Meritocracy and Its Discontents:
Evidence from Centralizing and Decentralizing School Admissions

Mari Tanaka Yusuke Narita Chiaki Moriguchi*

July 17, 2019

Abstract

We theoretically and empirically investigate the impacts of centralizing school admissions in higher education. In doing so, we take advantage of the world's first known implementation of centralized admissions and its subsequent reversals in early twentieth-century Japan. This centralization was designed to make the school seat allocation more meritocratic, but our analysis indicates that there was a sharp tradeoff between meritocracy and equal regional access to higher education. Specifically, in the short run, in line with theoretical predictions, we find that the centralization led students to apply to more selective schools and make more inter-regional applications. However, as high ability students were located disproportionately in urban areas, the centralization caused urban applicants to crowd out rural applicants from advancing to higher education. Moreover, these impacts were persistent: Four decades later, compared to the decentralized system, the centralized admissions increased the number of elites (e.g, high income earners, top managers, elite professionals) born in urban areas relative to those born in rural areas.

Keywords: Higher Education, Centralized vs Decentralized Admissions, Matching Algorithms, Strategic Behavior, Regional Mobility, Universal Access, Long-run Effects

Preliminary and Incomplete. Not for Circulation

*Mari Tanaka: Department of Economics, Hitotsubashi University, email: mari.tanaka@r.hit-u.ac.jp. Yusuke Narita: Department of Economics, Cowles Foundation, and Y-RISE, Yale University, email: yusuke.narita@yale.edu. Chiaki Moriguchi: Institute of Economic Research, Hitotsubashi University, email: chiaki@ier.hit-u.ac.jp. As being discontent with the tyranny of alphabetical order, we order our names in reverse alphabetical order. We thank Kentaro Fujioka for assisting data collection and Hidehiko Ichimura and Yasuyuki Sawada for sharing the Japanese Personnel Inquiry Records data. We gratefully acknowledge financial support from Hitotsubashi University IER Joint Usage and Research Center Grant (FY 2018).

Contents

1 Introduction **3**

2 Background **6**

2.1 College Admissions around the World 6

2.2 Centralizing Admissions in Imperial Japan 6

3 Theory (TBA) **10**

4 Data **10**

5 Short-run Impacts **11**

5.1 Strategic Responses by Applicants 11

5.2 Regional Mobility in Enrollment 13

5.3 Meritocracy vs Equal Regional Access 14

5.4 Political Economy of School Admission Reforms 15

5.5 Other Institutional Changes 16

6 Long-run Impacts **17**

6.1 Long-run Outcome Data 17

6.2 Regional Differences in Career Outcomes 18

7 Conclusion **22**

A Appendix **39**

1 Introduction

College and school admission processes vary across time and places. One of the big modern transformations in college admissions is a growing degree of centralization. Today, over 40 countries use regionally- or nationally-integrated, single-application, and single-offer college admissions. At the end of the 19th century, however, no country used such a centralized system. How does the tide of centralization affect students' lives?[1]

This paper studies the short- and long-run consequences of centralizing school admissions. We do so by combining a series of natural experiments in history, newly assembled historical data, and a game-theoretic model. Our theoretical and empirical investigations reveal the pros and cons of centralized admissions, especially a tradeoff between meritocracy and equal regional access to schools.

Our empirical setting is the first known transition from decentralized to nationally-centralized school admissions. At the end of the 19th century, to modernize its higher education system, the Japanese government set up elite national schools that served as an entry point to the most prestigious tertiary education. The acceptance into these schools was merit-based, using annual entrance examinations. Initially, the government let each school run its own exam and admissions based on exam scores, similar to many of today's decentralized K-12 and college admissions. The schools typically ran exams on the same day so that each applicant could apply only for one school. Similar restrictions on the number of applications exist in today's college admissions in Italy, Japan, and the UK.

At the turn of the 20th century, the government introduced a centralized system in order to improve the quality of admitted students. In the new system, applicants were allowed to list multiple schools, ranked these schools in the order of their preference, and took a single unified exam. Given their preferences and exam scores, applicants were then assigned to a school based on a computational algorithm. The algorithm was a mix of the so-called Immediate Acceptance (Boston) algorithm and Deferred Acceptance algorithm. To the best of our knowledge, this instance is the first recorded nation-wide use of a matching algorithm.[2] Even more remarkably, for reasons detailed below, the government later re-decentralized and re-centralized the system several times, producing multiple natural experiments for studying the consequences of centralization.

[1] Despite the rich theoretical literature on this question (Chade et al., 2014; Che and Koh, 2016; Hafalir et al., 2018), the empirical literature is thin due mainly to the scarcity of variations in college admission institutions. Carvalho et al. (2019); Machado and Szerman (2017) are recent exceptions discussed below.

[2] As far as we know, the earliest large-scale use of the Boston algorithm was the assignment of medical residents to hospitals in New York City in the 1920s (Roth, 1990). The oldest national use of the Deferred Acceptance algorithm was the National Resident Matching Program (NRMP) in the 1950s (Roth, 1984). See Abdulkadiroğlu and Sönmez (2003) for the details of these algorithms in school admission contexts.

We exploit these episodes of bidirectional institutional changes to identify the causal impacts of the centralized admission system.[3] We first use a game-theoretical model to predict the impacts of the centralization on application behavior and admissions.[4] Consistent with the stated goal of centralization, we prove the centralized system to produce a more meritocratic school seat allocation. Our model also predicts that the centralization would cause applicants to apply to more selective schools and make more inter-regional applications. These theoretical results guide our empirical analysis.

With newly digitalized records of application and enrollment, we first find centralization has large short-run effects on both application behavior and enrollment outcomes. First, consistent with the theoretical predictions, the centralization caused stark strategic responses in application behavior. In particular, strategic incentives in the centralized system led both urban and rural applicants to more frequently rank the most selective urban school first.[5] Second, the centralized system caused a greater number of high-ability applicants from urban areas to be admitted to schools in rural areas, often after being rejected by the school of their first choice. As a result, urban high-achievers crowded out rural applicants; the number of entrants to any national elite school coming from the urban area increases by about 10% during centralization.[6]

In total, the short-term impacts of the centralization highlight an equity-meritocracy tension. On the one hand, the centralization was designed to make the school seat allocation more meritocratic, as applicants with higher scores were more likely to be admitted to some school even if they failed to enter the most prestigious school. On the other hand, this meritocracy comes at the cost of distributional consequences of urban applicants dominating rural applicants.

This distributional consequence upset rural schools and communities, and such rural discontents were a part of the reason why the government went back and forth between decentralized and centralized systems, finally settling for a decentralized scheme.[7] Ironically,

[3]This use of bidirectional policy changes echoes other studies with similar identification strategies (Niederle and Roth, 2003; Redding and Sturm, 2008; Ahlfeldt et al., 2015; Nakamura and Steinsson, 2018).

[4]Our theoretical analysis is based on the observation that the centralized and decentralized systems can be interpreted as different versions of the same mechanism with different constraints on the number of schools applicants can rank. This interpretation connects our setting to the literature on constrained school choice (Chade and Smith, 2006; Haeringer and Klijn, 2009; Calsamiglia et al., 2010; Pathak and Sönmez, 2013; Chen and Kesten, 2017; Hafalir et al., 2018; Shorrer, 2019).

[5]We use the nomenclature of "urban" and "rural" schools, but note that "rural" schools were located in regional cities rather than in the countryside. See Section 2 for more details.

[6]It is also empirically true that the centralized system made a greater number of rural applicants to apply to and enter urban schools. The centralized system thus increased regional mobility across the country. But their net effects are such that urban high-achievers crowded out rural applicants.

[7]Yoshino (2001a) and Yoshino (2001b) provides historical accounts about this series of policy changes. This concern about equity-meritocracy tradeoff shares much in common with modern affirmative actions

it is this series of bidirectional reforms that enable us to identify the causal effects of centralization more precisely than in a usual setting of single policy changle. These short-run results complement existing empirical studies on the effects of centralization on application behavior, regional mobility, and applicant welfare (Niederle and Roth, 2003; Abdulkadiroğlu et al., 2006, 2009, 2017b; Carvalho et al., 2019; Hafalir et al., 2018; Machado and Szerman, 2017; Pallais, 2015; Pathak, 2017). More broadly, our analysis also relates to the literature that uses historical data to test and refine economic theory (Greif, 1993; Kranton and Swamy, 2008; Börner and Hatfield, 2017)

Secondly, we find that the centralization had lasting impacts on students' career outcomes. According to our short-run analysis, urban areas experienced a disproportionate gain in school access relative to rural areas under the centralized system. Based on this result, we compare career outcomes of urban- and rural-born cohorts reaching an application-eligible age before and after the admission reforms. The career outcome data come from the Japanese Personnel Inquiry Records published in 1939 that provides a list of highly distinguished individuals and their personal information.

Our differences-in-differences estimates suggest persistent effects of the centralization. Almost four decades later, the centralized system produced a greater number of high-income earners, top managers, and elite professionals who came from urban areas compared to rural areas. Quantitatively, the number of career elites born in urban areas increased by 10-20% for the cohorts exposed to the centralized admissions. The different admission systems therefore affected the geographical distribuions of highly educated and high skilled individuals, which in turn is an important driver of economic growth and inequality (Glaeser, 2011; Moretti, 2012; Autor, 2019). This finding also contributes to the literature on the long-term effects of economic mechanism design (Bleakley and Ferrie, 2014).

Our analysis sheds light on the impacts of different admission systems on student outcomes, complementing the literature on the effects of different schools conditional on a particular admission system (Dale and Krueger, 2002; Altonji et al., 2012; Dobbie and Fryer, 2013; Hastings et al., 2013; Pop-Eleches and Urquiola, 2013; Deming et al., 2014; Kirkeboen

(Arcidiacono and Lovenheim, 2016) and foreshadows ongoing policy discussions on the distributional effects of meritocratic college admissions. See, for example, discussions in Australia (Marginson, 2011), France ("Derriere l'algorithme de Parcoursup, un choix ideologique," at `https://www.nouvelobs.com/education/20180713.OBS9643/derriere-l-algorithme-de-parcoursup-un-choix-ideologique.html`, retrieved in August 2018), and the US ("How merit-based college admissions became so unfair," at `https://www.washingtonpost.com/opinions/how-merit-based-college-admissions-became-so-unfair/2018/01/10/45a3007e-f569-11e7-b34a-b85626af34ef_story.html?noredirect=on&utm_term=.e8a24d61bd11`, retrieved in August 2018). See also Kamada and Kojima (2015) and Agarwal (2017) among others for discussions about regional inequality in other matching markets. In addition to the distributional concerns, administrative costs of centralization (e.g., coordination and communication among schools) also burdened the government.

et al., 2016; Abdulkadiroğlu et al., 2017a; Zimmerman, 2019). Our results also relate to empirical studies of the long-term effects of educational institutions and resources (Duflo, 2001; Meghir and Palme, 2005; Oreopoulos, 2006; Pischke and Von Wachter, 2008). These studies focus on the effects of quantitative expansions of resources (such as school constructions and compulsory schooling extensions) while we investigate the effects of qualitatively different resource allocation mechanisms conditional on a pool of resources.

Section 2 provides historical backgrounds about school admissions in the world and Japan. Section 3 develops theoretical predictions, which we then test in Section 5 using data described in Section 4. Section 5 analyzes short-term impacts of centralizing admissions while Section 6 is about its long-term impacts. Finally, Section 7 summarizes our findings, discusses their limitations, and outlines future directions.

2 Background

2.1 College Admissions around the World

College and school admission institutions vary across time and places. Today, over 40 countries use regionally- or nationally-integrated, single-application, and single-offer college admissions. Figure 1 depicts countries that adopt some centralized college admissions in dark red and countries without any centralized college admissions in light yellow, showing that centralized college admissions are used in all continents except North America.

At the same time, the centralization of college admissions is a relatively new phenomenon in history. At the end of the 19th century, no country used such a centralized system. Even today, many countries like the US and Canada keep using decentralized systems. Similar points apply to K-12 school admissions as well. How does the centralization of college and school admissions affect students' application behavior, enrollment results, and future careers? Understanding the costs and benefits of centralization will have important implications for policy designs.

2.2 Centralizing Admissions in Imperial Japan

To evaluate the impacts of centralized school admissions, we go back to the world's first known implementation of a centralized system at the turn of the 20th century in Imperial Japan. After the Meiji Restoration of 1868, education reforms were a central part of modernization efforts by the Japanese government. In 1894, the government launched a new set of higher education institutions consisting of one Imperial University and five national

Higher Schools. By 1908, it was expanded to four Imperial Universities (Tokyo, Kyoto, Tohoku, and Kyushu) and eight national Higher Schools (First in Tokyo, Second in Sendai, Third in Kyoto, Fourth in Kanazawa, Fifth in Kumamoto, Sixth in Okayama, Seventh in Kagoshima, and Eighth in Nagoya, named after the order in which they were established) in key locations across Japan as shown in Figure 2a. Hereafter we refer to the eight national schools as Schools 1-8 for short.[8]

These schools served effectively as an entry point to Imperial Universities (the most prestigious tertiary education) as virtually all graduates of Schools 1-8 were admitted to these universities without further selection until 1918 if not later. Furthermore, Imperial University graduates were partially or wholly exempted from the Higher Civil Service Examinations and other highly selective national qualification exams (Amano, 2007). As a result, entering Schools 1-8 was considered an equivalent to obtaining a passport into the elite class in Imperial Japan. To apply to these schools, one must be male aged 17 or older and have completed a middle school. As Schools 1-8 admitted only about two thousand students each year, they constituted less than 0.5% of the cohort of male aged 17.

The admissions to Schools 1-8 were merit-based and determined by annual entrance examinations. Initially, the government let each school administer its own exam and admissions, and the schools typically ran their exams on the same day so that each applicant could apply to only one school. Following the convention in the literature (Che and Koh, 2016; Hafalir et al., 2018), we call this system "decentralized admissions," "decentralized applications," or Dapp for short.

All schools were not created equal, however. Among the eight schools, School 1 in Tokyo was considered by far the most prestigious due to its capital location and geographical proximity to Tokyo Imperial University. The next most prestigious was School 3 in Kyoto. By contrast, located in a remote southwest region, School 5 and School 7 were considered the least prestigious among all. Consequently, the schools differed substantially in their popularity and selectiveness. For example, in 1901, the rate of acceptance (i.e., the share of admitted applicants in all applicants) was 23% in School 1 (Tokyo), compared to 51% in School 5. In fact, many highly talented students who applied to School 1 (Tokyo) were rejected and had to give up or retake the exam in the subsequent year, while less popular schools were admitting not so talented students. For the government whose goal was to

[8]Schools 1-5 were established in 1894 and Schools 6, 7, and 8 were established in 1900, 1901, and 1908, respectively. Despite the growing demand for higher education, due to fiscal constraints, the number of national schools remained constant until 1917. In addition to Schools 1-8, there was a quasi-national school, Yamaguchi Higher School, which was established in 1894, discontinued in 1904, and re-established in 1918. The number of higher education institutions increased after 1918, as the government permitted not only national but also local public and private high schools and universities.

select the best and brightest and send them to higher education, the decentralized system seemed inefficient. Indeed, the Education Minister emphasized that failing to admit a high ability student is "*a loss for the country*" (Yoshino, 2001a).

To remedy this problem, in 1902, the government instituted a centralized system in which applicants were asked to select multiple schools they would like to enter, rank them in order of their preferences, and take a single unified entrance exam at the nearest school from their residence. Applicants were then assigned to a school (or no school if unsuccessful) according to their exam scores and school preferences, based on a well-specified centralized algorithm announced ex ante. To the best of our knowledge, this is the world's first recorded large-scale use of a matching algorithm. We call this system "centralized admissions," "centralized applications," or Capp for short. In proposing this system, the Higher Education Committee explained its purpose as to enroll "students of superior academic talents," placing a clear emphasis on meritocracy (Yoshino, 2001a, p.53).

This institutional innovation, however, was short-lived. Partly in response to the oppositions by school principals as discussed later, the government switched back to Dapp (with a modification of using a unified exam) in 1908. The government continued to oscillate between decentralization and centralization, however, reintroducing Capp (with a slight modification) in 1917, moving back to Dapp (with a unified exam) in 1919, reinstituting Capp (with major modifications) in 1926, finally settling down to Dapp (returning to its most decentralized form) in 1928.

In other words, in a space of thirty years, there were three periods of centralized admissions: first in 1902-07, next in 1917-18, and finally in 1926-27. We exploit this series of bidirectional policy changes to identify the causal impacts of centralization on the selection of students and their career outcomes.[9] According to historical studies, these repeated policy changes were the result of tugs-of-war between the Ministry of Education who pushed for centralization to advance meritocracy and the Association of School Principals who preferred decentralization to protect school autonomy and regional interests (Amano, 2017; Takeuchi, 2011). In the following empirical analysis, we take the timing of reform as exogenous, namely, we assume that every year there was a positive probability that the current system could change, but exactly when it happens was determined largely by external conditions that

[9]These historical episodes are well known among historians of the Japanese education, who provide detailed institutional accounts (e.g., Yoshino, 2001a,b; Takeuchi, 2011; Amano, 2007, 2017). The preceding studies, however, are mostly descriptive and qualitative except for Miyake, 1998, 1999 whose research question is similar to ours. Building on her work, we combine a formal model and rigorous econometric analysis to identify the causal effects of school admission reforms.

affect relative bargaining power of the two opposing parties.[10][11]

To understand the centralized system and how it operated, we briefly describe the algorithm and assignment results in 1917 (only year in which such data are available; note that the 1917-18 algorithm is only slightly different from the 1902-07 algorithm). New application procedures were announced in April, three months before the exam, as a public notice published in Government Gazette. The assignment rules were as follows (see Appendix Figure A.2 for a reprint of the original notice in Japanese).

(1) First, select the same number of applicants as the sum of each school capacity in descending order of exam score. If the score is tied, decide by lottery.

(2) Second, for applicants selected in (1), in descending order of exam score, assign each applicant to the school of his first choice until the school capacity is filled. If the score is tied, decide by lottery.

(3) Third, for those applicants who are selected in (1) and not assigned to any school in (2), in descending order of exam score, assign each applicant to a school of their second choice until the school capacity is filled. If the score is tied, decide by lottery.

(4) Finally, for those applicants who are selected in (1) and not assigned to any school in (2) and (3), in descending order of exam score, assign each applicant to a school of their third choice or below that has an unfilled seat. If the score is tied, decide by the school preference order. If both the score and the preference order are the same, decide by lottery.

Written more than a century ago, the rules were described clearly and precisely in an almost mathematical manner. Observe that the above method imposes meritocracy up front in which only top-scoring applicants were considered for admission regardless of their school preference order (Step (1)). Then these applicants are assigned to one of Schools 1-8 using a mix of the so-called Immediate Acceptance (Boston) algorithm (Steps (2) and (3)) and the Deferred Acceptance algorithm (Step (4)). In other words, consistent with the stated

[10]For example, the second and third introduction of Capp was implemented by the same person who was named the Education Minister in 1916 and again in 1924 under the different Cabinets (Amano, 2017, Chapter 6).

[11]Applicants had a fair amount of information about how selective each school was. Every year (during 1905-30), the Ministry of Education issued a report that contains the content of the entrance exam, the exam score distribution, each school's exam score cutoff, as well as the number of applicants and enrollment at each school.

purpose, the assignment rules were designed to maximize the lowest score of accepted applicants.

To see whether or not actual school assignments are consistent with the above algorithm, Appendix Table A.3 presents the number of admitted applicants (to the Department of Law and Literature in each school) and their exam scores by their school preference order. Observe that, in the prestigious School 1 (Tokyo) and School 3 (Kyoto), all seats were filled with applicants who ranked these schools as their first choice. Both the maximum and minimum exam scores of School 1 entrants were the highest among all schools, indicating that School 1 was the most selective, followed by School 3, School 4, and School 2, in that order. By contrast, Schools 5 and 7 were admitting a fair number of students who ranked the school as their third choice or below, because they did not have sufficient number of high-scoring applicants who placed these schools on the top of their preference order. Observe also that students who were admitted to the school of their third choice or below are not necessarily low ability students. For example, the highest-score entrant to School 7 (with the score of 450) was the applicant admitted to his third choice after failing to enter Schools 1 and 3 by a narrow margin.

Finally, consistent with the principle of meritocracy that maximizes the lowest score of entrants, setting aside Schools 1 and 3, the lowest score was comparable across schools (374 in School 2, 364 in School 4, 362 in School 5, 364 in School 6, 364 in School 7, and 363 in School 8). In summary, these observations indicate that the centralized admissions system was carefully designed and well implemented.

