Meritocracy and Its Discontents:
Long-run Effects of Repeated School Admission Reforms

Mari Tanaka Yusuke Narita Chiaki Moriguchi*

January 29, 2023

Abstract

We study the impacts of changing admissions systems in higher education. Our research design takes advantage of the world's first known implementation of nationally centralized meritocratic admissions and its subsequent reversals in the early twentieth century. We find an equity-meritocracy tradeoff both in the short and long run. On the one hand, the meritocratic centralization produces a greater number of top bureaucratic elites in the long run. On the other hand, this meritocracy come at the distributional cost of urban-born applicants crowding out rural-born applicants from elite higher education and career advancement. Several decades later, the meritocratic centralization increases the number of urban-born top income earners and other career elites relative to rural-born elites.

Keywords: Elite Education, Market Design, Strategic Behavior, Regional Mobility, Universal Access, Persistent Effects

Preliminary and Incomplete: Not for Circulation

*Zach Bleemer, David Card, Yeon-Koo Che, Caroline Hoxby, Pat Kline, Al Roth, Chris Walters, and seminar participants at Berkeley, Columbia, Penn State, Stanford, Rice, and the NBER (education group and market design group) provided helpful feedback. We thank Hidehiko Ichimura and Yasuyuki Sawada for sharing a part of the data, and an extensive list of students for research assistance. We gratefully acknowledge financial support from JSPS Grant Number JP19K13719, Yale Council on East Asian Studies, Hitotsubashi University IER Joint Usage and Research Center Grant (FY 2018). Mari Tanaka: Institute of Economic Research, 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.

1 Introduction

College and school admission processes vary across time and places. American college admissions use a decentralized system where each college makes its own admissions often based on opaque evaluation criteria. In contrast, China's public college admissions illustrate a regionally-integrated, single-application, and single-offer system using a transparent admission criterion. How do different admissions institutions affect students' behavior and future career? What are the impacts on the national production of high-skilled individuals and their distributions?

This paper studies the consequences of making school admissions meritocratic and centralized. We do so by combining a series of natural experiments in history, newly assembled historical data, and economic theory. Our investigations reveal the pros and cons of centralized meritocratic admissions, especially a tradeoff between meritocracy and equal access to selective higher education and career achievements.

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 National Higher Schools (roughly equivalent to today's colleges) as an exclusive entry point to the most prestigious tertiary education. These schools later produced many of the most influential members of the society, including several Prime Ministers, Nobel Laureates, and founders of global companies like Toyota.[1]

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 held exams on the same day so that each applicant could apply for only one school. Similar restrictions on the number of applications exist today in the college admission systems of Italy, Nigeria, and the UK.

At the turn of the 20th century, the government introduced a centralized system in order to accommodate the highest-achieving students. In the new system, applicants were allowed to rank multiple schools in the order of their preferences and take a single unified exam.[2] Given their preferences and exam scores, each applicant is assigned to a school (or none if unsuccessful) based on a computational algorithm. The algorithm was a mix of the Immedi-

[1] We study top elites on both substantive and pragmatic grounds. The individual holdings of prestigious economic, political, and cultural positions are skewed and concentrated on a tiny minority of the population who have big influences on the economy and society. For their social importance, we also have relatively rich historical data that allows us to trace back their careers from humble beginnings as students to wide societal recognition and acclaim.

[2] As shown later, the defining feature of the centralized system is to allow applicants to list multiple schools, not the use of a single unified exam.

ate Acceptance (Boston) algorithm and Deferred Acceptance algorithm with a meritocracy principle that the only highest-achieving applicants can get into any school. To our knowledge, this instance is the first nation-wide use of any matching algorithm.[3] Furthermore, 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 the different systems.[4] We exploit these bidirectional institutional changes to identify the short- and long-run impacts of the meritocratic centralization.

A stylized theoretical model predict the short-run impacts of the reforms on application behavior and admission outcomes. Consistent with its stated goal, the model confirms that the centralized system produces more meritocratic school seat allocations than the decentralized system. It also predicts that centralization would cause applicants to apply to more selective schools and make more inter-regional applications.

To test these predictions and analyze the effects of the meritocratic centralization, we newly collect and digitize data about application and enrollment as well as applicants' birth prefectures, based on Government Gazettes, Ministry of Education Yearbooks, and administrative school records. Our data record each student's regional origin, which is a strong predictor of socioeconomic status both in our empirical setting and other settings like the contemporary US.

We find that meritocratic centralization had large immediate effects on application and enrollment. First, consistent with the theoretical predictions, centralization caused stark strategic responses in application behavior. In particular, strategic incentives in the centralized system led applicants across the country to more often rank the most selective school first. This effect and the option to apply for multiple schools made students enroll at schools further away from their regional origin. The reform thus makes the elite higher education market more meritocratic, competitive, and regionally integrated.

The gains from centralization are not equally distributed, however. Because high-achieving students were disproportionately located in urban areas (mainly Tokyo), the centralized system caused a greater number of urban applicants to be admitted to schools in rural areas, typically after being rejected by their first choice schools.[5] As a result, urban high-achievers

[3]The earliest known large-scale use of the Boston algorithm is the assignment of medical residents to hospitals in New York City in the 1920s (Roth, 1990). The oldest known national use of the Deferred Acceptance algorithm is 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.

[4]The admission system was centralized in 1902, decentralized in 1908, re-centralized in 1917, re-decentralized in 1919, re-centralized in 1926, and re-decentralized in 1928, resulting in three periods of centralization (1902-07, 1917-18, and 1926-27).

[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.

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]

Historical documents suggest that this distributional consequence upset rural schools and communities. Partly as a result of such rural discontents, the government went back and forth between decentralized and centralized systems, finally settling for a decentralized scheme. This series of bidirectional reforms enables us to identify the causal effects of meritocratic centralization more precisely than a usual, single policy change would.[7]

We finally examine the long-run effects of the centralized system. We start by looking at its distributional impacts. In the short-run analysis, we find that centralization lets urban areas disproportionately gain school access relative to rural areas. This result motivates a difference-in-differences framework that compares long-term career outcomes of urban- vs rural-born individuals by each cohort's exposure to the centralized system. Our long-run career data come from the Japanese Personnel Inquiry Records (JPIR) published in 1939, more than thirty years after the first episode of meritocratic centralization in 1902–07. This data provides a list of distinguished individuals (e.g., high-income earners, national medal recipients, high-ranking politicians, corporate executives) along with their biographical information. We provide extensive investigations about the quality of the data.[8]

Distributional effects of meritocratic centralization turn out to be persistent. Almost four decades later, relative to the decentralized system, the centralized system produced a greater number of top income earners, prestigious medal recipients, and other elite professionals who came from urban areas compared to rural areas. The number of urban-born career elites increased by 10–20% for the cohorts exposed to meritocratic centralization. We also obtain suggestive evidence that the centralized system increased the number of career elites living in urban areas as adults in the long run.

We conclude the long-run analysis by examining the national productive efficiency implication of meritocratic centralization for the entire country. We focus on a specific subgroup of career elites, top bureaucrats. Top bureaucrats were an exemplar category of career elites in our empirical context, where many of the best and brightest graduates from the top schools competed to become bureaucrats (Johnson, 1982). We also have the most comprehensive

[6]It is also empirically true that the centralized system made a greater number of rural applicants 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]We provide evidence that the reform timings appear exogenous in that they are not correlated with other social and institutional outcomes.

[8]We find that the data covers a large fraction of the national population of elites (e.g., 53% of the top 0.01% income earners) by comparing our data with national administrative statistics. We also find no systematic variation in the sampling rates across prefectures, consistent with our assumption that sample selection bias is uncorrelated with the prefecture-cohort variation we use.

data for bureaucrats. Using the administrative data of all individuals who passed the national exams to become higher civil officials, we compare the national number of bureaucrats promoted to top ranks between cohorts exposed to the centralized admissions and cohorts exposed to the decentralized admissions. We find that the number of top-ranking bureaucrats in the centralized cohorts was 15% greater than that in the decentralized cohorts. Meritocratic centralization produced a larger number of high-quality bureaucratic elites for the whole country.

Overall, our findings reveal an equity-meritocracy tradeoff both in the short and long run. On the one hand, the meritocratic centralization of school admissions achieved the goal of rewarding applicants with higher academic performance in the short run and produced a greater number of top bureaucratic elites in the long run. On the other hand, this meritocracy came at the cost of urban-born applicants overwhelming rural-born applicants. The design of admission rules therefore affects the production and distribution of highly educated individuals or "upper-tail human capital" (Mokyr, 2005), which is an important determinant of economic growth and inequality (Glaeser, 2011; Moretti, 2012; Autor, 2019).

Related Literature

Our analysis sheds light on the impacts of the design of admission systems, contributing to the literature on their effects on application behavior, regional mobility, and applicants' academic achievement and welfare (Abdulkadiroğlu et al., 2006; Abdulkadiroğlu, Agarwal and Pathak, 2017; Machado and Szerman, 2017; Grenet, He and Kübler, 2022; Knight and Schiff, 2019; Chen, Jiang and Kesten, 2020).[9] While these prior studies focus on the short-run effects, we estimate the long-run effects by taking advantage of bidirectional, repeated policy changes in history. This use of bidirectional policy changes echoes other studies with similar identification strategies (Niederle and Roth, 2003).[10]

From a broader historical perspective, this paper relates to the literature that investigates the long-term effects of resource allocation mechanisms (Dell, 2010; Bleakley and Ferrie,

[9] Other studies measure the effects of selective schools conditional on a particular admission system (Dale and Krueger, 2002; Altonji, Blom and Meghir, 2012; Hastings, Neilson and Zimmerman, 2013; Pop-Eleches and Urquiola, 2013; Deming et al., 2014; Kirkeboen, Leuven and Mogstad, 2016; Abdulkadroğlu et al., 2017; Abdulkadiroglu et al., 2021; Zimmerman, 2019).

[10] With its interest in long-run effects, this paper also relates to studies of the long-term effects of educational resources (Duflo, 2001; Meghir and Palme, 2005; Oreopoulos, 2006). These studies focus on the effects of expanding resources (such as school constructions and compulsory education extensions), while we investigate the effects of changing resource allocation mechanisms given a fixed amount of resources. This zero-sum nature of school seat allocations induces an equity concern, sharing much in common with ongoing policy discussions on affirmative actions and meritocratic college admissions (Arcidiacono and Lovenheim, 2016; Bleemer, 2020, 2021; Otero, Barahona and Dobbin, 2021). See also Kamada and Kojima (2015) and Agarwal (2017) for discussions about regional inequality in other matching markets. Fu et al. (2021) study inequal regional access to US colleges.

2014, 2016). Our analysis is also related to Bai and Jia (2016), who examine political consequences of the abolition of a meritocratic elite recruitment system (civil service exam) in early twentieth-century China. While they focus on the short-run effects on revolution participation, we study the long-run impacts on career trajectories.

The next section provides historical and institutional backgrounds. Section 3 examines the short-term effects of meritocratic centralization, while Section 4 analyzes their long-term impacts. Finally, Section 5 summarizes our findings, discusses their limitations, and outlines future directions.

2 Background

One major trend in modern college admissions is a growing degree of centralization with transparent admission criteria. Today, over 30 countries use regionally- or nationally-integrated, single-application and single-offer college admissions. Appendix Figure A.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. These systems have well-specified admission criteria, mixing meritocratic achievement elements (such as GPA and entrance exams), and affirmative action and other priority considerations.

Before the turn of the 20th century, however, no country used such a centralized system.[11] Even today, many countries, including the U.S., continue to use decentralized systems. Such decentralized schemes tend to come with less transparent criteria for ranking applicants, as illustrated by recent court cases against American universities. Similar observations also apply to K-12 school admissions. How does the centralization of college and school admissions affect students' application behavior, enrollment outcomes, and future careers? Understanding the costs and benefits of meritocratic centralization is the goal of our paper.

2.1 Bidirectional Admissions Reforms in History

To evaluate the impacts of centralized admissions system, we take advantage of unique historical episodes in early twentieth-century Japan. Since the opening of the country in the mid 19th century, to catch up with Western knowledge, science, and technologies, education reforms became a central part of modernization efforts by the Japanese government. In 1894, the government set up a national higher education system consisting of one Imperial

[11] We summarize the information sources at https://www.scribd.com/document/437545135/Online-Appendix191018

University and five National Higher Schools. By 1908, the system 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 of establishment), as shown in Appendix Table A.2. We refer to these eight National Higher Schools as Schools 1–8 for short.[12]

Schools 1–8 served as an exclusive entry point to Imperial Universities, the most prestigious tertiary education. Virtually all graduates of Schools 1–8 were admitted to these universities without further selection well into the 1920s. Imperial University graduates were also partially or wholly exempted from the Higher Civil Service Examinations and other selective national qualification exams to become high-ranking administrators, diplomats, judges, and physicians (Amano, 2007). As a result, entering Schools 1–8 was considered equivalent to a passport into the elite class. Indeed, Schools 1–8 produced highly distinguished and influential individuals, including several Prime Ministers, Nobel Laureates, world-leading mathematicians, renowned novelists, and founders of global companies like Toyota. To apply to these schools, one must be male aged 17 or older and have completed a five-year middle school.[13] As Schools 1–8 admitted fewer than 2,300 students each year throughout 1900–1930, they constituted less than 0.5% of the cohort of males aged 17.

Among Schools 1-8, School 1 in Tokyo was considered by far the most prestigious due to its location in the capital and its geographical proximity to Tokyo Imperial University (today's University of Tokyo). The next most prestigious was School 3 in Kyoto, the ancient capital of Japan. By contrast, located in a remote southwest region, Schools 5 and 7 were considered the least prestigious among all schools. Consequently, the schools differed substantially in their popularity and selectiveness.

The admission to Schools 1–8 was merit-based and determined by annual entrance exams. Initially, the government took a laissez-faire approach and let each school administer its own exam and admissions. Schools 1–8 typically held their exams on the same day so that each applicant could only apply to one school. Following the convention in the literature (Che

[12]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 national higher education, due to fiscal constraints, the number of National Higher Schools remained constant until 1918. From 1918 to 1925, the number of National Higher Schools gradually increased from 8 to 25, but Schools 1–8 remained the most distinguished among all 25 schools. 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 higher schools and universities. In our empirical analyses, we control for the number of National Higher Schools as well as other characteristics of higher education institutions.

[13]The eligibility was changed in 1919 to males aged 16 or older who have completed the fourth year of middle school.

and Koh, 2016; Hafalir et al., 2018), we call this system "decentralized admissions" or Dapp for short. The single choice aspect of Dapp captures an essential feature of decentralization, which incentivizes each applicant to self-select into an appropriate school by comparing the selectivity of schools with his own standing.

Under Dapp, however, many high-achieving students were rejected by popular schools, while lower-achieving students entered less popular schools. For the government who wanted to send the most promising students to selective higher education, the decentralized system seemed inefficient. The Education Minister criticized the decentralized system as follows (*Educational Review* No.1146, p.21, published in February 15, 1917):

> "*[Under the decentralized system] among applicants rejected by School 1 and School 3, which attract a large number of high ability applicants, there are many applicants whose academic performance is superior to that of applicants admitted to other rural schools. (...) Namely, hundreds of applicants with sufficiently high academic ability to enter rural schools are idly wasting another year [to retake the exam]. This is not only a pity for them, but also a loss for the country.*"

To solve this problem, in 1901, all schools first agreed to unify their entrance exams to a single one, while maintaining decentralized admission decisions. Furthermore, in 1902, the government launched a centralized admission system in which applicants were allowed to apply for multiple schools, submit their preferences over schools, and take a unified exam at any school. Based on their exam scores and preferences, applicants were then assigned to a school (or no school if unsuccessful) by a well-specified computational algorithm announced ex ante. We call this system "centralized admissions" or Capp for short.

The centralized admission system operated as follows. Each year, the government announced application procedures in April, three months before the exam in July, as a public notice in Government Gazette. The assignment algorithm reads as follows.[14]

> (1) In the order of exam scores, select the same number of applicants as the sum of all schools' capacities. If the score is tied, decide by lottery.
>
> (2) For applicants selected in (1), in the order of exam scores, assign each applicant to the school of his first choice. If the score is tied, decide by lottery.
>
> (3) For applicants for whom the school of his first choice is already filled as a result of the assignments in (2), in the order of exam scores, assign each

[14]This is a simplified version of the assignment algorithm used in 1917. See Appendix Figure A.3 for a reprint of the original assignment algorithm published in April 1917. Strictly speaking, the centralized assignment algorithm was introduced first in 1902, slightly modified in 1903 and 1917, and revised further in 1926.

applicant to the school of his second choice. If the score is tied, decide by lottery.

(4) For applicants for whom the school of his second choice is already filled as a result of the assignments in (3), then assign each applicant to the school of his third choice or below, repeating the same procedure as (3).

(5) If all the schools that an applicant has chosen are filled, then such applicants are not admitted to any schools.

(6) If there is any vacancy as a result of the above assignments or due to an accident, then fill the vacancy by applying the above method to unadmitted applicants.

Written more than a century ago in natural language, the rule description is mathematically precise. Observe that the above algorithm imposes meritocracy up front in which only top-scoring applicants were considered for admission regardless of their preferences (Step (1)). Capp is meritocratic in the sense that the worst test score among assigned students under Capp is weakly better than that under other mechanisms, including Dapp. We also show that this step selects only applicants who would be admitted by any school under the Deferred Acceptance algorithm (Abdulkadiroğlu and Sönmez, 2003), one of the most widely used algorithms in today's college and selective K-12 admissions. See Appendix B for formal statements. These applicants are then assigned to one of Schools 1–8 using the Immediate Acceptance (Boston) algorithm (Steps (2) to (4)). This algorithm is therefore a variant of the Immediate Acceptance algorithm with a meritocracy constraint, making it closer to the Deferred Acceptance algorithm. To the best of our knowledge, this is the world's first recorded nation-wide use of any assignment algorithm.

This institutional innovation was short-lived, however. Due to political and administrative reasons detailed below, the government switched back to Dapp (with a unified exam) in 1908. The government then continued to oscillate between decentralization and centralization, reintroducing Capp in 1917, moving back to Dapp (with a unified exam) in 1919, reinstituting Capp (with major modifications of allowing applicants to list at most two schools) in 1926, and finally settling down to Dapp (with separate exams) in 1928. In a space of thirty years, there were three periods of centralized admissions: first in 1902–1907, next in 1917–1918, and finally in 1926–1927.

We exploit the series of bidirectional policy changes to examine the impacts of centralization. Importantly, it was difficult for applicants to anticipate the exact timing of these policy changes, as the admission policy was decided and announced only a few months in advance. This suggests that the reform timing is close to exogenous, as we further explore in Section 3.5.[15]

2.2 Expected Impacts

To guide our empirical analysis, we use historical documents and theoretical insights to form hypotheses about effects of centralization.[16] Historical documents suggest that the repeated policy changes resulted from intense bargaining between the Ministry of Education (MOE) in the central government and the Council of School Principals (CSP) representing local interests.[17] MOE emphasized the importance of using centralized admissions to enroll the best and brightest to the national higher education.

On the other hand, the Council of School Principals (CSP) was opposed to centralization, pointing out several adverse consequences for rural schools and their local communities.[18] First, the principals claimed that the centralized system encourages applicants in all areas to rank the most competitive and prestigious urban school as the first choice, since the centralized system provides applicants with options to apply for lower choice schools as insurance (see Proposition 2 as a formalization). This effect in turn allows the urban school to enroll the best students.

Hypothesis 1. *Under the centralized system, more applicants in all areas rank most prestigious School 1 as their first choice.*

Second, CSP also complained that the centralized system lets many reluctant and unmotivated students enter rural schools as fallback options, which lowered school morale. Indeed, the centralization allowed high-achieving applicants in urban areas to enter rural schools even if they failed at the most selective urban school. This, in turn, often resulted in the rejection of lower-achieving rural applicants who would have been able to enter their local schools under decentralized admissions. Our theory confirms that centralization leads

[15]These historical episodes are studied by historians of Japanese education (Yoshino, 2001*a*,*b*; Takeuchi, 2011; Amano, 2017). The preceding studies, however, are mostly qualitative. An important exception is Miyake (1998, 1999), who examines regional variations in access to higher schools and descriptively compares the number of higher school students per population across prefectures.

[16]The descriptions in this section are based on Moriguchi (2021), pp.195-199.

[17]An additional concern was the administrative cost of implementing the centralized system in the absence of modern computers and photocopying technologies. Both MOE officials and the school principals repeatedly pointed out the difficulty of grading thousands of exam sheets by a small number of people in a short period of time and assign applicants to schools according to the algorithm (Takeuchi, 2011, pp.118-119; Moriguchi, 2021, p.199).

[18]In addition to the reasons listed here, the principals deemed centralization as an intrusion on their power and autonomy.

to a reduction in the share of local entrants (Proposition 3).

Hypothesis 2. *Under the centralized system, the share of each school's seats allocated to its local students decreases.*

Third, since centralization made admissions more meritocratic (Propositions 1 and 4), it allocated a higher share of the entire school seats to high-achieving applicants. After reviewing the admission results of 1917 (the first year of the second centralization period), CSP found that the number of rural middle-school graduates admitted (not only to their local schools, but also) to any schools declined considerably compared to the previous three years of decentralized admissions. This is presumably because high-achieving applicants were disproportionately located in urban areas.

Hypothesis 3. *Under the centralized system, a share of urban-born applicants in the sum of all school seats increases.*

A noted historian summarizes these observations as follows (Takeuchi, 2011, p.121):

> "*Urban applicants mainly from Tokyo 'overwhelm' rural applicants by applying for rural schools as fallback options. Urban applicants rob rural applicants of opportunities that were once open to them. This ruins the meaning of building national higher schools across the nation.*"

This was upsetting for local communities of rural schools, especially because they had contributed land and other resources to the construction of rural schools (Takeuchi, 2011, p.56 and pp.106-107).

Overall, these documents highlight a possible meritocracy-equity tradeoff of centralization. On the one hand, the centralized admissions made the school seat allocation more meritocratic, enabling high-achieving students to enter one of the elite schools even if they failed at the most selective one. On the other hand, this meritocracy might have come at the expense of equal regional access to higher education, if high-achieving urban applicants dominated rural applicants. Below we test the above hypotheses as well as their persistence in the long run.

3 Short-run Impacts

3.1 Data

To analyze short-run effects of the centralized admission system, we assemble data on application and enrollment by digitizing administrative and non-administrative sources. First, we collect data on the number of applicants by school of their first choice from 1900 to 1930, using *Ministry of Education Yearbook* and other sources. For these two years (1916 and 1917), we also collect data on the number of applicants by school of their first-choice and by prefecture of their middle school. Appendix Section A.1.1 provides detailed explanations for data sources and definitions.

