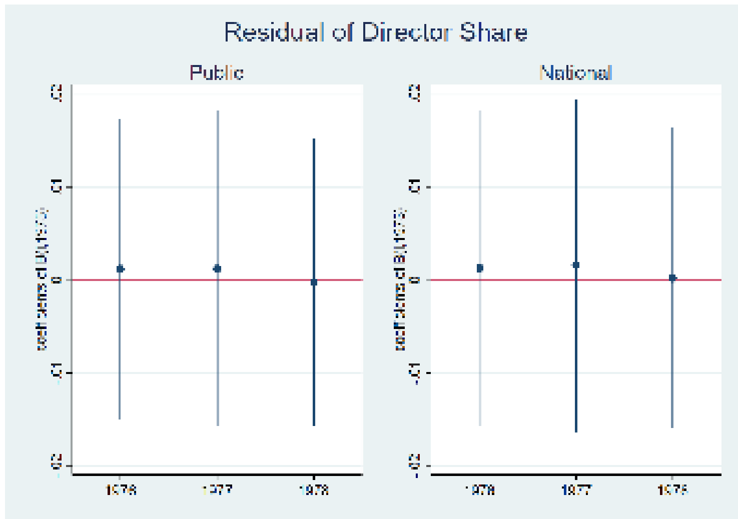

Figure 7: The impacts of $B(i, 1975)$ on director share after excluding the effect of covariates by each year: $\gamma_B(t)$.

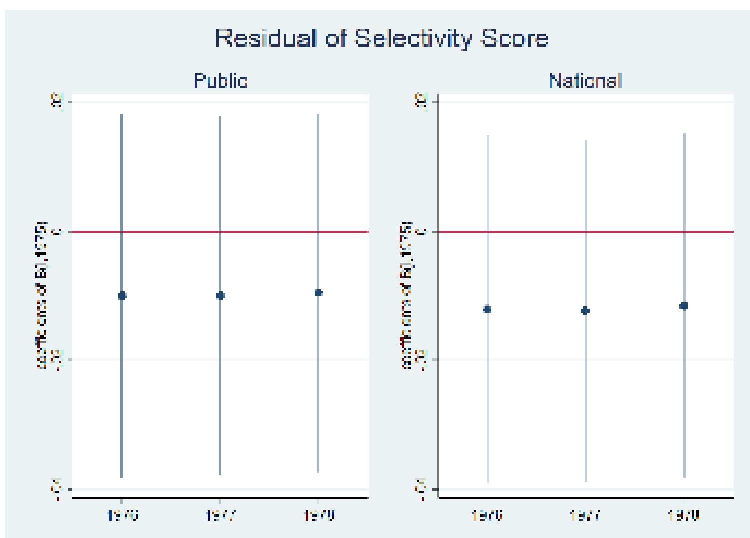

Figure 8: The impacts of $B(i, 1975)$ on selectivity score after excluding the effect of covariates by each year: $\gamma_B(t)$.

Director Share	(1) FE	(2) National+Local Public FE	(3) FEIV	(4) FE	(5) National FE	(6) FEIV
Number of Subjects	0.0758**		0.0761*	0.0753*		0.0829*
	(0.0338)		(0.0400)	(0.0382)		(0.0466)
			First Stage			First Stage
Mechanical Instrument		0.0731*	0.960***		0.0796*	0.961***
		(0.0385)	(0.0277)		(0.0448)	(0.0328)
Fisrt Stage F-stat			1202			859.1
Control	Y	Y	Y	Y	Y	Y
Observations	1,320	1,320	1,320	1,201	1,201	1,201
R-squared	0.501	0.501		0.503	0.503	
# of id	139	139	139	126	126	126

Table 3: Impacts of the Number of Subjects on the Director Shares in the Listed Companies: * 10% significance, ** 5% significance and *** 1% significance. The number inside the bracket is the robust standard error.

In the next section, we report our main results and report further robustness results.

6 Results

Director Share: Table 3 shows the effects of changes in the number of subjects on the director share. The first three columns report the results by of the sample of public universities (National+Local Public) and the last three column shows the results for the sample of national universities. Columns (1) and (4) report the results of our two-way fixed effect model (3), columns (2) and (5) report the reduced form regression (8), and columns (3) and (6) report the two-way fixed effects IV model.

All coefficients of the number of subjects are positive and statistically significant. All results show that an increase in the number of subjects increases the director share in degree program graduates.