3 Theory (TBA)

4 Data

For analyzing short-run effects of centralization, we collect data on applications, enrollments, and other outcomes from several administrative and non-administrative sources.

First, we collect data on the number of applicants by year and the school of their first choice from 1898 to 1930 for Schools 1-8 from multiple sources: Government Gazettes for 1902; Letters Exchanged between the Ministry of Education and Tokyo Imperial University for 1903 and 1904; Yoshino (2001a) for 1907; the Investigation Records of Higher School Entrance Examinations by the Ministry of Education for 1917,1918 and 1927; and the Yearbook of the Ministry of Education for other years.

Data on applicants' birth prefectures are available only for 1916 (under Dapp) and 1917 (under Capp) from the Investigation Records of Higher School Entrance Examinations. For

these two years, we collect the number of applicants by first-choice school and prefecture of the applicant's middle school. Birth prefecture is defined by the prefecture of legal domicile registered in Japan's Family Registry. We include applicants born in all 47 prefectures (excluding colonies) in Japan and exclude foreign-born applicants.

Second, we compile data on the number of entrants (i.e., successfully admitted applicants) by school, year, and birth prefecture from 1898 to 1930. For this, we use the Higher School Student Registers published annually by each school to collect the number of freshmen by birth prefecture. We include only native-born freshman in the university preparatory division, excluding foreign-born students and students in medical and engineering divisions which were part of higher schools in early years. Strictly speaking, the number of freshman may differ from the number of entrants due to dropouts and holdovers. However, because the number of entrants by birth prefecture is not available, we use the number of freshmen in place of entrants in the following regression analysis.

Third, we also collect data on the number of middle school graduates by year, school type (public or private), and prefecture (defined by the location of middle school) from 1897 to 1930, using the Yearbook of the Ministry of Education, to control for the supply of potential applicants as well as the general education level. We also control for the numbers of national, public, and private high schools by prefecture that were established in addition to Schools 1-8 after the 1919 reform, using the same source.

Finally, to measure the geographical mobility of applicants and entrants, we compute distance as follows. Since the finest geographical unit of observation is a prefecture, we define the distance between an applicant's birth prefecture and the school of his first choice by a direct (straight-line) distance between the capital of the birth prefecture and the capital of the prefecture in which the school was located. Similarly, the distance between an entrant's middle school and the higher school he was admitted to is defined by a direct distance between the two prefectural capitals determined by the prefectural locations of the middle school and the higher school. The distance data are from the Geospatial Information Authority of Japan (GSI). Descriptive statistics of main variables are summarized in Appendix Table A.2.

5 Short-run Impacts

5.1 Strategic Responses by Applicants

As an immediate effect, switching back and forth between Capp and Dapp caused stark strategic responses in application behavior. Figure 3 shows that the three periods of Capp (in 1902-07, 1917-18, and 1926-27) are associated with a sharp increase in the share of

applicants who select the most prestigious School 1 as their first choice. This is consistent with the theoretical prediction (Proposition **??**) in Section 3.

Furthermore, such response was present and statistically significant in all geographic areas. The top panel of Table 1 reports the difference in the propensity of applicants to rank School 1 first between the two years, 1916 (under Dapp) and 1917 (under Capp), using the following regression:

$$Y_{it} = \alpha + \beta \times Capp_t + \epsilon_{it},$$

where Y_{it} is the indicator variable that takes 1 if applicant i in year t selects School 1 as his first choice and $Capp_t$ is the indicator variable that takes 1 if year t is under Capp. The first column shows that, at the national level, the share of applicants who rank School 1 first increased by 16 percentage points under Capp. This is about 64% increase compared to the mean of 25% under Dapp (reported as the estimate of the constant term α). Next, to observe regional variations, we group applicants into school regions based on which of Schools 1-8 was the closest to the middle school from which the applicant graduated (see the map below Table 1) and run the same regression for each region. The results indicate that, in all school regions, the share of applicants selecting School 1 rose substantially (by 11 to 19 percentage points) under Capp.

These strategic responses have heterogeneous effects on application distance (i.e., the distance between an applicant's first-choice school and middle school) as the bottom panel of Table 1 shows. At the national level, the application distance seems to have changed little between Dapp and Capp (see the first column). However, at the regional level, there were major changes. The application distance decreased by 93 km (1 km is 0.62 miles) in the School 1 region under Capp as more applicants selected the nearest and most prestigious School 1, whereas it increased by more than 100 km in the School 5 and School 7 regions located in remote west.

Overall, the results in Table 1 show that the centralization of school admissions induced a greater number of applicants around the nation to apply to the most prestigious school in Tokyo as their first choice and encouraged applicants in remote areas to make more long-distance applications. As a result, the competition to enter School 1 became more intense under the centralized system. Appendix Figure A.1 depicts changes in the competitiveness of Schools 1-8, measured by the ratio of the number of applicants who select the school as their first choice (hereafter first-choice applicants) to the number of entrants to the school. It shows that, during the periods of centralized admissions, the ratio spiked at School 1 (Tokyo), increased modestly at School 3 (Kyoto), and declined sharply at the rest of the schools. For instance, at the second introduction of Capp in 1917, School 1 attracted 12

times more first-choice applicants (4,428 in total) than its capacity (of 361 seats). This implies that only a small fraction of the first-choice applicants were admitted to School 1, producing hundreds of high-scoring but rejected applicants. These applicants were likely to be admitted to schools of their second choice and below under the centralized assignment rules.[12]

5.2 Regional Mobility in Enrollment

Now we turn to enrollment outcomes and analyze the geographical distribution of successful applicants admitted to Schools 1-8. Note that the geographical distribution of entrants is determined by the geographical distributions of applicants as well as their abilities.

Figure 4 plots the average enrollment distance (i.e., the distance between an entrant's birth prefecture and the school he entered) from 1898 to 1930. It shows that the centralized system is associated with a sharp and discontinuous increase in enrollment distance, especially in the first two periods of Capp.[13]

This increase in regional mobility happened, to a large extent, through a sharp reduction in the number of "local" entrants (defined by entrants who were born in the prefecture in which the school is located). We estimate the following regression for each school s separately:

$$\begin{aligned} Y_{pt} = {} & \beta_1 \times Capp_t \times 1\{\text{school } s \text{ is located in prefecture } p\} \\ & + \beta_2 \times Capp_t \times 1\{\text{school } s \text{ is 1-100 km away from prefecture } p\} \\ & + \beta_3 \times Capp_t \times 1\{\text{school } s \text{ is 101-300 km away from prefecture } p\} \\ & + X_{pt} + \gamma_t + \gamma_p + \epsilon_{pt}, \end{aligned}$$

where Y_{pt} is the number of entrants born in prefecture p who entered school s in year t. $Capp_t$ is the indicator variable that takes 1 if the system was centralized in year t. $1\{$ school s is 1-100 km away from prefecture $p\}$ is the indicator variable that takes 1 if school s is not located in, but within 100 km from prefecture p. X_{pt} controls for observable characteristics of prefecture p and year t, including the number of middle school graduates from prefecture p and the number of higher schools other than School 1-8 in prefecture p. γ_t and γ_p are year and prefecture fixed effects.

[12] Recall that, under the meritocratic assignment rules discussed in Section 2, schools would reject first-choice applicants whose score is below a threshold and accept second-choice applicants with a sufficiently high score.

[13] The centralized mechanism used in the third period of Capp in 1926-27 was qualitatively different from that in the first and second periods. sBecause the number of national schools increased to 25 in 1926 from 8 in 1918, the schools were divided into two groups and applicants were allowed to choose and rank at most two schools from different groups in 1926-27.

According to the results in Table 2, the coefficients of 1{school s is located in prefecture p} are negative and significant for all schools, implying that Capp reduces the number of local entrants born in the school's prefecture. The column (1) shows that the number of School 1 entrants born in Tokyo Prefecture declined by 28 under Capp from the average of 103 entrants under Dapp, or a 27% reduction. School 7 was the most affected where the number of local entrants declined by 48%, while School 8 was least affected with a decline of 17%. Schools 4-7 experienced reductions in the number of entrants born not only from the school's prefecture but also from surrounding prefectures. In other words, the centralization weakened the local monopoly power of each school by creating a national market for higher education.[14]

5.3 Meritocracy vs Equal Regional Access

If the centralization reduced the number of local entrants, who replaced them? Which prefecture gained more school seats under the centralized system? Figure 5a plots the change in the number of entrants to Schools 1-8 from Dapp to Capp by birth prefecture (where blue colors indicate negative changes and red colors indicate positive changes). It shows that most of western prefectures and northern most prefectures lost school seats, while Tokyo Prefecture and its surrounding areas gained school seats under Capp.

Figure 5b depicts the time evolution of the share of entrants to Schools 1-8 who were born in the Tokyo area defined as prefectures located within 100 km from Tokyo (see Appendix Figure A.3). It shows that the share of Tokyo-area born entrants rose significantly during the years of centralization.

More formally, Table 3 compares the effects of Capp on Tokyo-area born entrants and locally-born entrants, estimating the following equation for a given school s:

$$\begin{aligned} Y_{pt} = {} & \beta_1 \times Capp_t \times 1\{\text{prefecture } p \text{ is Tokyo}\} \\ & + \beta_2 \times Capp_t \times 1\{\text{prefecture } p \text{ is 1-100 km away from Tokyo}\} \\ & + \beta_3 \times Capp_t \times 1\{\text{prefecture } p \text{ is 101-300 km away from Tokyo}\} \\ & + \beta_4 \times Capp_t \times 1\{\text{school } s \text{ is located in prefecture } p\} \\ & + \beta_5 \times Capp_t \times 1\{\text{school } s \text{ is 1-100 km away from prefecture } p\} \\ & + \beta_6 \times Capp_t \times 1\{\text{school } s \text{ is 101-300 km away from prefecture } p\} \\ & + X_{pt} + \gamma_t + \gamma_p + \epsilon_{pt}, \end{aligned}$$

[14] These results are robust to whether to control for prefecture characteristics (results available upon request).

where Y_{pt} is the number of entrants born in prefecture p who entered school s in year t.

The column (1) of Table 3 shows that the number of Tokyo-area born students admitted to any of Schools 1-8 increased by 23 under Capp, indicating a 10% increase from the average of 226 under Dapp. The estimates by school in the columns (2)-(9) reveal that this effect comes mainly from Tokyo-area born students entering not prestigious urban schools (Schools 1 and 3) but less selective schools (Schools 4-8).[15] In other words, the net effect of Capp is such that the increased inter-regional applications caused high-achieving students residing mainly in the Tokyo area to crowd out lower-achieving students in remote areas from their local schools.

5.4 Political Economy of School Admission Reforms

Overall, our analysis of the short-term impacts of the centralization highlights a meritocracy-equity tradeoff. On the one hand, the centralized admissions made the school seat allocation more meritocratic, enabling high-ability students to enter one of the eight national schools even if they failed at the most selective one (Figure A.3). On the other hand, this meritocracy comes at the expense of equal regional access to education, as high-achieving urban applicants tended to dominate rural applicants in the competition (Table 3).

The distributional consequence appeared to upset rural schools and communities, as indicated by several historical accounts. For example, in 1906, in the middle of the first period of centralization, the Association of School Principals submitted the following proposition to the Education Minister, demanding to re-decentralizing the school admission:

> " *(...) Switching back to decentralized admissions would greatly decrease the number of students who give a long shot at the urban schools and increase the number of high-achieving students who apply for rural schools.*" ("Proposal for the Higher School Admission Examination System Reform" submitted in 1906)[16]

[15] The results remain almost the same whether we control for observable prefecture characteristics or not (a table available upon request).

[16] In addition, a broader group of concerned parties presented arguments against Capp:

> "*Consider students who could not get an admission from the first choice school and end up with a second or third choice school. After thinking admittees at the first choice school are all superior, many of these students entering a lower-choice school would depreciate themselves, lack school spirit toward their school, and end up being servile whatever they do.*" ("On the Higher School Admission System Reform" published by the *Journal of School 6 Students and Alumni* in May 1908).

That is, this argument was concerned that less selective schools received many "reluctant" students who failed at their first choice and were left with a sense of inferiority.

The government was also aware of potential distributional consequences that centralization might entail. After the second introduction of the centralized system in 1917, the Ministry of Education published a special table (in the Investigation Records of the Higher School Entrance Examinations) that compared the share of middle school graduates admitted to Schools 1-8 by prefecture before and after the centralization. This suggests that the government was paying close attention to how the reform impacted regional disparity in the access to higher education. A noted education historian summarizes these episodes as follows:

> *Urban applicants "overwhelm" rural ones by applying for rural schools as fallback options. Urban applicants rob rural ones of opportunities that were open to rural applicants. This ruins the diffusion of schools over the country.* (*The Glory and Baffle of Educational Elites* by Hiroshi Takeuchi, p.XX)

This controversy was one of the reasons that compelled the government to go back and forth between decentralized and centralized systems, finally settling down to a decentralized scheme (recall Figure 2b). Ironically, this series of bidirectional reforms allows us to more credibly and precisely identify the effects of (de)centralization than a usual single policy change would.

5.5 Other Institutional Changes

We briefly discuss whether changes in other institutional factors could explain the results of our short-run analysis. First, if there were simultaneous reforms in middle schools, it could affect their application behavior. Second, if there were changes in the capacity of higher schools that were correlated with the admission reforms, it could affect application behavior and enrollment outcomes. Third, if the share of the capacity of School 1 increased relative to the capacity of other schools with the admission reforms, this could explain our findings on application behavior. However, as Appendix Table A.4 shows, across-time changes in the number of middle school graduates, the total number of entrants to higher schools, and the share of entrants to School 1 in all entrants are not systematically correlated with introductions of Capp. In the same table, we also examine and confirm that the total number of applicants as well as the level of competitiveness (measured by the total number of entrants divided by the total number of applicants) do not move systematically with introductions of Capp. In addition, if the probability of unsuccessful applicants retaking the exam in the subsequent years changes with the Capp reforms, this may also affect our results. As shown in the same table, however, we find that the mean age of entrants do not change systematically with the introductions of Capp.

A potential criticism to the above analyses is that the insignificance may be a result of a small sample size (where the number of observations is around 30). Yet, using the same empirical specification, we find that our main outcome variables (the share of applicants to School 1, the enrollment distance, and the share of entrants who were born in the Tokyo area) are significantly correlated with the centralization as shown in the last three columns of Appendix Table A.4. Taken together, these results show that it is unlikely that our baseline findings are driven by institutional changes other than the school admission reforms.

6 Long-run Impacts

6.1 Long-run Outcome Data

To assess longer-term effects, we use the Japanese Personnel Inquiry Records (JPIR) published in 1939.[17]. The JPIR is an equivalent of Who's Who in Japan, which compiles a list of distinguished individuals of Japanese nationals from a variety of sources. It contains approximately 60,000 individuals (such as the peerage, high-income earners, top business managers, elite professionals, high-ranking politicians, bureaucrats, and military personnels) and provide detailed information for each individual including a full name, birth date, birth prefecture, residing prefecture, final education, occupational titles and positions, the name of employer, medals and decorations received, and the amount of national income tax and corporate tax paid. Note that, because the final education reported in the JPIR is typically a university, we cannot identify which individuals attended Schools 1-8 from the JPIR. To capture the effects of the first period of the centralized admission system in 1902–1907, we use the cohorts born in 1880–1894 who became age 17 in 1897–1911 in the following regression analysis. The cohorts born in 1880–1894 were 45 to 59 years old in 1939, the year in which we observe them in the JPIR, and the number of individuals listed in the JPIR in each of these cohort is more than 1,500.[18] Using the occupational titles and positions, employer's names, and tax payments, we define the following (mutually non-exclusive) groups of elites: (1) top 0.1% income earners (JPIR-listed individuals with more than 15,000 yen of taxable income) and top 0.01% income earners (JPIR-listed individuals with more than 50,000 yen of taxable income), (2) managers (JPIR-listed individuals employed in a private sector with a positive amount of income or corporate tax payment), (3) professionals (JPIR-listed individuals whose occupation is either physician, engineer, lawyer, or scholar), (4) professors at Imperial Universities (JPIR-listed individuals whose occupation is either professor or as-

[17]Digital images of the JPIR are publicly available at the National Diet Library Digital Collections.
[18]The average life expectancy at age 20 for males born in 1880-1900 was about forty years.

sociate professor at one of the Imperial Universities), and (5) medal recipients (JPIR-listed individuals who received a decoration of the Order of the Fifth Class or above, excluding military personnels). Descriptive statistics are presented in Appendix Table A.2.

Because the JPIR does not provide explicit criteria for selecting distinguished individuals, we are concerned about potential incomplete sampling and sampling bias. For top income earners and Imperial University professors, we can compute the exact sampling rates by comparing the number of individuals in the JPIR against complete counts reported in government statistics.[19] We find that the sampling rates are decent even by modern standards: that is, 38% for top 0.1% income earners, 53% for top 0.01% income earners,[20] and 70% for Imperial University professors. In our empirical analysis using differences-in-differences, a sampling bias becomes a problem only in a rare scenario in which the difference in sampling rates between urban and rural areas changes with the cohort's exposure to the centralized admission system. Nevertheless, we further check this concern using the prefecture-level JPIR sampling rates for the top 0.1% income earners. As Appendix Figure A.5 shows, the number of people listed in the JPIR and the complete count from tax statistics are highly correlated, and the sampling rates are similar across prefectures. Even so, one potential concern is that Imperial University graduates might have had a higher likelihood of being sampled by the JPIR even after controlling for the income level. However, we do not find higher sampling rates in prefectures with a greater number of Imperial University graduates (see Appendix Table A.9).

In addition, we control for various time-varying prefecture characteristics for a robustness check. To control for demographical changes, we collect prefecture-level birth population for the cohorts born in 1886-1894 from the population census and estimate birth population for the cohorts born in 1880-1885 using age-specific population data available in 1876-1894. To control for economic conditions, we take prefecture-level manufacturing GDP estimates in 1874, 1890, 1909, and 1925 from Tangjun et al. (2009) and interpolate them linearly for each prefecture. To control for changes in middle schools, we collect the number of middle school graduates in each prefecture in the year when the cohort became age 16.

6.2 Regional Differences in Career Outcomes

We conduct a differences-in-differences analysis by cohorts and areas to estimate the long-run impacts of the centralized school admissions (Capp). The key idea behind our empirical

[19]The number of high income earners are reported in the Tax Bureau Year Book and the number of faculty members in Imperial Universities are reported in the Ministry of Education Year Book.

[20]Consistent with the nature of the JPIR that lists only distinguished individuals, the sampling rate is increasing with the income level. See Appendix Figure A.5 for details.

strategy is that applicants born in the Tokyo area experienced a greater gain in entering Schools 1-8 under Capp relative to Dapp (recall Figure 5 and Table 3). We exploit this differential gain in school access to compare the career outcomes of individuals born inside and outside the Tokyo area by the cohort's exposure to Capp.

Before diving to the main analysis, we first check the validity of our JPIR data by comparing the number of JPIR-listed Imperial University graduates born inside and outside the Tokyo area by the cohort's exposure to Capp. Recall that, during our data period (1896–1911), all graduates from higher schools were automatically admitted to one of the Imperial Universities. Therefore, we expect the area that produced more higher school entrants to produce more Imperial University graduates, which in turn would result in a greater number of distinguished Imperial University graduates to be listed in the JPIR under Capp. To compute the intensity of exposure to Capp for a given cohort is straightforward if all applicants to Schools 1-8 took the entrance exam only once at age 17. In such case, the only cohorts exposed to Capp would be those who turned age 17 during the first period of Capp in 1902–1907. However, in reality, a nontrivial number of unsuccessful applicants retook the exam in the subsequent years.[21] As such, the cohorts who turned age 17 in 1899–1901 were partially exposed to Capp (as they might have taken the exam in 1902), and the cohorts who turned age 17 in 1905–1907 are partially exposed to Dapp (as they might have taken the exam in 1908). Figure 6 (a) compares the number of Imperial University graduates who were born inside and outside the Tokyo area by cohorts (represented by their birth year plus 17 on the horizontal axis). In these and subsequent plots, we color cohorts according to their intensity of exposure to Capp. Observe that the intensity gradually increases from 1899 to 1902, reaches 100% in 1902–1904, declines moderately from 1905 to 1907, and drops to 0% in 1908.[22] Figure 6 (c) shows that the regional difference in the number of Imperial University graduates gradually rises with the intensity of exposure to Capp and falls sharply in 1908. In other words, the observed pattern is consistent with the results of our short-run analysis, providing some assurance that our JPIR data contain valuable information for the long-run analysis.

Next, for robustness check, we repeat the same analysis using an alternative geographical area of comparison. Instead of the Tokyo area, we identify a set of prefectures that experienced a net increase in the number of entrants to Schools 1-8 in 1902–1907 under Capp and compare individuals born inside and outside of this area. As shown in Figures 6 (b) and (d), the results are qualitatively the same as the results using the Tokyo area.