Second, we compile data on the number of entrants (first-year students) by school and by their birth prefecture from 1900 to 1930, using *Student Registers* of Schools 1–8. Finally, to control for the size of potential applicants and the number of competing schools, we collect data on the number of middle-school graduates by prefecture of their middle school, as well as the number of other Higher Schools (established in addition to Schools 1–8 starting in 1919) by prefecture from 1900 to 1930. See Appendix Section A.1.2 for detailed descriptions of the data. Descriptive statistics of main variables are reported in Appendix Table A.1.

3.2 Strategic Responses by Applicants

As an immediate effect, switching back and forth between the centralized and the decentralized admission systems caused stark strategic responses in application behavior. Figure 1a shows that the three periods of Capp are associated with sharp increases in the share of applicants who chose the most selective School 1 in Tokyo as their first choice, as predicted.

To observe regional variations, we examine how the propensity of applicants to rank School 1 as their first choice changes between 1916 (under Dapp) and 1917 (under Capp). The results in Appendix Table A.2 show that the meritocratic centralization induced applicants in all regions to rank the most prestigious school first and to make more long-distance applications. As a result, the competition to enter School 1 became even more intense under Capp (Appendix Figure A.4).[19] As a result, under Capp, only a small fraction of first-choice applicants were admitted to School 1, producing many high-scoring applicants who were rejected by School 1 and then assigned to their second or lower-choice school.[20]

[19]Under Capp, the competitiveness of School 3 in Kyoto also slightly increased. However, this increase was not as drastic as that of School 1 (see Appendix Figure A.4).

[20]For example, at the second introduction of Capp in 1917, School 1 attracted 12 times more first-choice applicants (4,428 in total) than its capacity (361 seats).

3.3 Regional Mobility in Enrollment

We next examine changes in enrollment outcomes. To measure the geographical mobility of entrants, we compute the "enrollment distance" defined as the direct distance between an entrant's birth prefecture and the school he entered. As Figure 1b shows, the centralized system is associated with a sharp and discontinuous increase in enrollment distance.[21] This increase in regional mobility is driven by a sharp reduction in the number of "local entrants" defined as entrants who entered a school in (or near) their birth prefecture. To show this, we estimate the following regression for each school s separately:

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

where Y_{pst} is the number of entrants born in prefecture p who entered school s in year t. $Centralized_t$ is the indicator that the admission system was centralized in year t. $1\{\text{school } s$ is located in prefecture $p\}$ is the indicator that school s was located in prefecture p. $1\{\text{school } s$ is $1-100$ km away from prefecture $p\}$ is the indicator that school s was located 1-100 km away from prefecture p, which roughly corresponds to the definition of school regions (described in the map under Table A.2 in the Appendix). X_{pt} controls for observable characteristics of prefecture p and year t, including the number of middle-school graduates from prefecture p in year t and the number of higher schools other than Schools 1–8 in prefecture p in year t. γ_t and γ_p are year and prefecture fixed effects, respectively.

As shown in Panel (a) of Table 1, Capp reduces the number of local entrants born in the school's prefecture across the country. The coefficients of $Centralized_t \times 1\{\text{school } s$ is located in prefecture $p\}$ are significantly negative for all schools. Column (1) shows that the number of School 1 entrants born in Tokyo prefecture declined by about 25%. 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, centralization weakened the local monopoly power of each school by creating a national market for higher education, consistent with our theoretical prediction in Appendix B (Proposition 3).

[21] The effect is especially stark in the first two periods of Capp. The third period of Capp in 1926–27 was qualitatively different from that in the first and second periods. In the third period of Capp, schools were divided into two groups and applicants were allowed to choose and rank at most two schools (one school per group) in 1926–27.

3.4 Meritocracy vs Equal Regional Access

Which regions gained more school seats under the centralized system? We now investigate how centralization altered the geographical allocation of total school seats. Figure 2a plots the change in the total number of entrants to Schools 1–8 from Dapp to Capp by their birth prefecture, where the darker blue color indicates the greater decline and the darker red color indicates the greater increase. The figure shows that most of western and northern prefectures lost school seats, while Tokyo prefecture (where School 1 was located) and its surrounding area gained school seats under Capp.

To see this quantitatively, we regress the number of entrants to Schools 1–8 in year t born in prefecture p on the interaction terms between $Centralized_t$ and each of the following two indicator variables: the indicator that takes 1 if prefecture p was Tokyo and the indicator that takes 1 if prefecture p was 1-100 km away from Tokyo. To control for the decline of local entrants, we also add the interaction terms between $Centralized_t$ and each of the following two indicator variables: the indicator that takes 1 if any of Schools 1–8 was located in prefecture p and the indicator that takes 1 if any of Schools 1–8 was located 1-100 km away from prefecture p. As in Equation 1, we also control for observable characteristics of prefecture p and year t and include year and prefecture fixed effects.

The result in Column (1) in Table 1 Panel (b) shows the number of entrants born in Tokyo prefecture increased by 13% per year under Capp relative to its mean under Dapp (201). The degree of increase in the number of entrants is even higher for its surrounding area: the number of entrants born in prefectures 1-100 km away from Tokyo increased by 45% per prefecture per year under Capp relative to its mean under Dapp (26).[22]

Motivated by these observations, we define "Tokyo area" as a set of prefectures located within 100 km from Tokyo (see Appendix Table A.2 for its location) and use this area to measure the impact of Capp in our long-run analysis. Figure 2b depicts the time evolution of the share of entrants to Schools 1–8 who were born in the Tokyo area. Consistent with the above results, the share of Tokyo-area born entrants rose during the periods of Capp.

To see which schools received more Tokyo-area born entrants under Capp, we regress the number of entrants to each school s in year t born in prefecture p on the interaction terms between $Centralized_t$ and the variables indicating whether entrants' birth prefecture p is Tokyo or near Tokyo. We include the same variables used in Equation 1 to control for school locations and other prefecture and year characteristics. Under Capp, a greater number of

[22] One possible reason for this is that applicants from this area might be marginal applicants who were not admitted under Dapp but were admitted under Capp. On the other hand, many high-scoring applicants from the Tokyo prefecture might be admitted even under Dapp. Consistent with this hypothesis, the number of entrants from Tokyo (201) is much larger than the number of entrants from surrounding prefectures (26 per prefecture) under Dapp.

Tokyo-area-born students entered less selective rural schools, as shown in Columns (2)–(9) in Table 1 Panel (b).[23]

In summary, the net effect of Capp is such that the increased inter-regional applications caused high-achieving students in the Tokyo area to crowd out lower-achieving, rural-born students from their local schools. This evidence is consistent with the historian's observation (Takeuchi (2011) cited in section 2.2) that, as a result of the centralization, urban applicants mainly from Tokyo dominated rural applicants in entering national elite schools.

The Tokyo area shares common characteristics with what is generally considered urban. Appendix Table A.4 shows that prefectures in the Tokyo area had a larger population, higher income per capita, and better educational infrastructure (indicated by greater number of middle-school graduates eligible for higher education) compared to other prefectures. In Appendix Table A.5, we use these urban characteristics instead of the Tokyo area indicators in the same specification as Column (1) in Panel (b) of Table 1. The result shows that these urban characteristics positively predict the areas which produced a greater number of entrants under Capp. Therefore, one explanation for why the Tokyo area gained more school seats under centralization is that these urban advantages produced greater number of high achieving students in the area.

The difference in students' preferences across areas can be another reason why the Tokyo area gained more school seats under the centralized system. Students have a preference for a local school for geographical and cultural proximity, and the local school for students born in the Tokyo area happened to be the most competitive School 1. As a result, it is likely that, holding academic achievement constant, during the decentralization, students born in the Tokyo area were more likely to apply to School 1 and therefore fail to enter any higher school (even though they might have been able to enter Schools 2–8 had they applied). Appendix Table A.5 shows evidence consistent with this hypothesis, indicating that the share of applicants to School 1 during the decentralization is associated with greater number of entrants to Schools 1–8 during the centralization. In summary, our analysis suggests that a combination of better educational infrastructure and strong preference for School 1 explan why the Tokyo area gained more school seats under the centralized system.

3.5 Other Institutional Changes

We discuss potential threats to our empirical analysis, especially whether changes in other institutional factors could explain our short-run results. Our analysis takes the timing of the reforms as exogenous, which raises a few concerns. The first concern is that if there were

[23]The results remain almost the same when we additionally control for observable prefecture characteristics (see Appendix Table A.3).

simultaneous reforms in middle schools, it could affect application behavior. Second, if there were capacity changes at Schools 1–8 that were correlated with the admission reforms, it could influence application behavior and enrollment outcomes. The third concern is that if 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.

We investigate these concerns and confirm that centralization periods are not correlated with time-series changes in the number of middle school graduates, the total number of entrants to Schools 1–8, and the share of entrants to School 1 in all entrants (Columns (1)–(3) in Appendix Table A.6). In Columns (4) and (5), we also verify that the number of applicants as well as the level of competitiveness (measured by the number of entrants divided by the number of applicants) do not move systematically with introductions of Capp. In addition, if the probability of unsuccessful applicants retaking the exam in subsequent years changes with the admission reforms, this may also affect our results. As shown in Column (6), however, we find that the average age of entrants does not change with the introductions of centralization.

A potential concern with the above robustness analysis is that the insignificant results in Appendix Table A.6 may be due to a small sample size (around 30). Yet, using the same empirical specification, we find that centralization is significantly correlated with 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), as shown in Columns (7)–(9) of Appendix Table A.6. Taken together, these results suggest that our findings are unlikely to be driven by institutional changes other than the school admission reforms.

Finally, the centralization reform introduced not only the meritocratic assignment algorithm, but also the unified entrance exam that applicants could take at any school location. As such, the estimated impacts of centralization may be confounded by the unification of entrance exams and more flexible exam location choices. To investigate this issue, we analyze how key outcomes change from 1900 to 1901, during which the government also introduced a single entrance exam that applicants were allowed to take anywhere while the assignment method remained unchanged (i.e., decentralized). Figures 1a and 1b show that this institutional change from 1900 to 1901 induced little changes in application and enrollment patterns. The estimated impacts of centralization are therefore likely due to the meritocratic assignment algorithm rather than the changes in exam contents and locations.

4 Long-run Impacts

To assess long-run effects of the meritocratic centralization, we provide two sets of empirical analysis. First, we investigate the persistence of the distributional effect of centralization we document in the short-run analysis. We do so by a difference-in-differences strategy comparing labor-market outcomes of urban- and rural-born individuals across birth cohorts with differential exposure to the centralized admissions. Our analysis shows that the centralization increased both (a) the number of career elites coming from (born in) urban areas and (b) the number of career elites living in urban areas as adults. The admission reforms thus influence the regional origins and destinations of career elites.

Second, we explore the national productive efficiency of the two admission systems. We find that cohorts more intensely exposed to the centralized admissions produce a larger national number of civil officials who were promoted to top ranks. This finding indicates that the centralization boosted the national production of career elites, at least for the specific important category of top-ranking government officials.

4.1 Regional Distribution of Career Elites

Japanese Personnel Inquiry Records Data

To analyze long-run effects of the centralization on students' career outcomes, we use the *Japanese Personnel Inquiry Records* (JPIR) published in 1939.[24] The JPIR is an equivalent of Who's Who, which compiles a selective list of socially distinguished individuals (including high-income earners, top business managers, elite professionals, and high-ranking public servants) and provides their biographical information. In total, the 1939 JPIR lists 55,742 individuals or 0.15% of the adult Japanese population of that time. We detail the selection process in Appendix Section A.2.1.

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 turned 17 years old (the age eligible for application) in 1897–1911. The cohorts born in 1880–1894 were 45 to 59 years old in 1939. The number of individuals listed in the JPIR in each of these cohorts is about 1,800. We use the following information from the JPIR data for each individual: full name, birth year, birth prefecture, prefecture of residence, final education, occupation titles and organization names, the medal for merit and the court rank awarded (if any), and the amount of national

[24] Japan went into the military regime with the promulgation of the National General Mobility Act in 1938. Although the military government began massive economic interventions, their effect was relatively small in 1939 (Moriguchi and Saez (2008)). In addition, most of the information in JPIR (1939) is based on 1938 data.

income tax and business tax paid (if any).

We define the following groups of elites as a subset of JPIR-listed individuals: (1) the top 0.01% and 0.05% income earners according to the national income distribution, (2) prestigious medal recipients (civilians who received either the medal of the fifth order of merit or above, or the court rank of the junior fifth rank or above), (3) corporate executives (individuals who hold an executive position in a corporation and pay a positive amount of income or business tax), (4) top politicians and bureaucrats (individuals whose occupation is either Imperial Diet member, Cabinet member, or high-ranking central government official), and (5) Imperial University professors or associate professors. Appendix Section A.2.1 and Table A.7 provides detailed definitions and descriptions of each group. These categories encompass economic, social, cultural, political, and academic definitions of career elites.

We use this data to count the number of elites in each group defined by birth prefecture and birth cohort. These counts allow us to conduct a difference-in-differences analysis that compares long-term career outcomes of urban- and rural-born individuals by each cohort's exposure to the centralized admission system. Descriptive statistics of main variables are summarized in Appendix Table A.1.

Assessing the Coverage and Bias of the JPIR Data

Since our JPIR data is not exhaustive administrative data, we are concerned about potential sample selection bias. For the top income earners and Imperial University professors, we can compute the exact sampling rates by comparing the number of individuals in our data against complete counts reported in government statistics. We find that the sampling rates are decent even by modern standards: 53% and 39% for the top 0.01% and 0.05% income earners, respectively, and 70% for Imperial University professors. Consistent with the nature of our data, which lists only distinguished individuals, the sampling rates increase with the income level (see Appendix Figure A.5).

Sample selection bias becomes a problem for our difference-in-differences analysis only if the difference in sampling rates between urban and rural areas changes with cohorts' exposure to the centralized admission system. To assess this possibility, we examine the prefecture-level sampling rates for the top income earners. As Appendix Figure A.6 shows, the number of high income earners in our data and the complete count from tax statistics are highly correlated at the prefecture level, with similar sampling rates across prefectures. This result provides further support for the quality of our data. Even so, one potential concern is that Imperial University graduates might have a higher likelihood of being sampled by the JPIR even after controlling for the income level. However, we find no positive correlation between the sampling rates of top income earners and the numbers of Imperial University graduates across prefectures (see Appendix Table A.8). This series of findings suggests that possible sample selection bias in the JPIR data is unlikely to drive our empirical results.

Urban-Rural Disparity in Producing Career Elites

We estimate the long-run impacts of Capp, by conducting a difference-in-differences analysis by birth cohorts and birth areas. The key idea behind our empirical strategy is that applicants born in the Tokyo area should experience a greater gain in entering Schools 1–8 under Capp relative to Dapp, since the centralized system is designed to be more meritocratic and high-achieving students are disproportionately located in urban areas. This expectation is confirmed in Figure 2 and Table 1. 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. If admission to Schools 1–8 increases one's chance of becoming a career elite, we should observe a greater number of elites born inside the Tokyo area for the cohorts exposed to Capp. We estimate a difference-in-differences specification as follows:

$$Y_{pt} = \beta \times Centralized_t \times Tokyo\_area_p + \gamma_p + \gamma_t + \epsilon_{pt},$$

where Y_{pt} is the number of elites born in cohort t and prefecture p. $Centralized_t$ is a measure of cohort t's exposure to Capp, which is, in the baseline specification, a binary indicator that cohort t turned 17 during Capp (1902–1907). $Tokyo\_area_p$ is the indicator variable that takes 1 if prefecture p is in the Tokyo area. γ_p and γ_t are prefecture and cohort fixed effects. To allow for serial correlation of ϵ_{pt} within prefecture over time, we cluster the standard errors at the prefecture level in our baseline specification.[25] In addition, we report the results of clustering at cohort level, which are estimated by wild cluster bootstrap (Cameron and Miller, 2015; Roodman et al., 2019) due to the small number of clusters (15 cohorts).

The above regression defines $Centralized_t$ to be a binary indicator, as the simplest proxy for the intensity of exposure to Capp. In reality, however, a nontrivial number of unsuccessful applicants retook the exam at age 18 and beyond. As a result, the cohorts who turned age 17 in 1899–1901 were partially and increasingly exposed to Capp (as some of them took the exam in 1902), the cohorts who turned age 17 in 1902–1904 were fully exposed to Capp, and the cohorts who turned age 17 in 1905–1907 were partially and decreasingly exposed to Capp (as some of them took the exam in 1908), and the intensity of exposure drops to zero for the cohorts who turned age 17 in 1908.[26] In the following analysis, we explicitly

[25] Bertrand, Duflo and Mullainathan (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.

[26] The intensity of exposure to Capp is estimated to be 0.00, 0.02, 0.09, 0.36, 1.00, 0.98, 0.91, 0.64, and

incorporate cohort's intensity of exposure to Capp in visual results.

We first check whether the number of Imperial University graduates born inside the Tokyo area increased for the cohorts exposed to Capp. Since all Schools 1–8 graduates were automatically admitted to an Imperial University during this period, the areas that produced more Schools 1–8 entrants should produce more Imperial University graduates. Figure 3 (a) compares the average number of Imperial University graduates who were born in prefectures inside and outside the Tokyo area by cohorts (represented by their birth year plus 17 on the horizontal axis). In these and subsequent plots, cohorts are colored according to their intensity of exposure to Capp. Figure 3 (b) shows that the urban-rural difference in the number of Imperial University graduates rises as the intensity of exposure to Capp increases and falls sharply when Capp ends in 1908. Column (1) in Table 2 shows that the estimate of β in the above regression is positive and statistically significant.

Our main results are presented in Figure 3 (c)–(f) and Table 2 Columns (2)–(7). Figure 3 (c)–(f) show difference-in-differences plots that compare the number of elites (the top 0.05% income earners and medal recipients) who were born inside and outside the Tokyo area by the cohort's exposure to Capp. For both elite categories, the plots show that the difference between the Tokyo area and the rest grows as the intensity of exposure to Capp increases, and then drops sharply when Capp ends. Appendix Figure A.7 shows qualitatively similar difference-in-differences plots for the top 0.01% income earners, corporate executives, top politicians and bureaucrats, and Imperial University professors.

Table 2 Columns (2)–(7) show that the long-run effects of Capp are economically and statistically significant. For the cohorts exposed to Capp, the number of career elites born inside the Tokyo area (compared to those born outside the Tokyo area) increases by 34% for the top 0.01% income earners, 24% for the top 0.05% income earners, 36% for medal recipients, 14% for corporate executives, 50% for top politicians and bureaucrats, and 47% for Imperial University professors (in Panel B).[27] In Panel A, we control only for cohort and prefecture fixed effects. In Panel B, we additionally control for time- and cohort-varying prefecture characteristics.[28] The coefficients fall slightly in magnitude after adding control variables, but remain sizable.

Table 2 Panel C shows that the effects are symmetric with respect to the direction of the admission reforms, i.e., the change from Dapp to Capp and the change from Capp to Dapp

0.00 for the cohort who turned age 17 in 1896–98, 1899, 1900, 1901, 1902–04, 1905, 1906, 1907, and 1908–11, respectively. See Appendix Section A.2.1 for data and methods.

[27] In Appendix Table A.9, we also examine groups of elite professionals and obtain similar results for scholars, engineers, and physicians.

[28] Cohort birth population, the number of primary schools, the number of middle school graduates, and prefecture-level GDP. See Appendix Section A.2.1 for variable definitions and data sources.

produce similar effects of the opposite sign. These results suggest that almost four decades after its implementation, Capp had lasting effects on the career trajectories of students. In Table 2 Panel D, we replace the centralization dummy by the cohort's intensity of exposure to Capp. The results remain qualitatively the same as the baseline results.

The above results are robust to alternative specifications. First, the analysis in Table 2 Panel D assumes that the cohort's intensity to exposure to Capp is exogenous and the same across years, which may be a strong assumption. However, even when we drop the cohorts who are exposed to both Capp and Dapp (i.e., cohorts who became age 17 in 1901 and 1907) from the sample, we still find qualitatively the same results (Appendix Table A.10). Second, we test if the assumption of parallel pre-event trends holds. Appendix Table A.11 verifies that the differences in pre-event trends between the areas of comparison are small and mostly insignificant.

Another potential threat to our identification strategy is that there may be some age-specific trends in the number of elites that covary with the cohort-region variation we use. Specifically, the number of observations in the 1939 long-term data peaks at around the cohort who were 51 years old in 1939 (corresponding to the cohort who turned age 17 in 1905) and gradually falls for younger and older cohorts, suggesting that there are certain ages at which individuals are more likely to be listed in the long-term data. Such age effects may generate different trends in the number of elites born in the Tokyo and other areas, due, for example, to differences in population size across these areas. To address this concern, we use an earlier edition of the JPIR published in 1934, construct the prefecture-cohort level data for the same cohorts used in our main analysis (but observed 5 years earlier), and conduct similar regression analyses. The results in Appendix Table A.12 confirm that our key results remain qualitatively the same even when we use the 1934 JPIR data.

Finally, we conduct placebo tests to examine if the results are driven by other factors such as the sample selection of the JPIR or changes in cohort populations. The urban-rural difference in the cohort's birth populations does not change significantly with the cohort's exposure to Capp, as in Appendix Table A.13. As an additional placebo test, we also look at unrelated career outcomes. Among the distinguished individuals listed in the JPIR, we expect that landlords (defined as individuals whose occupational titles include landlord, but excluding the top 0.05% income earners, medal recipients, corporate executives, top politicians and bureaucrats, and imperial university professors) are least likely to be affected by the introduction of Capp as receiving higher education was not a typical pathway to become a landlord. As shown in Appendix Table A.13, the estimated effect of Capp on the number of landlords is small and statistically insignificant.

Geographical Destinations of Career Elites

Having established that Capp affects the geographic *origins* of elites, we now ask how it affects their geographic *destinations*. While the former is about regional inequality in educational opportunities, the latter is about regional inequality in the supply of highly skilled human capital, which potentially affects economic growth and inequality.

We first examine if the centralization-induced increase in inter-regional mobility in the short run boosted the geographical mobility of elites in the long run. Surprisingly, it did not: The urban-rural difference in the fraction of elites whose prefectures of residence differ from their birth prefectures did not increase under Capp, as shown in Appendix Table A.13. We find similar results when we use the distance between an elite's birth prefecture and his prefecture of residence as an alternative measure of long-run mobility. This result suggests that, even though a greater number of students born in the Tokyo area entered rural schools under Capp, most of them returned to the Tokyo area when pursuing their careers

If the greater number of Tokyo-area born students admitted to rural schools under Capp returned to the Tokyo area eventually for their subsequent careers, we should observe a greater number of elites living in the Tokyo area for the cohorts exposed to Capp. To test this hypothesis, we redefine the outcome variables by changing the prefecture (p) from birth prefecture to prefecture of residence and estimate the equation with the same specification.