The magnitude is not small. An increase by one more subject in the entrance examination increases the probability of producing directors from the degree program graduates by about 0.08%. Table 1 shows that on average 0.27% of graduates in our sample become directors. It means that an extra subject in the entrance examination is likely to increase the share of directors from the degree program graduates by a factor of about $\frac{0.27+0.08}{0.27} \approx 1.3$ for the average degree program in our sample. We will discuss the robustness of this number later.

Selectivity Score: Having seen the positive impact of increasing the broadness of examination subjects on the director share, we must ask the following question: why does increasing the number of subjects in an entrance examination for a degree program increase the future business leaders among its graduates? To provide evidence to infer the mechanism, we try to separate two potential types of students that can be selected by increasing the number of subjects: 1) Increasing the number of subjects screens out the students with higher academic skills. 2) Increasing the number of subjects on the entrance examinations select students who have a comparative advantage in learning a wide range of topics. For this purpose, this paper examines the impact on selectivity scores of degree programs to investigate whether the increase in the number of subjects simply selects intellectually capable students.

As we discussed before, many Japanese labor economists use the selectivity score as a proxy for the average academic skill of the graduates from a degree program (e.g., Abe, 2002; Araki et al., 2016; Goodman & Oka, 2018; Ito & Nakamura, 2019). Hence, if increasing the number of subjects screens out students who have higher academic skills, the selectivity score is likely to increase.

Table 4 shows the effects of the number of subjects on the selectivity score. The structure of the table is the same as Table 3. The results show that all coefficients of the number of subjects are significantly negative and that adding one more subject to the entrance examinations reduces the selectivity score of the degree program by about 0.5 and 0.7 in the samples of public and national universities, respectively, which suggests that an increase in the number of subjects is unlikely to improve the average intellectual ability of degree program graduates.

Selectivity Score	(1) FE	(2) National+Local Public FE	(3) FEIV	(4) FE	(5) National FE	(6) FEIV
Number of Subjects	-0.474**		-0.504**	-0.597***		-0.686***
	(0.185)		(0.213)	(0.157)		(0.169)
			First Stage			First Stage
Mechanical Instrument		-0.484**	0.960***		-0.659***	0.961***
		(0.206)	(0.0277)		(0.164)	(0.0328)
Fisrt Stage F-stat			1201			859.1
Control	Y	Y	Y	Y	Y	Y
Observations	1,320	1,320	1,320	1,201	1,201	1,201
R-squared	0.560	0.559		0.574	0.576	
# of id	139	139	139	126	126	126

Table 4: Impacts of the Number of Subjects on the Selectivity Measure: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

In summary, the study results support the hypothesis that by broadening the range of subjects for entrance examinations, colleges can select people who can learn a wide range of knowledge and produce future business leaders from their graduates.

6.1 Robustness

In this section, we conduct several robustness checks. First, we conduct simple regressions using the sample of degree programs that did not change their number of subjects between 1975 and 1978. Second, we conduct the same regression for the 1978 cohort. Third, we investigate a possibility that any other unobserved characteristics might be correlated with our instrument variables.

Estimation with Selected Sample: Once we drop the degree programs that changed their number of subjects between 1975 and 1978, the number of subjects and our mechanical instrument coincide. Hence, if this selection procedure does not create any bias, the simple regression equation (3) with this selected sample

	Director Share		Selectivity Score	
	National+Local Public	National	National+Local Public	National
Director Share	FE	FE	FE	FE
Number of Subjects	0.0682*	0.0740	-0.437**	-0.633***
(Mechanical Instrument)	(0.0403)	(0.0484)	(0.220)	(0.175)
Control	Y	Y	Y	Y
Observations	1,131	1,012	1,131	1,012
# of id	118	105	118	105

Table 5: Impacts of the Number of Subjects on the Director Share and Selectivity Score for the Sample of Degree Programs for Which There Were No Changes in the Number of Subjects Between 1975 and 1978: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

must identify the parameter β_B under the assumption of equation (9). Because Figure 4 suggests that a fairly small number of degree programs changed their number of subjects between 1975 and 1978, we expect that the selection bias is small and that we will obtain similar results.

Table 5 shows the results of the two-way fixed effect model for the sample of degree programs for which there were no changes in their number of subjects between 1975 and 1978. The first two columns show the effects on the number of subjects on the director share. Compared with table 3, the coefficients are slightly smaller and the coefficients for the sample of national university is not significant at the 10% level. This is understandable because the selected sample inevitably reduces sample size. The last two columns show the effects of the number of subjects on the selectivity score. Similar to the director share, the magnitudes of coefficients are slightly smaller than the results in the table 4. While there are minor differences between the results in the selected sample and our main results, we cannot find any results that force us to change our main conclusion.