[21] According to the limited data available, out of all higher school entrants in 1903, 63% graduated middle school in the same year, 29% graduated in the previous year, 6% graduated two years before, and 1% graduated three years before.

[22] We use the 1903 data and simplifying assumptions to compute the intensity of exposure by cohort.

Our main results are presented in Figure 7 and Table 4. Figure 7 shows differences-in-differences plots that compares the number of (a) the top 0.1% income earners, (b) professionals (physicians, engineers, lawyers, and scholars), and (c) medal recipients (the Order of the Fifth Class and above) who were born inside and outside the Tokyo area by the cohort's exposure to Capp. In each category of elites, the plots show that the difference between the Tokyo area and the rest grows larger as the intensity of exposure to Capp increases, then it drops sharply in 1908 after the end of Capp. Overall, Figure 7 suggests that, almost four decades after its implementation, the centralized admission system had lasting effects on the career outcomes of students. Figure A.6 confirms that the results are similar when we use, in place of the Tokyo area, the area where entrants to Schools 1-8 increased under Capp.

To quantify the long-run effects, we provide differences-in-differences estimates in Table 4, using the following regression:

$$Y_{pt} = \beta \times Capp_t \times Urban_p + \gamma_p + \gamma_t + \epsilon_{pt},$$

where Y_{pt} is the number of elites listed in the JPIR in cohort t who were born in prefecture p. $Capp_t$ is the indicator variable that takes 1 if the admission system was Capp when cohort t became age 17 (as a simple proxy for the intensity of exposure to Capp), $Urban_p$ is the indicator variable that takes 1 if prefecture p is in the Tokyo area, or alternatively, if the number of entrants to Schools 1-8 who were born in prefecture p increases under Capp. γ_p and γ_t are prefecture and cohort fixed effects, respectively. The prefecture fixed effects capture any systematic difference in career outcomes across prefectures that do not vary across cohorts. The cohort fixed effects control for common shocks that affect career outcomes in all prefectures as well as secular time trends. To allow for serial correlation of ϵ_{pt} within prefectures over time (without imposing a particular structure on the form of the serial correlation), we cluster the standard errors at the prefecture level.[23]

The results in Table 4, columns (2) to (7), show that the long-run effects of the centralized admissions are statistically and economically significant. Quantitatively, Panel A indicates that the number of JPIR-listed elites born in the Tokyo area (compared to those born outside the Tokyo area) increases by 24% for the top 0.1% income earners, 37% for the top 0.01% income earners, 22% for managers, and 19% for professionals, 44% for Imperial University professors, and 41% for medal recipients for the cohorts exposed to Capp relative to Dapp. Panel B of Table 4 shows that the effects are symmetric with respect to the direction of institutional change, i.e., a change from Dapp to Capp and a change from Capp to Dapp

[23]Bertrand et al. (2004) evaluate approaches to deal with serial correlation within each cross-sectional unit in panel data. They suggest that clustering the standard errors on each cross-section unit performs well in settings with 50 or more cross-section units, as in our setting.

produce quantitatively similar effects with an opposite sign. Panels C and D confirm that the results are qualitatively the same when we replace the Tokyo area by the area where the number of entrants to Schools 1-8 increases under Capp.

The results are robust to alternative specifications. First, controlling for time- and cohort-varying prefecture characteristics (i.e., cohort birth population, the number of primary schools, the number of middle school graduates, prefecture-level manufacturing GDP estimates at age 20) do not change the qualitative results (see Appendix table A.7). Second, in the above regression analysis, we assume that the cohorts who became age 17 in 1902–1908 are fully exposed to Capp while the rest of the cohorts are fully exposed to Dapp. When we drop the cohorts who were heavily exposed to both Capp and Dapp (i.e., cohorts who became age 17 in 1901 and 1907) from the sample, we find qualitatively the same results with higher statistical significance (for the results, see Appendix table A.8). We further test if the assumption of parallel pre-event trends is satisfied. Appendix Table A.5 verifies that the differences in pre-event trends between the areas of comparison are small and statistically insignificant for all of our outcome variables.

Next, we explore potential pathways through which the centralization affected career outcomes. First, in columns (1) and (2) of Table 5, we test if the centralization, which caused substantial inter-regional mobility in the short-run outcomes, increased the geographical mobility of elites in a long run. Somewhat surprisingly, the results indicate that it did not: the urban-rural difference in the fraction of elites whose residing prefectures differ from their birth prefectures did not increase significantly under Capp. We find similar results when we use the distance between an elite's birth prefecture and his residing prefecture as an alternative measure of long-run mobility. The results suggest that, even though a greater number of students born in the Tokyo area entered rural schools under Capp, most of them might have returned to the Tokyo area when pursuing their careers.

Second, we test whether the centralization affected the urban-rural difference in (not only the quantity but also) the quality of higher school entrants. To measure the quality, we use the ratio of the number of Imperial University graduates (a proxy for the number of higher school entrants) listed in the JPIR to the total number of higher school entrants when the cohort became age 17. We assume that if the quality of entrants is higher, then a greater fraction of them would become distinguished and selected into the JPIR in their adulthoods. The estimated coefficients in column (3) are negative and insignificant.[24] This result implies that our main results shown in Table 4 are driven mainly by an increase in the quantity (but not the quality) of higher school entrants from urban areas under Capp.

[24]We expect the coefficient to be negative if the quality of entrants born inside the Tokyo area declined relative to that of entrants born outside the Tokyo area under Capp.

Finally, we conduct placebo tests to examine if the results are driven by other factors such as the sampling design of the JPIR or changes in cohort populations. Among the elites listed in the JPIR, landlords (defined as individuals whose occupational titles includes landlord, but excluding managers and professionals) were unlikely to be affected by the introduction of Capp as receiving higher education was not a typical pathway to become landlords. As shown in column (4) of Table 5, the estimated effect of Capp on the number of landlords is small and statistically insignificant. As an additional placebo test, column (5) also confirms that the urban-rural difference in the cohort's birth populations do not change significantly with the cohort's exposure to Capp.

7 Conclusion

Natural experiments in history provide us with a rare opportunity to study how different school admission systems impact students' outcomes. Especially unusual natural experiments occurred during the first recorded nation-wide centralization of school admissions and its later abolitions in Imperial Japan. These episodes produced bidirectional institutional changes that allow us to more transparently identify the effects of centralization than a usual single policy event would. The use of historical events may be also valuable for studying the long-run effects of market designs in other important areas, such as housing, labor, and health markes.

Substantively, both in the short- and long-run, we find a clear tradeoff between meritocracy (the goal of the centralized system) and equal regional access to schools. In particular, the centralization led students to apply to more prestigious and selective schools and make more inter-regional applications. As high ability students were located disproportionately in urban areas, however, the centralization caused urban applicants to crowd out rural applicants from advancing to higher education. Moreover, these impacts were persistent: Four decades later, compared to the decentralized system, the centralized admissions increased the number of high income earners, top managers, and elite professionals born in urban areas relative to those born in rural areas. Even though our study used the admission reforms unique to Japan, the implications of our study might be relevant for other contexts. For instance, distributional consequences of centralized admissions may be a reason why many countries (such as the US) keep using seemingly inefficient, decentralized college admissions.

It is the bidirectional policy changes in history that allow us to measure the long-term effects. The disadvantage of using historical events, however, is the limited availability of data. The ideal way to alleviate the data concerns would be to use contemporary administrative data. For example, one may imagine linking the US Internal Revenue Service data on tax

returns and school district data to measure the long-term effects of school choice reforms in the US in the past few decades. Such an ambitious contemporary study would be a fruitful complement to our historical study.

References

Abdulkadiroğlu, Atila and Tayfun Sönmez, "School Choice: A Mechanism Design Approach," *American Economic Review*, 2003, *93*, 729–747.

__ , Joshua Angrist, Yusuke Narita, and Parag A. Pathak, "Research Design Meets Market Design: Using Centralized Assignment for Impact Evaluation," *Econometrica*, 2017, *85* (5), 1373–1432.

__ , Nikhil Agarwal, and Parag A. Pathak, "The Welfare Consequences of Coordinated School Assignment: Evidence from the NYC High School Match," *American Economic Review*, 2017.

__ , Parag A. Pathak, Alvin E. Roth, and Tayfun Sönmez, "Changing the Boston School Choice Mechanism," 2006. Working Paper.

__ , __ , and __ , "Strategy-proofness versus Efficiency in Matching with Indifferences: Redesigning the New York City High School Match," *American Economic Review*, 2009, *99(5)*, 1954–1978.

Agarwal, Nikhil, "Policy Analysis in Matching Markets," *American Economic Review*, 2017, *107* (5), 246–50.

Ahlfeldt, Gabriel M, Stephen J Redding, Daniel M Sturm, and Nikolaus Wolf, "The Economics of Density: Evidence from the Berlin Wall," *Econometrica*, 2015, *83* (6), 2127–2189.

Altonji, Joseph G, Erica Blom, and Costas Meghir, "Heterogeneity in Human Capital Investments: High School Curriculum, College Major, and Careers," *Annual Review of Economics*, 2012, *4* (1), 185–223.

Amano, Ikuo, *Social History of Examination (In Japanese)*, Heibon-sha, 2007.

__ , *Imperial Universities: Elite Factory in Modern Japan (In Japanese)*, Chuou-kouron-shinsha, 2017.

Arcidiacono, Peter and Michael Lovenheim, "Affirmative Action and the Quality-fit Trade-off," *Journal of Economic Literature*, 2016, *54* (1), 3–51.

Autor, David, "Work of the Past, Work of the Future," in "Richard T. Ely Lecture given at Annual Meeting of American Economics Association, Atlanta, GA, January," Vol. 4 2019.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan, "How Much Should We Trust Differences-in-differences Estimates?," *Quarterly Journal of Economics*, 2004, *119* (1), 249–275.

Bleakley, Hoyt and Joseph Ferrie, "Land Openings on the Georgia Frontier and the Coase Theorem in the Short and Long Run," 2014. Working Paper.

Börner, Lars and John William Hatfield, "The Design of Debt-Clearing Markets: Clearinghouse Mechanisms in Preindustrial Europe," *Journal of Political Economy*, 2017, *125* (6), 1991–2037.

Calsamiglia, Caterina, Guillaume Haeringer, and Flip Kljin, "Constrained School Choice: An Experimental Study," *American Economic Review*, 2010.

Carvalho, José Raimundo, Thierry Magnac, and Qizhou Xiong, "College Choice, Selection and Allocation Mechanisms: A Structural Empirical Analysis," *Quantitative Economics*, 2019.

Chade, Hector and Lones Smith, "Simultaneous search," *Econometrica*, 2006, *74* (5), 1293–1307.

__ , Gregory Lewis, and Lones Smith, "Student Portfolios and the College Admissions Problem," *Review of Economic Studies*, 2014, *81* (3), 971–1002.

Che, Yeon-Koo and Youngwoo Koh, "Decentralized College Admissions," *Journal of Political Economy*, 2016, *124* (5), 1295–1338.

Chen, Yan and Onur Kesten, "Chinese College Admissions and School Choice Reforms: A Theoretical Analysis," *Journal of Political Economy*, 2017, *125* (1), 99–139.

Dale, Stacy Berg and Alan B Krueger, "Estimating the Payoff to Attending a More Selective College: An Application of Selection on Observables and Unobservables," *Quarterly Journal of Economics*, 2002, *117* (4), 1491–1527.

Deming, David, Justine Hastings, Thomas Kane, and Douglas Staiger, "School Choice, School Quality and Postsecondary Attainment," *American Economic Review*, 2014, *104(3)*, 991–1013.

Dobbie, Will and Roland G. Fryer, "The Impact of Attending a School with High-Achieving Peers: Evidence from the New York City Exam Schools," *American Economic Journal: Applied Economics*, 2013.

Duflo, Esther, "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment," *American Economic Review*, 2001, *91* (4), 795–813.

Glaeser, Edward, *Triumph of the City*, Pan, 2011.

Greif, Avner, "Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition," *American Economic Review*, 1993, pp. 525–548.

Haeringer, Guillaume and Flip Klijn, "Constrained School Choice," *Journal of Economic Theory*, 2009, *144*, 1921–1947.

Hafalir, Isa, Rustamdjan Hakimov, Dorothea Kuebler, and Morimitsu Kurino, "College Admissions with Entrance Exams: Centralized versus Decentralized," *Journal of Economic Theory*, 2018.

Hastings, Justine, Christopher Neilson, and Seth Zimmerman, "Are Some Degrees Worth More than Others? Evidence from College Admission Cutoffs in Chile," 2013. Working Paper.

Kamada, Yuichiro and Fuhito Kojima, "Efficient Matching under Distributional Constraints: Theory and Applications," *American Economic Review*, 2015, *105* (1), 67–99.

Kirkeboen, Lars, Edwin Leuven, and Magne Mogstad, "Field of Study, Earnings, and Self-Selection," *Quarterly Journal of Economics*, 2016.

Kranton, Rachel and Anand V Swamy, "Contracts, Hold-up, and Exports: Textiles and Opium in Colonial India," *American Economic Review*, 2008, *98* (3), 967–89.

Machado, Cecilia and Christiane Szerman, "Centralized Admissions and the Student-College Match," 2017. Working Paper.

Marginson, Simon, "Equity, Status and Freedom: A Note on Higher Education," *Cambridge Journal of Education*, 2011, *41* (1), 23–36.

Meghir, Costas and Marten Palme, "Educaitonal Reform, Ability, and Family Background," *American Economic Review*, 2005, *95(1)*, 414–424.

Miyake, Sono, "Regional Difference in Access to Higher Schools during the Late Meiji Era," *Socio-Cultural Studies of Education*, 1998, *5*, 35–52.

__ , "Regional Difference in Attaining High Academic Career: From an Analysis of Higher School Enrollment in Taisho Era," *Bulletin of the Graduate School of Education at Kyoto University*, 1999.

Moretti, Enrico, *The new geography of jobs*, Houghton Mifflin Harcourt, 2012.

Nakamura, Emi and Jón Steinsson, "Identification in Macroeconomics," *Journal of Economic Perspectives*, 2018.

Niederle, Muriel and Alvin E Roth, "Unraveling Reduces Mobility in a Labor Market: Gastroenterology with and without a Centralized Match," *Journal of Political Economy*, 2003, *111* (6), 1342–1352.

Oreopoulos, Philip, "Estimating Average and Local Average Treatment Effects of Education When Compulsory Schooling Laws Really Matter," *American Economic Review*, 2006, *96* (1), 152–175.

Pallais, Amanda, "Small Differences That Matter: Mistakes in Applying to College," *Journal of Labor Economics*, 2015, *33* (2), 493–520.

Pathak, Parag A, "What Really Matters in Designing School Choice Mechanisms," in "Advances in Economics and Econometrics: Volume 1: Eleventh World Congress," Cambridge University Press, 2017.

Pathak, Parag A. and Tayfun Sönmez, "School Admissions Reform in Chicago and England: Comparing Mechanisms by Their Vulnerability to Manipulation," *American Economic Review*, 2013, *103(1)*, 80–106.

Pischke, Jörn-Steffen and Till Von Wachter, "Zero Returns to Compulsory Schooling in Germany: Evidence and Interpretation," *Review of Economics and Statistics*, 2008, *90* (3), 592–598.

Pop-Eleches, Cristian and Miguel Urquiola, "Going to a Better School: Effects and Behavioral Responses," *American Economic Review*, 2013, *103(4)*, 1289–1324.

Redding, Stephen J and Daniel M Sturm, "The Costs of Remoteness: Evidence from German Division and Reunification," *American Economic Review*, 2008, *98* (5), 1766–97.

Roth, Alvin E., "The Evolution of the Labor Market for Medical Interns and Residents: A Case Study in Game Theory," *Journal of Political Economy*, 1984, *92*, 991–1016.

__ , "New Physicians: A Natural Experiment in Market Organization," *Science*, 1990, *250*, 1524–1528.

Shorrer, Ran, "Simultaneous Search: Beyond Independent Successes," 2019. Working Paper.

Takeuchi, Hiroshi, *The Glory and Baffle of Educational Elites (in Japanese)*, Kodansha, 2011.

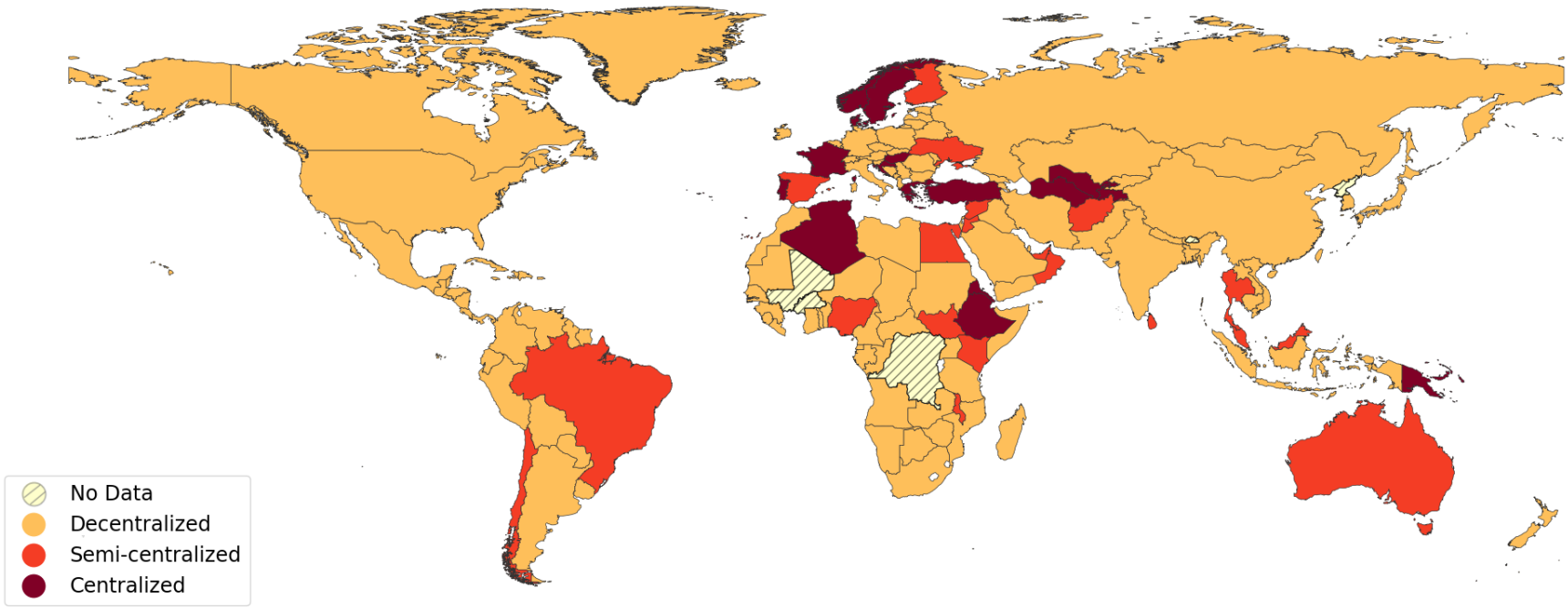
Tangjun, Yuan, Settsu Tokihiko, Jean-Pascal Bassino, and Kyoji Fukao, "Gross Prefectural Domestic Product and Industrial Structure in Pre-war Japan [in Japanese]," 2009. Institute of Economic Research, Hitotsubashi University, Global COE Hi-Stat Discussion Paper Series gd09-071.

Yoshino, Takehiro, "Entrance Examination of Higher Schools in the Early Taisho Period (in Japanese)," *Keio University Studies in Sociology, Psychology, and Education*, 2001, (53), p.19–31.

__ , "Entrance Examination of Higher Schools in the Meiji Period (in Japanese)," *Keio University Studies in Sociology, Psychology, and Education*, 2001, (52), p.51–62.

Zimmerman, Seth D, "Elite colleges and upward mobility to top jobs and top incomes," *American Economic Review*, 2019, *109* (1), 1–47.