Table 3 shows large positive effects of Capp on the urban-rural gap in the number of elite residents. For the cohorts exposed to Capp relative to Dapp, the number of elites living in the Tokyo area in their middle age (compared to those living outside the Tokyo area) increases by 28% for the top 0.01% income earners, 23% for the top 0.05% income earners, 29% for medal recipients, 22% for corporate executives, 20% for top politicians and bureaucrats, and 50% for Imperial University professors (Panel B). These results suggest that the meritocratic centralization likely intensified the concentration of career elites in urban areas relative to rural areas in the long run.

4.2 National Production of Career Elites

The above analysis examines the distributional consequence of the centralized admissions. We now turn to its productive efficiency implication for the whole country and explore whether the meritocratic centralization improved the national production of career elites in the long run. To do so, we focus on a specific group of elites, i.e., higher civil officials, for whom we have complete-count data from administrative records. We investigate whether cohorts exposed to Capp produced a greater national number of top-ranking civil officials compared to cohorts exposed to Dapp.

Higher Civil Officials Data

Our main data source is the list of individuals who passed the Higher Civil Service Examinations (HCSE) and their biographical information compiled by Hata (1981). The HCSE were selective national qualification exams held annually from 1894 to 1947.[29] We digitized the information of all individuals who passed the administrative division of the HCSE in 1894–1941, including their full name, education, year of university graduation, year of passing the exam, starting position, final position, year of retirement, and other notable positions held. Because education includes not only final but also the second to final education, we observe both university and higher school (if applicable).

In the Japanese bureaucracy system, the higher civil service refers to the top ten ranks of national government offices in the administrative, judicial, and diplomatic divisions. Within the higher civil service, the top three ranks were distinctively called "imperial appointees" in the prewar period. The first rank consisted of minister level positions, and the second and third ranks consisted of vice minister level positions such as vice minister, director general, bureau chief, and prefectural governor. In the following analysis, we define "top-ranking officials" as higher civil officials who were internally promoted to reach one of the top three ranks by the end of their career (see Appendix Section A.2.2 for details).

To identify each individual's exposure to the centralized admissions, we must find out in which year each individual took the entrance exam and entered a higher school (or failed and entered an alternative school). However, since we only observe the year of university graduation in the above data, we estimate "the year of entering a higher school or its equivalent" using the method described in Appendix A.2.2. We first find the exact year of entering a higher school for all top-ranking officials who graduated from Schools 1–8 by searching their names in Student Registers of Schools 1–8. Using this information, we then estimate "the year of entering a higher school or its equivalent" for the rest of higher civil officials.

To create cohort-level data, we count the number of individuals who passed the administrative division of the HCSE (hereafter "exam passers") by cohort defined by "the year of entering a higher school or its equivalent." We also count the number of top-ranking officials by cohort.[30] Descriptive statistics of main variables are shown in Appendix Table A.1. Out of 6,255 exam passers in our dataset, 55.8% are Schools 1–8 graduates and 15.7% are top-ranking officials; and among 982 top-ranking officials, 71.4% are Schools 1–8 graduates.

[29] The 1893 ordinance required all individuals to pass the HCSE for appointment in the administrative division of higher civil service with some exceptions for special appointments (Spaulding, 1967, Chapter 25; Shimizu, 2019, Chapter 5).

[30] Appendix Figure A.10 plots the number of exam passers and the number of top-ranking officials by cohort.

Analysis of Higher Civil Service Exams Passers

As an intermediate outcome, we first examine the impacts of the centralized admission system on the number of individuals who passed the selective HCSE. We expect that, the centralized system (which effectively selected top-scoring students and assign them to Schools 1-8) would increase the average quality of students who entered Schools 1–8, which in turn would improve the likelihood of Schools 1–8 graduates to pass the HCSE.

To test this hypothesis, we divide exam passers into three mutually exclusive subgroups: (a) those who graduated from School 1, (b) those who graduated from Schools 2–8, and (c) those who are not Schools 1–8 graduates. For each subgroup, we count the number of exam passers by cohort. We estimate the following equation for the entire group and for each subgroup:

$$Y_t = \theta Centralized_t + \xi_1 X_t + \xi_2 Trend_t + \xi_2 Trend_t^2 + \omega_t,$$

where Y_t is the number of exam passers in a given group in cohort t (defined by the year of entering a higher school or its equivalent), and $Centralized_t$ is the indicator that takes 1 if cohort t entered a higher school or its equivalent during Capp. For a subgroup regression, we control for the total number of exam passers in cohort t (denoted by X_t). We also control for a quadratic time trend where $Trend_t$ is the number of years since 1897.

The results are presented in Table 4 Panel A. Column (3) shows that Capp increased the number of exam passers who graduated from Schools 2–8 by 23%, while Column (4) indicates that Capp reduced the number of exam passers who are not Schools 1–8 graduates by 13%. By contrast, Capp did not have significant effect on the total number of exam passers or the number of exam passers who graduated from School 1 (Columns (1) and (2)). In other words, the centralization had little impact on the total number of exam passers, but had a major impact on the composition of exam passers, and its positive effect was concentrated on Schools 2–8 graduates. This finding is consistent with the result of our short-run analysis that the centralization led to a large increase in Tokyo-area born entrants to Schools 2–8 (Table 1 Columns (3)–(9)), which likely improved the academic standing of these schools.

Analysis of Top-Ranking Higher Civil Officials

Finally, we analyze the impact of the centralization on the national production of top-ranking officials. Our main outcome variable is the number of higher civil officials who were internally promoted to the top three ranks by the end of their career. We use the same specification as above and run a regression for the entire group and for each of the following subgroups: (a) those who graduated from School 1, (b) those who graduated from Schools 2–8, and (c) those who are not Schools 1–8 graduates, and count the number of top-ranking officials by cohort in each subgroup. For all regressions, we control for the total number of exam passers.

The results are presented in Table 4 Panel B Columns (1)–(4). Importantly, Column (1) shows that the total number of top-ranking officials increased for Capp cohorts by 15%, with high statistical significant.[31] This result suggests that meritocratic centralization produced a larger number of high-quality bureaucratic elites for the whole country.

One potential threat to our identification is that the number of available top-ranking positions might increase during the Capp periods. To alleavite this concern, we define our cohort by the year of entering a higher school or its equivalent (not by the year of becoming top-ranking officials). Within each cohort, the number of years taken from entering a higher school to the appointment for the first top-ranking position varied widely from 20 to 30 years (see Appendix Figure A.9 and Appendix A.3 for details). Individuals in a given cohort were therefore promoted to top-ranking positions in different years. This limits the degree to which a potential correlation between the number of top-ranking positions and the lagged periods of centralized admissions drives our results.

Another potential threat is that the number of top-ranking officials may be differentially impacted by wars between Dapp and Capp cohorts. In particular, during the postwar U.S. Occupation, a substantial number of top officials were purged from public service, and a few were sentenced to death for war crimes. In Appendix Table A.15, however, we show that the number of top-ranking officials who died in wars, or were purged or executed after WWII, changes little between Dapp and Capp cohorts.

We also explore why Capp had a positive effect on the total number of top-ranking officials. Table 4 Panel B Columns (2) and (3) indicate that Capp had a small, negative, and insignificant effect on the number of top-ranking officials who graduated from School 1, but had a large, positive, and significant effect on the number of top-ranking officials who graduated from Schools 2–8 (see Appendix Figure A.11 for visual presentation). According to Column (3), the number of top-ranking officials who graduated from Schools 2–8 increased by 47% for Capp cohorts compared to Dapp cohorts. This result is consistent with our analysis of the exam passers (recall Table 4 Panel A Columns (2) and (3)). Unlike Panel A Column (4), however, Panel B Column (4) shows that Capp had no significant negative effect on the number of top-ranking officials who did not graduate from Schools 1–8.

These observations suggest that Capp had a positive effect on the total number of top-ranking officials (Column (1)) because Capp's positive effect on Schools 2–8 graduates was so large (Column (3)) that it dominated Capp's small and negative effect on those who

[31]This positive association is also observed in Appendix Figure A.10, where the number of top-ranking officials in Panel (b) tends to be greater for cohorts exposed to Capp, given the number of exam passers in Panel (a).

did not graduate from Schools 1–8 (Column (4)). It is important to note that this result is inconsistent with the selection hypothesis that the role of the centralized admissions is simply to select a fixed number of high-achieving students from a pool of applicants and send them to receive national higher education (i.e., higher school and imperial university), but national higher education itself does not give students any value added. Under this selection hypothesis, Capp would produce a greater number of top-ranking officials from Schools 1–8 graduates, but such effect would be offset by a smaller number of top-ranking officials from other schools so that the total number of top-ranking officials would be constant.

What are the mechanisms through which the meritocratic centralization increased the total number of top-ranking officials? There are four main hypotheses: (1) matching, (2) peer effects, (3) connections, and (4) signaling. The matching hypothesis states that the higher quality of match between students and schools would result in greater human capital. If higher-achieving students gained more from national higher education than from private higher education (due to higher quality of teachers and more demanding curriculum, for example), then by assigning top-scoring students to Schools 1–8, the meritocratic centralization would produce a greater number of upper-end human capital. The peer effect hypothesis claims that students benefit more from having higher-achieving peers. If that is the case, by gathering top-scoring students in Schools 1–8, the meritocratic centralization would produce positive learning externality among these students. Lastly, national higher education may not improve students' academic achievement or human capital per se, but students may benefit from gaining connections with powerful alumni or from its signaling value, which may improve their prospects of getting promoted to top-ranking positions.

Although we cannot distinguish matching effects from peer effects in our data, we can test if the connections or signaling was an important channel. In Column (5) of Table 4 Panel B, we reexamine the result of Column (3) by controlling for the number of exam passers from the same schools in the same cohort (instead of the total number of exam passers). The coefficient of Capp remains significant. In Column (6), we further restrict our sample to top-ranking officials who graduated from Schools 2–8 and Tokyo Imperial University. Even within this narrowly specified subgroups with common connections and educational qualification, the coefficient of Capp is positive. In summary, our analyses using HCSE data suggest that the meritocratic centralization produced a greater number of top-ranking officials by improving the quality of civil officials.

For career bureaucrats, the meritocratic centralization turns out to be more productively efficient than the decentralized system, as the government envisioned. However, whether or not this was true for all career elites is an open question. For example, it is possible that the quality of career bureaucrats improved at the expense of other types of elites. To examine this possibility, we use the 1939 JPIR data to compute the share of top bureaucrats among all "socially distinguished individuals" listed in the JPIR.[32] As Appendix Figure A.12 shows, although the share of government officials is rising over time reflecting a growing public sector, we observe no positive association between the share of government officials and the cohort's exposure to the centralized admissions. Our result is unlikely to be driven by students' brain drain from other elite occupations under the meritocratic centralization.

Furthermore, higher exposure to the centralized system is associated with a greater total number of individuals listed in the JPIR, as Appendix Figure A.13 and Table A.16 show. To distinguish the cohort effect from the age effect (e.g., people of certain ages may have had a higher chance of holding important positions and being selected into the JPIR), we use both 1934 and 1939 editions of the JPIR and find that the number of individuals listed in the JPIR is 4–5% higher among Capp cohorts. This finding indicates a possibility that the meritocratic centralization produced a greater number of elites in general.

5 Conclusion

The design of school admissions persistently impacts the production and geography of career elites. We reveal this fact by looking at the world's first recorded use of nationally centralized admissions and its subsequent abolitions in early twentieth-century Japan. While centralization was designed to make the school seat allocations more meritocratic, there turns out to be a tradeoff between meritocracy and equal regional access to elite higher education and career advancement. The meritocratic centralization led students to apply to more selective schools and make more inter-regional applications. As high-achieving students were located disproportionately in urban areas, however, centralization caused urban applicants to crowd out rural applicants from advancing to higher education.

Most importantly, these impacts were persistent: Several decades later, the meritocratic centralization increased the number of high income earners, medal recipients, and other elite professionals born in urban areas relative to those born in rural areas. The distributional effect also persists: The centralized system produced a greater number of top-ranking government officials, indicating that the meritocratic centralization may be more productively efficient.

Though our study uses the admission reforms unique to our historical setting, the implications of our study might be relevant for other contexts. For instance, distributional consequences of centralized meritocratic admissions may be a reason why many countries continue to use seemingly inefficient decentralized college admissions. Methodologically, the

[32] Top bureaucrats are defined as high-ranking central government officials listed in the JPIR as in Section

use of natural experiments in history may be also valuable for studying the long-run effects of market designs in other areas, such as housing, labor, and health markets.

It is the multiple bidirectional policy changes in history that allow us to measure the long-run 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 modern administrative data. For example, one may imagine linking administrative tax return data and school district data to measure the long-run effects of school choice reforms in the past few decades. Such an effort would be a fruitful complement to our historical study.

References

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

Abdulkadiroglu, Atila, Joshua D Angrist, Yusuke Narita, and Parag A Pathak. 2021. "Breaking Ties: Regression Discontinuity Design Meets Market Design." *Econometrica.*

Abdulkadiroğlu, Atila, Nikhil Agarwal, and Parag A. Pathak. 2017. "The Welfare Effects of Coordinated Assignment: Evidence from the New York City High School Match." *American Economic Review*, 107(12): 3635–3689.

Abdulkadiroğlu, Atila, Parag Pathak, Alvin E Roth, and Tayfun Sonmez. 2006. "Changing the Boston School Choice Mechanism." National Bureau of Economic Research.

Abdulkadroğlu, Atila, Joshua D Angrist, Yusuke Narita, Parag A Pathak, and Roman A Zarate. 2017. "Regression Discontinuity in Serial Dictatorship: Achievement Effects at Chicago's Exam Schools." *American Economic Review*, 107(5): 240–45.

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

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

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

Amano, Ikuo. 2017. *Imperial Universities: Elite Factory in Modern Japan (in Japanese).* Chuou Kouron Shinsha.

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

Autor, David. 2019. "Work of the Past, Work of the Future."

Bai, Ying, and Ruixue Jia. 2016. "Elite Recruitment and Political Stability: the Impact of the Abolition of China's Civil Service Exam." *Econometrica*, 84(2): 677–733.

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

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

Bleakley, Hoyt, and Joseph Ferrie. 2016. "Shocking Behavior: Random Wealth in Antebellum Georgia and Human Capital Across Generations." *Quarterly Journal of Economics*, 131(3): 1455–1495.

Bleemer, Zachary. 2020. "Top Percent Policies and the Return to Postsecondary Selectivity." Working Paper.

Bleemer, Zachary. 2021. "Affirmative Action, Mismatch, and Economic Mobility after California's Proposition 209." *Quarterly Journal of Economics*.

Cameron, A Colin, and Douglas L Miller. 2015. "A Practitioner's Guide to Cluster-robust Inference." *Journal of Human Resources*, 50(2): 317–372.

Chen, Yan, Ming Jiang, and Onur Kesten. 2020. "An Empirical Evaluation of Chinese College Admissions Reforms through a Natural Experiment." *Proceedings of the National Academy of Sciences*, 117(50): 31696–31705.

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

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

Dell, Melissa. 2010. "The Persistent Effects of Peru's Mining Mita." *Econometrica*, 78(6): 1863–1903.

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

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

Fu, Chao, Junjie Guo, Adam J. Smith, and Alan T. Sorensen. 2021. "Students' Heterogeneous Preferences and the Uneven Spatial Distribution of Colleges." NBER Working Paper 28343.

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

Grenet, Julien, Yinghua He, and Dorothea Kübler. 2022. "Preference Discovery in University Admissions: The Case for Dynamic Multi-offer Mechanisms." *Journal of Political Economy.*

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

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

Hata, Ikuhiko. 1981. *The System, Organization, and Personnel of the Bureaucracy in Prewar Japan (in Japanese).* Tokyo Daigaku Shuppankai.

Johnson, Chalmers. 1982. *MITI and the Japanese Miracle: the Growth of Industrial Policy, 1925-1975.* Stanford University Press.

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

Kirkeboen, Lars, Edwin Leuven, and Magne Mogstad. 2016. "Field of Study, Earnings, and Self-Selection." *Quarterly Journal of Economics*, 131: 1551–1552.

Knight, Brian, and Nathan Schiff. 2019. "Reducing Frictions in College Admissions: Evidence from the Common Application."

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

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

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

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

Mokyr, Joel. 2005. "Long-Term Economic Growth and the History of Technology." In *Handbook of Economic Growth*. Vol. 1, 1113–1180. Elsevier.

Moretti, Enrico. 2012. *The New Geography of Jobs.* Houghton Mifflin Harcourt.

Moriguchi, Chiaki. 2021. "Higher School Admission Procedure Reforms in Prewar Japan (in Japanese)." *Economic Analysis*, 203: 184–213.

Moriguchi, Chiaki, and Emmanuel Saez. 2006. "The Evolution of Income Concentration in Japan, 1886-2002: Evidence from Income Tax Statistics." NBER Working Paper 12558.

Moriguchi, Chiaki, and Emmanuel Saez. 2008. "The Evolution of Income Concentration in Japan, 1886–2005: Evidence from Income Tax Statistics." *Review of Economics and Statistics*, 90(4): 713–734.

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

Ogawa, Kenji. 2009. *Sociology of the Medals (in Japanese).* Shoyo Shobo; Kyoto.

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

Otero, Sebastián, Nano Barahona, and Cauê Dobbin. 2021. "Affirmative Action in Centralized College Admission Systems: Evidence from Brazil." Working Paper.

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

Roodman, David, Morten Ørregaard Nielsen, James G MacKinnon, and Matthew D Webb. 2019. "Fast and Wild: Bootstrap Inference in Stata Using boottest." *The Stata Journal*, 19(1): 4–60.

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

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

Shimizu, Yuichiro. 2019. *The Origins of the Modern Japanese Bureaucracy.* Bloomsbury Academic.

Spaulding, Robert. 1967. *Imperial Japan's Higher Civil Service Examinations.* Princeton University Press.

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

Tangjun, Yuan, Settsu Tokihiko, Jean-Pascal Bassino, and Kyoji Fukao. 2009. "Prefectural Gross Domestic Product and Industrial Structure in Pre-war Japan [in Japanese]." Hitotsubashi University Global Hi-Stat Discussion Paper No.071.

Yazawa, Hirotake. 2004. *Income Distribution and Family Economics in Modern Japan (in Japanese).* Tokyo Book Center.

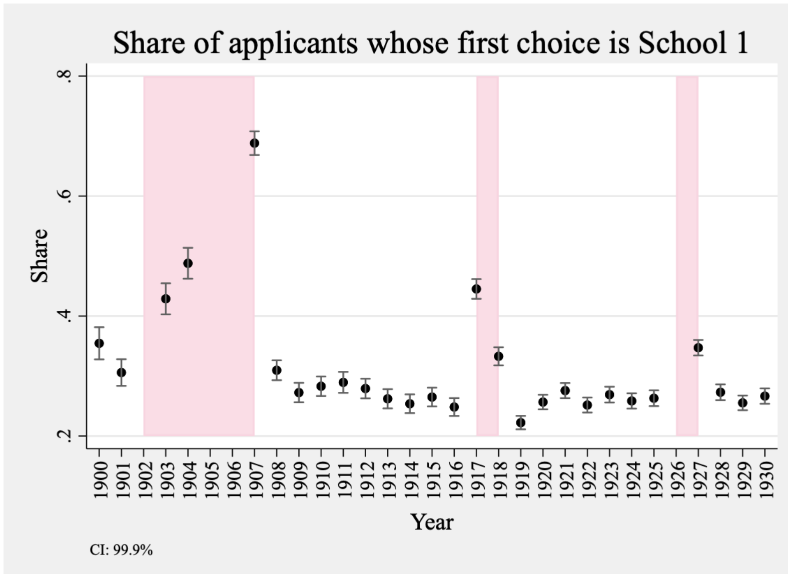
Yoshino, Takehiro. 2001*a*. "Entrance Examination of Higher Schools in the Early Taisho Period (in Japanese)." *Keio University Studies in Sociology, Psychology, and Education*, , (53): 19–31.

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

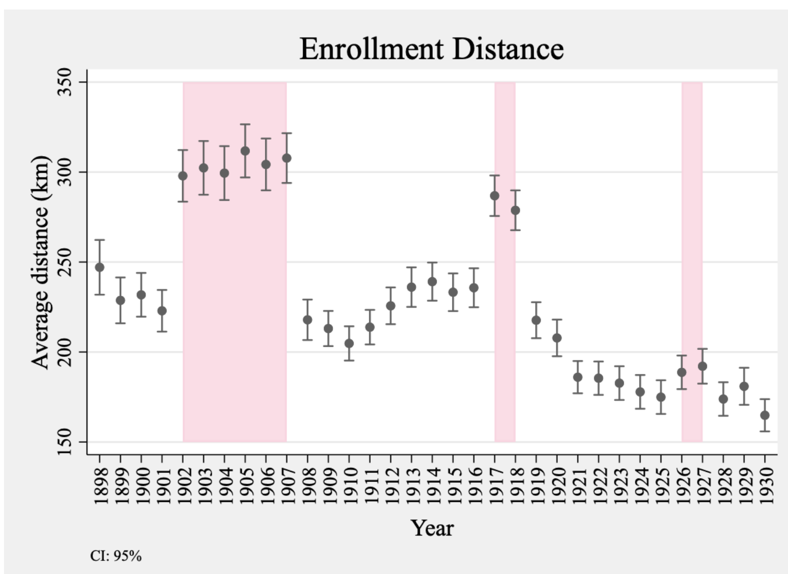
Zimmerman, Seth D. 2019. "Elite Colleges and Upward Mobility to Top Jobs and Top Incomes." *American Economic Review*, 109(1): 1–47.

Figure 1: Short-run Effects of Centralization: First Look

(a) Centralization Caused Applicants to Apply More Aggressively



(b) Centralization Increased Regional Mobility in Enrollment



Notes: Panel (a) shows the time evolution of the share of applicants who selected the most prestigious School 1 (Tokyo) as their first choice (the only choice under the decentralized admissions) in all applicants. No data are available for 1902, 1905, 1906, and 1926. Colored years (1902–07, 1917–18, and 1926–27) indicate the three periods of the centralized admission system. Bars show the 99.9 percent confidence intervals. See Section 3.2 for discussions about this figure. Panel (b) shows the time evolution of the average enrollment distance (defined by the distance between an entrant's birth prefecture and the prefecture of the school he entered). Colored years indicate the three periods of the centralized admission system. Bars show the 95 percent confidence intervals. See Section 3.3 for discussions about this figure.