Director Share	(1) FE	(2) National+Local Public FE	(3) FEIV	(4) FE	(5) National FE	(6) FEIV
Number of Subjects	0.109**		0.121**	0.105*		0.125*
	(0.0474)		(0.0559)	(0.0547)		(0.0661)
			First Stage			First Stage
Mechanical Instrument		0.117**	0.966***		0.121*	0.967***
		(0.0540)	(0.0248)		(0.0639)	(0.0294)
Fisrt Stage F-stat			1514			1082
Control	Y	Y	Y	Y	Y	Y
Observations	1,184	1,184	1,184	1,078	1,078	1,078
R-squared	0.528	0.528		0.534	0.535	
# of id	139	139	139	126	126	126

Table 6: Impacts of the Number of Subjects on Director Shares in the Listed Companies: Without the 1978 Cohort: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

Selectivity Score	(1) FE	(2) National+Local Public FE	(3) FEIV	(4) FE	(5) National FE	(6) FEIV
Number of Subjects	-0.468**		-0.505**	-0.595***		-0.693***
	(0.190)		(0.216)	(0.160)		(0.172)
			First Stage			First Stage
Mechanical Instrument		-0.488**	0.966***		-0.670***	0.967***
		(0.211)	(0.0248)		(0.168)	(0.0294)
Fisrt Stage F-stat			1514			1082
Control	Y	Y	Y	Y	Y	Y
Observations	1,184	1,184	1,184	1,078	1,078	1,078
R-squared	0.551	0.551		0.570	0.573	
# of id	139	139	139	126	126	126

Table 7: Impact of the Number of Subjects on the Selectivity Measure Excluding 1978: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

Estimation Without the 1978 Cohort: Because the introduction of JFSAT was announced before 1978, it might influence the application decisions of students in the 1978 cohort. For example, if students failed to pass the entrance examination in 1978, they need to wait one year to take the entrance examination. Because they know that they can only apply to one public university in that following year, they may apply to less-competitive universities. In fact, Figure 3 shows some indication that applications to local public universities did increase in 1978. This result might influence our estimates.

Tables 6 and 7 report the same estimation results without the 1978 cohort. Both tables show that overall results are the same as before, while the magnitude of the impact on the director share is slightly larger. This indicates that changes in the application decisions of students in the 1978 cohort do not influence our results very much.

Unobserved Characteristics: While Figures 7 and 8 are consistent with our identification assumptions (equations (7) and (9)), these figures do not guarantee our identification assumptions. We conduct further robustness checks.

For this purpose, we add the interaction of the number of subjects in 1975 and the year dummy in our control variables. The results are reported in Tables 8 and 9.

Table 8 shows that the coefficients of the number of subjects in the two-way fixed effect model and two-way fixed IV model show a positive sign, but are not significant. The results of the reduced form models are even worse. The coefficients of mechanical instruments are negative, but these are also not significant. Compared with the results in Tables 3 and 6, the magnitude of the coefficients is unstable. These results suggest that adding the interaction of the number of subjects in 1975 and year dummy in our control variables are likely to cause multicollinearity with both our treatment variable and IV. Therefore, it is likely that the instruments are weak.

The results in table 9 are better. All coefficients have the expected sign

Director Share	(1)	(2)	(3)	(4)	(5)	(6)
	National+Local Public				National	
	FE	FE	FEIV	FE	FE	FEIV
Number of Subjects	0.0661		0.194	0.0426		0.189
	(0.0529)		(0.130)	(0.0513)		(0.135)
			First Stage			First Stage
Mechanical Instrument		-0.0591	0.945***		-0.0188	0.945***
		(0.0659)	(0.0367)		(0.0718)	(0.0435)
Fisrt Stage F-stat			664.1			472.5
Control	Y	Y	Y	Y	Y	Y
Observations	1,320	1,320	1,320	1,201	1,201	1,201
R-squared	0.506	0.506		0.508	0.508	
# of id	139	139	139	126	126	126

Table 8: Impacts of the Number of Subjects on Director Shares in Listed Companies When We Add the [Initial Number of Subjects]x[Year Dummy] Under Our Control: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