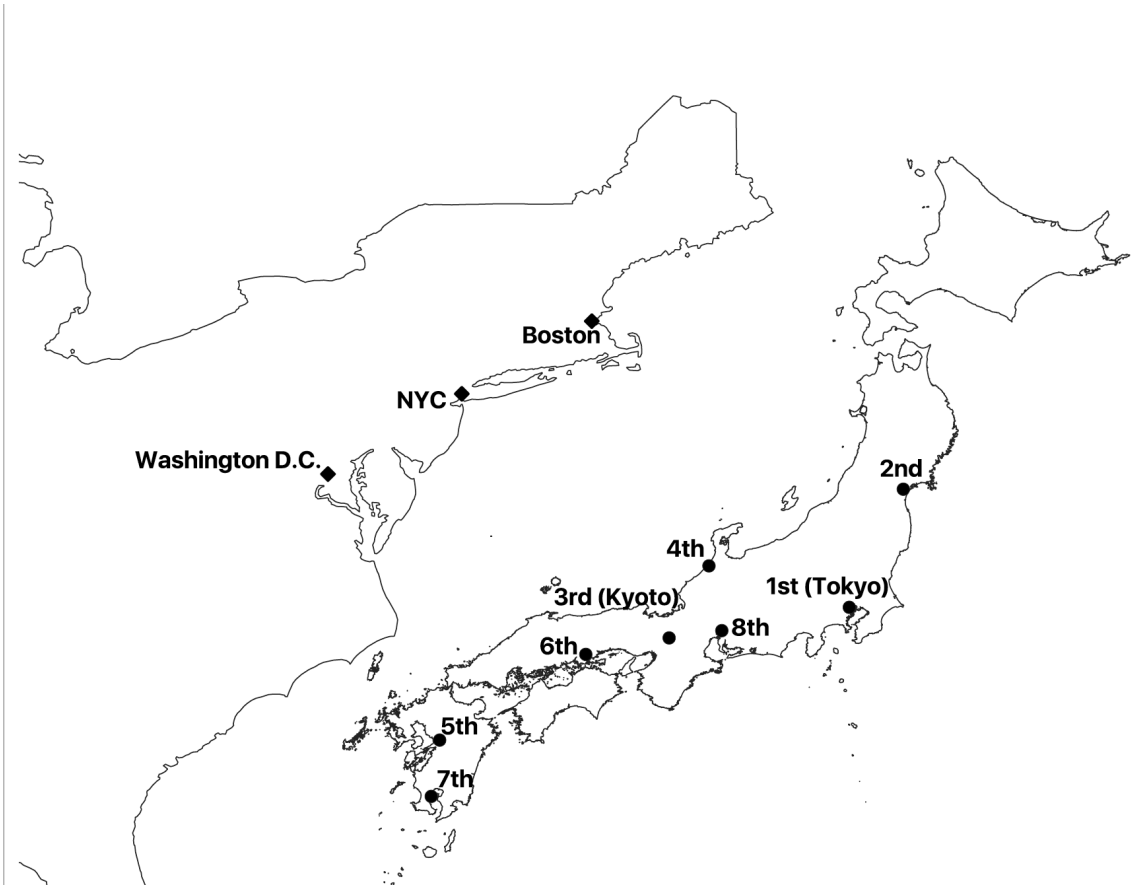
Figure 1: College Admissions around the World Today



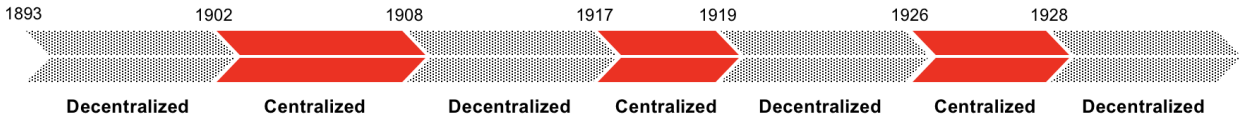
Notes: This figure summarizes each country's college admission system today. Dark, red color (e.g. Russia): Regionally- or nationally-centralized college admissions, where a single-application, single-offer assignment algorithm (well-defined rule) is used to make admissions to multiple colleges. Both public and private universities are included in the system. Medium, orange color (e.g. Brazil): Semi-centralized, defined as either (1) there is a centralized system, but not all universities (e.g. private universities) are included in the single-application, single-offer system or (2) students submit a single application and receive multiple offers. Light, orange color (e.g. U.S.A.): Decentralized college admissions, where each college defines its own admissions standards and rules. Yellow with diagonal lines (e.g. Mali): Not enough data available. See Section 2 for discussions about this figure.

Figure 2: Higher Schools in Imperial Japan

(a) Map of Schools 1-8 in Japan (with the US East Coast in Comparison)

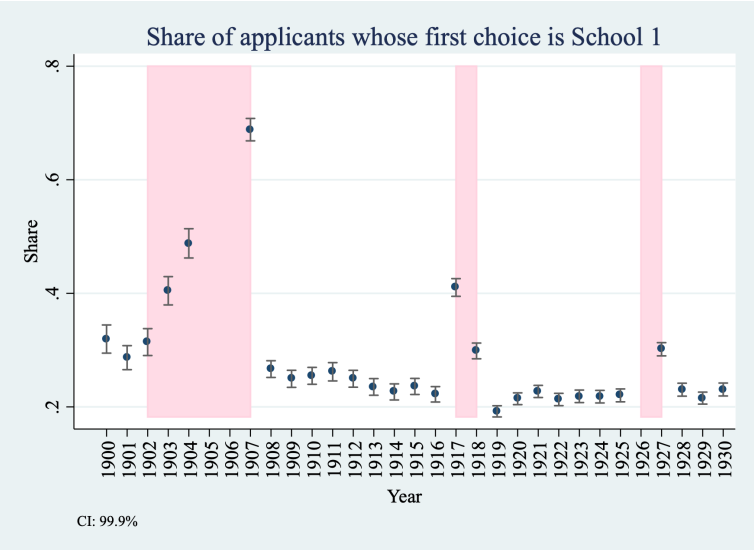


(b) Timeline of Policy Changes



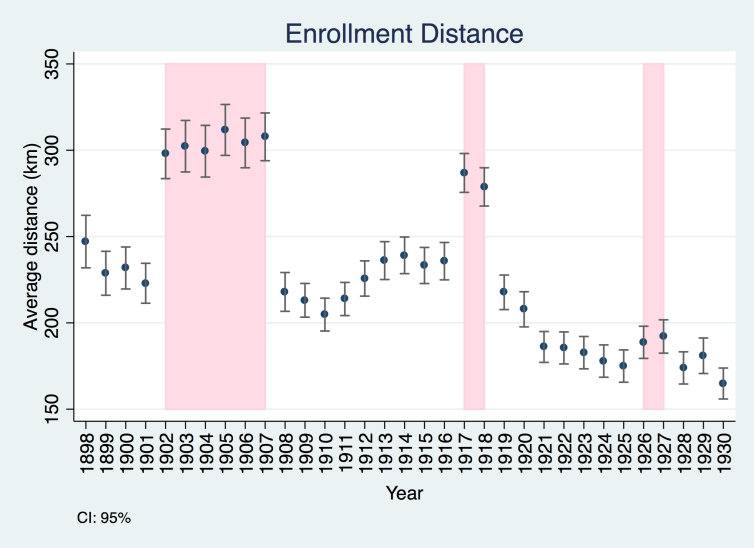
Notes: Panel (a) shows the locations of the eight national higher schools and compares their geographical distribution to the US east coast in the same scale unit. Panel (b) provides the timeline of key policy changes in school admissions systems. See Section 2 for discussions about this figure.

Figure 3: Centralization Caused Applicants to Apply More Aggressively: First Look



Notes: This figure shows the time evolution of the share of applicants who select the most prestigious School 1 (Tokyo) as their first choice. Colored years (1902-07, 1917-18, and 1926-27) indicate the three periods of the centralized school admission system. No data are available for 1905, 1906, and 1926. Bars show the 99.9 percent confidence intervals. See Section 5.1 for discussions about this figure.

Figure 4: Centralization Increased Regional Mobility in Enrollment: First Look



Notes: This figure shows the time evolution of the average enrollment distance, i.e., the distance between an entrant's birth prefecture and the prefecture of the school he entered (measured by the direct distance between the two prefectural capitals). Colored years indicate the three periods of the centralized school admission system. Bars show the 95 percent confidence intervals. See Section 5.2 for discussions about this figure.

Table 1: Centralization Caused Applicants Across the Country to Apply More Aggressively

Dependent var	Select School 1 as First Choice								
Sample region	All	S1 Region	S2 Region	S3 Region	S4 Region	S5 Region	S6 Region	S7 Region	S8 Region
Centralized	0.159***	0.192***	0.151***	0.146***	0.128	0.168***	0.180***	0.166***	0.114***
	(0.0106)	(0.00924)	(0.0329)	(0.0232)	(0.0646)	(0.0245)	(0.0336)	(0.0136)	(0.00786)
Constant	0.248***	0.494***	0.169***	0.0892***	0.178**	0.107***	0.184***	0.0813**	0.127*
	(0.0717)	(0.0437)	(0.0357)	(0.0162)	(0.0373)	(0.0185)	(0.0218)	(0.00991)	(0.0508)
Observations	20,913	6,505	2,555	3,248	1,266	2,730	2,276	615	1,718
Dependent var	Application Distance								
Sample region	All	S1 Region	S2 Region	S3 Region	S4 Region	S5 Region	S6 Region	S7 Region	S8 Region
Centralized	-2.534	-92.88***	10.95	2.080	-15.74	128.0***	46.52**	145.4**	-25.57
	(23.22)	(2.888)	(24.65)	(5.482)	(22.92)	(23.11)	(13.91)	(21.27)	(18.64)
Constant	226.2***	231.7***	289.7***	158.8***	166.7*	252.6***	294.1***	218.0*	154.2*
	(15.74)	(16.43)	(79.51)	(28.11)	(56.94)	(42.52)	(51.54)	(70.94)	(48.89)
Observations	20,913	6,505	2,555	3,248	1,266	2,730	2,276	615	1,718

Notes: In this table, we estimate the effects of centralization on the propensity of an applicant to select the most prestigious school (School 1) as his first choice, using the applicant-level data in 1916 (under the decentralized system) and 1917 (under the centralized system). The prefecture-level application data are available only for these two years. We group applicants into "school regions" based on which school (among Schools 1-8) is nearest to the applicant's middle school in 1916, where "nearest" is defined by the distance between the prefectural capitals. Standard errors are clustered at the prefecture level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 5.1 for discussions about this table.

The following map shows the locations of the eight school regions.

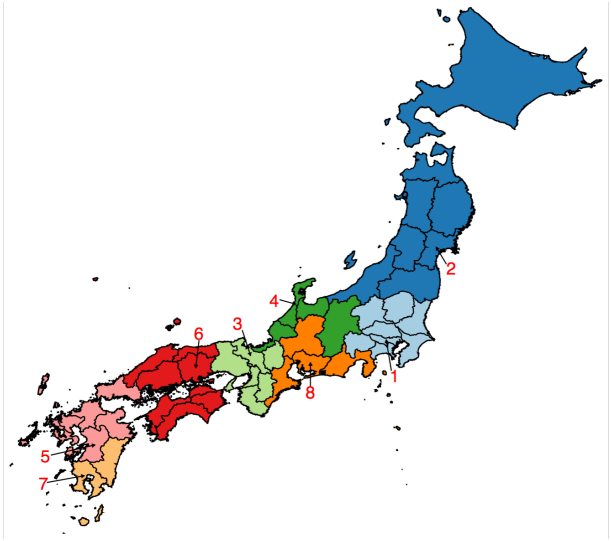


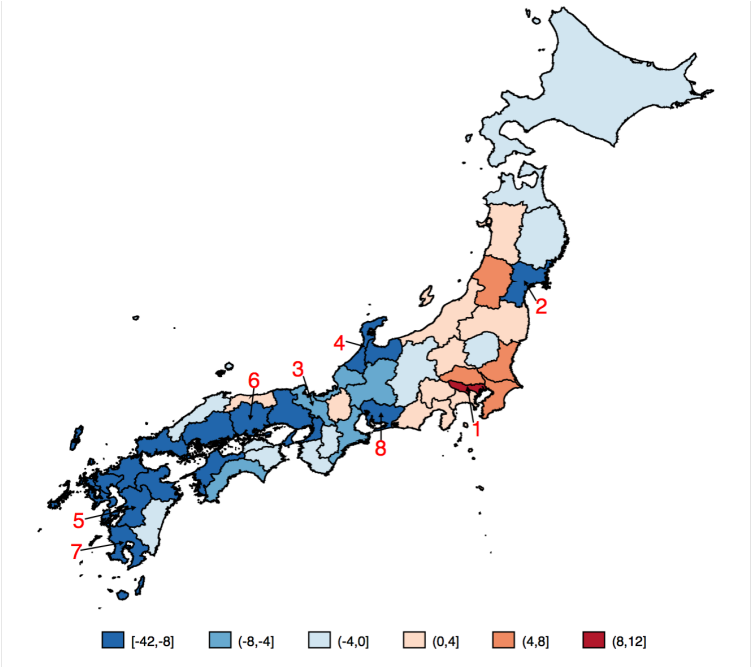
Table 2: Centralization Broke Local Monopoly and Increased Regional Mobility across Japan

Dependent variable = No. of entrants to:	(1) Sch. 1	(2) Sch. 2	(3) Sch. 3	(4) Sch. 4	(5) Sch. 5	(6) Sch. 6	(7) Sch. 7	(8) Sch. 8
Centralized x Born in school's prefecture	-27.80***	-17.61***	-15.63***	-23.08***	-28.43***	-23.02***	-45.86***	-13.42***
	(0.887)	(0.141)	(0.624)	(0.245)	(0.189)	(0.565)	(0.358)	(0.864)
Centralized x D to school's prefecture (1-100km)	0.298	-3.192	-3.993*	-9.316***	-11.99***	-2.866**	-1.996***	1.053
	(0.662)	(2.443)	(2.062)	(3.129)	(3.213)	(1.334)	(0.273)	(0.982)
Centralized x D to school's prefecture (100-300km)	1.064*	-0.104	-0.160	-0.210	-3.299***	-1.945**	-3.031***	1.240
	(0.550)	(0.655)	(0.549)	(0.551)	(0.908)	(0.836)	(0.777)	(1.061)
Observations	1,410	1,410	1,363	1,410	1,363	1,363	1,269	1,034
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	7.942	5.535	6.213	5.677	6.305	5.202	5.079	5.726
Mean dep var (school's pref dur. Dapp)	103.3	62.00	56.37	59.90	73.40	76.05	93.44	77.00
Mean dep var (within 1-100km dur. Dapp)	9.150	21.20	17.68	26.88	34.90	8.439	8.333	15.50

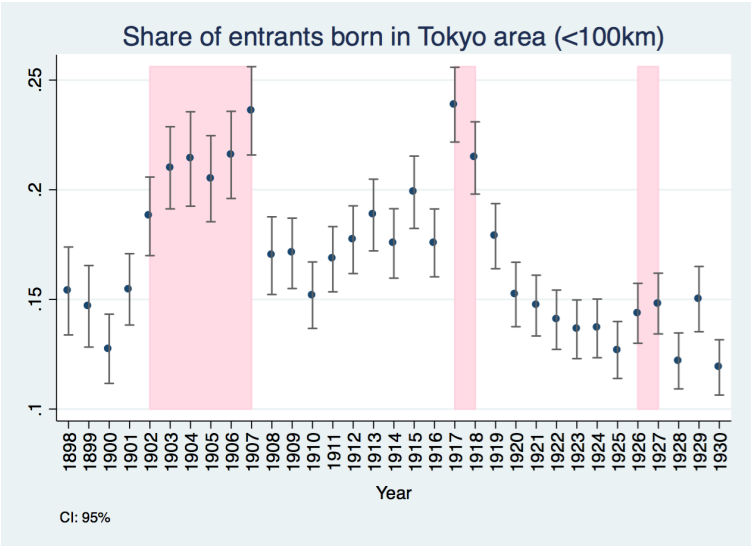
Notes: Using the prefecture-year level data in 1900-1930, we define the dependent variable as the number of entrants born in each prefecture entering the school indicated in the column in each year. "Born in school's prefecture" takes 1 if the school indicated in the column is located in the entrant's birth prefecture. "D to school's prefecture (1-100km)" takes 1 if the school indicated in the column is not located in, but within 100 km from the entrant's birth prefecture (measured by the distance between the two prefectural capitals). "D to school's prefecture (100-300km)" takes 1 if the school indicated in the column is between 100 km and 300 km from the entrant's birth prefecture. We control for year fixed effects, prefecture fixed effects, the lagged number of public and private middle school graduates in the prefecture, and the number of high schools other than Schools 1-8 in the prefecture. "Mean dep var" shows the mean of the dependent variable during decentralization for all prefecture-year observations. "Mean dep var (school's pref dur. Dapp)" shows the mean of the dependent variable who entered the school located in his birth prefecture during decentralization. "Mean dep var (within 1-100km dur. Dapp)" shows the mean of the dependent variable who entered the school that was not located in, but within 100km from his birth prefecture during decentralization. For Schools 7 and 8, we drop the years in which they held an early exam (School 7 in 1908-1910 and School 8 in 1908). Standard errors are clustered at the prefecture level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 5.2 for discussions about this figure.

Figure 5: Which Regions Win from Centralization? First Look

(a) In Which Prefectures Did Entrants Increase during Centralization?



(b) Centralization Increased Tokyo Area-born Entrants to Schools 1-8



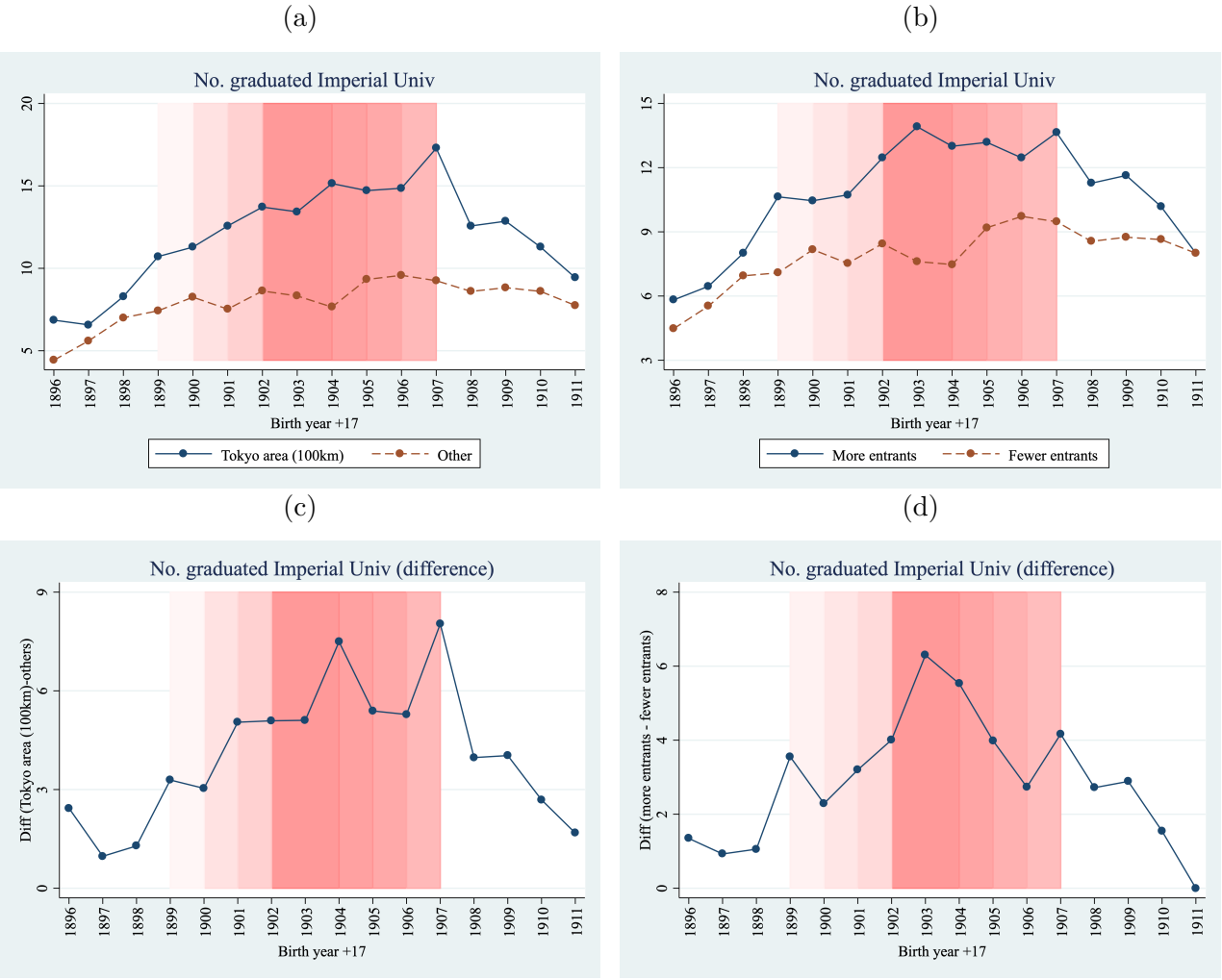
Notes: Panel (a) estimates and plots the prefecture-specific coefficient β_i in $\#Entrants_{it} = \beta_i Capp_t + \alpha_i X_{it} + e_{it}$, using the 1900-1930 data for each prefecture i, where $\#entrants_{it}$ is the number of entrants in year t who were born in prefecture i and X_{it} is the number of schools other than Schools 1-8 in prefecture i in year t. Panel (b) uses the entrant-level data from 1898 to 1930 to show the time evolution of the fraction of entrants to Schools 1-8 who were born in the Tokyo area defined as a set of prefectures that are within 100km from Tokyo (see Appendix Figure A.3 for a map). Bars show the 95 percent confidence intervals. See Section 5.3 for discussions about this figure.