Table 1: Short-run Effects of Centralization on Enrollment

(a) Centralization Broke Local Monopoly and Increased Regional Mobility across the Country

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	-26.70	-18.60	-15.67	-23.45	-27.86	-22.72	-48.25	-13.79
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
	[0.003]***	[0.022]**	[0.073]*	[0.005]***	[0.001]***	[0.073]*	[0.001]***	[0.375]
Centralized x Born near school's prefecture (1–100 km)	0.13	-2.97	-4.09	-9.41	-11.60	-2.10	-1.86	0.60
	(0.852)	(0.265)	(0.056)*	(0.004)***	(0.001)***	(0.109)	(0.000)***	(0.523)
	[0.794]	[0.037]**	[0.000]***	[0.001]***	[0.001]***	[0.021]**	[0.456]	[0.838]
Observations	1,457	1,457	1,410	1,457	1,410	1,410	1,269	1,081
Year FE, Prefecture FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	7.95	5.55	6.23	5.69	6.32	5.23	5.02	5.74
Mean dep var (School's pref. under Decentralization)	104.70	62.86	56.15	60.33	73.38	76.35	95.94	77.00
Mean dep var (Within 1–100km under Decentralization)	9.12	20.90	17.87	27.07	34.96	8.37	8.56	15.53

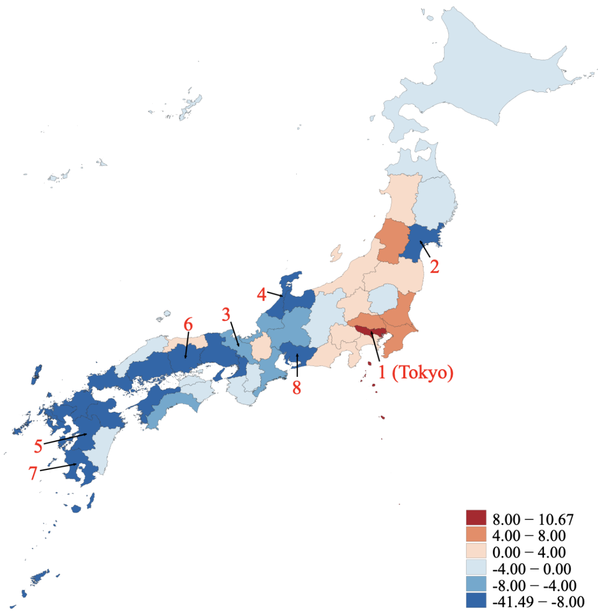
(b) Centralization Increased Tokyo-area-born Entrants to Schools 2–8

Dependent variable = No. of entrants to:	(1) All schools	(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 Tokyo prefecture	25.04	0.99	3.56	6.34	3.80	11.67	6.27	19.56
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
	[0.215]	[0.760]	[0.255]	[0.019]**	[0.028]**	[0.000]***	[0.049]**	[0.000]***
Centralized x Born near Tokyo prefecture (1–100 km)	11.81	0.17	0.76	1.95	0.55	1.11	0.53	0.57
	(0.000)***	(0.675)	(0.016)**	(0.000)***	(0.192)	(0.020)**	(0.290)	(0.365)
	[0.001]***	[0.722]	[0.001]***	[0.000]***	[0.092]*	[0.009]***	[0.307]	[0.079]*
Observations	1,457	1,457	1,410	1,457	1,410	1,410	1,269	1,081
Year FE, Prefecture FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	45.43	5.55	6.23	5.69	6.32	5.23	5.02	5.74
Mean dep var (Tokyo pref. under Decentralization)	201.10	27.52	10.85	14.48	6.10	9.200	11.72	20.21
Mean dep var (Within 1–100km from Tokyo pref. under Decentralization)	26.23	6.74	1.21	2.87	0.75	1.24	1.55	3.23

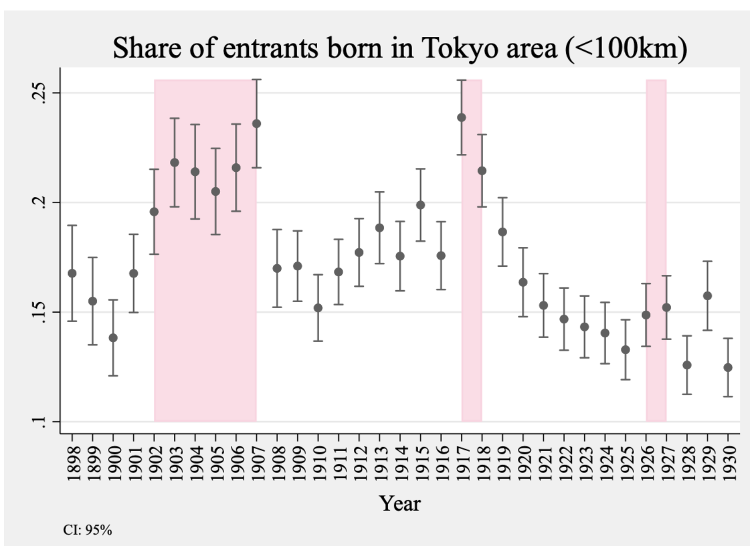
Notes: Using the prefecture-year level data in 1900–1930, we define the dependent variable as the number of entrants who were born in the prefecture and entered the school indicated in the column in each year. In both panels, we control for year fixed effects, prefecture fixed effects, the number of middle school graduates in the prefecture, and the number of higher schools other than Schools 1–8 in the prefecture. In Panel (b), we additionally control for "Born in school's prefecture" and "Born near school's prefecture (1-100 km)" as in Panel (a). "Mean dep var" shows the mean of the dependent variable during decentralization for all prefecture-year observations. "Mean dep var (school's pref. under decentralization)" shows the mean number of entrants to the school under the decentralized system, restricted to those born in the prefecture where the school is located. "Mean dep var (within 1-100km under decentralization)" shows the mean number of entrants to the school during decentralization, restricted to those born in the prefectures within 100 km (excluding the prefecture where the school is located). Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain p-values based on standard errors clustered at the year level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Sections 3.3 and 3.4 for discussions about these tables.

Figure 2: Which Regions Win from Centralization?

(a) Change in No. of Entrants to Schools 1–8 under Centralization

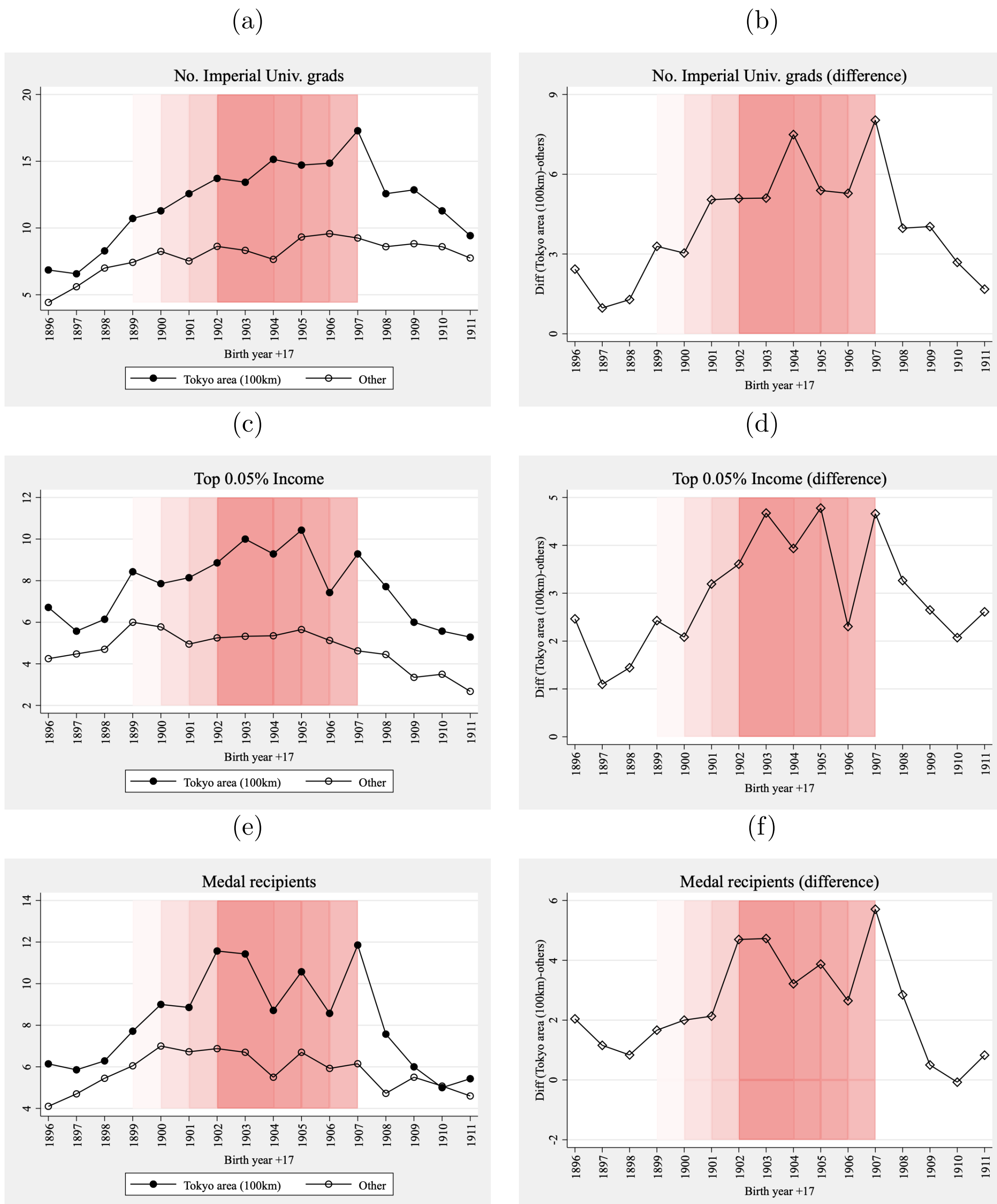


(b) Centralization Increased Tokyo-area-born Entrants to Schools 1–8



Notes: Panel (a) plots the estimated prefecture-specific coefficient β_p in $\#entrants_{pt} = \beta_p Centralized_t + \alpha_p X_{pt} + e_{pt}$, using the 1900-1930 data for each prefecture p, where $\#entrants_{pt}$ is the number of entrants in year t who were born in prefecture p and X_{pt} is the number of schools other than Schools 1–8 in prefecture p 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 100 km from Tokyo (see Appendix Figure A.2 for a map). Bars show the 95 percent confidence intervals. See Section 3.4 for discussions about this figure.

Figure 3: Long-run Impacts of Centralization: Geographical Origins of Career Elites



Notes: This figure shows difference-in-differences plots that compare the average number of elites born in prefectures inside and outside the Tokyo area by cohort. The plots are based on the data from the *Japanese Personnel Inquiry Records* in 1939 (JPIR 1939), which covers cohorts who were born in 1879–1894 and turned age 17 (main application age) in 1896–1911. The vertical axis shows the number of indicated elites who were born in the indicated area in the indicated cohort. The cohorts are colored according to their intensity of exposure to the centralized admissions in 1902–1907, where darker color indicates higher intensity. Because a portion of unsuccessful applicants retook the exam in subsequent years, the intensity began to increase from the cohort who turned age 17 in 1899, reaches the highest level for the cohorts who turned age 17 in 1902, and began to decline from the cohort who turned age 17 in 1904. See Section 4.1 for discussions about this figure.

Table 2: Long-run Impacts of Centralization: Difference-in-Differences Estimates

	(1) Imperial Univ. grads	(2) Top 0.01% income earners	(3) Top 0.05% income earners	(4) Medal recipients	(5) Corporate executives	(6) Top politicians & bureaucrats	(7) Imperial Univ. professors
				A. Baseline Specification			
Age 17 under centralization	3.18	0.61	1.68	2.82	1.84	0.84	0.45
× Tokyo area (<100 km)	(0.027)**	(0.016)**	(0.060)*	(0.010)***	(0.088)*	(0.002)***	(0.048)**
	[0.000]***	[0.020]**	[0.008]***	[0.001]***	[0.045]**	[0.016]**	[0.131]
				B. With Control Variables			
Age 17 under centralization	1.93	0.52	1.59	2.44	1.57	0.63	0.41
× Tokyo area (<100 km)	(0.002)***	(0.025)**	(0.026)**	(0.002)***	(0.071)*	(0.001)***	(0.037)**
	[0.014]**	[0.017]**	[0.007]***	[0.000]***	[0.040]**	[0.041]**	[0.123]
				C. Bidirectional Specification with Control Variables			
Age≤17 in 1902	1.31	0.68	1.90	2.00	2.44	0.43	0.32
× Tokyo area (<100 km)	(0.165)	(0.078)*	(0.006)***	(0.004)***	(0.057)*	(0.010)***	(0.136)
	[0.034]**	[0.049]**	[0.006]***	[0.003]***	[0.023]**	[0.170]	[0.223]
Age≤17 in 1908	-2.59	-0.36	-1.26	-2.91	-0.64	-0.83	-0.50
× Tokyo area (<100 km)	(0.001)***	(0.022)**	(0.183)	(0.004)***	(0.338)	(0.006)***	(0.018)**
	[0.005]***	[0.131]	[0.021]**	[0.008]***	[0.488]	[0.032]**	[0.079]*
				D. Centralization Exposure with Control Variables			
Cohort's exposure to centralization	2.03	0.64	1.73	2.51	1.73	0.60	0.47
× Tokyo area (<100 km)	(0.001)***	(0.008)***	(0.020)**	(0.002)***	(0.024)**	(0.006)***	(0.050)*
	[0.005]***	[0.001]***	[0.007]***	[0.004]***	[0.055]*	[0.017]**	[0.126]
Observations	705	705	705	705	705	705	705
Birth cohort FE, Birth pref. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	8.77	1.24	5.19	6.21	7.99	1.34	0.74
Mean dep var (Tokyo area under decentralization)	10.62	1.51	6.75	6.86	11.21	1.25	0.87

Notes: This table shows difference-in-differences estimates of the long-run effects of the centralized admissions on the geographical origins of career elites. We construct prefecture-cohort level data by counting the number of individuals specified in (1)–(7) by birth prefecture and birth cohort (born in 1880–1894). "Imperial University grads" are individuals whose final education is Imperial University. "Top 0.01% (or 0.05%) income earners" are individuals whose income is above the 99.99th (or 99.95th) percentile of the national income distribution. "Medal recipients" are civilian individuals who received either the medal of the Fifth Order of Merit and above, or the court rank of the Junior Fifth Rank and above. "Corporate executives" are individuals who hold an executive position in a corporation and pay a positive amount of national tax. "Top politicians & bureaucrats" are individuals who are Imperial Diet members or high-ranking central government officials. "Imperial University professors" are Imperial University professors or associate professors. "Age 17 under centralization" is the indicator variable that takes 1 if the cohort became age 17 (main application age) under the centralized admissions in 1902–07. "Age≤17 in 1902 (or 1908)" is the indicator variable that takes 1 if the cohort turned 17 years old in 1902 (or 1908) or later. "Mean dep var" is the mean of the dependent variable for all prefecture-cohort observations, and "Mean dep var (Tokyo area under decentralization)" is that for the Tokyo area under the decentralized admissions. "Cohort's exposure to centralization" is each cohort's intensity of exposure to the centralized admissions in 1902–07. In Panels B, C, and D, 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 turned eligible age, the number of middle-school graduates in the prefecture in the year when the cohort turned age 17, log of GDP of the prefecture when the cohort turned age 20, and the birth population of the cohort in the prefecture. Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain wild cluster bootstrap p-values based on standard errors clustered at the cohort level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 4.1 for discussions about this table.

Table 3: Long-run Impacts of Centralization: Destinations of Career Elites

	(1) Imperial Univ. grads	(2) Top 0.01% income earners	(3) Top 0.05% income earners	(4) Medal recipients	(5) Corporate executives	(6) Top politicians & bureaucrats	(7) Imperial Univ. professors
			A. Baseline Specification				
Age 17 under centralization	4.20	0.48	2.03	3.11	3.47	0.61	0.82
× Tokyo area (<100 km)	(0.060)*	(0.151)	(0.320)	(0.056)*	(0.238)	(0.000)***	(0.135)
	[0.000]***	[0.154]	[0.060]*	[0.005]***	[0.003]***	[0.077]*	[0.029]**
			B. Adding Control Variables				
Age 17 under centralization	3.16	0.74	2.44	2.90	3.64	0.41	0.56
× Tokyo area (<100 km)	(0.021)**	(0.221)	(0.263)	(0.038)**	(0.223)	(0.017)**	(0.031)**
	[0.008]***	[0.010]***	[0.012]**	[0.010]***	[0.002]***	[0.122]	[0.105]
Observations	705	705	705	705	705	705	705
Birth cohort FE, Pref. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	8.30	1.21	5.08	5.88	7.74	1.27	0.70
Mean dep var (Tokyo area under decentralization)	14.73	2.46	9.60	9.64	15.54	2.14	1.10

Notes: This table shows difference-in-differences estimates of the long-run effects of the centralized admission system on the geographical destinations of career elites. We count the number of elites who reside in each prefecture in 1939 by birth cohort (born in 1880–1894). Unlike the previous tables, all outcome variables are measured at the prefecture of residence. In Panel B, 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 turned age 17, the number of middle-school graduates in the prefecture in the year when the cohort turned age 17, log GDP of the prefecture when the cohort turned age 20, and birth population of the cohort in the prefecture. Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain wild cluster bootstrap p-values based on standard errors clustered at the cohort level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 4.1 for discussions about this table.

Table 4: Long-run Impacts of Centralization: National Production of Top Government Officials

(a) Passers of the Higher Civil Service Exams

	(1) Exam passers	(2) Exam passers graduated from School 1 (Tokyo)	(3) Exam passers graduated from Schools 2–8	(4) Exam passers not graduated from Schools 1–8
Centralized	5.96	-2.81	14.93	-12.11
	(0.802)	(0.221)	(0.014)**	(0.044)**
Higher Civil Service Exam passers		0.10	0.35	0.55
		(0.000)***	(0.000)***	(0.000)***
Observations	33	33	33	33
Mean dep var	189.55	37.29	68.47	83.80
Mean dep var (decentralization)	194.22	37.96	64.09	92.17

(b) Top-Ranking Higher Civil Officials

	(1) Top-ranking officials	(2) Top-ranking officials graduated from School 1 (Tokyo)	(3) Top-ranking officials graduated from Schools 2–8	(4) Top-ranking officials not graduated from Schools 1–8	(5) Top-ranking officials graduated from Schools 2–8	(6) Top-ranking officials graduated from Schools 2–8 and Tokyo Imperial Univ.
Centralized	4.19	-0.48	5.22	-0.55	2.72	1.76
	(0.006)***	(0.648)	(0.000)***	(0.596)	(0.000)***	(0.039)**
Higher Civil Service Exam passers	0.10	0.02	0.05	0.03		
	(0.000)***	(0.056)*	(0.003)***	(0.000)***		
Exam passers graduated from Schools 2-8					0.17	
					(0.000)***	
Exam passers graduated from Schools 2-8 and Tokyo Imperial Univ.						0.19
						(0.000)***
Observations	33	33	33	33	33	33
Mean dep var	29.77	8.27	12.97	8.53	12.97	11.82
Mean dep var (decentralization)	28.66	8.30	11.22	9.14	11.22	10.00

Notes: Panel (a) shows OLS estimates of the effects of the centralized admissions on the number of individuals who passed the administrative division of the Higher Civil Service Exams (administrative HCSE). Panel (b) shows OLS estimates of the effects of the centralized admissions on the number of top-ranking higher civil officials. The estimates are based on the cohort level data, 1898–1930, where cohort is defined by the year of entering a higher school or its equivalent. The data are compiled from the complete list of individuals who have passed the administrative HCSE in 1894–1941 and their biographical information. "Higher Civil Service Exam passers" or "Exam passers" is the number of individuals in cohort t who passed the administrative HCSE. "Top-ranking officials" is the number of top-ranking officials in cohort t (i.e., the number of individuals who entered a higher school or its equivalent in year t, passed the administrative HCSE, and were internally promoted to the top three ranks of higher civil service in their lifetime). "Centralized" is the indicator variable that takes 1 if cohort t entered a higher school or its equivalent under the centralized admissions in 1902–07, 1917–18, and 1926–27. "Mean dep var (decentralization)" is the mean of the dependent variable for the cohorts who entered a higher school or its equivalent under the decentralized admissions. In all regressions, we control for quadratic time trends. Parentheses contain P values based on Newey-West standard errors with the maximum lag order of 3. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 4.2 for discussions about this table.

A Online Empirical Appendix

A.1 Data for the Short-run Analysis

To analyze short-run effects of the centralized admissions (Capp), we collect data on application and enrollment outcomes for Schools 1–8 by newly digitizing several administrative and non-administrative sources. Descriptive statistics of main variables are presented in Appendix Table A.1.

A.1.1 Data on Application Behavior

First, we collect data on the number of applicants by school of their first choice (hereafter first-choice school) for 1900–1930 from the following sources: *Ministry of Education Yearbook* (*Monbushou Nenpou* in Japanese) for 1900, 1901, 1908–1916, 1919–1925, and 1928–1930;[33] Correspondences from the Ministry of Education to the Tokyo Imperial University for 1903 and 1904;[34] the entrance exam preparation magazine called *Middle School World* (*Chugaku Sekai* in Japanese), vol.10, no.12, for 1907; and *Higher School Entrance Examination Investigation Report* (*Koutou Gakkou Nyugaku Shiken ni kansuru Shochousa* in Japanese) by the Ministry of Education for 1917, 1918 and 1927;[35] no data are available for 1902, 1905, 1906, and 1926. First-choice school is defined as the school to which an applicant applied under the decentralized admission system (Dapp) and the school which an applicant ranked as his first choice under the centralized admission system (Capp). We compute the share of applicants who choose School 1 as their first choice using these data (Figure 1a). In addition, we collect data on the number of entrants by school for 1900–1930 from *Ministry of Education Yearbook* and compute the ratio of first-choice applicants to entrants for each school (Appendix Figure A.4).

Taking advantage of more detailed data in a supplementary volume of *Higher School Entrance Examination Investigation Report* of 1917, we collect data on the number of applicants by their first-choice school and by their middle-school prefecture for 1916 and 1917. Middle-school prefecture is defined as the prefecture in which an applicant's middle school is located. Japan consists of 47 prefectures that form the first level of sub-national administrative unit, and the finest geographical unit of observation in our data is prefecture. To measure the geographical mobility of applicants, we define application distance (i.e., the distance between an applicant's middle school and his first-choice school) by the direct (straight-line) distance between the capital of the prefecture in which his middle school is located and the capital of

[33]Digital images are available online at the National Diet Library Digital Collections.
[34]Digital images are available online at the University of Tokyo Digital Archives.
[35]Digital images are available online at the National Diet Library Digital Collections.

the prefecture in which his first-choice school is located. The distance data are provided by the Geospatial Information Authority of Japan. These data are used to examine the impact of centralized admissions on (a) the share of applicants whose first choice is School 1 and (b) the application distance by regions (Appendix Table A.2). We also collect information on admission results, such as the maximum and minimum exam scores of successful applicants by school and by their school preference order, from the supplementary volume of *Higher School Entrance Examination Investigation Report* of 1917 (Appendix Table **??**).