Selectivity Score	(1)	(2)	(3)	(4)	(5)	(6)
	National+Local Public				National	
	FE	FE	FEIV	FE	FE	FEIV
Number of Subjects	-0.347		-1.380***	-0.271		-1.525***
	(0.324)		(0.510)	(0.322)		(0.496)
			First Stage			First Stage
Mechanical Instrument		-0.510*	0.945***		-0.696***	0.945***
		(0.269)	(0.0367)		(0.242)	(0.0435)
Fisrt Stage F-stat			664.1			472.5
Control	Y	Y	Y	Y	Y	Y
Observations	1,320	1,320	1,320	1,201	1,201	1,201
R-squared	0.561	0.559		0.579	0.577	
# of id	139	139	139	126	126	126

Table 9: Impact of the Number of Subjects on Selectivity Score in Listed Companies When We Add the [Initial Number of Subjects]x[Year Dummy] Under Our Control: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

	(1)	(2)	(3)	(4)	(5)	(6)
	National+Local Public			National		
Director Share	FE	FE	FEIV	FE	FE	FEIV
Number of Subjects	0.129**		0.164**	0.112**		0.155*
	(0.0511)		(0.0722)	(0.0548)		(0.0826)
			First Stage			First Stage
Mechanical Instrument		0.165**	1.006***		0.156*	1.007***
		(0.0730)	(0.0309)		(0.0835)	(0.0380)
Fisrt Stage F-stat			664.1			472.5
Control	Y	Y	Y	Y	Y	Y
Observations	1,320	1,320	1,320	1,201	1,201	1,201
R-squared	0.506	0.506		0.508	0.508	
# of id	139	139	139	126	126	126

Table 10: Impact of the Number of Subjects on Director Shares in the Listed Companies When We Include the [More Than Six Initial Subjects Dummy]x[Year Dummy] Under Our Control: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

and the coefficients of number of subjects in the two-way fixed IV model and those of mechanical instruments in the reduced form models are significant. However, compared with the results in Tables 4 and 7, the magnitude of the coefficients are again unstable. Hence, the results might be influenced by the multicollinearity and weak IV problems.

To avoid the possibility of multicollinearity, we instead add the interaction of the more than six initial subjects and year dummies in our control variables and conduct the same estimation. The results are reported in Tables 10 and 11. The overall results are similar to our main results. All coefficients have the expected sign and are statistically significant and stable. The magnitude of the coefficients is slightly larger than that in Tables 3 and 4. All results show that an increase in the number of subjects of a degree program increases the probability of being appointed to the board of directors of publicly traded

	(1)	(2)	(3)	(4)	(5)	(6)
	National+Local Public			National		
Selectivity Score	FE	FE	FEIV	FE	FE	FEIV
Number of Subjects	-0.526**		-0.631**	-0.546**		-0.734***
	(0.215)		(0.253)	(0.234)		(0.271)
			First Stage			First Stage
Mechanical Instrument		-0.635**	1.006***		-0.740***	1.007***
		(0.261)	(0.0309)		(0.282)	(0.0380)
Fisrt Stage F-stat			664.1			472.5
Control	Y	Y	Y	Y	Y	Y
Observations	1,320	1,320	1,320	1,201	1,201	1,201
R-squared	0.561	0.559		0.579	0.577	
# of id	139	139	139	126	126	126

Table 11: Impact of the Number of Subjects on Selectivity Score When We Include the [More Than Six Initial Subjects Dummy]x[Year Dummy] Under Our Control: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

companies, although it lowers the selectivity score.

The Robustness of the Magnitude of Parameters: Let us discuss the magnitude of our estimates. After conducting several robustness checks, an increase of one more subject in the entrance examination increases the probability of producing directors from the degree program graduates by between 0.07 and 0.16 for public universities from Tables 3, 5, 6 and 10. Table 1 shows that on average 0.27% of graduates become directors. Hence, one more subject in the entrance examination is likely to increase the share of directors from the degree program graduates by a factor of between $\frac{0.27+0.07}{0.27} \approx 1.26$ and $\frac{0.27+0.16}{0.27} \approx 1.6$. This suggests a fairly large impact of an increase in the number of subjects on the director share.

Similarly, an increase by one more subject in the entrance examination lowers the selectivity score by between 0.44 and 0.63 for public universities from Tables

4, 5, 7 and 11. Table 1 shows that the average selectivity score is 61.11. Hence, an increase of one more subjects in entrance examination increases the selectivity score by a factor of $\frac{61.11-0.44}{61.11} \approx \frac{61.11-0.63}{61.11} \approx 0.99$. This result suggests that an increase in the number of subjects has a very small impact on the selectivity score.