Table 3: Which Regions Win from Centralization?

Dependent variable = No. of entrants to:	(1) All schools	(2) Sch. 1	(3) Sch. 2	(4) Sch. 3	(5) Sch. 4	(6) Sch. 5	(7) Sch. 6	(8) Sch. 7	(9) Sch. 8
Centralized x Born in Tokyo prefecture	9.111***		0.338	2.544	7.062***	3.410***	10.21***	6.872***	19.87***
	(2.682)		(0.312)	(1.736)	(0.525)	(0.314)	(1.688)	(0.493)	(1.340)
Centralized x D to Tokyo prefecture (1-100km)	13.14***		0.525	0.964**	2.046***	0.122	0.875**	0.455	0.367
	(2.173)		(0.603)	(0.361)	(0.447)	(0.341)	(0.431)	(0.460)	(0.655)
Centralized x D to Tokyo prefecture (100-300km)	3.912		0.913*	1.674**	-0.0237	0.596*	1.360**	1.149**	0.133
	(3.751)		(0.459)	(0.776)	(0.891)	(0.336)	(0.593)	(0.479)	(0.523)
Centralized x Born in the school's prefecture		-27.80***	-17.41***	-15.14***	-22.81***	-28.16***	-22.08***	-47.82***	-13.42***
		(0.887)	(0.170)	(0.578)	(0.904)	(0.206)	(0.357)	(0.402)	(1.135)
Centralized x D to school's prefecture (1-100km)		0.298	-3.910	-3.761*	-9.068***	-11.70***	-1.912	-1.686***	1.030
		(0.662)	(2.476)	(1.962)	(3.150)	(3.205)	(1.298)	(0.275)	(1.015)
Centralized x D to school's prefecture (100-300km)		1.064*	-0.345	-0.367	-0.691	-3.025***	-1.166*	-2.503***	0.260
		(0.550)	(0.747)	(0.513)	(0.429)	(0.917)	(0.676)	(0.816)	(0.371)
Observations	1,410	1,410	1,410	1,363	1,410	1,363	1,363	1,222	1,034
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pref FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	45.26	7.942	5.535	6.213	5.677	6.305	5.202	5.020	5.726
Mean dep var (Tokyo pref dur. Dapp)	199.9	103.3	27.15	11.00	14.40	6.100	9.474	12.00	20.39
Mean dep var (within 1-100km from Tokyo pref. dur. Dapp)	26.38	9.150	6.733	1.246	2.867	0.767	1.254	1.618	3.250

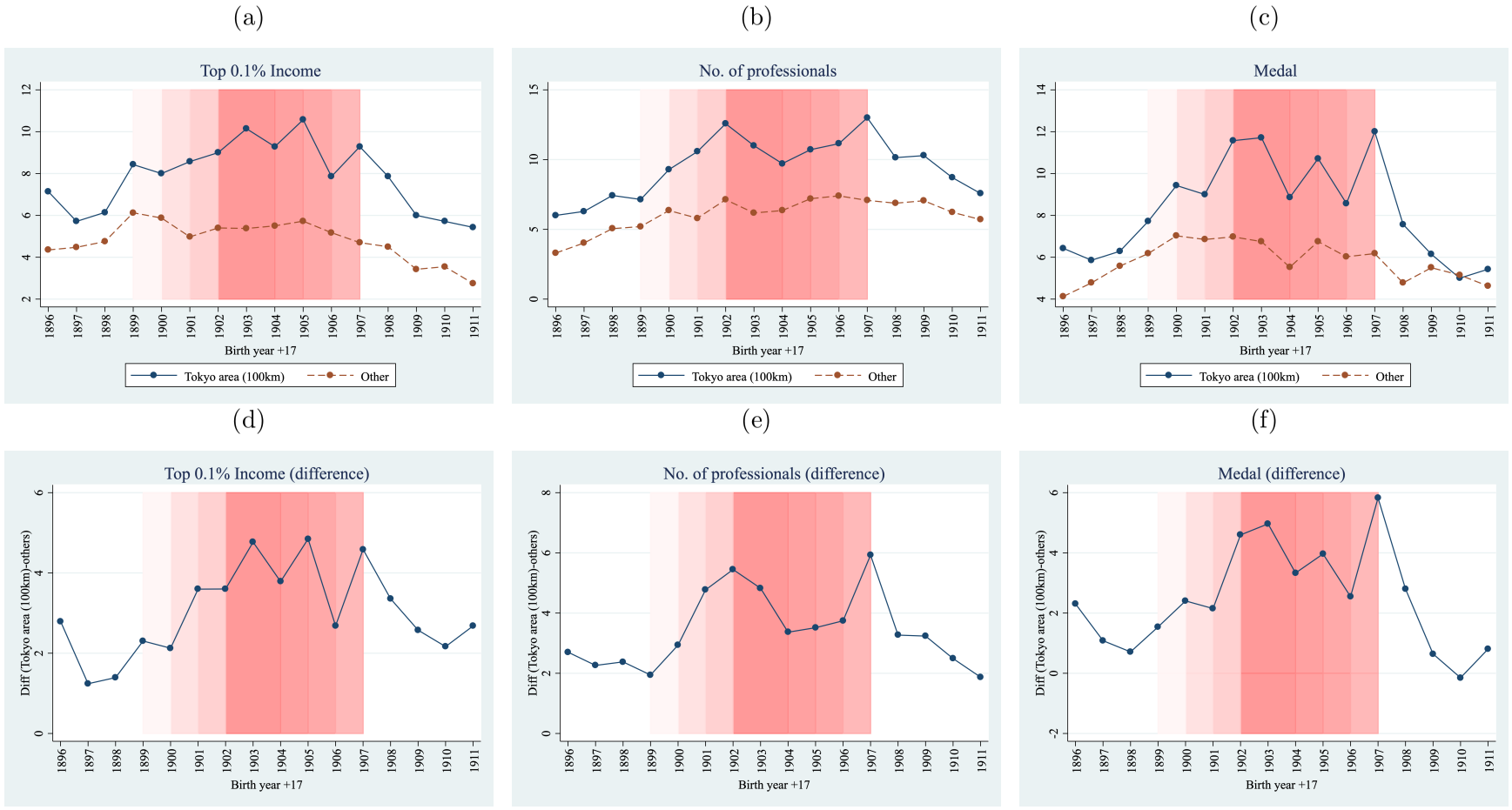
Notes: This table uses the prefecture-year level data in 1900-1930. In column (1), the dependent variable is the number of students from birth prefecture i who entered one of Schools 1-8 in year t. In columns (2)–(10), the dependent variable is the number of students from birth prefecture i who entered the school indicated in the column in year t. For Schools 7 and 8, we drop the years in which they held an early exam (School 7 in 1908-1910 and School 8 in 1908). We control for prefecture fixed effects, year fixed effects, the lagged number of public and private middle school graduates in the prefecture and the number of high schools other than Schools 1-8 in the prefecture. "Born in the school's prefecture" takes 1 if the school indicated in the column is located in the entrant's birth prefecture. "D to school's prefecture (1-100km)" takes 1 if the school indicated in the column is not located in, but within 100 km from the entrant's birth prefecture. "D to school's prefecture (100-300km)" takes 1 if the school indicated in the column is between 100 km and 300 km from the entrant's birth prefecture. "Mean dep var" shows the mean of the dependent variable during decentralization for all prefecture-year observations. "Mean dep var (Tokyo pref dur. Dapp)" shows the mean of the dependent variable whose birth prefecture is Tokyo during decentralization. "Mean dep var (within 1-100km dur. Dapp)" shows the mean of the dependent variable whose birth prefecture is within 100km from Tokyo excluding Tokyo prefecture. Standard errors are clustered at the prefecture level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 5.3 for discussions about this figure.

Figure 6: Validity of Long-run Outcome Data: Differences-in-Differences



Notes: This figure shows differences-in-differences plots that compare the number of Imperial University graduates born in "urban" and "rural" areas by cohorts. The plots are based on the prefecture-cohort level data compiled from the Japanese Personnel Inquiry Records (JPIR) in 1939, which includes cohorts who were born in 1879-1894 and became age 17 in 1896-1911. The y axis shows the number of individuals listed in the JPIR who were born in the indicated area in the indicated cohort whose final education was one of the Imperial Universities. The cohorts are colored according to their intensity of exposure to the first period of Capp (centralized admission system) in 1902–1907, where the darker color indicates the higher intensity of exposure. The intensity gradually increases from the cohort who turned age 17 in 1899 as some unsuccessful applicants might have retaken the exam in 1902 under Capp. The intensity reaches 100% for the cohorts who turned age 17 during 1902–1904 and declines moderately from the cohort who turned age 17 in 1904 as some might have retaken the exam in 1908 under Dapp. The intensity drops to 0% for the cohort who turned age 17 in 1908 as they had no opportunity to take the exam under Capp. Panels (a) and (c) define "urban" area as the Tokyo area, while panels (b) and (d) define "urban" area as a set of prefectures that experienced a net increase in the number of entrants to Schools 1-8 during the first period of Capp in 1902-1907.
See Section 6 for discussions about this figure.

Figure 7: Long-run Impacts of Centralization: Differences-in-Differences



Notes: This figure shows differences-in-differences plots that compare the number of elites born inside and outside the Tokyo area by cohorts. The plots are based on the prefecture-cohort level data compiled from the Japanese Personnel Inquiry Records (JPIR) in 1939, which includes cohorts who were born in 1879-1894 and became age 17 in 1896-1911. The cohorts are colored according to their intensity of exposure to the first period of Capp (centralized admission system) in 1902–1907, where the darker color indicates the higher intensity of exposure. In (a) and (d), "Top 0.1% income earners" are defined as individuals listed in the JPIR with more than 15,000 yen of taxable income. In (b) and (e), "Professionals" is defined as individuals listed in the JPIR whose occupation is either physician, engineer, lawyer, or scholar. In (c) and (f), "Medal recipients" is defined as individuals listed in the JPIR who received a decoration of the Order of the Fifth Class or above, excluding military personnels. The y axis shows the number of individuals in each of the above categories of elites who were born in the indicated area in the indicated cohort. See Section 6 for discussions about this figure.

Table 4: Long-run Impacts of Centralization: Differences-in-Differences Estimates

VARIABLES	(1) Imperial University	(2) Top 0.1% income earners	(3) Top 0.01% income earners	(4) Managers	(5) Professionals	(6) Professors at Imperial Universities	(7) Medal recipients
(Panel A)							
Age 17 during Centralization ×	3.18**	1.66*	0.43**	4.25**	1.67**	0.44**	2.87***
Tokyo area (<100km)	(1.39)	(0.87)	(0.18)	(2.02)	(0.79)	(0.18)	(1.06)
Observations	705	705	705	705	705	705	705
Mean dep var	8.774	5.274	0.963	13.25	6.756	0.810	6.279
Mean dep var (Tokyo area during Dapp)	10.62	6.873	1.159	19.76	8.603	1	6.937
(Panel B)							
Age≤17 in 1902 ×	3.34	1.91**	0.65***	4.95*	1.61	0.36*	2.63**
Tokyo area (<100km)	(2.22)	(0.74)	(0.24)	(2.48)	(1.34)	(0.20)	(1.03)
Age≤17 in 1908 ×	-2.97***	-1.35	-0.16	-3.37**	-1.75**	-0.54**	-3.18***
Tokyo area (<100km)	(0.70)	(1.11)	(0.25)	(1.50)	(0.69)	(0.21)	(1.17)
Observations	705	705	705	705	705	705	705
(Panel C)							
Age 17 during centralization ×	2.43**	1.30**	0.44***	2.77*	1.56***	0.29*	2.08**
Area where entrants increased	(0.99)	(0.63)	(0.13)	(1.52)	(0.57)	(0.15)	(0.82)
Observations	705	705	705	705	705	705	705
Mean dep var	8.774	5.274	0.963	13.25	6.756	0.810	6.279
Mean dep var (Area entrants increased during Dapp)	9.707	5.182	0.859	14.92	7.586	0.919	6.657
(Panel D)							
Age≤17 in 1902 ×	2.25	1.54***	0.54***	3.21*	1.32	0.17	1.47
Area where entrants increased	(1.52)	(0.54)	(0.18)	(1.83)	(0.93)	(0.18)	(0.88)
Age≤17 in 1908 ×	-2.67***	-1.00	-0.30	-2.23*	-1.85***	-0.45**	-2.85***
Area where entrants increased	(0.59)	(0.85)	(0.21)	(1.24)	(0.52)	(0.18)	(0.82)
Observations	705	705	705	705	705	705	705

Notes: This table shows differences-in-differences estimates of the long-run effects of the centralized admission system. The estimates are based on the prefecture-cohort level data compiled from the Japanese Personnel Inquiry Records (JPIR) in 1939, which includes cohorts who were born in 1880-1894 and became age 17 in 1897-1911. All regressions control for prefecture fixed effects and cohort fixed effects. All outcome variables below are measured at the prefecture-cohort level. In (1), "Imperial University graduates" is defined as the number of individuals listed in the JPIR whose final education is one of the Imperial Universities. In (2) and (3), "Top 0.1% income earners" (or "Top 0.01% income earners") is defined as the number of individuals listed in the JPIR with taxable income above 15,000 yen (or above 50,000 yen) which corresponds to the top 0.06% (or top 0.01%) of the national income distribution. In (4), "Managers" is defined as the number of individuals listed in the JPIR who is employed in a private sector and pays any positive amount of income tax or corporate tax. In (5), "Professionals" is defined as the number of individuals listed in the JPIR whose occupation is either scholar, physician, lawyer, or engineer. In (6), "Imperial University professors" is defined as the number of individuals listed in the JPIR who are a professor or associate professor at one of the Imperial Universities. In (7), "Medal Recipients" is the number of individuals listed in the JPIR who received a decoration of the Order of the Fifth Class or above, but excluding military personnels. "Age 17 during Centralization" is the indicator variable that takes 1 if the cohort became age 17 during Capp in 1902-1907. "Age≤17 in 1902" is the indicator variable that takes 1 if the cohort became age 17 in 1902 or later. "Age≤17 in 1908" is the indicator variable that takes 1 if the cohort became age 17 in 1908 or later. "Mean dep var" shows the mean of the dependent variable for all prefecture-cohort observations. "Mean dep var (Tokyo area or Area entrants increased during Dapp)" shows the mean of the dependent variable in the Tokyo area or the area where entrants to Schools 1-8 increased during decentralization. Standard errors are clustered at the prefecture level. See Section 6 for discussions about this table.

Table 5: Long–run Impacts of Centralization: Pathways and Placebo Tests

VARIABLES	(1) Pathway Fraction moved	(2) Pathway Distance moved	(3) Pathway Imperial Univ. divided by the school entrants	(4) Placebo Landlords officers	(5) Placebo Population
Age 17 during Centralization × Tokyo area (<100km)	-0.013	-4.810	-0.02	0.165	0.624
	(0.016)	(6.622)	(0.02)	(0.289)	(0.435)
Observations	705	705	703	705	657
Cohort FE	YES	YES	YES	YES	YES
Pref FE	YES	YES	YES	YES	YES
Mean dep var	0.233	89.73	0.26	1.179	11.55
Mean dep var (Tokyo area during Dapp)	0.241	24.07	0.22	3.286	12.69
Age 17 during Centralization × Area where entrants increased	0.005	-4.092	-0.03	-0.060	-0.227
	(0.014)	(7.136)	(0.02)	(0.219)	(0.714)
Observations	705	705	703	705	657
Cohort FE	YES	YES	YES	YES	YES
Pref FE	YES	YES	YES	YES	YES
Mean dep var	0.233	89.73	0.26	1.179	11.55
Mean dep var (Area entrants increased during Dapp)	0.229	42.06	0.22	2.212	13.69

Notes: This table shows differences-in-differences estimates to explore pathways of the long-run effects and to provide placebo tests. The estimates are based on the prefecture-cohort level data compiled from the Japanese Personnel Inquiry Records (JPIR) in 1939, which includes cohorts who were born in 1880-1894 and became age 17 in 1897-1911. All outcome variables below are measured at the prefecture-cohort level. In (1), "Fraction moved" is defined as the fraction of individuals listed in the JPIR whose residing prefecture is different from his birth prefecture. In (2), "Distance moved" is defined as the average distance between the birth prefecture and the residing prefecture of individuals listed in the JPIR. In (3), "Imperial University graduates divided by School Entrants" is defined by the number of Imperial University graduates listed in the JPIR (as defined earlier) divided by the total number of entrants to Higher Schools in the year when the cohort became age 17. This variable is a measure for the quality of higher school entrants. In (4), "Landlords" is defined as the number of individuals listed in the JPIR whose occupational titles include landlord, but excluding managers and professionals (as defined earlier). In (5), "Population" is the cohort's birth population in a given prefecture. "Age 17 during Centralization" is the indicator variable that takes 1 if the cohort became age 17 during Capp in 1902-1907. "Mean dep var" shows the mean of the dependent variable for all prefecture-cohort observations. "Mean dep var (Tokyo area or Area entrants increased during Dapp)" shows the mean of the dependent variable in the Tokyo area or the area where entrants to Schools 1-8 increased during decentralization. Standard errors are clustered at the prefecture level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 6 for discussions about this figure.