A.1.2 Data on Enrollment

To analyze enrollment outcomes, we use *Higher School Student Registers* (*Gakkou Ichiran* in Japanese) published annually by Schools 1–8.[36] For each school, as a proxy for the number of entrants, we collect data on the number of first-year students in the university preparatory course (*daigaku yoka* in Japanese). Our data starts in 1896 for Schools 1, 2, 4, and 5, 1897 for School 3, 1900 for School 6, 1901 for School 7, and 1908 for School 8, reflecting the year of establishment for each school (School 3 was established in 1896, but the university preparatory course started in 1897).[37] Birth prefecture is the prefecture of a student's legal domicile (*honsekichi* in Japanese) recorded in the official family registry system (*koseki* in Japanese). We include students born in all 47 prefectures, but exclude foreign-born students and students born in colonies.

To measure the geographical mobility of entrants, we define enrollment distance (i.e., the distance between an entrant's birth prefecture and the school he entered) by the direct distance between the capital of the birth prefecture and the capital of the prefecture in which the school he entered is located (Figure 3 1b). The distance data are provided by the Geospatial Information Authority of Japan.

To analyze the impact of centralized admissions on the geographical composition of entrants (Figure 2a, Figure 2b, and Table 1), we control for the size of potential applicants and the number of competing schools in each prefecture, using the following variables. From *Ministry of Education Yearbook*, we collect data on the number of middle-school graduates (including both public and private schools) by prefecture (defined by school location) [38] as well as the number of higher schools (including national, public, and private schools) by prefecture (defined by school location) for 1900–1930. The total number of higher schools increased from 8 (consisting of 8 national schools) in 1918 to 32 (consisting of 25 national, 3 public, and 4 private schools) in 1930. The Tokyo area is defined by seven prefectures located

[36]Digital images are available online at the National Diet Library Digital Collections.

[37]The data is missing in the following years: 1929 for School 3, 1904 and 1907 for School 5, 1920 for School 6, and 1909 for School 7.

[38]The data on middle-school graduates is missing for 1920 and is linearly interpolated.

within 100 km from Tokyo (i.e., Chiba, Gumma, Ibaraki, Kanagawa, Saitama, Tochigi, and Tokyo prefectures) measured by the distance between two prefectural capitals (Appendix Table A.2).

To analyze why the Tokyo area has a greater number of entrants during the centralized admissions, in addition to the number of middle-school graduates by prefecture, we control for prefecture-level population and GDP per capita. For GDP per capita, we use prefecture-level gross real value-added per capita estimates in 1890, 1909, 1925, and 1935 (expressed in 1934–36 constant prices) in the revised 2021 version of Tangjun et al. (2009) data (downloaded from "Database on Gross Prefectural Product in Prewar Japan" in the online databases at the Institute of Economic Research at Hitotsubashi University website in January 2021) and interpolate them linearly for each prefecture to obtain annual estimates for 1900–1930. Prefecture-level population estimates for 1900–1940 are provided by the authors of Tangjun et al. (2009) who produced annual population estimates to compute per capita gross prefectural products. Prefecture-level data on the share of applicants to School 1 in all applicants during the decentralized admissions is available only for 1916 (reported in the supplementary volume of *Higher School Entrance Examination Investigation Report* of 1917). The result of our analysis is presented in Table A.5.

Finally, to test the exogeneity of the timing of admission reforms, in addition to the data collected above, we collect data on the mean age of entrants for 1905–1930 from *Ministry of Education Yearbook*.[39] We also collect data on government expenditures on national higher education (the sum of ordinary and extraordinary expenditures spent on National Higher Schools and imperial universities) for 1900–1930 from *Ministry of Education Yearbook*. Our analysis is presented in Appendix Table A.6.

A.2 Data for the Long-run Analysis

To assess long-run effects of the centralized admission system (Capp), we provide two sets of empirical analyses. In the first analysis, we compile prefecture-cohort level data of career elites using Who's Who publications and compare career outcomes of urban- and rural-born individuals across birth cohorts that differed in their exposure to Capp. In the second analysis, we construct cohort level data of central government officials using the complete list of individuals who have passed the Higher Civil Service Examinations and compare promotion outcomes of these individuals across cohorts that differed in their exposure to Capp. Descriptive statistics of main variables are presented in Appendix Table A.1.

[39]No data on the mean age of entrants is available for 1900–1904.

A.2.1 Data on the Regional Distribution of Career Elites

Japanese Personnel Inquiry Records (JPIR) data

In the first set of long-run analysis, to measure students' career outcomes, we use *Japanese Personnel Inquiry Records* (*Jinji Koushin-roku* in Japanese), an equivalent of Who's Who in Japan, which compiles a highly selective list of "socially distinguished individuals" (*shakai-teki meishi* in Japanese) and provides their biographical information. We use the 1939 edition of the JPIR in our main analysis and the 1934 edition for a supplementary analysis.[40] The 1939 edition of the JPIR lists approximately 56,000 individuals (about 0.15% of adult Japanese population), while the 1934 edition lists approximately 26,000 individuals.

In selecting the socially distinguished individuals, the JPIR refers to multiple sources such as the government personnel directory (*Shokuin-roku* in Japanese), the directories of banks and companies (*Teikoku Ginkou Kaisha Youroku* and *Zenkoku Ginkou Kaisha Youroku* in Japanese), the directory of the national chamber of commerce and industry members (*Zenkoku Shoukou Kaigisho Giin Meibo* in Japanese), and the directory of Japanese notables (*Nihon Shinshi-roku* in Japanese) (see JPIR 1934, p.2, for details).[41] The government personnel directory provides a complete list of public servants (and their job titles and ranks) in national and local governments, including the national diet members, civil and military officials, and Imperial University professors. One of the directories of banks and companies provides a complete list of directors of banks and companies whose capital is 300,000 yen or above (*Teikoku Ginkou Kaisha Youroku* 1938, p.2). The directory of Japanese notables includes "wealthy persons" (*shisanka* in Japanese, defined by individuals who paid income tax of 80 yen or greater or business tax of 70 yen or greater) living in urban areas in 24 prefectures (out of 47 prefectures) in Japan (*Nihon Shinshi-roku*, 1938, p.i). The JPIR also lists imperial and peerage family members, but we exclude theses individuals as our analysis focuses on career elites.

We use the following information from the JPIR for each individual: full name, birth year, birth prefecture, the prefecture of residence, final education, occupation titles and organization names, corporation type (if organization is incorporated), the medal for merit and the court rank awarded (if any), and the amounts of national income tax and business tax paid in the previous year (if any). To check for accuracy, the JPIR verifies the information of birth date and birth prefecture for each individual by obtaining a transcript of the official family register (JPIR 1934, p.2).

To capture the effects of the first period of Capp in 1902–1907, we focus on the cohorts

[40]Digital images of the JPIR are available online at the National Diet Library Digital Collections. We thank Hidehiko Ichimura and Yasuyuki Sawada for sharing their digitized the JPIR data.

[41]Digital images of these directories are available online at the National Diet Library Digital Collections.

born in 1880–1894, who turned 17 years old (the age eligible for higher school application) in 1897–1911. These cohorts were 45 to 59 years old in 1939. The average life expectancy at age 20 for males born in the 1880s was about 40 years. The number of individuals listed in JPIR (1939) in each of these cohorts is about 1,800.

Defining the Groups of Career Elites

We define the following (mutually non-exclusive) groups of elites among the individuals listed in the JPIR: (1) Imperial University graduates (individuals whose final education institution is an Imperial University), (2) top 0.01% and 0.05% income earners (individuals whose taxable income is above the 99.99th and 99.95th percentile, respectively, of the national income distribution), (3) prestigious medal recipients (civilian individuals who are awarded either the imperial medal of the Fifth Order of Merit or above, or the court rank of the Junior Fifth Rank or above), (4) corporate executives (individuals holding an executive position in a corporation in the private sector with a positive amount of income tax or business tax payment), (5) top politicians and bureaucrats (individuals whose occupation is either Imperial Diet member, Cabinet member, or high-ranking central government official), (6) Imperial University professors (individuals whose occupations include either professor or associate professor at an Imperial University), (7) landlords (individuals whose occupations include landlord, but excluding the top 0.05% income earners, prestigious medal recipients, corporate executives, top politicians and bureaucrats, and Imperial University professors) and (8) other elite professionals (individuals whose occupations include scholar, engineer, physician, or lawyer).

To define the top 0.01% income earners, following Moriguchi and Saez (2008), we use the number of income tax payers and the amount of income tax paid by income bracket from *Tax Bureau Statistical Yearbook* (*Shuzei-kyoku Toukei Nenpousho* in Japanese)[42] and the number of adults from the population census to compute the threshold (99.99th percentile) value of income tax payment. Using Pareto interpolation, the threshold income tax payment for the top 0.01% in 1938 is estimated to be 9,972 yen. This is equivalent to around 50,000 yen of taxable income, which is well over 50 times the estimated mean household income (Yazawa, 2004). In 1938, the share of national income accrued to the top 0.01% is as high as 3.8% of national income in Japan, indicating a high degree of income concentration comparable to that in the U.S. in the 1930s (Moriguchi and Saez, 2006, Table A1). Similarly, the threshold income tax payment for the top 0.05% income earners is estimated to be 2,135 yen, which is equivalent to 16,950 yen of taxable income.

In the pre-WWII Japanese honor system, the the medals for merit (*kuntou* in Japanese)

[42] Digital images are available online at the National Diet Library Digital Collections.

and the court ranks (*ikai* in Japanese) were conferred on individuals in recognition of their exceptional public service or distinguished merit. The medals consisted of 8 grades from the First Order of Merit (the highest honor) to the Eighth Order of Merit (the lowest honor), and the court ranks consisted of 16 ranks from the Senior First Rank (the highest rank) to the Junior Eighth Rank (the lowest rank). According to Ogawa (2009), the highest honors are given mostly to public servants (such as top-ranking military officers, bureaucrats, and politicians), while individuals in a private sector (such as top corporate executives) receive the Fourth Order of Merit and below. Given this, we define prestigious medal recipients as those who receive at least the Fifth Order of Merit (*kun-gotou* in Japanese) or the Junior Fifth Rank (*ju-goi* in Japanese).

To determine individual's occupations, we search if a set of specific Japanese characters that signify a given occupation are found in one's occupational titles and organization names. The precise definitions of corporate executives, top politicians and bureaucrats, Imperial University professors, landlords, scholars, engineers, physicians, and lawyers are provided in Appendix Table A.7.

Control Variables

In the regression analysis presented in Table 2 Panels B, C, and D, we control for time- and cohort-varying prefecture characteristics for the cohorts born in 1880–1894. For the robustness check to test the parallel trend assumption (Appendix Table A.11), we also use the cohorts born in 1874–1883.

First, to control for local educational conditions, we collect data on the number of primary schools and the number of middle-school graduates by prefecture (defined by school location) in the year when the cohort turns eligible age of 6 and 17, respectively, from *Ministry of Education Yearbook*. Second, to control for local economic conditions, we take prefecture-level real GDP estimates in 1874, 1890, 1909, and 1925 (expressed in 1934–36 yen) from the revised 2021 version of Tangjun et al. (2009) data (see above) and interpolate them linearly for each prefecture to obtain the value in the year when the cohort turns age 20.

Third, to control for local demographic changes, we estimate the prefecture-level male birth population of the cohorts born in 1874–1894 using the following data sources: (a) *Japanese Population Census* (*Nihon Zenkoku Kokou-hyo* in Japanese) in 1880–1892 that provides the number of male births by prefecture in each year and (b) *Japanese Imperial Population Census* (*Nihon Teikoku Minseki Kokou-hyou* in Japanese) in 1886 that provides the age-specific population by prefecture (from which we use the population of males who were born in 1874–1885 and were 1–12 years old in 1886).[43] For the cohorts born in 1874–

[43] Digital images of population censuses are available online at the National Diet Library Digital Collections.

1879, we estimate their birth population combining (a) and (b) as follows. Specifically, for the cohorts born in 1880–1886, we define the survival rate of cohort c up to 1886 in prefecture j by the number of age-specific population of cohort c in 1886 from (b) divided by the number of births of cohort c from (a). Then, using the data of these cohorts, we estimate the following equation using OLS:

$$Ln(Survival_{jc}) = \phi_j Age_c + \theta Age_c^2 + \epsilon_{jc}, \tag{2}$$

where Age_c is the age of cohort c in 1886. Using the estimated coefficients, we predict the log of survival rates up to 7–11 years old in each prefecture. The birth population of cohorts born in 1875–1879 is obtained by

$$Ln(Birth\_Population_{jc}) = Ln(Population_{jc}^{1886}) - Ln(\hat{Survival}_{jc}). \tag{3}$$

where $Population_{jc}^{1886}$ is the population of cohort c in 1886. There are several prefectures whose boundaries changed between 1874 and 1886, however. For these prefectures, we use birth population data in 1887–1892 to estimate the linear time trend of male birth population for each prefecture and impute the data prior to 1886. For the cohorts born in 1893 and 1894, we do not have data for their birth population by prefecture. Therefore, we impute them by the average birth population in the prefecture in 1891 and 1892.

Estimating the Intensity of Exposure to Capp

Before 1918, the qualifications for the higher school entrance exam were male middle-school graduates who were at least 17 years old. Accordingly, applicants typically took the exam for the first time at age 17. Given this, in the regression analyses in Table 2 Panels A–C, Table A.13, and Table 3, we simply assume that, among cohorts who were born in 1880–1894 and turned age 17 in 1897–1911, only the cohorts who turned age 17 during the first period of centralized admissions (Capp) in 1902–1907 were fully exposed to Capp, while the rest of the cohorts were fully exposed to Dapp.

Precisely speaking, however, a nontrivial number of unsuccessful applicants retook the exam multiple times in the subsequent years at age greater than 17. For this reason, we also estimate each cohort's intensity of exposure to Capp that takes into account the presence of exam re-takers as follows. We use a special table in *Government Gazette* No.5838 (published in December 17, 1902) that reports the number of applicants and the number of admitted applicants in 1902 by the year of middle-school graduation. According to the table, 63.9% of the applicants in 1902 graduated from middle schools in 1902 (the same year), 27.3% in 1901 (the previous year), 7.2% in 1900 (two years before), 1.3% in 1899 (three years before), 0.2%

in 1898 (four years before), and 0.1% in 1897 (five years before), indicating that applicants were retaking the exam up to six times.

We estimate two sets of parameters from the 1902 data to compute the total number of exams taken and the number of exams taken under Capp for each cohort, where cohort is defined by the year of middle-school graduation. The first set of parameters is the probability of passing the exam in year t for applicants in cohort c who have taken the exam n times before year t, denoted by a_n^t (where $n = 0, ..., 5$ and $t = 1896, ..., 1911$). Note that the subscript for cohort c is suppressed because $c = t - n$. The second set of parameters is the probability of applicants (who have taken the exam n times) retaking the exam in year $t+1$ conditional on failing the exam in year t, denoted by r_n^t. Because we only have the data for a single year, we assume that these parameters are constant across years (and therefore expressed as a_n and r_n) and that the cohort size is constant across cohorts. Under these assumptions, the probability of passing the exam is estimated to be $a_0 = 0.352$, $a_1 = 0.377$, $a_2 = 0.313$, $a_3 = 0.286$, $a_4 = 0,429$, $a_5 = 0.200$, and the probability of retaking the exam is estimated to be $r_0 = 0.660$, $r_1 = 0.423$, $r_2 = 0.255$, $r_3 = 0.175$, $r_4 = 0.011$, $r_5 = 0.000$.

Using these parameters, we make a simulation to count the total number of exams taken by each cohort and compute the share of the exams taken under Capp, which we define as the intensity of exposure to Capp. Finally, we assume that all cohorts graduated from middle-schools at age 17 (so that birth cohorts and cohorts defined by the year of middle-school graduation coincide). The estimated intensity of exposure to Capp is 0.00, 0.02, 0.09, 0.36, 1.00, 0.98, 0.91, 0.64, and 0.00 for the cohort who turned age 17 in 1896–98, 1899, 1900, 1901, 1902–04, 1905, 1906, 1907, and 1908–11, respectively. We color cohorts according to their intensity of exposure to Capp in Figure 3 and Appendix Figures A.7, A.12, and A.13. We also use the estimated intensity of exposure in the regression analyses in Table 2 Panel D and Appendix Table A.16.

A.2.2 Data on the National Production of Government Officials

In the second set of long-run analysis, we focus on a specific group of career elites, higher civil officials, for whom we have complete count data.

Higher Civil Service Examinations (HCSE) data

Our main data source is Hata (1981), which provides not only the list of all individuals who passed the Higher Civil Service Examinations (HCSE, *Bunkan Koutou Shiken* in Japanese) but also their biographical information available as of 1981 (Hata, 1981, Section 3). The HCSE were highly selective national qualification exams held annually from 1894 to 1947. The 1893 ordinance mandated that one must pass the HCSE for any appointment in the administrative division of higher civil service, although there were some exceptions for special appointments (Spaulding, 1967, Chapter 25; Shimizu, 2019, Chapter 5). The administrative division of the HCSE consisted of two parts: the preliminary exams and the main exams. Until 1922, graduates of the law departments of imperial universities were exempted from the preliminary exams, but had to take the main exams (Hata, 1981, pp.663-666; Spaulding, 1967, Chapter 12).

We newly digitized the information of all individuals who passed the administrative division of the HCSE in 1894–1941, including their full name, education, year of university graduation, year of passing the HCSE, starting position, final position, year of retirement, and other notable positions held. Because education includes not only final education, but also the second to final education, unlike the JPIR data, we observe both university and higher school (or its equivalent) in the HCSE data. Unlike the JPIR data, however, birth year and birth prefecture are missing in the HCSE data.

In the bureaucracy system in Japan, the higher civil service refers to the top ten ranks of national government offices in the administrative, judicial, and diplomatic divisions. Within the higher civil service, the top three ranks were distinctively called "imperial appointees" (*chokunin-kan* in Japanese) during the prewar period. The first rank consisted of minister level positions, and the second and third ranks consisted of vice minister level positions such as vice minister, director general, bureau chief, and prefectural governor (*fuku-daijin, jikan, kyokuchou*, and *chiji* in Japanese). The correspondence between civil service positions and their ranks was reported in the section of salary tables in the government personnel directory (*Shokuin-roku* in Japanese).

We define "top-ranking officials" as higher civil officials who were internally promoted to reach one of the top three ranks by the end of their career. More precisely, we define "top-ranking officials" as higher civil officials (a) whose final position was in the top three ranks excluding postwar governorship and (b) whose final and notable positions do not include positions in the first rank (i.e., minister-level positions). We exclude postwar governors from top-ranking officials, because starting in 1947 governors were no longer internally promoted but selected by direct election. We further exclude higher civil officials who were appointed to any minister-level positions, because these positions were filled by political appointments and not by internal promotion. See Spaulding (1967) and Shimizu (2019) for the establishment of a meritocratic system of internal promotion in prewar Japan.

Defining Cohorts (by the year of entering a higher school or its equivalent)

To identify each individual's exposure to the centralized admission system (Capp), we must find out in which year each individual had taken the entrance exam and entered a higher school (or failed and entered an alternative school). However, since we only observe the year of university graduation in the HCSE data, we estimate "the year of entering a higher school or its equivalent" separately for (1) top-ranking officials who graduated from one of Schools 1–8 (and an imperial university), (2) officials who graduated from one of Schools 1–8 (and an imperial university) but are not top-ranking officials, and (3) the rest of officials (who did not graduate from Schools 1–8), as follows.

First, for top-ranking officials who graduated from Schools 1–8, we find the exact year by searching each individual's full name in the list of first-year students in the Student Registers of Schools 1–8 in all editions. The exact match was found for 699 out of 733 individuals with a matching rate of 95.1%. For these individuals, in Appendix Figure A.8, we plot the number of years taken from entering Schools 1–8 to university graduation by cohort (defined by the year of university graduation) using a round marker. Because higher school and imperial university were both three-year programs, in principle one could complete both programs in 6 years. However, it was quite common for students to repeat the same year in both higher school and imperial university, especially in the earlier period when there was a strict system of holding back students who failed year-end exams. As a result, as the figure indicates, it took substantially longer than 6 years on average to complete both programs especially for the earlier cohorts.

Second, for non top-ranking officials who graduated from Schools 1–8, we assume that the distribution of the number of years taken from entering Schools 1–8 to university graduation is the same as that of the top-ranking officials (who graduated from Schools 1–8) of the same cohort (defined by the year of university graduate) computed above. To check the validity of this assumption, for two representative cohorts of 1914 and 1922, we randomly select 25% of the non top-ranking officials (who graduated from Schools 1–8) from each cohort and find the exact year of entering a higher school for each individual using the same method of searching a full name in the Student Registers. In Appendix Figure A.8, we plot the average number of years taken from entering Schools 1–8 to university graduation for each subsample in 1914 and 1922 using a diamond marker. It shows that the average number is not significantly different between top-ranking and non top-ranking officials (i.e., both numbers are mutually within the 95% confidence intervals) in both 1914 and 1922.

Third, for the officials who are not Schools 1–8 graduates, we simply assume that the year of entering a higher school or its equivalent is "the year of university graduation minus 6." Because the number of National Higher Schools increased from 8 in 1918 to 25 by 1925, this group includes the officials who graduated from a higher school other than Schools 1–8 and an imperial university, as well as the officials who graduated from private higher education institutions (e.g., Waseda or Meiji University and its affiliated high school). In either case, most universities and higher schools or their equivalent were three-year programs. For a robustness check, we alternatively assume that the year of entering a higher school or its equivalent is "the year of university graduation minus 7" and show that the empirical results are qualitatively the same (see the Appendix Table A.12 A.14).

To proceed to an empirical analysis, we redefine cohort by "the year of entering a higher school or its equivalent" estimated above (so that we can see which cohorts are exposed to Capp as opposed to Dapp). That is, to create cohort-level data, we count the number of exam passers (i.e., those who passed the administrative division of the HCSE) and the number of top-ranking officials by the year in which they entered a higher school or its equivalent. Our dataset consists of 6,255 individuals who entered a higher school or its equivalent in 1898–1930 and passed the HCSE in 1901–1941. Descriptive statistics of main variables are summarized in Appendix Table A.1.

Out of 6,255 exam passers, 3,490 individuals or 55.8% are Schools 1–8 graduates, 4,767 individuals or 76.2% are Imperial University graduates, and 982 individuals or 15.7% are top-ranking officials. The share of Imperial University graduates is greater than that of Schools 1–8 graduates because the number of higher schools increased from 8 to 25 in 1919–1930. Among 982 top-ranking officials, 701 officials or 71.4% are Schools 1–8 graduates, and 891 officials or 90.7% are Imperial University graduates. The HCSE consisted of preliminary and main exams, and because Imperial University law graduates were the only group exempted from the administrative preliminary exams from 1894 to 1922, they had substantial advantages in passing the HCSE (Hata, 1981, pp.663-666; Spaulding, 1967, Chapter 12). This exemption, however, does not explain why Imperial University graduates had such a high share in the top-ranking officials.