In sum, the results of our robustness tests also support the main hypothesis that by broadening the range of subjects for entrance examinations, colleges can select people who can learn a wide range of knowledge and produce future business leaders from their graduates.

7 Conclusion

This paper examines whether expanding the range of subjects in the entrance examinations to attend particular colleges also increase the number of business leaders from the graduates of these colleges. To solve this endogeneity problem, we use a historical event in Japan: i.e., the government introduced a nationwide standardized entrance examination test, the JFSAT, in 1979. Using the fact that the number of subjects has exogenously increased to seven, we construct a mechanical IV, which consists of the number of subjects of the degree program in 1975, a year prior to 1978 when the reform was announced, and seven, which it is after the reform was introduced. We then conduct two-way fixed effect IV estimates using a sample consisting of public universities between 1975 and 1985. Our results show that an increase in the number of subjects of a degree program also increases the probability of appointment to the board of directors of a publicly traded company, although it lowers the selectivity score. This indicates that by broadening the range of subjects for entrance examinations, colleges can select people who can learn a wide range of knowledge and produce future business leaders from their graduates.

We can discuss the remaining questions in future research. First, while we find evidence that increases in the number of subjects in the entrance examinations that students must study also increase the number of business leaders from the graduates of the colleges, we are not sure that this is the result of education before applying to colleges or the students' innate ability. While it is beyond the scope of this paper, it would be important to separate the impact of education from innate ability as future research.

Next, it would be interesting to know if increases in the number of subjects in the entrance examinations that students must study also increase the number of other types of leaders from the college graduates, such as bureaucrats and politicians. Some colleges may prefer to attract other types of leaders such as bureaucrats and politicians rather than business leaders. If expanding the range of subjects also helps to produce future bureaucrats and politicians, we can suggest that any colleges that wish to raise social leaders in general should test ability to learn a broad range of subjects. If not, they must clarify their mission regarding which types of leaders they wish to produce. This would also be a subject for important and interesting future research.

8 Appendix

8.1 Descriptive Statistics of Director-Level Data

We report the summary statistics of the director-level data used for the construction of the director share. We start with a sample of 13,517 directors of Japanese listed companies post-1990 who were born after 1955. Of the initial sample, 10,310 (76%) directors graduated from major degree programs and 9,206 (68%) were directors of major companies. Finally, because we restrict our analysis to between 1975 and 1986, the number of observation came down to 4,866 (36%).

Table 12 describes the final sample of 4,842 directors who both graduated from major degree programs and have been a board member of at least one major company. The average age at which their first experience as a board member began is 51 years. Almost one quarter of the directors graduated from national universities.

Variable	Obs	Mean	Std. Dev.	Min	Max
First Age	4,842	51.160	6.877	26	66
Manufacturing	4,866	0.482	0.500	0	1
Non-manufacturing	4,866	0.419	0.493	0	1
Graduate from					
National Univ.	4,866	0.255	0.436	0	1
First Tier Univ.	4,866	0.169	0.375	0	1
Second Tier Uni	4,866	0.085	0.280	0	1
Local Pub. Univ.	4,866	0.024	0.153	0	1
Private Univ.	4,866	0.721	0.449	0	1
Enrollment Year					
Until 1978	4,866	0.626	0.484	0	1
From 1979	4,866	0.374	0.484	0	1

Table 12: Summary Statistics of Director Data

Variable	Obs	Response Rate
Above the 90th Percentile Firms in Total Assets	2,254	0.714
Between the 80th and 90th Percentile Firms in Total Assets	1,786	0.638
Between the 70th and 80th Percentile Firms in Total Assets	1,637	0.599
Between the 60th and 70th Percentile Firms in Total Assets	1,555	0.606
Between the 50th and 60th Percentile Firms in Total Assets	1,425	0.599
Between the 40th and 50th Percentile Firms in Total Assets	1,335	0.637
Between the 30th and 40th Percentile Firms in Total Assets	1,127	0.582
Between the 20th and 30th Percentile Firms in Total Assets	1,056	0.547
Between the 10th and 20th Percentile Firms in Total Assets	893	0.534
Below 10th Percentile Firms in Total Assets	449	0.419