A Appendix

Table A.1: College Admissions around the World Today: Details

College Admission System Around the World

Country	System	Source
Afghanistan	Semi-Centralized	"Higher Education in Afghanistan", https://www.baag.org.uk/sites/www.baag.org.uk/files/resources/attachments/WB%20Afghan%20Higher%20Education%202013.pdf "Higher Education in Afghanistan", https://www.engineering.sk/english/2745-higher-education-in-afghanistan
Albania	Not Centralized	"Overview of the Higher Education System Albania", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_albania_2017.pdf "Education and diplomas Albania", https://www.nuffic.nl/en/subjects/education-and-diplomas-albania/ "Admission Requirements for Higher Education Institutions in Albania", http://www.albaniaeducation.info/Admission-Requirements/Admission-Requirements-for-Higher-Education.html
Algeria	Centralized	"Overview of the Higher Education System Algeria", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_algeria_2018.pdf
Angola	Not Centralized	"Higher education in Angola", https://www.justlanded.com/english/Angola/Angola-Guide/Education/Higher-education-in-Angola
Argentina	Not Centralized	"Study in Argentina", http://www.universia.es/estudiar-extranjero/argentina/sistema-educativo/proceso-admision/2648 "Guía práctica para los ingresantes a la UBA", http://www.uba.ar/archivos_generales/ingresantesUBA.pdf
Armenia	Exams Centralized	"Education for All 2015 National Review: Armenia", http://unesdoc.unesco.org/images/0022/002299/229906E.pdf "Improving Armenia's Unified Entrance Exam with Computer-Based Testing", http://www.worldbank.org/en/news/feature/2018/03/27/improving-armenias-unified-entrance-exam-with-computer-based-testing "Improving Education Quality through Stronger Student Assessment Systems Republic of Armenia", http://www.worldbank.org/content/dam/Worldbank/Event/education/Armenia%20Presentation%20with%20Note.pdf
Austria	Not Centralized	"Admission in Austria", https://studyinaustria.at/en/study/admission/
Australia	Semi-Centralized	"Tertiary education in Australia", https://en.wikipedia.org/wiki/Tertiary education in Australia "University and college admission in Australia", https://en.wikipedia.org/wiki/University and college admission#Australia "Australian Tertiary Admission Rank", https://en.wikipedia.org/wiki/Australian Tertiary Admission Rank "University of Sydney Admission Process", https://sydney.edu.au/study/admissions/apply/how-to-apply.html
Azerbaijani	Centralized	"Overview of the Higher Education System Azerbaijan", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiches_azerbaijan_2017.pdf "Education, Health, and Welfare", http://countrystudies.us/azerbaijan/23.htm
Bangladesh	Not Centralized	"Bangladesh University Admission Process", http://www.bu.edu.bd/admission/admission-requirements/ "University of Rajshahi", http://admission.ru.ac.bd/undergraduate/
Belarus	Not Centralized	"Admission Requirements for Higher Education Institutions in Belarus", http://www.belaruseducation.info/Admission-Requirements/Admission-Requirements-for-Belarus-Higher-Education-Institutions.html
Belgium	Not Centralized	"Higher Education in Belgium", http://www.matching-in-practice.eu/higher-education-in-belgium/
Belize	Exams Centralized	Each institution's admission process. "University of Belize Admission Process", https://www.ub.edu.bz/admissions/apply-now/ "Galen Univeristy Admission Process", http://www.galen.edu.bz/undergraduateadmins
Benin	Not Centralized	"World Higher Education Database (WHED), Benin - Education system", http://webcache.googleusercontent.com/search?q=cache:15KZgcCvJxIJ:catalog.ihsn.org/index.php/catalog/70/download/28555+&cd=9&hl=en&ct=clnk&gl=us
Bolivia	Not Centralized	Each institution's admission process. "Universidad Católica Boliviana Admission Process", http://www.ucbscz.edu.bo/es/Requisitos-Inscripcion-Estudiantes-Nuevos "Universidad Mayor de San Simón Admission Process", http://www.umss.edu.bo/index.php/facultad-de-ciencias-juridicas-y-politicas-examen-de-ingreso-2018/
Bosnia and Herzegovina	Not Centralized	"Overview of the Higher Education System Bosnia and Herzegovina", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_bosniaherzegovina_2017.pdf
Botswana	Not Centralized	Each institution's admission process. "University of Botswana Admission Process", https://www.ub.bw/admissions/apply-to-study
Brazil	Semi-Centralized	"Plazo para confirmar inscripción de liceales", https://www.elpais.com.uy/informacion/plazo-confirmar-inscripcion-liceales.html "Oficina Reguladora De La Inscripcion Liceal", http://www.ces.edu.uy/ces/images/stories/2014/aaaaa_dic/reguladora/Fechas_destino_alumnos_diciembre_2014.pdf "Consejo de Educacion Secundaria", http://www.ces.edu.uy/files/EXP_5847_2_2017.pdf
Bulgaria	Not Centralized	"Bulgaria Higher Education System", http://www.euroeducation.net/prof/bulgaco.htm

Country	System	Source
Burma	Exams Centralized	"New admissions process to start at 11 universities", https://www.mmtimes.com/news/new-admissions-process-start-11-universities.html
Cambodia	Not Centralized	Each institution's admission process. "Zaman University Admission Process", https://www.zamanu.edu.kh/node/77/
Cameroon	Not Centralized	"Education System Cameroon", https://www.nuffic.nl/en/publications/education-system-cameroon/ "University of Buea Admission Process", http://www.ubuea.cm/admission-2016-open/
Canada	Not Centralized	"University and college admission", https://en.wikipedia.org/wiki/University_and_college_admission#Canada
Central African Republic	Not Centralized	Each institution's admission process.
Chad	Not Centralized	Each institution's admission process.
Chile	Semi-Centralized	"Endogenous Market Formation: Theory and Evidence from Chilean College Admissions", link here: http://econweb.umd.edu/~espinoza/espinoza_lee_lopez_2016.pdf
China	Exams Centralized	"Chinese College Admissions and School Choice Reforms: Theory and Experiments", http://yanchen.people.si.umich.edu/papers/Chen_Kesten_2014_01.pdf "National college entrance examinations: The dynamics of political centralism in China's elite education", https://www.jstor.org/stable/42743977 "National Higher Education Entrance Examina", https://en.wikipedia.org/wiki/National_Higher_Education_Entrance_Examination
Colombia	Exams Centralized	"Study in Colombia Admission Process", http://www.universia.es/estudiar-extranjero/colombia/sistema-educativo/proceso-admision/3078 "ICFES Examination", https://en.wikipedia.org/wiki/ICFES_Examination
Congo	Not Centralized	Each institution's admission process. "University of Goma Admission Process", http://unigom.org/inscriptions/comment-sinscrire/
Costa Rica	Not Centralized	"Centralized Assignment of Students to Majors: Evidence from the University of Costa Rica", https://kwet.ku.edu/sites/kwet.ku.edu/files/files/paper_Hernandez.pdf "Proceso de Inscripcion a las Universidades Estatales", http://163.178.170.40/SAU/menuPortada/FOLLETO%20INSCRIPCION%202018-2019-ANEXOS.pdf "National University of Costa Rica Admisson Process", http://www.registro.una.ac.cr/index.php?option=com_content&view=article&id=242&Itemid=796 "University of Costa Rica Admission Process", http://ori.ucr.ac.cr/web_adm/instruc/2018-2019/folleto05-18.pdf
Côte d'Ivoire	Not Centralized	"Education Systems in Africa Part XIV: Cote d'Ivoire", http://aevaluators.com/blog/education-systems-africa-part-xiv-cote-d%E2%80%99ivoire
Croatia	Centralized	"Croatia: How to apply", http://www.studyincroatia.hr/studying-in-croatia/admissions-and-enrolment/how-to-apply-undergraduate-studies
Cuba	Exams Centralized	"A Look at Cuba's Education System", https://learningfirst.org/blog/look-cubas-education-system-high-literacy-rates-free-college-come-price Each institution's admission process. "Universities in Cuba", https://es.wikipedia.org/wiki/Categor%C3%ADa:Universidades_de_Cuba
Czech Republic	Not Centralized	Each university's admission page.
Denmark	Centralized	"Den Koordinerede Tilmelding", https://ufm.dk/uddannelse/videregaende-uddannelse/sogning-optag-og-vejledning/kot
Dominican Republic	Not Centralized	"Autonomous University of Santo Domingo Admission Process", https://uasd.edu.do/files/ADMISIONES/descargables/Requisitos_de_admisiones_Dominicanos_18917.pdf "Universidad Iberoamericana Admission Process", https://admisiones.unibe.edu.do/Ayuda/Proceso_Admision
DR Congo	No Info	"Democratic Congo - Higher Education", http://education.stateuniversity.com/pages/363/Democratic-Congo-HIGHER-EDUCATION.html
Ecuador	Exams Centralized	Each university's admission page. "Pontificia Universidad Católica del Ecuador Admission Process" https://www.puce.edu.ec/admisiones_GP.php "Universidad Andina Simón Bolívar Admission Process" http://www.uasb.edu.ec/proceso-de-admision
Egypt	Semi-Centralized	"Admission Requirements for Higher Education Studies in Egypt", http://www.egypteducation.info/Admission-Requirements/Admission-Requirements.html "Overview of the Higher Education System Egypt", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiches_egypt_2017.pdf
El Salvador	Not Centralized	Each university's admission page. "Don Bosco University Admisison Process", http://www.udb.edu.sv/udb/index.php/pagina/ver/matricula_nuevo_ingreso
Equatorial Guinea	Not Centralized	Each univesity's admission page. "National University of Equatorial Guinea Homepage", http://unge.education/main/
Eritrea	Centralized	"Educationa and diplomas Eritrea", https://www.nuffic.nl/en/subjects/education-and-diplomas-eritrea/
Estonia	Exams Centralized	"Description of Estonian Education System", https://www.hm.ee/sites/default/files/higher_education_system_2013.pdf
Ethiopia	Centralized	"Education and diplomas Ethiopia", https://www.nuffic.nl/en/subjects/education-and-diplomas-ethiopia/

Country	System	Source
Finland	Semi-Centralized	"Reformen av högskolornas gemensamma ansökan skjuts upp till hösten 2014", https://www.oph.fi/aktuellt/meddelanden/101/0/reformen_av_hogskolornas_gemensamma_ansokan_skjuts_upp_till_hosten_2014 "University of Helsinki Admission Process", https://www.helsinki.fi/en/networks/vakava/about-vakava-0
France	Centralized	"Matching in Practice", http://www.matching-in-practice.eu/university-admission-practices-france/ "Faut-il sauver les algorithmes d'affectation?", http://tnova.fr/system/contents/files/000/001/571/original/Terra_Nova_Rapport__Algorithmes_060618.pdf?1528276927
French Guinea	Not Centralized	Each institution's admission page. "University of French Guiana Homepage", https://www.univ-guyane.fr
Gabon	Not Centralized	Each Institution's admission page. http://universiteomarbongo.org/u0b/index.php/la-formation/admission-inscription http://ufgse.org/Formation/Licence1/index.asp?Page=A#Debut
Gambia	Not Centralized	"Toward an Integrated University of the Gambia", http://siteresources.worldbank.org/GAMBIAEXTN/Resources/TOWARDANINTEGRATEDUNIVERSITYOFTHEGAMBIADecember11.doc
Georgia	Exams Centralized	"Overview of the Higher Education System Georgia", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_georgia_2017.pdf
Germany	Exams Centralized	"An Analysis of the German University Admissions System", https://link.springer.com/content/pdf/10.1007%2Fs00199-012-0704-4.pdf "Matching in Practice", http://www.matching-in-practice.eu/higher-education-in-germany/
Ghana	Not Centralized	"Imperfect Information and School Choice in Ghana", http://people.bu.edu/kajayi/AjayiTelli_ImperfectInformation.pdf "University of Ghana Admission Portal", https://admission.ug.edu.gh/undergrad/login.php "How to Get Admission to Ghana Universities", https://buzzghana.com/get-admission-ghana-universities/
Gibraltar	Not Centralized	Each institution's admission page. "University of Gibraltar: How to Apply", https://www.unigib.edu.gi/how-to-apply/
Greece	Centralized	"Education and diplomas Greece", https://www.nuffic.nl/en/subjects/education-and-diplomas-greece/
Greenland	Not Centralized	Each institution's admission page. "Top Universities in Greenland", https://www.4icu.org/gl/
Guatemala	Exams Centralized	Each institution's admission page. http://registro.usac.edu.gt/formularios_rye/GUIA_INSCRIPCION2018.pd http://principal.url.edu.gt/images/recursos/pdfs/admisiones/Proceso_CCentral.pdf http://uvg.edu.gt/admisiones/index.php#proceso-de-admision
Guinea	Not Centralized	Each institution's admission page. "Kofi Annan University of Guinea", https://www.univ-kag.org/admission-formation-initiale/
Guyana	Not Centralized	Each institution's admission page. List of universities: https://en.wikipedia.org/wiki/List_of_universities_and_colleges_in_Guyana University of Guyana, https://www.uog.edu.gy/admissions Lincoln American University, https://www.laumed.org/admission.php
Haiti	Not Centralized	Each institution's admission page. "University Caraibe Admission Process", http://www.universitecaraibe.com/_UC/index.php/admission "University of Haiti Admission Process", http://www.ueh.edu.ht/etudes/index.php#
Honduras	Not Centralized	Each institution's admission page. "UNAH Admission Process", http://www.admisiones.unah.edu.hn/Inscripcion.aspx "UNICAH Admission Process", http://www.unicah.edu/procesoAdmisiones.html
Hungary	Centralized	"Higher education admissions site: Admissions procedures and deadlines", https://www.felvi.hu/felveteli/jelentkezes/mikor_es_mire/Mikor_lehet_jelentkezni "Education system Hungary", https://www.nuffic.nl/en/publications/education-system-hungary/
Iceland	Exams Centralized	"University and College Admission", https://en.wikipedia.org/wiki/University_and_college_admission#Iceland
India	Exams Centralized	"Entrace Exams", https://www.mapsofindia.com/education/exam/entrance-exams.html "Student Selection and Admission to Higher Education", https://www.jstor.org/stable/pdf/3448186.pdf?refreqid=excelsior%3A1085f679f6e08832cd96aab6bd1981c5
Indonesia	Exams Centralized	"Student Selection and Admission to Higher Education: Policies and Practices in the Asian Region", https://www.jstor.org/stable/pdf/3448186.pdf?refreqid=excelsior%3A1085f679f6e08832cd96aab6bd1981c5 "University and college admission: Indonesia", https://en.wikipedia.org/wiki/University_and_college_admission#Indonesia
Iran	Exams Centralized	"Education System in Iran", https://www.nuffic.nl/en/publications/education-system-iran/

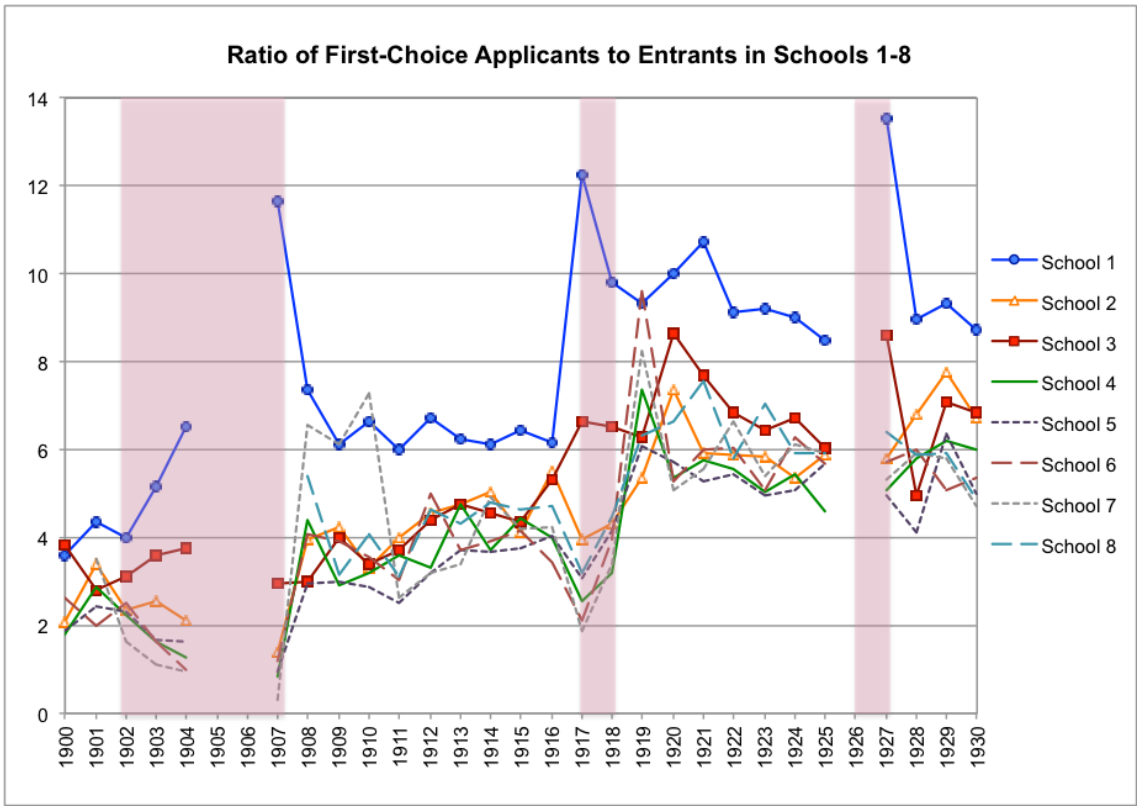
Country	System	Source
Iraq	Exams Centralized	"Education and diplomas Iraq", https://www.nuffic.nl/en/subjects/education-and-diplomas-iraq/ "Strategies of the Iraqi Ministry of Higher Education and Scientific Research", https://iraqiculture-usa.com/i/u/10090719/f/Education%20in%20Iraq/hes.pdf
Ireland	Not Centralized	"Matching in Practice", http://www.matching-in-practice.eu/higher-education-in-ireland/
Israel	Exams Centralized	Each insitution's admission page. http://info.huji.ac.il/reception-channels/ http://www.israeleducation.info/Admission-Requirements/Index.html
Italy	Exams Centralized	"Matching in Practice", http://www.matching-in-practice.eu/higher-education/
Jamaica	Not Centralized	Each institution's admission page. MICO, https://www.themico.edu.jm/how-to-apply1 Northern Caribbean University, http://www.ncu.edu.jm/requeriments.html University of Technology, Jamaica, http://www.utech.edu.jm/admissions/how-to-apply/undergraduate-prospective-students/undergraduate
Japan	Exams Centralized	Yeon-Koo Che and Youngwoo Koh, "Decentralized College Admissions," Journal of Political Economy, 2016, 124 (5), 1295–1338. http://www.columbia.edu/~yc2271/files/papers/Che-Koh-Final.pdf
Jordan	Semi-Centralized	"Country Profile Jordan", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiches_jordan_2017.pdf
Kazakhstan	Exams Centralized	"Developments in Central Asian Higher Education", https://wenr.wes.org/2007/06/wenr-june-2007-feature "Country Profile", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_kazakhstan_2017.pdf
Kenya	Semi-Centralized	"What is KUCCPS and what can it do for you?", http://blog.educartis.co.ke/what-is-kuccps-and-what-it-can-do-it-for-you/ "Kenya Universties and Colleges Central Placement Service", https://www.kuccps.net/
Korea	Exams Centralized	"College Admissions as Non-Price Competition: The Case of South Korea", http://www.nber.org/papers/w20774 "Historical analysis of the policy on the college entrance system in South Korea", https://files.eric.ed.gov/fulltext/EJ1068660.pdf
Kosovo	Exams Centralized	"Country Profile Kosovo", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_kosovo_2017.pdf
Kyrgyzstan	Exams Centralized	"Developments in Central Asian Higher Education", https://wenr.wes.org/2007/06/wenr-june-2007-feature
Laos	Exams Centralized	"The Higher Education in Lao PDR and Roles of International Cooperation for Its University Development", https://www2.gsid.nagoya-u.ac.jp/blog/anda/files/2010/06/19_bounheng-siharath.pdf "Laos Higher Education System", http://www.headfoundation.org/featuredresearch/Final%20-%20Laos%20PB.pdf
Latvia	Not Centralized	Each institution's admission page. https://www.lu.lv/gribustudet/uznemsanas-kartiba/pamatstudijas/ http://www.studyinlatvia.eu/en/how-to-apply/admission-at-universities
Lechtenstein	Not Centralized	"Admission Requirements fo Liechtenstein Higher Education Institutions", http://www.liechtensteineducation.info/Admission-Requirements/Admission-Requirements-for-Liechtenstein-Higher-Education-Institutions.html
Liberia	Exams Centralized	"Every Single Applicant Fails University of Liberias Entrance Exam", http://newsfeed.time.com/2013/08/27/every-single-applicant-fails-university-of-liberias-entrance-exam/
Libya	Not Centralized	"Education in Libya", https://wenr.wes.org/2004/07/wenr-julyaugust-2004-education-in-libya
Lithuania	Not Centralized	"Higher Education Funding", https://eacea.ec.europa.eu/national-policies/eurydice/content/higher-education-funding-44_sl "Admission Requirements for Higher Education", http://www.lithuaniaeducation.info/Admission-Requirements/Admission-Requirements-for-Higher-Education.html
Luxembourg	Not Centralized	"Education in Luxembourg", https://en.wikipedia.org/wiki/Education_in_Luxembourg
Macedonia	Exams Centralized	Each institution's admission page. https://www.anadolu.edu.tr/acikogretim/nasil-ogrenci-olabilirim/yeni-kayit http://education.stateuniversity.com/pages/896/Macedonia-HIGHER-EDUCATION.html
Madagascar	Exams Centralized	Each institution's admission page.
Malawi	Semi-Centralized	Each institution's admission page. "Malawi Adventist University", http://mchsmau.ac.mw/?q=node/26
Malaysia	Semi-Centralized	"Education and diplomas Malaysia", https://www.nuffic.nl/en/subjects/education-and-diplomas-malaysia/
Malta	Exams Centralized	"Short Cycle Higher Education", https://eacea.ec.europa.eu/national-policies/eurydice/content/short-cycle-higher-education-49_en
Mauritania	Exams Centralized	Each institution's admission page.
Mexico	Not Centralized	Each institution's admission page.
Moldova	Not Centralized	"Country Profile, Moldova", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiches_moldova_2017.pdf