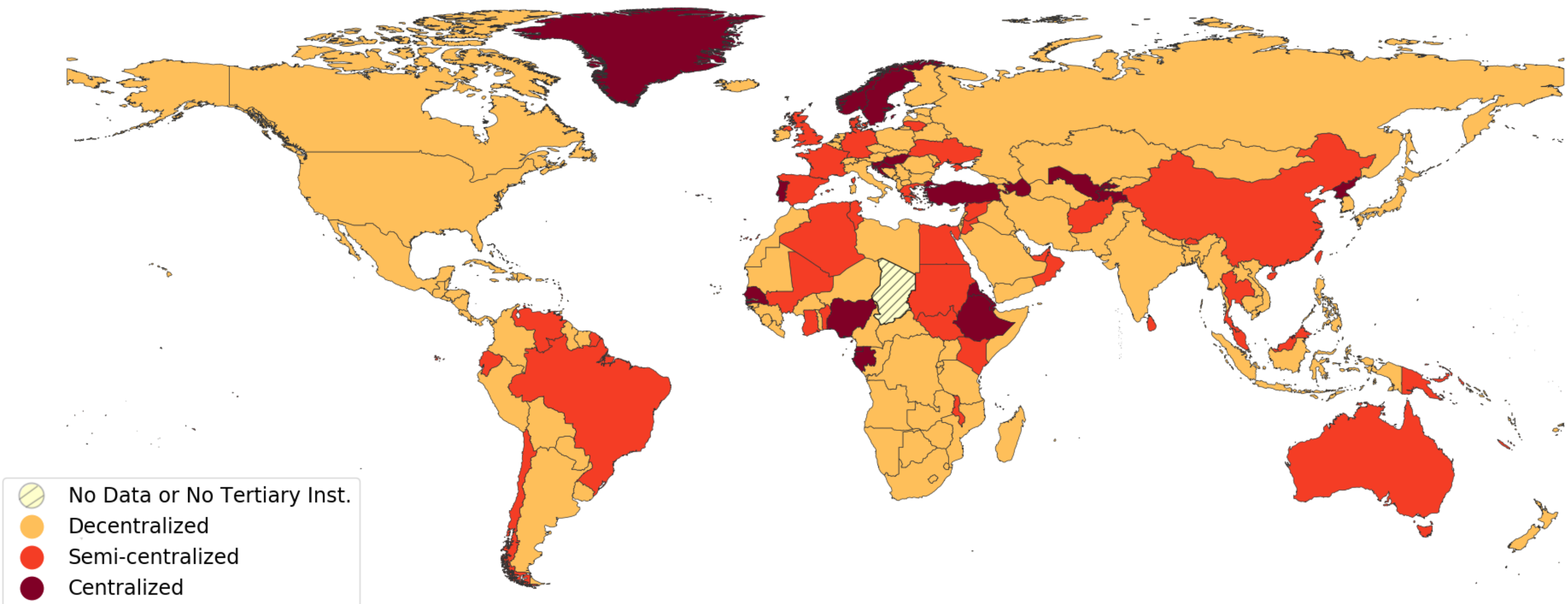
A.3 More on the National Production of Government Officials

One potential threat to our identification in Table 4 Panel (b) is a possibility that the number of available top-ranking positions happened to have increased during the periods of Capp. However, we argue that even if this was the case, it is not likely to affect our results, since our cohort is defined by the year of entering a higher school or its equivalent, and not by the year of becoming top-ranking officials. Namely, as long as individuals in a given cohort were not promoted to a top-ranking position in the same year, a potential correlation between the number of top-ranking positions and the lagged periods of centralized admissions does not bias our results.

To examine this possibility, we first randomly selected two cohorts exposed to Capp (1903 and 1916) and two cohorts exposed to Dapp (1913 and 1922). Then for all top-ranking officials who graduated from Schools 1–8 in these cohorts, we searched the years in which these officials were appointed to their first top-ranking positions. Using online searches to find biographical information for each official, we obtained necessary information for 82% of these officials. As shown in Appendix Figure A.9, within each cohort, the number of years taken from entering a higher school to the appointment for the first top-ranking position varied widely from 20 to 30 years. This within-cohort variation is a sum of the two variations, the variation in the number of years taken from entering a higher school to passing the exams and the variation in the number of years taken from passing the exams to becoming a top-ranking official. Therefore, it is unlikely that the result in Table 4 Panel (b) is driven by a greater number of available top-ranking positions that coincided with the periods of Capp.

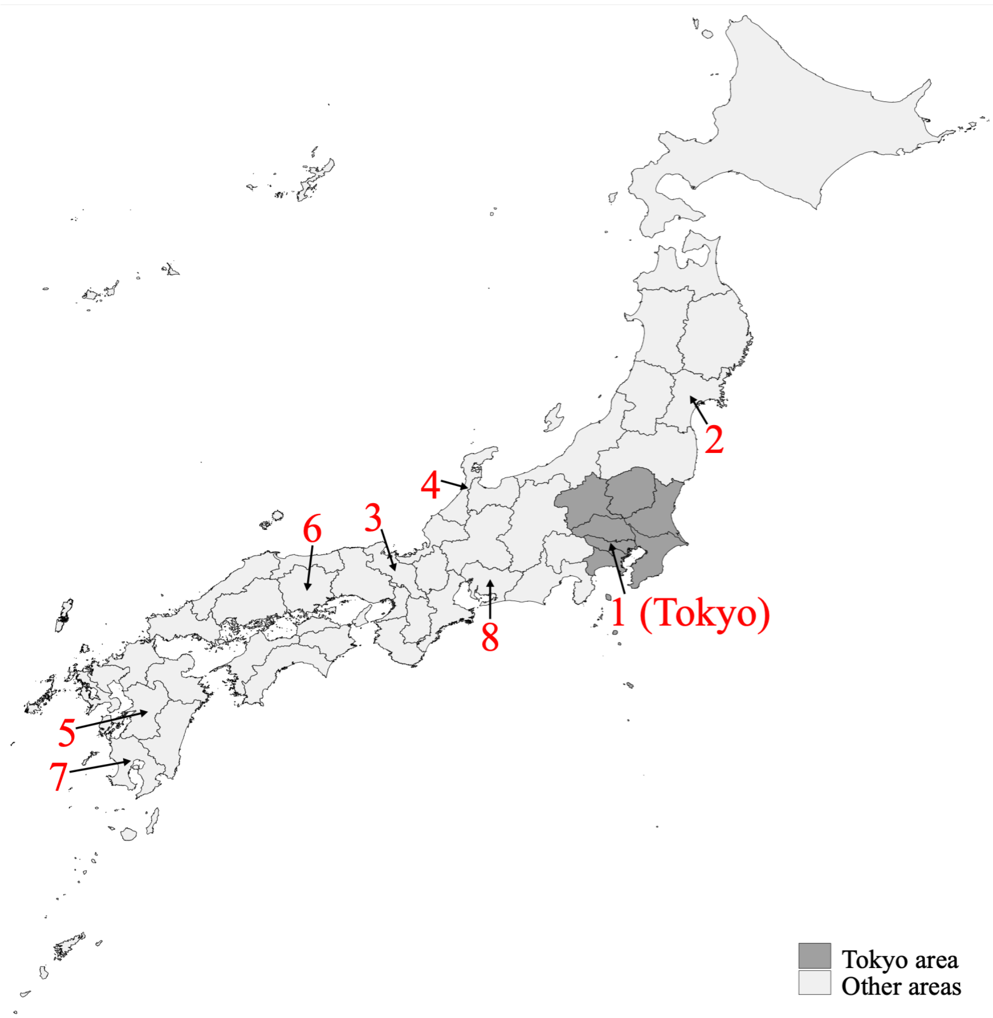
A.4 Additional Tables and Figures

Figure A.1: College Admissions around the World Today



Notes: This figure summarizes each country and territory's college admission system today. Dark red color (e.g. Norway): Regionally- or nationally-centralized college admissions where a single-application, single-offer assignment algorithm (well-defined rule) is used to make admissions to both public and private universities. Medium orange color (e.g. Brazil): Semi-centralized college admissions defined as either (1) there is a centralized system, but not all universities (such as 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.): Decentralized college admissions where each college defines its own admission standards and rules. Yellow with diagonal lines (e.g. Chad): Not enough information available or if the country or territory does not have tertiary institutions. We summarize the information sources at `https://www.scribd.com/document/437545135/Online-Appendix191018`. See Section 2 for discussions about this figure.

Figure A.2: Map of Schools 1–8 and Definition of the Tokyo Area



Notes: This figure shows the locations of Schools 1–8 and the location of the Tokyo area (in dark gray color) defined as a set of 7 prefectures that are within 100 km from Tokyo (i.e., Tokyo, Chiba, Kanagawa, Saitama, Ibaraki, Tochigi, and Gunma prefectures). See Sections 2 and 3.4 for discussions about this figure.

Figure A.3: Centralized Assignment Rule

第六條　入學ヲ許可スヘキ者ハ左ノ方法ニ依リ之ヲ定ム

一、高等學校ヲ通シ各部毎ニ其ノ部ニ入學セシムヘキ人員ノ總數ト同數ノ人員ヲ試驗ノ成績順ニ依リ選出ス

二、前號ノ場合ニ於テ試驗成績相同シキトキハ抽籤ニ依ル

三、前號ニ依リ選出セル人員ニ就キ試驗ノ成績順ニ依リ第一部又ハ第二部ノ志望者ニ在リテハ本人ノ指定スル第一ノ志望類ニ基キ第一ノ志望學校ニ第三部ノ志望者ニ在リテハ本人ノ指定スル第一ノ志望學校ニ配當ス

四、前號ノ場合ニ於テ試驗成績相同シキトキハ抽籤ニ依ル

五、第三號及第四號ニ依リ配當ノ結果本人ノ指定スル第一ノ志望學校已ニ滿員トナリタル場合ニ於テハ更ニ成績順ニ依リ本人ノ指定スル第二ノ志望學校ニ配當ス

六、前號ノ場合ニ於テ試驗ノ成績相同シキトキハ抽籤ニ依ル

七、第五號及第六號ニ依リ配當ノ結果本人ノ指定スル第二ノ志望學校已ニ滿員トナリタル場合ニ於テハ更ニ其ノ第三以下ノ志望學校ニ就キ第五號及第六號ニ準シ配當ス

八、第一部又ハ第二部ノ志望者ニ在リテハ本人ノ指定スル第一ノ志望類カ志望學校ニ於テ悉ク滿員トナリタルトキハ更ニ本人ノ指定スル第二以下ノ志望順中缺員アルモノニ之ヲ配當ス其ノ方法ハ第三號乃至第七號ニ準ス

九、本人ノ志望スル類及學校悉ク滿員トナリタルトキハ入學スルコトヲ得サルモノトス

前項ニ依リ配當ノ結果又ハ事故ノ爲メ入學者ニ缺員ヲ生シタルトキハ入學スルコトヲ得サリシ者ニ就キ更ニ前項ノ方法ニ依リ之ヲ補塡ス

Notes: This figure is a reprint of the assignment algorithm of the centralized admission system stated in the Ordinance of the Ministry of Education No.4 published in *Government Gazette* No.1419, pp.580-581, on April 27, 1917. See Sections 2 and 3.3 for an English translation and discussions.

Table A.1: Summary Statistics

Variable	Mean	Std. Dev.	Median	N
Year level data on short-run outcomes, 1900–1930				
No. of applicants to Schools 1–8	10613	4221	9997	28
Share of applicants choosing School 1 as their first choice	0.314	0.097	0.274	28
No. of entrants to Schools 1–8	1821	227	1919	31
Applicant level data on short-run outcomes, 1916–1917				
Distance between middle-school prefecture and the first-choice school (km)	224.88	272.03	117	20913
Applying to School 1 as first choice	0.33	0.47	0	20913
Entrant level data on short-run outcomes, 1900–1930				
Distance between birth prefecture and the school entered (km)	226.8	258.65	139	66193
Entering the nearest school from birth prefecture	0.49	0.5	0	66193
Born in Tokyo prefecture	0.09	0.29	0	66193
Born in the Tokyo area (7 prefectures within 100 km from Tokyo)	0.17	0.38	0	66193
Prefecture-year level data on short-run outcomes, 1900–1930				
No. of entrants to Schools 1-8	45.06	37.45	34	1469
No. of entrants to School 1	7.88	14.11	5	1469
No. of entrants to School 2	5.50	10.40	2	1469
No. of entrants to School 3	6.19	10.34	3	1421
No. of entrants to School 4	5.64	9.91	3	1469
No. of entrants to School 5	6.27	14.20	1	1422
No. of entrants to School 6	5.19	11.80	2	1421
No. of entrants to School 7	5.03	12.99	2	1328
No. of entrants to School 8	5.67	12.45	2	1093
No. of public middle-school graduates	415.38	350.01	299	1410
No. of private middle-school graduates	118.49	435.12	0	1410
No. of national higher schools other than Schools 1–8	0.13	0.43	0	1469
Prefecture-cohort level data on long-run outcomes, JPIR-listed individuals born in 1880–1894				
No. of all Imperial University graduates	8.77	7.81	7	705
No. of individuals in the top 0.01% income group	1.24	2.05	1	705
No. of individuals in the top 0.05% income group	5.19	7.57	3	705
No. of civilians receiving medal of the Order of Fifth Class and above	6.21	4.94	5	705
No. of corporate executives with a positive amount of tax payment	7.99	8.91	5	705
No. of top politicians and high-ranking bureaucrats	1.34	1.38	1	705
No. of Imperial University professors	0.73	1.11	0	705
Cohort level data on long-run outcomes, government officials entering higher school or equivalent in 1898–1930				
No. of the passers of the Higher Civil Service Exams	189.55	84.27	159.7	33
No. of top-ranking officials (internally promoted to top three ranks)	29.77	8.36	29.1	33
No. of top-ranking official who are School 1 graduates	8.27	3.36	8	33
No. of top-ranking officials who are Schools 2–8 graduates	12.97	5.98	12	33
No. of top-ranking officials who are not Schools 1–8 graduates	8.53	5.73	6.8	33

Notes: This table provides summary statistics of main variables in the empirical analyses.

Table A.2: Centralization Caused Applicants Across the Country to Apply More Aggressively

	A. Selecting School 1 as First Choice								
Centralized	0.159	0.192	0.151	0.146	0.128	0.168	0.180	0.166	0.114
	(0.000)***	(0.000)***	(0.003)***	(0.001)***	(0.142)	(0.001)***	(0.001)***	(0.007)***	(0.001)***
Constant	0.248	0.494	0.169	0.0892	0.178	0.107	0.184	0.0813	0.127
	(0.001)***	(0.000)***	(0.002)***	(0.003)***	(0.018)**	(0.002)***	(0.000)***	(0.015)**	(0.088)*
Sample region	All	S1 Region	S2 Region	S3 Region	S4 Region	S5 Region	S6 Region	S7 Region	S8 Region
Observations	20,913	6,505	2,555	3,248	1,266	2,730	2,276	615	1,718
	B. Application Distance								
Centralized	-2.534	-92.88	10.95	2.080	-15.74	128.0	46.52	145.4	-25.57
	(0.914)	(0.000)***	(0.670)	(0.720)	(0.541)	(0.003)***	(0.012)**	(0.021)**	(0.264)
Constant	226.2	231.7	289.7	158.8	166.7	252.6	294.1	218.0	154.2
	(0.000)***	(0.000)***	(0.008)***	(0.002)***	(0.061)*	(0.002)***	(0.001)***	(0.092)*	(0.051)*
Sample region	All	S1 Region	S2 Region	S3 Region	S4 Region	S5 Region	S6 Region	S7 Region	S8 Region
Observations	20,913	6,505	2,555	3,248	1,266	2,730	2,276	615	1,718

Notes: In Panel A, we estimate the effects of the centralized admissions on the propensity of an applicant to select the most prestigious and selective school (School 1 in Tokyo) as the 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 estimate the following regression: $Y_{it} = \alpha + \beta \times Centralized_t + \epsilon_{it}$, where Y_{it} is the indicator that applicant i in year t selects School 1 as the first choice. $Centralized_t$ is the indicator that year t is under the centralized system. To observe regional variations, we estimate the equation separately by region of the applicant's middle school. More specifically, we group applicants into "school regions" based on which school (among Schools 1–8) is closest to the applicant's middle school in 1916. The following map shows the locations of the eight school regions. In Panel B, we estimate the effects of centralization on the application distance defined by the distance between an applicant's first-choice school and middle school. Parentheses p-values based on standard errors clustered at the prefecture level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 3.2 for discussions about this table.

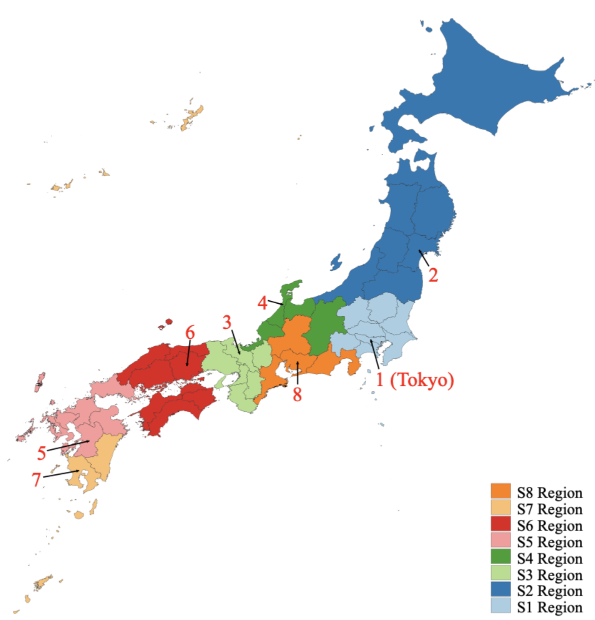
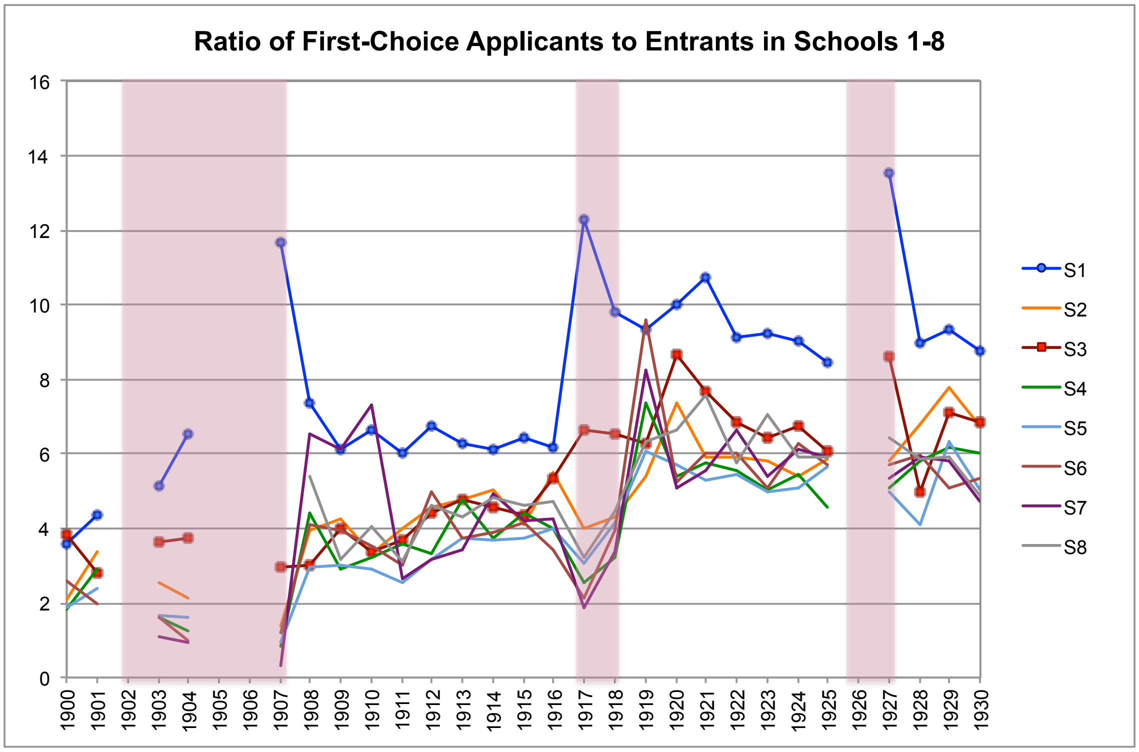


Figure A.4: Changes in the Competitiveness of Schools 1–8



Notes: This figure shows the time evolution of the competitiveness of Schools 1–8 (measured by the ratio of the number of applicants who rank the school first to the number of entrants to the school) from 1900 to 1930. No data are available for 1902, 1905, 1906, and 1926. Colored years (1902–07, 1917–18, 1926–27) indicate the periods of the centralized admission 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. See Section 3.2 for discussions about this figure.