Table 13: Response Rate for Educational Background

Director Share	(1)	(2)	(3)	(4)
	Public		National	
	FE	FEIV	FE	FEIV
Above 90th Precentile	0.0884***	0.0978***	0.0910***	0.104***
	(0.0258)	(0.0285)	(0.0292)	(0.0332)
Above 80th Precentile	0.0859***	0.0925***	0.0773**	0.0859**
	(0.0267)	(0.0291)	(0.0301)	(0.0337)
Above 70th Precentile	0.0620**	0.0718**	0.0572*	0.0711**
	(0.0279)	(0.0303)	(0.0319)	(0.0355)
Above 60th Precentile	0.0605**	0.0624**	0.0557*	0.0607*
	(0.0276)	(0.0311)	(0.0310)	(0.0360)
Above 50th Precentile	0.0751**	0.0753**	0.0759**	0.0813**
	(0.0313)	(0.0356)	(0.0351)	(0.0410)
Above 40th Precentile	0.0578*	0.0538	0.0556	0.0557
	(0.0335)	(0.0379)	(0.0380)	(0.0444)
Above 30th Precentile	0.0603*	0.0569	0.0603	0.0623
	(0.0323)	(0.0384)	(0.0365)	(0.0449)
Above 20th Precentile	0.0727**	0.0721*	0.0715*	0.0772*
	(0.0337)	(0.0397)	(0.0381)	(0.0463)
Above 10th Precentile	0.0758**	0.0761*	0.0753*	0.0829*
	(0.0338)	(0.0400)	(0.0382)	(0.0466)
Below 10th Precentile	-0.00344	0.00267	-0.00518	0.00207
	(0.00320)	(0.00260)	(0.00373)	(0.00298)

Table 14: Impact of the Number of Subjects on Director Shares in the Listed Companies by Firm Size: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

Table 13 summarizes the percentage of the available data on the directors' educational background for deciles according to firm size (total assets). The table shows that the response rate is positively related to the size of the firm.

8.2 Appendix Estimation

Estimation by Firm Sizes: Table 14 shows the impact of the number of subjects in the entrance examination on the director by firm size (total assets). We report the results above the 10th percentile as our main result. The table shows that the results are stable except for the estimation below the 10th percentile.

	(1)	(2)	(3)	(4)	(5)	(6)
		National+Local Public			National	
Director Share	FE	FE	FEIV	FE	FE	FEIV
Number of Subjects	0.0351*		0.0399*	0.0513**		0.0672**
	(0.0202)		(0.0239)	(0.0251)		(0.0312)
			First Stage			First Stage
Mechanical Instrument		0.0334*	0.836***		0.0528**	0.785***
		(0.0199)	(0.0347)		(0.0243)	(0.0444)
Fisrt Stage F-stat			581.3			312.3
Control	Y	Y	Y	Y	Y	Y
Observations	3,262	3,262	3,262	2,756	2,756	2,756
R-squared	0.328	0.328		0.353	0.353	
# of id	344	344	344	288	288	288

Table 15: Impact of the Number of Subjects on the Director Share in the Listed Companies When We Use All Degree Programs That Produce a Director After 1990: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

	(1)	(2)	(3)	(4)	(5)	(6)
		National+Local Public			National	
Selectivity Score	FE	FE	FEIV	FE	FE	FEIV
Number of Subjects	-0.261**		-0.234*	-0.356***		-0.356***
	(0.102)		(0.121)	(0.105)		(0.127)
			First Stage			First Stage
Mechanical Instrument		-0.196*	0.836***		-0.280***	0.785***
		(0.103)	(0.0347)		(0.103)	(0.0444)
Fisrt Stage F-stat			581.3			312.3
Control	Y	Y	Y	Y	Y	Y
Observations	3,262	3,262	3,262	2,756	2,756	2,756
R-squared	0.420	0.417		0.434	0.429	
# of id	344	344	344	288	288	288

Table 16: Impact of the Number of Subjects on Selectivity Score in the Listed Companies When We Use All Degree Programs That Produce a Director After 1990: * 10% significance, ** 5% significance and *** 1% significance. The number in the bracket is the robust standard error.

Estimation with All Degree Programs: We use a sample of 142 degree programs that have produced more than five graduates who have been a director of one or more Japanese listed firms after 1990 as our benchmark estimation. In this Appendix, we reestimate the same regression using the sample of all degree programs that produce at least one graduate who has been a director of one or more Japanese listed firms after 1990.

Tables 15 and 16 report the results of the reestimation. Both tables show that overall results are the same as before, while the magnitudes are slightly smaller in both tables. These results indicate that our sample selection criterion seems not to influence the final result very much.

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