Country	System	Source
Mongolia	Exams Centralized	"Secondary Education", http://uis.unesco.org/sites/default/files/documents/secondary-education-regional-information-base-country-profile-for-mongolia-en.pdf
Montenegro	Exams Centralized	"Admission Requrements for Higher Education Institutions", http://www.montenegroeducation.info/Admission-Requirements/Admission-Requirements-for-Higher-Education-Institutions.html
Morocco	Exams Centralized	"Education System Morocco", https://www.nuffic.nl/en/publications/education-system-morocco/
Mozambique	Not Centralized	"The Educational System of Mozambique", https://photos.state.gov/libraries/mozambique/164103/nguluvep/Edusys.pdf
Namibia	Exams Centralized	Each institution's admission page. http://www.unam.edu.na/apply-to-unam/undergraduate-admission-requirements http://www.nust.na/?q=study-nust/admission/admission-requirements
Nepal	Exams Centralized	"Education in Nepal", https://wenr.wes.org/2018/04/education-in-nepal
New Zealand	Exams Centralized	Each institution's admission page.
Nicaragua	Exams Centralized	Each institution's admission page. https://portalestudiantes.unanleon.edu.ni/prematricula/informacion.php http://www.uca.edu.ni/images/pregrado/pdf/admision-nacional-nacional.pdf
Niger	Exams Centralized	Each institution's admission page. "University of Agadez Admissions Page", http://www.univ-agadez.edu.ne/index.php/l-universite/admission
Nigeria	Semi-Centralized	"University and College Admission", https://en.wikipedia.org/wiki/University_and_college_admission
Norway	Centralized	"Field of Study, Earnings, and Self-Selection", https://academic.oup.com/qje/article/131/3/1057/2461218 "University of Oslo Website", http://www.usit.uio.no/om/it-historien/studenter/so.html
Oman	Semi-Centralized	"Central Admission System", http://www.oman.om/wps/wcm/connect/en/site/home/gov/gov1/gov5governmentorganizations/mohe/moheheac "Higher Education Admissions Center", http://www.heac.gov.om/media/doc/EnglishIQ_Student_GB_2018-2019.pdf "Admission Systems", http://heac.gov.om/ "Unified admission for higher education", https://gulfnews.com/news/gulf/oman/unified-admission-for-higher-education-1.308926
Pakistan	Exams Centralized	"Management of higher education reforms in Pakistan", https://dspace.library.uu.nl/bitstream/handle/1874/29330/jahangir.pdf?sequence=1
Palestine	Exams Centralized	"The Higher Education System in Palestine", http://www.reconow.eu/files/fileusers/5140_National-Report-Palestine-RecoNOW.pdf
Panama	Exams Centralized	Each institution's admission page. http://www.up.ac.pa/ftp/2010/principal/imagenes/varias/AficheAdmision.jpg http://www.utp.ac.pa/proceso-de-admision-para-las-carreras-de-pregrado
Papua New Guinea	Centralized	"Online Grade 12 School Leavers Forms Now Available", https://edu.pngfacts.com/education-news/online-grade-12-school-leavers-forms-now-available
Paraguay	Exams Centralized	Each institution's admission page. Universidad American, https://www.americana.edu.py/content/admisiones-carreras-de-grado Universidad Católica, https://www.universidadcatolica.edu.py/admision-2/
Peru	Not Centralized	Each institution's admission page. Universidad de Lima, http://www.ulima.edu.pe/admision/examen-de-admision PUCP, http://www.pucp.edu.pe/admision/pregrado/modalidades-de-admision/
Poland	Exams Centralized	Each institution's admission page. "University Admission Requirements", http://www.go-poland.pl/admission-requirements
Portugal	Centralized	"University and College Admission", https://en.wikipedia.org/wiki/University_and_college_admission
Puerto Rico	Exams Centralized	Each institution's admission page. "Universidad de Puerto Rico", http://www.upr.edu/wp-content/uploads/2017/12/Manual-de-Admisiones-UPR-2018.pdf "Pontificia Universidad Católica de Puerto Rico", https://www.pucpr.edu/admisiones/requisitos-admisiones/subgraduados-requisitos/ "Universidad Interamericana de Puerto Rico", http://www.inter.edu/admisiones-2/
Qatar	Not Centralized	Each institution's admission page. "Qatar University Admission Page", http://www.qu.edu.qa/students/admission/undergraduate/admission-requirements/high-school-applicants
Romania	Exams Centralized	"The Romanian Educational System", http://www.fulbright.ro/educational-advising-center/experience-romania/the-romanian-educational-system "Computerized Admission", http://www.siveco.ro/en/about-siveco-romania/press/press-releases/computerized-admission-high-schools-and-vocational-schools-provided-transparency-objectivity-and
Russia	Exams Centralized	"University and College Admission", https://en.wikipedia.org/wiki/University_and_college_admission

Country	System	Source
Saudi Araibia	Exams Centralized	"Managing Admission in Saudi Universities: A System Approach", http://www.ijiet.org/vol6/706-E004.pdf "Admission Requirement for Higher Education in Saudi Arabia", http://www.saudiarabiaeducation.info/Admission-Requirements/Admission-Requirements-for-Higher-Education.html
Senegal	Exams Centralized	Each institution's admission page.
Serbia	Not Centralized	"Admission Requirements for Higher Education in Serbia", http://www.serbiaeducation.info/Admission-Requirements/Admission-Requirements-for-Higher-Education.html
Sierra Leone	Exams Centralized	Sierra Leone - Higher and Tertiary Education Sector Policy Note ", http://documents.worldbank.org/curated/en/857591468302730070/Sierra-Leone-Higher-and-tertiary-education-sector-policy-note
Singapore	Exams Centralized	"Student Selection and Admission to Higher Education", https://link.springer.com/article/10.1007/BF01432073
Slovakia	Not Centralized	Each institution's admission page. "Universities in Slovakia", http://office.studyin.sk/universities/
Slovenia	Exams Centralized	"Admission Requirements for Higher Education", http://www.sloveniaeducation.info/Admission-Requirements/Admission-Requirements-for-Higher-Education.html
Somalia	Exams Centralized	Each institution's admission page. "Kismayo University: Admissions Process", http://www.ku.edu.so/Detail?url=Application%20Process "Simad Univesity", https://simad.edu.so/admission-simad-university/
South Africa	Exams Centralized	"Higher Education Admission Requiements", http://www.southafricaeducation.info/Admission-Requirements/Admission-Requirements-Higher-Education.html "Education and diplomas South Africa", https://www.nuffic.nl/en/subjects/education-and-diplomas-south-africa/
South Korea	Exams Centralized	"College Admissions as Non-Price Competition: The Case of South Korea", http://www.nber.org/papers/w20774 "Historical analysis of the policy on the college entrance system in South Korea", https://files.eric.ed.gov/fulltext/EJ1068660.pdf
South Sudan	Semi-Centralized	"More Than 5,000 Students Admitted To Public Universities In South Sudan", http://www.gurtong.net/ECM/Editorial/tabid/124/ctl/ArticleView/mid/519/articleId/16269/More-Than-5000-Students-Admitted-To-Public-Universities-In-South-Sudan.aspx
Spain	Semi-Centralized	"College admissions with stable score-limits", https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=GAMES2012&paper_id=340 "Spanish Universities and Thier Origins", http://www.guninetwork.org/articles/history-spanish-universities-their-origins-12th-century "Matching Practices in Spain", http://www.matching-in-practice.eu/matching-practices-for-elementary-and-secondary-schools-spain/#5
Sri Lanka	Semi-Centralized	"Education in Sri Lanka", https://wenr.wes.org/2017/08/education-in-sri-lanka
Sudan	Exams Centralized	Each institution's admission page.
Suriname	Exams Centralized	Each institution's admission page. "Anton de Kom Universiteit van Suriname Admission requirement page" : http://www.uvs.edu/studie/algemene-info/toelating-en-inschrijving/
Sweden	Centralized	"En introduktion till den svenska högskolan", http://www.uka.se/download/18.12f25798156a345894e4af1/1487841869103/introduktion-arsrapport-2015.pdf "Swedish Council for Higher Education Website", https://www.uhr.se
Switzerland	Exams Centralized	"University and College Admission", https://en.wikipedia.org/wiki/University_and_college_admission
Syria	Semi-Centralized	"Higher education in Syria", http://supporthere.org/page/higher-education-syria "Overview of the Higher Education System Syria", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiches_syria_2017.pdf "Understanding the Syrian Educational System in a Context of Crisis", https://www.oeaw.ac.at/fileadmin/subsites/Institute/VID/PDF/Publications/Working_Papers/WP2016_09.pdf
Taiwan	Exams Centralized	"New Admission Criteria for Higher Education", https://english.moe.gov.tw/cp-48-17303-93FB6-1.html
Tajikistan	Centralized	"Overview of the Higher Education System Tajikistan", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_tajikistan._2017pdf.pdf "Assessmet of Higher Education Tajikistan", https://www.adb.org/sites/default/files/institutional-document/175952/higher-education-taj.pdf
Tanzania	Exams Centralized	"Education and diplomas Tanzania", https://www.nuffic.nl/en/subjects/education-and-diplomas-tanzania/ "Undergraduate Students Admission Guidebook for Higher Education Institutions in Tanzania", http://www.tcu.go.tz/images/documents/Undegraduate_AdmissionGuideBook_2015_2016_Final.pdf
Thailand	Semi-Centralized	"Education in Thailand", https://wenr.wes.org/2018/02/education-in-thailand-2 "Student selection and admission to higher education", https://link.springer.com/article/10.1007/BF01432073
The Netherlands	Exams Centralized	"What grades do you need to get into a Dutch university?", https://www.studyinholland.co.uk/admissions_information.html
The Philippines	Not Centralized	"Student Selection and Admission to Higher Education", https://www.jstor.org/stable/pdf/3448186.pdf?refreqid=excelsior%3A1085f679f6e08832cd96aab6bd1981c5

Country	System	Source
Togo	Exams Centralized	Each institution's admission page. "Université des Sciences et Technologies du Togo Admission Page", http://rusta-usttg.org/inscription.html
Trinidad and Tobago	Exams Centralized	"Trinidad and Tobago's education system is multi-faceted and well funded", https://oxfordbusinessgroup.com/overview/trinidad-and-tobagos-education-system-multi-faceted-and-well-funded "Trinidad and Tobago: Education Reform and Societal Mobilization", http://www.coha.org/trinidad-and-tobago-education-reform-and-societal-mobilization/ "Educational System of Trinidad and Tobago", https://photos.state.gov/libraries/port-of-spain/223843/PDFs/EDUCATIONAL%20SYSTEM%20T_amp_T%202011.pdf
Turkey	Centralized	"The University Entrance Exam in Turkey", https://ac.els-cdn.com/0191491X9600020X/1-s2.0-0191491X9600020X-main.pdf?_tid=9c107890-7161-43d7-82c6-bf79fd8b7ed9&acdnat=1528333168_4c7acdb9995839c7f290cba8d4babee3 "A Tale of Two Mechanisms: Student Placement", https://ac.els-cdn.com/S0022053198924693/1-s2.0-S0022053198924693-main.pdf?_tid=2814c837-1087-45d4-83ca-b3a1ded6b25&acdnat=1528334822_cc8a698544f7dc7c63e584fbd6552086 "Anadolu University info package", http://abp.anadolu.edu.tr/en/kurumsal/genelKabul
Turkmenistan	Centralized	"Overview of the Higher Education System Turkmenistan", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_turkmenistan_2017.pdf
Turnisia	Centralized	"Overview of the Higher Education System Tunisia", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiches_tunisia_2017.pdf "Admission Requirements for Higher Education Institutions in Tunisia", http://www.tunisiaeducation.info/Admission-Requirements/Admission-Requirements-for-Higher-Education.html
Uganda	Exams Centralized	"Uganda - Higher Education", http://education.stateuniversity.com/pages/1588/Uganda-HIGHER-EDUCATION.html
UK	Semi-Centralized	"Matching in Practice", http://www.matching-in-practice.eu/higher-education/
Ukraine	Semi-Centralized	"Matching in Practice", http://www.matching-in-practice.eu/higher-education/
United Arab Emirates	Semi-Centralized	Each institution's admission page. "UAEU Admission Process", https://www.uaeu.ac.ae/en/admission/children_of_national_mothers.shtml
United States	Exams Centralized	Yeon-Koo Che and Youngwoo Koh, "Decentralized College Admissions," Journal of Political Economy, 2016, 124 (5), 1295–1338.
Uruguay	Not Centralized	Each institution's admission page. "Universidad Católica del Uruguay", https://carreras.ucu.edu.uy/index.php/admision "Universidad de Montevideo", http://www.um.edu.uy/admisiones/proceso-grado/ "Universidad ORT", https://www.ort.edu.uy/admisiones
Uzbekistan	Centralized	"Developments in Central Asian Higher Education", https://wenr.wes.org/2007/06/wenr-june-2007-feature "Overview of the Higher Education System Uzbekistan", https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiche_uzbekistan_2017.pdf
Venezuela	Exams Centralized	Each institution's admission page. "Universidad de Los Andres Homepage", http://www.ula.ve/ofae/
Vietnam	Exams Centralized	"Education in Vietnam", https://wenr.wes.org/2017/11/education-in-vietnam
West Sahara	No Info	Each institution's admission page.
Yemen	Exams Centralized	Each institution's admission page. "Al Nasser University Admission Process", http://www.al-edu.com/en/admissions/admission-process/application-process/
Zambia	Exams Centralized	Each institution's admission page. "University of Zambia Admission Page", https://www.unza.zm/how-apply
Zimbabwe	Exams Centralized	"Education and diplomas Zimbabwe", https://www.nuffic.nl/en/subjects/education-and-diplomas-zimbabwe/

Figure A.1: Changes in the Competitiveness of Schools 1-8



Notes: This figure shows the changes in the competitiveness of each school (measured by the ratio of the number of applicants who select the school as their first choice to the number of entrants to the school) from 1900 to 1930. The number of entrants is the number of applicants who are admitted to the school in that year and is a proxy for school capacity. No data are available for 1905, 1906, and 1926. Colored years (1902-07, 1917-18, 1926-27) indicate the periods of the centralized system, while other years were under the decentralized system. (School 7 in 1901, 1908, 1909, and 1910, and School 8 in 1908 held their exams on different dates from other schools due to special circumstances, attracting a high number of applicants in these years.) Under the decentralized system, because an applicant can apply to only one school in principle, entrants are chosen from the applicants who select the school as their first choice. By contrast, under the centralized system, because an applicant can apply to multiple schools and is assigned to a school based on his exam score and school preference order, entrants are not necessarily a subset of the applicants who select the school as their first choice. See Section 5.1 for discussions.

Figure A.2: Centralized Assignment Rules of 1903


第九條　選拔試驗ヲ受ケタル者ハ之ヲ第一部、第二部及第三部ノ三部ニ分類シ其ノ試驗ノ成績順ニ依リ各高等學校ニ於ケル各部募集ノ總員ト同數ナル人員ヲ選出シ其ノ內ニ就キ左ノ方法ニ依リ各高等學校ニ配當スルモノトス

一　入學試驗ノ成績順ニ依リ本人ノ指定スル第一ノ入學志望學校ニ於ケル第一ノ志望部類ニ配當ス

二　第一號ノ場合ニ於テ試驗成績相同シキトキハ抽籤ニ依ル

三　第一號第二號ニ依リ配當ノ結果本人ノ指定スル第一ノ入學志望學校已ニ滿員トナリ配當スルコトヲ得サル者ニ付テハ更ニ成績順ニ依リ本人ノ指定スル第二以下ノ入學志望學校ニ於ケル第一ノ志望部類ニシテ缺員アルモノニ配當ス

四　第三號ノ場合ニ於テ試驗ノ成績相同シキトキハ入學志望學校ノ順序ニ依ル

五　第三號ノ場合ニ於テ試驗ノ成績及入學志望學校ノ順序相同シキトキハ抽籤ニ依ル

六　前數號ニ依リ配當ノ結果本人ノ志望スル學校悉ク滿員トナリタルトキハ第一部又ハ第二部志望者ニ在テハ更ニ本人ノ指定スル第二以下ノ志望部類ニシテ缺員アルモノニ配當ス其ノ方法ハ第一號乃至第五號ニ準ス

七　前數號ニ依リ配當ノ結果本人ノ志望スル學校及部類悉ク滿員トナリタルトキハ入學スルヲ得サルモノトス

前項ニ依リ配當ノ結果又ハ事故ノ爲入學者ニ缺員ヲ生シタルトキハ前項選出人員以外ニ就キ更ニ前項ノ方法ニ依リ之ヲ補塡スヘシ

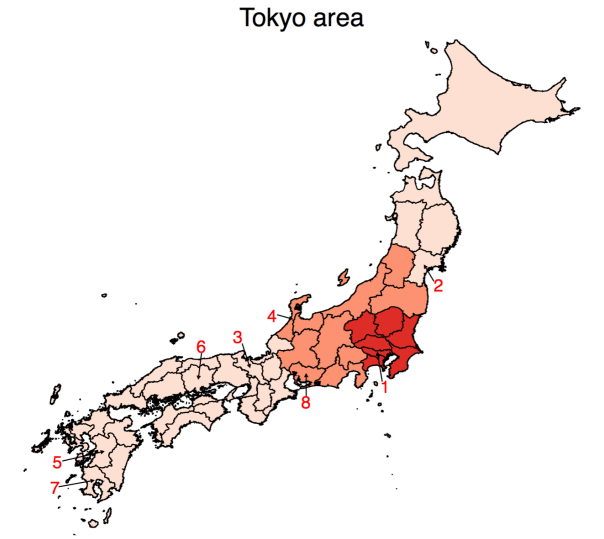
Notes: This figure is a reprint of the assignment rules in the centralized admissions system announced in the public notice of the Ministry of Education No 84 published in Government Gazette No. 5937 p.428, on April 21, 1903. See Section 2 for discussions.

Table A.2: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Applicant level data on short-run outcomes					
Distance between middle school prefecture and the school applied as first choice (km)	224.88	272.03	0	1821.7	20913
Share of applicants applying to School 1 as first choice	0.33	0.47	0	1	20913
Entrant level data on short-run outcomes					
Distance between birth prefecture and the school entered (km)	226.8	258.65	0	1821.7	66193
Share of entrants entering the nearest school from birth prefecture	0.49	0.5	0	1	66193
Share of entrants born in Tokyo prefecture	0.09	0.29	0	1	66193
Share of entrants born in Tokyo area (7 prefectures within 100km from Tokyo)	0.17	0.38	0	1	66193
Prefecture-year level data on short-run outcomes					
No. of entrants to Schools 1-8	45.06	37.45	0	337	1469
No. of entrants to School 1	7.88	14.11	0	132	1469
No. of entrants to School 2	5.5	10.4	0	100	1469
No. of entrants to School 3	6.19	10.34	0	104	1421
No. of entrants to School 4	5.64	9.91	0	90	1469
No. of entrants to School 5	6.27	14.2	0	103	1422
No. of entrants to School 6	5.19	11.8	0	131	1421
No. of entrants to School 7	5.03	12.99	0	156	1328
No. of entrants to School 8	5.67	12.45	0	133	1093
No. of public middle school graduates	415.38	350.01	11	3095	1410
No. of private middle school graduates	118.49	435.12	0	4675	1410
No. of schools other than School 1-8	0.13	0.43	0	5	1469
Prefecture-year level data on long-run outcomes in JPIR (1939)					
No. of all Imperial University graduates	8.77	7.81	0	74	705
No. of people earning top 0.06\ % level of income	5.27	7.72	0	48	705
No. of people earning top 0.01\ % level of income	0.96	1.74	0	13	705
No. of managers of private companies paying any positive amount of income or cor	13.25	16.34	0	122	705
No. of scholars, physicians, lawyers, and engineers	6.76	6.11	0	52	705
No. of professors at Imperial Universities	0.81	1.18	0	9	705
No. of civilian people who received a medal of above 5th order	6.28	5.03	0	42	705

Notes: This table provides summary statistics of variables used in the empirical analysis. The sample period for applicant level data is during 1916 and 1917. The sample period for entrant level data and prefecture level data for short-run outcomes is from 1900 to 1930. The birth cohorts of long-run outcomes span from 1880 to 1894. The information on the school applications is based on the applications to the school selected as first choice. The information on the school "entrants" is based on the first year students in the schools.

Figure A.3: Definition of the Tokyo Area



Notes: This figure shows the Tokyo area (in the dark color, also called Kanto area in Japanese) defined as prefectures that are within 100 km from Tokyo (Tokyo, Chiba, Kanagawa, Saitama, Ibaraki, Tochigi, and Gunma) and the Outer Tokyo area (in the medium color) defined as prefectures that are 100-300 km away from Tokyo. See Section 5.2 for discussions about this figure.

Table A.3: Admission Outcomes of the Centralized Assignment Algorithm

Exam Scores of Entrants in 1917 Under Centralized Admission System

School Name	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8
Location	Tokyo	Sendai	Kyoto	Kanazawa	Kumamoto	Okayama	Kagoshima	Nagoya
Total no. of entrants	77	29	38	22	68	36	37	64
Entrants Admitted to their 1st Choice								
No. of entrants	77	14	38	18	23	18	6	18
Max exam score	548	462	521	496	471	456	415	455
Min exam score	451	374	404	364	363	364	364	363
Entrants Admitted to their 2nd Choice								
No. of entrants		15		4	30	18	8	46
Max exam score		450		450	438	433	449	450
Min exam score		442		421	362	369	372	363
Entrants Admitted to their 3rd Choice								
No. of entrants					15		3	
Max exam score					450		450	
Min exam score					393		407	
Entrants Admitted to their 4th Choice								
No. of entrants							9	
Max exam score							400	
Min exam score							366	
Entrants Admitted to their 5th Choice								
No. of entrants							11	
Max exam score							444	
Min exam score							369	

Notes: This figure shows admission outcomes for the Department of Law and Literature in Schools 1-8 in 1917 under the centralized assignment algorithm. See Section 5.2 for discussions about this figure.