Table A.3: Centralization Increased Urban-born Entrants to Schools 2–8: Additional Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable = No. of entrants to:	All schools	Sch. 1	Sch. 2	Sch. 3	Sch. 4	Sch. 5	Sch. 6	Sch. 7	Sch. 8
Centralized x Born in Tokyo prefecture	40.25		3.96	6.14	6.91	3.87	10.72	4.08	19.41
	(0.000)***		(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.016)**	(0.000)***
	[0.028]**		[0.160]	[0.036]**	[0.010]**	[0.031]**	[0.000]***	[0.264]	[0.000]***
Centralized x Born near Tokyo prefecture (1–100 km)	11.20		0.14	0.66	1.85	0.51	1.01	0.59	0.59
	(0.000)***		(0.725)	(0.072)*	(0.000)***	(0.214)	(0.040)**	(0.240)	(0.382)
	[0.000]***		[0.769]	[0.128]	[0.000]***	[0.057]*	[0.018]**	[0.194]	[0.044]**
Centralized x Born in school's prefecture	-17.77	-18.84	-18.47	-14.75	-23.00	-27.66	-21.99	-47.49	-13.33
	(0.001)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
	[0.025]**	[0.006]***	[0.021]**	[0.065]*	[0.005]***	[0.001]***	[0.079]*	[0.001]***	[0.386]
Centralized x Born near school's prefecture (1–100 km)	-3.79	-0.01	-2.86	-3.29	-8.96	-11.33	-1.65	-1.55	1.16
	(0.116)	(0.987)	(0.271)	(0.107)	(0.007)***	(0.001)***	(0.177)	(0.000)***	(0.231)
	[0.047]**	[0.980]	[0.043]**	[0.000]***	[0.001]***	[0.001]***	[0.062]*	[0.510]	[0.687]
No. middle-school grads in prefecture	6.02	-2.64	-0.77	0.78	-0.16	2.76	1.87	2.77	1.67
	(0.200)	(0.136)	(0.336)	(0.440)	(0.800)	(0.001)***	(0.434)	(0.211)	(0.406)
	[0.010]***	[0.000]***	[0.021]**	[0.077]*	[0.645]	[0.003]***	[0.003]***	[0.000]***	[0.013]**
No. middle-school grads in prefecture (1–100km)	-1.62	-0.18	-0.27	1.72	-0.31	0.09	-0.43	-1.32	-0.17
	(0.439)	(0.580)	(0.579)	(0.191)	(0.632)	(0.898)	(0.589)	(0.140)	(0.819)
	[0.003]***	[0.303]	[0.032]**	[0.000]***	[0.274]	[0.695]	[0.067]*	[0.000]***	[0.274]
No. other schools	-24.06	-1.83	-2.74	-3.01	-1.94	-3.33	-2.40	-3.42	-4.87
	(0.000)***	(0.031)**	(0.011)**	(0.054)*	(0.005)***	(0.006)***	(0.080)*	(0.027)**	(0.066)*
	[0.000]***	[0.001]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Population in prefecture	14.35	8.80	3.55	1.39	-0.33	-0.59	-2.32	-1.20	1.42
	(0.043)**	(0.066)*	(0.014)**	(0.066)*	(0.729)	(0.540)	(0.380)	(0.204)	(0.674)
	[0.000]***	[0.000]***	[0.000]***	[0.058]*	[0.622]	[0.465]	[0.001]***	[0.118]	[0.184]
GDP per capita in prefecture	18.36	2.84	0.25	4.65	4.60	2.86	5.34	-3.40	0.03
	(0.074)*	(0.209)	(0.878)	(0.087)*	(0.034)**	(0.033)**	(0.031)**	(0.530)	(0.986)
	[0.000]***	[0.000]***	[0.573]	[0.001]***	[0.000]***	[0.012]**	[0.000]***	[0.002]***	[0.978]
Observations	1,457	1,457	1,457	1,410	1,457	1,410	1,410	1,269	1,081
Year FE, Prefecture FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	45.43	7.95	5.55	6.23	5.69	6.32	5.23	5.02	5.74
Mean dep var (Tokyo pref under decentralization)	201.1	104.7	27.52	10.85	14.48	6.10	9.20	11.72	20.21
Mean dep var (Within 1–100km from Tokyo pref. under decentralization)	26.23	9.119	6.738	1.208	2.865	0.746	1.242	1.546	3.228

Notes: This table uses the prefecture-year level data in 1900–1930. "Middle-school graduates in prefecture" is the number of students who graduated from middle schools in prefecture p in year t. "Middle-school graduates in nearby prefectures" is the number of students who graduated from middle schools in the prefectures within 100 km from prefecture p (excluding prefecture p) in year t. "Population in prefecture" is the population in prefecture p in year t. "GDP per capita in prefecture" is gross value-added per capita in prefecture p in year t. See Tables 1 for the definition of the variables. Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain p-values based on standard errors clustered at the year level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 3.4 for discussions about this table.

Table A.4: Characteristics of the Tokyo Area

	Mean	Std. Dev.	Min	Max	N
Tokyo Area					
Population in prefecture (in million)	1.497	0.866	0.820	5.437	217
GDP per capita in prefecture (in 1,000 yen)	0.209	0.095	0.108	0.469	217
Middle-school graduates in prefecture	0.871	1.172	0.011	6.427	217
Middle-school graduates in nearby prefectures (1-100 km)	4.604	2.150	0.395	12.212	217
Share of applicants at School 1 under decentralization	0.379	0.090	0.270	0.545	217
Other Areas					
Population in prefecture (in million)	1.072	0.522	0.414	3.568	1240
GDP per capita in prefecture (in 1,000 yen)	0.173	0.058	0.097	0.494	1240
Middle-school graduates in prefecture	0.474	0.431	0.029	3.307	1240
Middle-school graduates in nearby prefectures (1-100 km)	1.299	1.594	0.000	11.729	1240
Share of applicants at School 1 under decentralization	0.156	0.078	0.044	0.421	1240

Notes: This table shows the characteristics of the Tokyo area (defined as 7 prefectures within 100 km of Tokyo as in the map in Appendix Figure A.2) compared to other areas. All numbers are the prefecture-level average in 1900–1930. GDP per capita is in real terms expressed in 1934–1936 prices.

Table A.5: Replacing the Tokyo Area indicators by Urban Characteristics

	(1)	(2)	(3)	(4)
	Entrants to Schools 1-8			
Centralized × Population in prefecture	2.63 (0.440) [0.183]			
Centralized × GDP per capita in prefecture		3.16 (0.274) [0.224]		
Centralized × Middle-school graduates in prefecture			3.73 (0.003)*** [0.171]	
Centralized × Middle-school graduates in nearby prefectures (1–100 km)			4.32 (0.001)*** [0.019]**	
Centralized × Share of applicants at School 1 (under Decentralization)				5.48 (0.000)*** [0.002]***
Population in prefecture	11.74 (0.061)* [0.000]***			
GDP per capita in prefecture		17.30 (0.099)* [0.001]***		
Middle-school graduates in prefecture	10.70 (0.004)*** [0.000]***	13.64 (0.001)*** [0.000]***	15.65 (0.000)*** [0.000]***	16.59 (0.000)*** [0.000]***
Middle-school graduates in nearby prefectures (1–100 km)			-0.73 (0.765) [0.322]	
Observations	1,457	1,457	1,457	1,457
Year FE, Prefecture FE	Yes	Yes	Yes	Yes
Mean dep var	45.43	45.43	45.43	45.43

Notes: This table uses the prefecture-year level data in 1900–1930. The dependent variable is the number of students from birth prefecture p who entered one of Schools 1–8 in year t. "Population in prefecture" is population in prefecture p in year t. "GDP per capita in prefecture" is real gross value-added per capita in prefecture p in year t. "Middle-school graduates in prefecture" is the number of students who graduated from middle schools in prefecture p in year t. "Middle-school graduates in nearby prefectures" is the number of students who graduated from middle schools in the prefectures within 100 km from prefecture p (excluding prefecture p) in year t. "Share of applicants to School 1 (under decentralization)" is the share of applicants to School 1 among all applicants to Schools 1–8 in prefecture p under the decentralized system in 1916 (the only year for which the data is available). All variables interacted with "Centralized" are standardized to be mean 0 and standard deviation 1. We control for year fixed effects, prefecture fixed effects, and the number of higher schools other than Schools 1–8 in prefecture p in year t. We also control for "Born in school's prefecture," "Born near school's prefecture (1-100 km)," and "Born near school's prefecture (100-300 km)" as in Table 1. Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain p-values based on standard errors clustered at the year level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 3.4 for discussions about this table.

Table A.6: Testing Exogeneity of Centralization

	(1) No. middle school graduates	(2) No. entrants to Schools 1–7	(3) Share of entrants to School 1	(4) No. applicants to Schools 1–7	(5) Ratio of entrants to applicants	(6) Mean age of entrants	(7) Government expenditures on higher education	(8) Share of applicants to School 1	(9) Enrollment distance	(10) Share of entrants born in Tokyo area
Centralized	1.357	-0.0425	-0.000291	-0.348	0.0251	0.0523	0.760	0.165	51.54	0.0392
	(0.418)	(0.210)	(0.907)	(0.576)	(0.144)	(0.518)	(0.676)	(0.000)***	(0.000)***	(0.000)***
No. of middle-school graduates		0.00402	-0.000701	-0.109	0.000709	0.0656	-0.429	0.00161	1.937	0.00150
		(0.210)	(0.085)*	(0.108)	(0.505)	(0.000)***	(0.062)*	(0.508)	(0.008)***	(0.033)**
Observations	31	31	31	27	27	26	31	27	31	31
Mean dep var	23.41	1.821	0.196	9.790	0.214	19.03	13.56	0.313	231.4	0.174

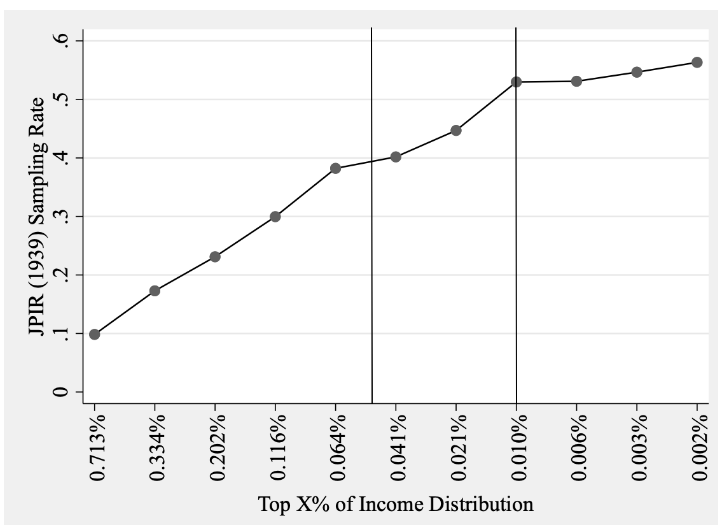
Notes: Columns 1–6 test if important institutional variables are correlated with the timing of centralization using year-level data. Columns 7–9 examine the robustness of our main short-run outcomes using year-level data. All numbers are at the national-level from 1900 to 1930. We focus on Schools 1–7 when calculating the number of 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, entrants, and applicants are denominated by 1,000. In all regressions, quadratic time trends (i.e. trend and trend squared, where the trend is defined by "year - 1899") are controlled. Parentheses contain p-values based on Newey-West standard errors with the maximum lag order of 3. See Section 3.5 for discussions about this table.

Table A.7: Definitions of Career Elites in the JPIR

Corporate Executives	
	[Last letters of Occupation Title are 社長, 会長, 頭取, 理事, 店長, 常務取締役, 監査役, 企業家, or 支配人]
	AND [Corporation Type is 株, 名, 資, or 合] AND [Income or Business Tax Payment is positive]
Top Politicians and Bureaucrats	
	{[Last letters of Occupation Title are 議長 or 議員] AND [Organization Name contains 貴族院 or 衆議院]}
	OR {[Last letters of Occupation Title are 大臣] AND [Organization Name contains 内閣]}
	OR {[Last letters of Occupation Title are 長官, 次官, 局長, 大使, 公使, 領事, 知事, 総督参事官, 参與官, 書記官, 秘書官, 事務官, or 理事官]
	AND [Organization Name cointains neither 薬局, 新聞, 新報, 放送郵便局, 放送局, 電気局, 水道局, 土木局, nor 印刷局]
	AND [Corporation Type is neither 株, 名, 資, nor 合]}
Imperial University Professors	
	[Last letters of Occupation Title are 教授 or 講師] AND [Organization Name contains 帝国大学 or 帝大]
Scholars	
	[Last letters of Occupation Title are 教授, 講師, 博士, 学長, 研究員, 研究家, or 学校長]
Engineers	
	[Occupation Title contains 技 or 工]
Physicians	
	{[Occupation Title contains 医]}
	OR {[Last Letters of Occupation Title are 院長] AND [Last letters of Organization Name are 病院 or 医院]}
Lawyers	
	[Last letters of Occupation Title are 判事, 検事, 検察官, 裁判官, 裁判長, or 弁護士]
Landlords	
	[Last letters of Occupation Title are 地主 or 家主]
	AND [Neither top 0.05% income earners, medal recipients, corporate executives, top politicians and bureaucrats, or IU professors]

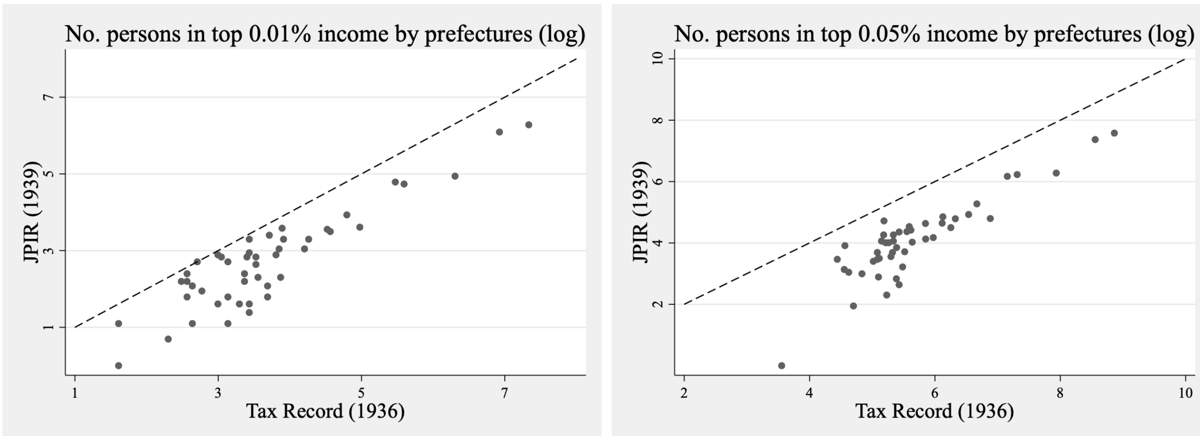
Notes: This table provides the precise definitions of career elites, defined as a subset of individuals listed in JPIR (1939). See Section 4.1 for the analysis.

Figure A.5: Sampling Rates of High Income Earners in JPIR



Notes: This figure plots the sampling rate of the high income earners listed in JPIR (1939) by the income level expressed as a top percentile of the national income distribution. The sampling rates and the top income percentiles are computed from the complete count data in National Tax Bureau Yearbook. The vertical lines indicate the top 0.05% and 0.01% thresholds. See Section 4.1 for discussions about this figure.

Figure A.6: High Income Earners in the JPIR vs Income Tax Statistics across Prefectures



Notes: These figures compare the number of high income earners in each prefecture listed in JPIR (1939) and the complete count of the number of high income earners in each prefecture reported in National Tax Bureau Yearbook (1936). The vertical axis is log of the number of individuals in the JPIR who earned more than 50,000 yen taxable income (corresponding to the top 0.01% income group) or 16,950 yen taxable income (corresponding to the top 0.05% income group) in 1938. The horizontal axis is log of the number of individuals in tax statistics who earned more than 30,000 yen taxable income (corresponding to the top 0.013% income group) or 10,000 yen taxable income (corresponding to the top 0.08% income group) in 1936 (the closest year to 1938 for which prefecture-level tax statistics are available). See Section 4.1 for discussions about these figures.

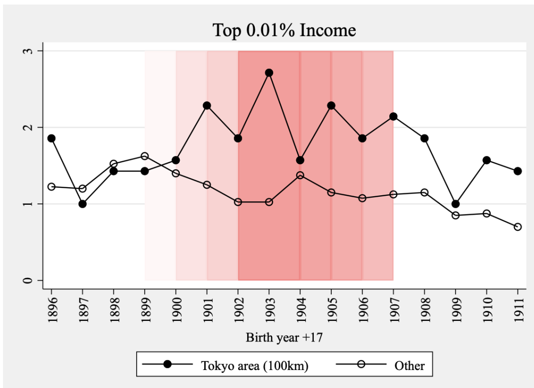
Table A.8: Correlations between Prefecture-level Sampling Rates and Outcome Variables

	Top 0.01% income earners	Top 0.05% income earners	Top 0.01% income earners	Top 0.05% income earners
Entrants to Schools 1–8	-0.000035	0.000056		
	(0.000059)	(0.000043)		
Imperial Univ. grads			-0.000052	0.000030
			(0.000032)	(0.000022)
Observations	47	47	47	47
R-squared	0.003527	0.033977	0.006313	0.008153
Mean dep var	0.44	0.24	0.44	0.24

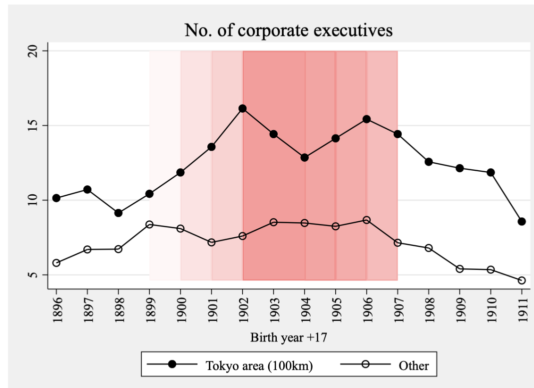
Notes: This table shows the results of regressing the sampling rates of JPIR (1939) on our outcome variables using prefecture-level data. "Top 0.01% income earners" is the sampling rate of the top 0.01% income earners defined by the number of individuals with more than 50,000 yen of taxable income in 1938 divided by the complete count of the number of individuals with more than 30,000 yen of taxable income in 1936. "Top 0.05% income earners" is the sampling rate of the top 0.05% income earners defined by the number of individuals with more than 16,950 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. "Entrants to Schools 1–8 " is the number of entrants to Schools 1–8 during 1900–1911 who were born in the prefecture (mean=590 and SD=383). "Imperial Univ. grads" is the number of individuals residing in the prefecture in 1938 who graduated from one of the Imperial Universities (mean=224 and SD=349). See Section 4.1 for discussions about this table.

Figure A.7: Long-run Impacts of Centralization: Geographical Origins of Other Career Elites

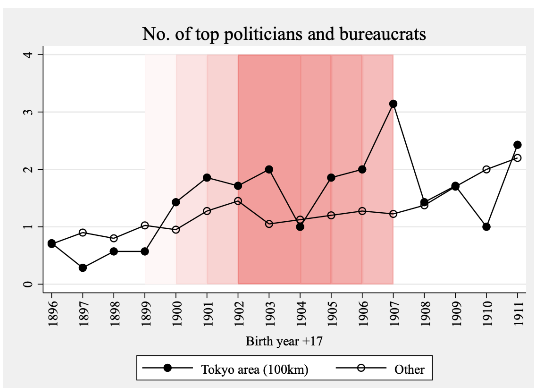
(a)



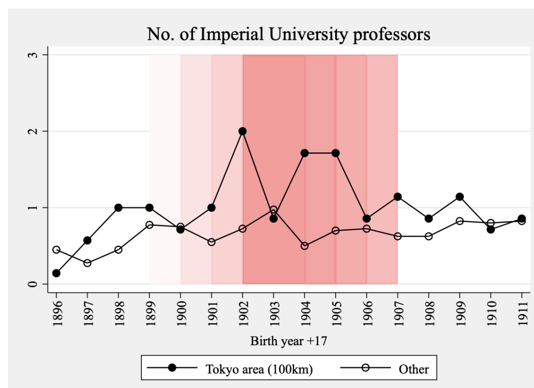
(b)



(c)



(d)



Notes: This figure shows additional difference-in-differences plots that compare the average number of elites born in prefectures inside and outside the Tokyo area by cohort (see Figure 3). The plots are based on the data from JPIR (1939) which covers cohorts who were born in 1879–1894 and turned age 17 (main application age) in 1896–1911. The vertical axis shows the number of indicated elites who were born in the indicated area in the indicated cohort. The cohorts are colored according to their intensity of exposure to the centralized admissions in 1902–07, where the darker color indicates the higher intensity. See Section 4.1 for discussions about this figure.

Table A.9: Long-run Impacts: Other Elite Professionals

	(1) Scholars	(2) Engineers	(3) Physicians	(4) Lawyers
Age 17 under centralization	0.87	0.66	0.46	0.18
× Tokyo area (<100 km)	(0.026)**	(0.048)**	(0.038)**	(0.420)
	[0.094]*	[0.125]	[0.091]*	[0.544]
Observations	705	705	705	705
Birth cohort FE, Birth pref. FE	Yes	Yes	Yes	Yes
Mean dep var	3.61	2.46	1.92	1.11
Mean dep var (Tokyo area under decentralization)	4.76	3.13	2.52	1.16

Notes: This table shows difference-in-differences estimates of the long-run effects of the centralized admission system. The estimates are based on the birth-prefecture-cohort level data from JPIR (1939) which covers cohorts who were born in 1880–1894 and turned age 17 (main application age) in 1897–1911. All regressions control for birth-prefecture fixed effects and cohort fixed effects. "Scholars," "Engineers," "Physicians," and "Lawyers" are defined at the prefecture-cohort level as the number of individuals listed in JPIR (1939) whose occupations include scholar, engineer, physician, and lawyer, respectively. "Age 17 under centralization" takes 1 if the cohort turned 17 years old during 1902–07 under the centralized admissions, and takes 0 otherwise. "Mean dep var" shows the mean of the dependent variable for all prefecture-cohort observations. "Mean dep var (Tokyo area under decentralization)" shows the mean of the dependent variable in the Tokyo area under the decentralized admissions. Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain wild cluster bootstrap p-values based on standard errors clustered at the cohort level. See Section 4.1 for discussions about this table.

Table A.10: Long-run Impacts: Excluding Cohorts who Turned Age 17 in 1901 or 1907

	Imperial Univ. grads	Top 0.01% income earners	Top 0.05% income earners	Medal recipients	Corporate executives	Top politicians & bureaucrats	Imperial Univ. professors
				A. Baseline Specification			
Age 17 under centralization	3.05	0.68	1.65	2.61	1.89	0.68	0.51
× Tokyo area (<100 km)	(0.003)***	(0.007)***	(0.048)**	(0.007)***	(0.030)**	(0.019)**	(0.084)*
	[0.000]***	[0.026]**	[0.011]**	[0.000]***	[0.066]*	[0.023]**	[0.143]
				B. Adding Control Variables			
Age 17 under centralization	1.70	0.58	1.53	2.18	1.60	0.45	0.45
× Tokyo area (<100 km)	(0.021)**	(0.013)**	(0.007)***	(0.000)***	(0.014)**	(0.028)**	(0.071)*
	[0.017]**	[0.008]***	[0.020]**	[0.006]***	[0.069]*	[0.086]*	[0.157]
Observations	611	611	611	611	611	611	611
Birth cohort FE, Birth pref. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	8.68	1.23	5.16	6.08	7.96	1.34	0.75
Mean dep var (Tokyo area under decentralization)	10.38	1.41	6.57	6.61	10.91	1.21	0.86

Notes: This table repeats the same difference-in-differences analysis in Table 2, but excluding the cohorts who turned age 17 (main application age) in 1901 or 1907 from the sample as these cohorts were exposed to both centralized and decentralized admission systems. All the variables are defined as in Table 2. Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain wild cluster bootstrap p-values based on standard errors clustered at the cohort level. See Section 4.1 for discussions about this table.