Table A.4: Testing Correlations between Centralization and Related Variables

VARIABLES	(1) No. middle school graduates	(2) No. entrants to Schools 1–7	(3) Share of entrants to School 1	(4) No. applicants to School 1–7	(5) Ratio of entrants to applicants	(6) Mean entrants' age	(7) Share of applicants to School 1	(8) Distance	(9) Share of entrants born in Tokyo area
Centralization	1.351	20.55	-0.00131	-0.189	0.0188	0.116	0.181***	49.36***	0.0371***
	(1.347)	(21.54)	(0.00365)	(0.552)	(0.0132)	(0.0984)	(0.0491)	(11.70)	(0.0100)
No. of middle school graduates		-1.248	-0.000618	-0.134**	0.00179*	0.0549***	-0.00306	1.990***	0.00167**
		(2.705)	(0.000565)	(0.0550)	(0.00101)	(0.0175)	(0.00300)	(0.698)	(0.000737)
Law Department		315.9***	-0.00512	1.144	-0.0484	0.437	0.234	-38.41	-0.0120
		(42.43)	(0.0122)	(1.461)	(0.0400)	(0.348)	(0.161)	(23.60)	(0.0193)
Observations	31	31	31	28	28	26	28	31	31
R-squared	0.921	0.952	0.834	0.899	0.931	0.856	0.741	0.905	0.807
Mean dep var	23.42	1821	0.196	9.578	0.219	19.03	0.314	228.9	0.174

Notes: Columns (1)–(6) of this table test if other variables related to this study are correlated with centralization episodes using year-level data. Columns (7)–(9) of this table examine the robustness of our main short-run outcomes using year-level data. All numbers are at the national-level from 1900 to 1930. We focus on Schools 1-7 when calculating the number of of entrants, the share of entrants to School 1, the number of applicants, the entrants to applicants ratio, and the share of applicants to school 1. The numbers of middle school graduates and applicants are denominated by 1,000. Robust standard errors are shown in the parentheses.

Table A.5: Parallel Pre-event Trends

VARIABLES	Imperial University	Top 0.1% income earners	Top 0.01% income earners	Managers	Professionals	Professors at Imperial Universities	Medal recipients
Tokyo area (< 100km) × Time trend	0.189	0.058	-0.039	0.343	0.202	0.019	0.178
	(0.445)	(0.311)	(0.068)	(0.658)	(0.239)	(0.082)	(0.253)
Observations	470	470	470	470	470	470	470
Mean dep var	5.023	4.579	0.938	10.09	3.994	0.381	4.402
Mean dep var (Tokyo area during Dapp)	6.471	6.114	0.957	15.77	5.486	0.500	5.329
Area where entrants increased × Time trend	0.174	-0.076	-0.046	0.076	0.133	0.036	0.177
	(0.297)	(0.217)	(0.043)	(0.446)	(0.168)	(0.056)	(0.180)
Observations	470	470	470	470	470	470	470
Mean dep var	5.023	4.579	0.938	10.09	3.994	0.381	4.402
Mean dep var (Area entrants increased during Dapp)	6.218	4.827	0.755	11.99	5.064	0.500	5.436

Notes: This table tests if there are differences in pre-event trends between urban and rural areas in the differences-in-differences analysis in Section 6. The estimates are based on the prefecture-cohort level data compiled from the JPIR in 1939, which includes cohorts born in 1874-1883 who became age 17 in 1891-1900. This table runs the following regression:

$$Y_{pt} = \alpha_p + \alpha_t + \beta \times Timetrend \times Urban_p + \epsilon_{pt},$$

where the linear time trend is defined as the cohort's birth year minus 1870. All the other variables are defined in the same way as in Table 4. See Section 6 for discussions about this figure.

Table A.6: Long-run Impacts of Centralization: Professionals in Details

VARIABLES	Professionals: Scholars		Professionals: Doctors/Lawyers		Professionals: Engineers	
Age 17 during Centralization × Tokyo area (<100km)	1.007**		0.603*		0.801	
	(0.420)		(0.337)		(0.674)	
Age 17 during Centralization × Area where entrants increased		0.697*		0.648**		0.686
		(0.349)		(0.280)		(0.461)
Observations	705	705	705	705	705	705
Cohort FE	YES	YES	YES	YES	YES	YES
Pref FE	YES	YES	YES	YES	YES	YES
Mean dep var	3.587	3.587	2.959	2.959	2.401	2.401
Mean dep var (Tokyo area or Area entrants increased during Dapp)	4.746	4.242	3.603	3.162	3.016	2.626

Notes: This table shows differences-in-differences estimates of the long-run effects of the centralized admission system. The estimates are based on the prefecture-cohort level data compiled from the Japanese Personnel Inquiry Records (JPIR) in 1939, which includes cohorts who were born in 1880-1894 and became age 17 in 1897-1911. All regressions control for prefecture fixed effects and cohort fixed effects. All outcome variables below are measured at the prefecture-cohort level. "Scholars," "Doctors/Lawyers," and "Engineer" are defined as the number of individuals listed in the JPIR whose occupation is scholar, physician or lawyer, and engineer, respectively. "Age 17 during Centralization" takes 1 if the cohort became 17 years old during 1902–1907, and takes 0 otherwise. "Mean dep var" shows the mean of the dependent variable for all prefecture-cohort observations. "Mean dep var (Tokyo area or Area entrants increased during Dapp)" shows the mean of the dependent variable in the Tokyo area or the area where entrants to Schools 1-8 increased during decentralization. Standard errors are clustered at the prefecture level. See Section 6 for discussions about this figure.

Table A.7: Long-run Impacts of Centralization: Differences-in-Differences Estimates with Control Variables

VARIABLES	Imperial University	Top 0.1% income earners	Top 0.01% income earners	Managers	Professionals	Professors at Imperial Universities	Medal recipients
Age 17 during centralization ×	2.06***	1.48**	0.39*	3.24***	0.96*	0.44**	2.40***
Tokyo area (<100km)	(0.55)	(0.66)	(0.22)	(1.12)	(0.53)	(0.20)	(0.72)
Observations	704	704	704	704	704	704	704
Mean dep var	8.777	5.273	0.964	13.25	6.763	0.810	6.280
Mean dep var (Treated group during decentralization)	10.62	6.873	1.159	19.76	8.603	1	6.937
Age≤17 in 1902 ×	1.66*	1.72***	0.61**	3.58**	0.50	0.34	1.89***
Tokyo area (<100km)	(0.91)	(0.63)	(0.30)	(1.40)	(0.60)	(0.21)	(0.55)
Age≤17 in 1908 ×	-2.50***	-1.22	-0.13	-2.87***	-1.46*	-0.54**	-2.96***
Tokyo area (<100km)	(0.75)	(0.93)	(0.24)	(0.98)	(0.83)	(0.22)	(0.98)
Observations	704	704	704	704	704	704	704
Age 17 during centralization ×	1.73***	1.04**	0.38**	1.92*	1.15***	0.29*	1.76***
Area where entrants increased	(0.49)	(0.50)	(0.15)	(0.97)	(0.42)	(0.16)	(0.58)
Observations	704	704	704	704	704	704	704
Mean dep var	8.777	5.273	0.964	13.25	6.763	0.810	6.280
Mean dep var (Treated group during decentralization)	9.707	5.182	0.859	14.92	7.586	0.919	6.657
Age≤17 in 1902 ×	1.33*	1.12**	0.47*	2.00*	0.85	0.16	0.98*
Area where entrants increased	(0.78)	(0.48)	(0.24)	(1.16)	(0.53)	(0.18)	(0.58)
Age≤17 in 1908 ×	-2.15***	-0.95	-0.28	-1.83*	-1.49**	-0.43**	-2.62***
Area where entrants increased	(0.64)	(0.74)	(0.21)	(0.95)	(0.61)	(0.19)	(0.71)
Observations	704	704	704	704	704	704	704

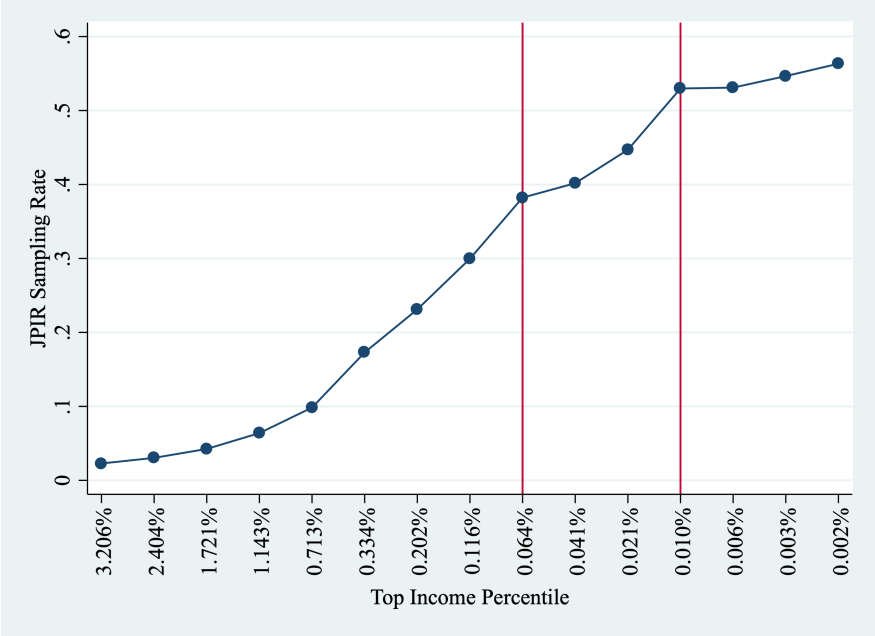
Notes: In this table, we control for time- and cohort-varying prefecture characteristics, i.e.,, the number of primary schools in the prefecture in the year when the cohort became eligible age, the number of middle school graduates in the prefecture in the year when the cohort became age 17, log of manufacturing GDP of the prefecture when the cohort became age 20, and birth population of the cohort in the prefecture. All the other variables are defined in the same way as in Table 4. See Section 6 for discussions about this table.

Table A.8: Long-run Impacts of Centralization: Differences-in-Differences Estimates excluding Cohorts who Became Age 17 in 1901 or 1907

VARIABLES	Imperial University	Top 0.1% income earners	Top 0.01% income earners	Managers	Professionals	Professors at Imperial Universities	Medal recipients
Age 17 during centralization × Tokyo area (<100km)	3.05***	1.71**	0.55***	4.83**	1.63***	0.48*	2.65***
	(0.97)	(0.84)	(0.20)	(2.12)	(0.58)	(0.24)	(0.93)
Observations	611	611	611	611	611	611	611
Mean dep var	8.684	5.247	0.967	13.14	6.682	0.827	6.152
Mean dep var (Tokyo area during decentralization)	10.38	6.661	1.107	19.16	8.357	1	6.679
Age 17 during centralization × Area where entrants increased	2.64***	1.13*	0.55***	2.83*	1.69***	0.37**	2.01***
	(0.70)	(0.65)	(0.15)	(1.66)	(0.48)	(0.18)	(0.72)
Observations	611	611	611	611	611	611	611
Mean dep var	8.684	5.247	0.967	13.14	6.682	0.827	6.152
Mean dep var (Treated group during decentralization)	9.580	5.057	0.818	14.56	7.477	0.932	6.455

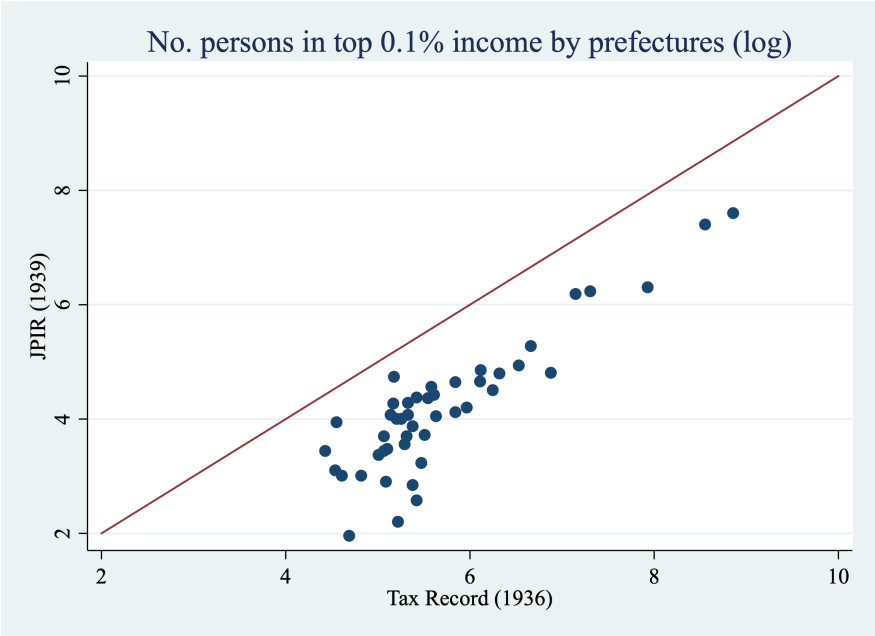
Notes: In this table, we repeat the same analysis in Table 4, but excluding the cohorts who became age 17 in 1901 or 1907 from the sample as these cohorts were heavily exposed to both Capp and Dapp. All the variables are defined in the same way as in Table 4. See Section 6 for discussions about this table.

Figure A.4: Sampling Rates of High Income Earners in the JPIR



Notes: This figure plots the sampling rate of the high income earners in JPIR (1939) by the income level expressed as a top percentile of the national income distribution. The sampling rates and the top income percentile are computed from the income tax statistics in the Tax Bureau Yearbook in 1938.

Figure A.5: Comparison of High Income Earners in the JPIR and the Income Tax Statistics by Prefecture



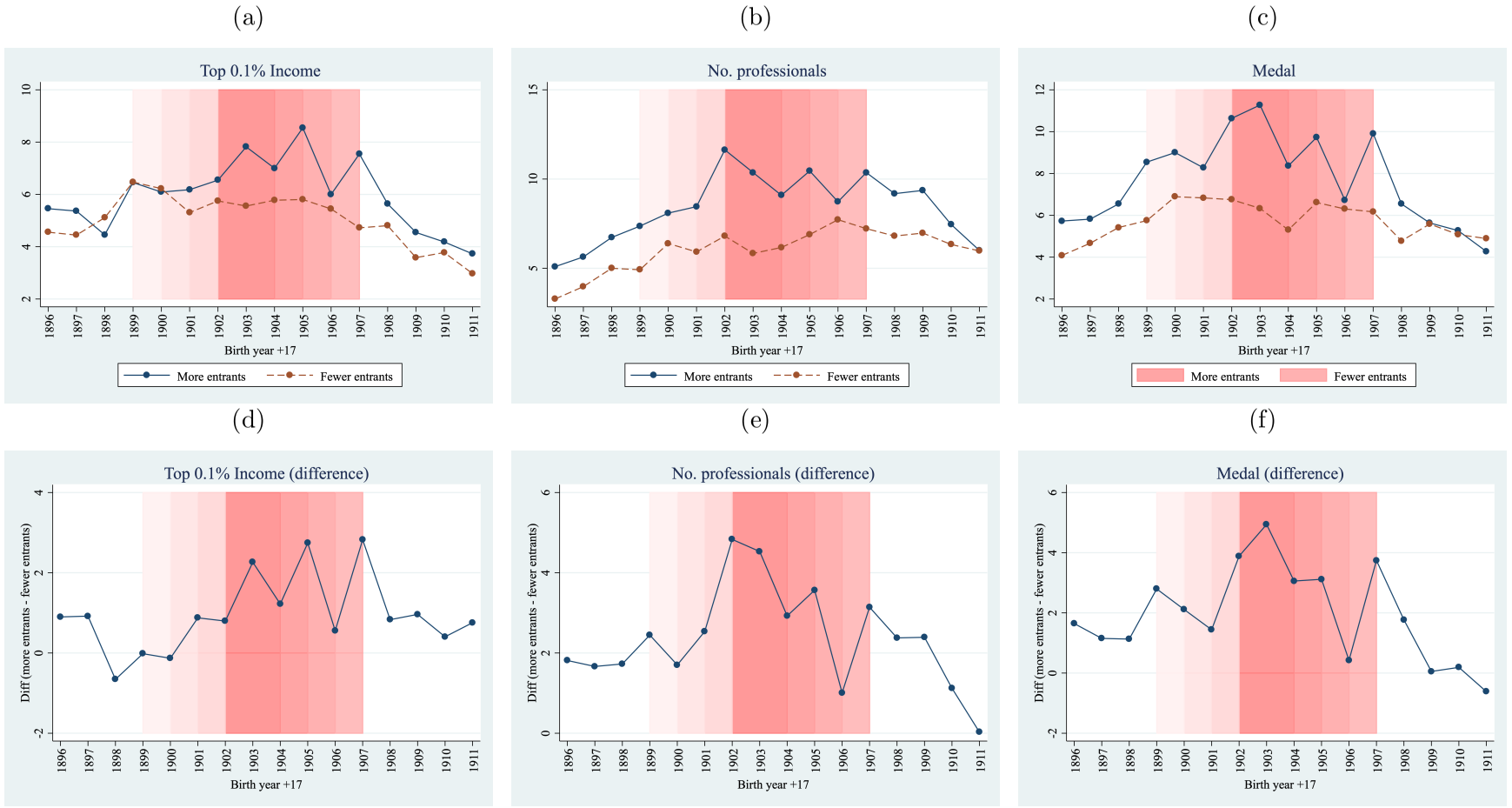
Notes: This figure compares the number of high income earners in each prefecture listed in the JPIR (1929) and the number of complete counts of the high income earners in each prefecture reported in the tax statistics in the Tax Bureau Yearbook (1936). The y-axis is log of the number of individuals in JPIR (1939) who earned more than 15,000 taxable income (or the top 0.06% income group) in 1938. The x-axis is log of the number of individuals who earned more than 10,000 taxable income (or the top 0.08% income group) in 1936 (the closest year to 1938 for which prefecture-level data are available).

Table A.9: Correlations between Prefecture-level Sampling Rates of JPIR and Outcome Variables

VARIABLES	Top 0.1% income earners (sampling rate)	Top 0.01% income earners (sampling rate)	Top 0.1% income earners (sampling rate)	Top 0.01% income earners (sampling rate)
Entrants to Higher Schools	0.00751	-0.0259		
	(0.00518)	(0.0214)		
Imperial Universities			0.00336	-0.0251**
			(0.00240)	(0.0114)
Observations	47	46	47	46
R-squared	0.038	0.006	0.009	0.007
Mean dep var	0.240	1.030	0.240	1.030

Notes: This table tests if the sampling rates of the JPIR (1939) are correlated with our outcome variables using prefecture-level data. "Top 0.1% income earners (sampling rate)" is the sampling rate of the top 0.1% income earners in the JPIR defined by the number of individuals in the JPIR with more than 15,000 yen of taxable income in 1938 divided by the complete count of the number of individuals with more than 10,000 yen of taxable income in 1936. "Top 0.01% income earners (sampling rate)" is the sampling rate of the top 0.01% income earners in the JPIR defined by the number of individuals in the JPIR with more than 50,000 yen of taxable income in 1938 divided by the complete count of the number of individuals with more than 50,000 yen of taxable income in 1936. "Entrants to Higher Schools" is the number of entrants to Higher Schools during 1900–1911 who were born in the prefecture (mean =477 and SD= 316). "Imperial Universities graduates" is the total number of individuals in the JPIR residing in the prefecture in 1938 who graduated from one of the Imperial Universities (mean =224 and SD= 349). "Entrants to Higher Schools" and "Imperial Universities" are denominated by 100.

Figure A.6: Long-run Impacts of Centralization: Differences-in-Differences: Area where entrants increased



Notes: This figure shows visual differences-in-differences plots that measure how the centralization affected the number of elite executives, public officials, and high income taxpayers born in the prefectures where entrants increased during Capp in 1902–1907. The plots use the prefecture-cohort level data of the number of persons listed on the Japanese Personnel Inquiry Records (JPIR) in 1939, which includes cohorts who became age 17 during 1899 and 1911. We measure the outcomes per prefecture per year. Most darkly colored years used the centralized system while other years used the decentralized system. Lightly colored years are those with the decentralized system but potentially affected by centralization due to the presence of students who wait and prepare for additional years after having failed in a particular year. See Section 6 for discussions about this figure.