Table A.11: Long-run Impacts: Pre-event Trends Are Parallel

	Imperial Univ. grads	Top 0.01% income earners	Top 0.05% income earners	Medal recipients	Corporate executives	Top politicians & bureaucrats	Imperial Univ. professors
				A. Baseline Specification			
Tokyo area (< 100 km)	0.35	-0.09	0.06	0.04	-0.31	0.11	0.05
× Time trend	(0.744)	(0.516)	(0.879)	(0.947)	(0.364)	(0.568)	(0.544)
	[0.250]	[0.812]	[0.688]	[0.812]	[0.438]	[0.812]	[0.875]
				B. Adding Control Variables			
Tokyo area (< 100 km)	-0.40	-0.07	-0.28	-0.33	-0.56	-0.05	0.10
× Time trend	(0.291)	(0.535)	(0.310)	(0.440)	(0.189)	(0.701)	(0.286)
	[0.375]	[0.500]	[0.062]*	[0.375]	[0.062]*	[0.750]	[0.250]
Observations	233	233	233	233	233	233	233
Birth cohort FE, Birth pref. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	6.87	1.40	5.32	5.69	7.63	0.86	0.56
Mean dep var (Tokyo area under decentralization)	8.74	1.46	6.94	7.00	10.46	0.74	0.69

Notes: This table tests if there are differences in pre-event trends between urban and rural areas in the difference-in-differences analysis in Table 2. We compile the data from JPIR (1939) for cohorts who were born in 1874-1883 and turned age 17 in 1891–1900 and run the following regression:

$$Y_{pt} = \beta \times Time\_trend_t \times Tokyo\_area_p + \alpha_p + \alpha_t + \epsilon_{pt},$$

where $Time\_trend_t$ is defined as the cohort's birth year minus 1870 (the linear time trend). All the other variables are defined in the same way as in Table 2. Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain wild cluster bootstrap p-values based on standard errors clustered at the cohort level. See Section 4.1 for discussions about this table.

Table A.12: Long-run Impacts: Difference-in-Differences Estimates Using the JPIR in 1934

	(1) Imperial Univ. grads	(2) Top 0.01% income earners	(3) Top 0.05% income earners	(4) Medal recipients	(5) Corporate executives	(6) Top politicians & bureaucrats	(7) Imperial Univ. professors
Age 17 under centralization × Tokyo area (<100 km)	1.71	0.50	1.81	1.44	1.11	0.39	0.14
	(0.016)**	(0.044)**	(0.029)**	(0.070)*	(0.013)**	(0.018)**	(0.418)
	[0.004]***	[0.003]***	[0.004]***	[0.008]***	[0.008]***	[0.282]	[0.496]
Observations	705	705	705	705	705	705	705
Birth cohort FE, Birth pref. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	4.79	0.81	3.64	3.86	2.80	1.18	0.47
Mean dep var (Tokyo area under decentralization)	5.68	1.11	6.18	4.46	4.46	1.14	0.59

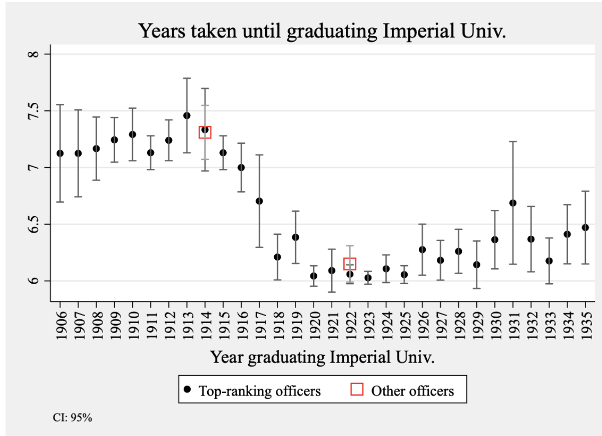
Notes: In this table, we repeat the same difference-in-differences analysis as in Table 2 Panel B, but using JPIR (1934) instead of JPIR (1939). In JPIR (1934), we observe the cohorts born in 1880–1894 when they are 40 to 54 years old. Sampling rates in JPIR (1934) for top income earners are similar to those in JPIR (1939): 51% and 40% for the top 0.01% and 0.05% income earners, respectively. All the variables are defined as in Table 2. Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain wild cluster bootstrap p-values based on standard errors clustered at the cohort level. See Section 4.1 for discussions about this table.

Table A.13: Long-run Impacts of Centralization: Placebo Tests and Pathways

	(1) Placebo: Population	(2) Placebo: Landlords	(3) Pathway: Fraction moved in the long-run	(4) Pathway: Distance moved in the long-run
	A. Baseline Specification			
Age 17 under centralization	0.34	-0.10	-0.01	-4.81
× Tokyo area (<100 km)	(0.270)	(0.588)	(0.449)	(0.471)
	[0.245]	[0.818]	[0.422]	[0.719]
	B. Adding Control Variables			
Age 17 under centralization	-0.06	0.01	-0.02	-9.58
× Tokyo area (<100 km)	(0.872)	(0.947)	(0.360)	(0.345)
	[0.790]	[0.969]	[0.361]	[0.507]
Observations	705	705	705	705
Birth cohort FE, Birth pref. FE	Yes	Yes	Yes	Yes
Mean dep var	11.67	0.94	0.29	89.73
Mean dep var (Tokyo area under decentralization)	13.18	2.89	0.37	24.07

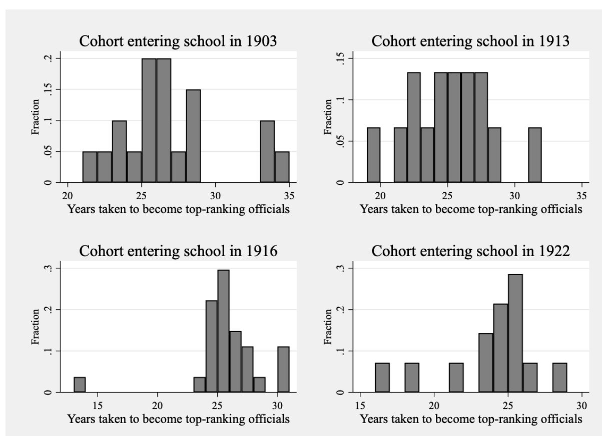
Notes: This table provides placebo tests and explores pathways of the long-run effects. We construct the prefecture-cohort level data from JPIR (1939) by counting the number of elites by birth prefecture and by birth cohort (born in 1880–1894). In (1), "Population" is the cohort's birth population in the birth prefecture. In (2), "Landlords" is defined as individuals listed in the JPIR whose occupations include landlord, but excluding the top 0.05% income earners, medal recipients, corporate executives, top politicians and bureaucrats, and Imperial University professors. In (3), "Fraction moved" is defined as the fraction of individuals listed in the JPIR whose prefecture of residence is different from his birth prefecture. In (4), "Distance moved" is defined as the average distance between the birth prefecture and the prefecture of residence among individuals listed in the JPIR. "Age 17 under centralization" is the indicator variable that takes 1 if the cohort became age 17 under the centralized admissions in 1902–07. "Mean dep var" shows the mean of the dependent variable for all prefecture-cohort observations. "Mean dep var (Tokyo area under decentralization)" shows the mean of the dependent variable in the Tokyo area under the decentralized admissions. In Panel B, 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 turned eligible age, the number of middle-school graduates in the prefecture in the year when the cohort turned age 17, log GDP of the prefecture when the cohort turned age 20, and the birth population of the cohort in the prefecture (except for Column (1)). Parentheses contain p-values based on standard errors clustered at the prefecture level. Square brackets contain wild cluster bootstrap p-values based on standard errors clustered at the cohort level. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 4.1 for discussions about this table.

Figure A.8: Years Taken from Entering Higher School to University Graduation



Notes: This figure plots the average number of years taken from entering a higher school to graduating from an Imperial University by cohort (where cohort is defined by the year of university graduation) for two groups of individuals who passed the administrative division of the Higher Civil Service Exams. The first group is top-ranking officials who graduated from Schools 1–8 (shown in black round markers), and the second group is non-top-ranking officials who graduated from Schools 1–8 (shown in red rectangular markers for two representative years, 1914 and 1922, only). For both groups, we find the exact year of entering Schools 1–8 for each individual using the Student Registers. The figure shows that the average number of years is not significantly different between the two groups. See Section 4.2 for discussions about this figure.

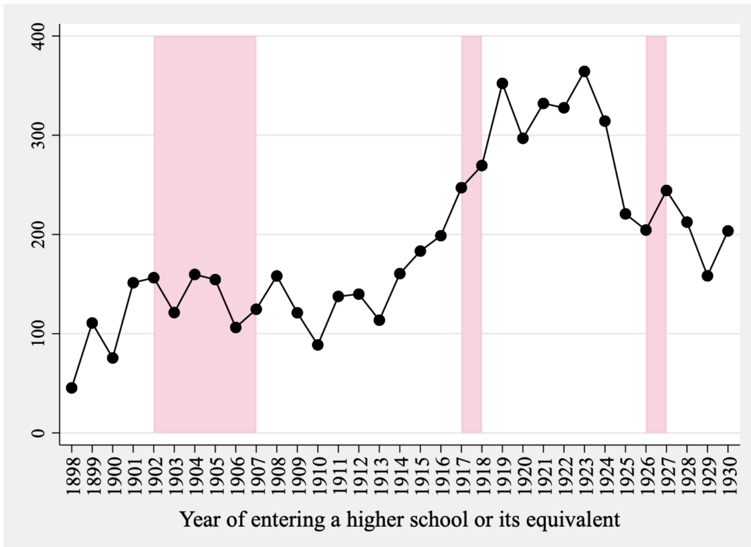
Figure A.9: Years Taken to Become Top-ranking Government Officials



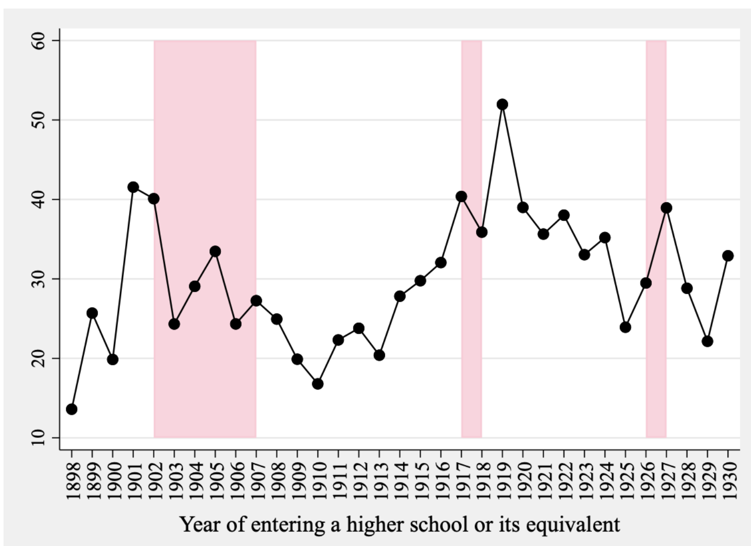
Notes: This figure plots the distribution of the number of years taken from entering a higher school to becoming a top-ranking government official for representative cohorts. We focus on top-ranking official who graduated from Schools 1–8 and four randomly selected cohorts (the cohorts entering a higher school in 1903, 1913, 1916, and 1922). For each top-ranking official in each cohort, we look for his biographical information by online searches to find the year of appointment to his first top-ranking position (with a success rate of 82%). The figure shows that, for all cohorts, there is a large within-cohort variation in the number of years taken to be promoted to a top-ranking position. See Section 4.2 for discussions about this figure.

Figure A.10: Exam Passers and Top-ranking Government Officials

(a) Number of Passers of the Higher Civil Service Exams



(b) Number of Top-ranking Government Officials



Notes: Panel (a) plots the number of individuals who passed the administrative division of the Higher Civil Service Exams by cohort (defined by the year of entering a higher school or its equivalent). Panel (b) plots the number of top-ranking government officials (defined by higher civil officials who were internally promoted to the top three ranks in their lifetime) by cohort. Colored cohorts are the cohorts exposed to the centralized admission system in 1902–07, 1917–18, and 1926–27. While the number of exam passers changes relatively little under the centralization, the number of top-ranking officials tends to be greater under the centralization.

Table A.14: Long-run Impacts on Top-Ranking Government Officials: Alternative Definition of the Year of Entering Higher School or its Equivalent

	(1) Top-ranking officials	(2) Top-ranking officials graduated from School 1	(3) Top-ranking officials graduated from Schools 2-8	(4) Top-ranking officials not graduated from Schools 1-8	(5) Top-ranking officials graduated from Schools 2-8	(6) Top-ranking officials graduated from Schools 2-8 and Tokyo Imperial Univ.
Centralized	4.15	-0.54	5.05	-0.36	2.69	1.76
	(0.003)***	(0.600)	(0.001)***	(0.702)	(0.000)***	(0.039)**
Higher Civil Service Exam passers	0.10	0.02	0.06	0.03		
	(0.000)***	(0.024)**	(0.001)***	(0.000)***		
Exam passers graduated from Schools 2-8					0.17	
					(0.000)***	
Exam passers graduated from Schools 2-8 and Tokyo Imperial Univ.						0.19
						(0.000)***
Observations	33	33	33	33	33	33
Mean dep var	29.77	8.273	12.97	8.53	12.97	11.82
Mean dep var (decentralization)	28.57	8.30	11.22	9.05	11.22	10.00

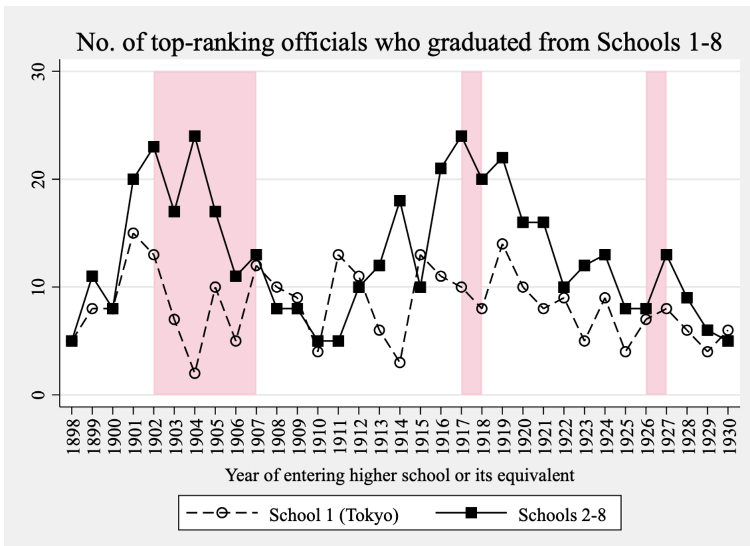
Notes: This table shows OLS estimates of the long-run effects of the centralized admission system on the number of top-ranking government officials. The definitions of the variables and the specifications are the same as in Table 4, except that the computation of the year of entering a higher school or its equivalent for individuals who did not graduate from Schools 1–8 is changed from "year of graduating the final education - 6" to "year of graduating the final education - 7." The results are qualitatively the same as the results in Table 4. In all regressions, we control for quadratic time trends. Parentheses contain p-values based on Newey-West standard errors with the maximum lag order of 3. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 4.2 for discussions about this table.

Table A.15: Robustness Check: Government Officials Died in Wars or Purged after WWII

	(1) Exam passers who were purged	(2) Exam passers who died in wars	(3) Top-ranking officials who were purged	(4) Top-ranking officials who died in wars
Centralized	0.854	0.010	0.847	-0.037
	(0.767)	(0.952)	(0.682)	(0.214)
Higher Civil Service Exam passers	0.025	0.000	0.002	0.001
	(0.358)	(0.956)	(0.897)	(0.182)
Observations	33	33	33	33
Mean dep var	15.58	0.61	6.18	0.03
Mean dep var (decentralization)	15.03	0.69	5.88	0.0435

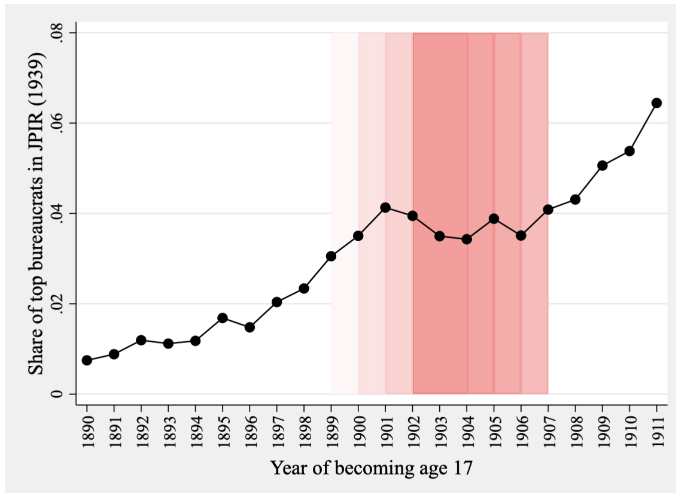
Notes: This table tests if the results in Table 4 are affected by war deaths and post-WWII purge of government officials. Column (1) shows an OLS estimate of the effect of the centralized admissions on the number of HCSE passers (individuals who passed the administrative division of the Higher Civil Service Exams) who were purged from public service after WWII by the occupational authority. Column (2) shows an OLS estimate of the effect on the number of HCSE passers who died in wars or were executed after WWII for war crimes. Columns (3) and (4) show OLS estimates of the effects on the number of top-ranking officials who were purged after WWII (Column (3)) or died in wars or were executed after WWII (Columns (4)). The estimates are based on the cohort level data, 1898–1930, where cohort is defined by the year of entering a higher school or its equivalent. "Mean dep var (decentralization)" is the mean of the dependent variable for the cohorts who entered a higher school or its equivalent under the decentralized admissions. In all regressions, we control for quadratic time trends. Parentheses contain p-values based on Newey-West standard errors with the maximum lag order of 3. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 4.2 for discussions about this table.

Figure A.11: Long-run Impacts of Centralization: Government Officials Graduating from Schools 1–8



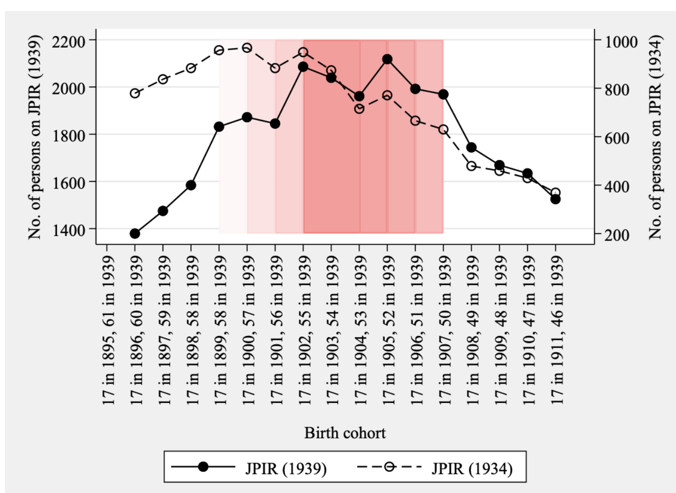
Notes: This figure plots the number of top-ranking government officials who graduated from School 1 and the number of top-ranking government officials who graduated from Schools 2–8 by cohort (defined by the year of entering a higher school). The plots are based on the data from the complete list of individuals who passed the administrative division of the Higher Civil Service Exams in 1894–1941 and their biographical information. The number of top-ranking government officials who graduated from School 1 in cohort t is the number of individuals who entered School 1 in year t, passed the administrative division of the Higher Civil Service Exams, and were internally promoted to the top three ranks of higher civil service by the end of their lifetime. Colored cohorts are those who entered Schools 1–8 under the centralized admission system. See Section 4.2 for discussions about this figure.

Figure A.12: Share of Government Officials in JPIR-listed Individuals



Notes: This figure plots the share of central government officials in all individuals listed in JPIR (1939) by birth cohort. The cohorts are colored according to their exposure to the centralized admissions in 1902–1907, where the darker color indicates the higher intensity of exposure. We observe no significant increase in the share of central government officials for the cohorts who are exposed to the centralized admissions. See Section 4.2 for discussions about this table.

Figure A.13: Total Number of JPIR-listed Individuals by Cohort



Notes: This figure plots the total number of individuals listed in JPIR (1939) and JPIR (1934) by birth cohort. The cohorts are colored according to their exposure to the centralized admissions in 1902–1907, where the darker color indicates the higher intensity of exposure. In both JPIR (1939) and JPIR (1934), cohorts exposed to the centralization tend to have a greater number of individuals selected into the JPIR. See Appendix Table A.16 for a statistical analysis and Section 4.2 for discussions about this figure.

Table A.16: Long-run Impacts: Total Number of JPIR-listed Individuals

	(1)	(2)
	No. of Individuals in JPIR (No. of individuals aged 50 in JPIR = 100)	
Age 17 under centralization	3.77	
	(0.086)*	
Cohort's exposure to centralization		4.78
		(0.060)*
Age	40.32	39.69
	(0.000)***	(0.000)***
Age squared	-0.39	-0.38
	(0.000)***	(0.000)***
JPIR (1939) dummy	0.37	0.37
	(0.808)	(0.805)
Observations	46	46

Notes: This table examines the long-run effects of the centralized admissions on the total number of career elites in the JPIR. To distinguish the cohort effect from the age effect, we use two editions of the JPIR, i.e., JPIR (1934) and JPIR (1939), count the number of individuals aged 40–62 by birth cohort in each edition (see Appendix Figure A.13), and pool these data. We standardize the dependent variable by setting the number of individuals at age 50 in each edition to be 100. "Age 17 under centralization" takes 1 if the cohort turned 17 years old under the centralized system in 1902–1907, and takes 0 otherwise. "Cohort's exposure to centralization" is defined as in Table 2 Panel D. We control for quadratic age trends and the edition fixed effect. Parentheses contain p-values based on robust standard errors. ***, **, and * mean significance at the 1%, 5%, and 10% levels, respectively. See Section 4.2 for discussions about this table.

B Online Theoretical Appendix

To guide our empirical investigation, we develop a model to predict the impacts of centralization on application behavior and assignment. We first confirm that centralized admissions (Capp) was indeed designed to make the school seat allocation more meritocratic compared to decentralized admissions (Dapp). Our model also has two predictions about application behavior. First, a greater number of applicants apply to the most popular school under Capp than under Dapp. Second, applicants make more inter-regional applications under Capp relative to Dapp, thus breaking the "local monopoly" of each school in its local area.

A school admission problem is $(S, I, q, (t_i)_{i\in I}, \succ)$ where $S = \{s_1, \dots, s_m\}$ is the set of schools while $I = \{i_1, \dots, i_n\}$ is the set of students. Motivated by our empirical setting, schools' common priority order over students is based on test scores $(t_i)_{i\in I} \in \mathbb{R}^n_+$ (the higher the better). Without loss of generality, sort students so that $t_{i_j} > t_{i_k}$ if $j < k$. We also assume that all students are acceptable for any school, which, in our institutional setting, is true conditional on the pool of eligible applicants. A capacity vector is $q = (q_{s_1}, \dots, q_{s_m})$ where q_s is the number of students school s can accommodate. The profile of student (strict) reported preferences is $\succ = (\succ_{i_1}, \dots, \succ_{i_n})$ defined over $S \cup \{o\}$ where o is the outside option. Let P_i denote the set of all possible preference relations for student i. $P = \times_{i\in I} P_i$ is the set of all preference profiles. Let $\succ$, $\succ'$ and so on denote students' reported preference profiles.

The outcome of a school admission problem is a matching $\nu : I \to S \cup I$ where $\nu(i)$ means the school that admits student i (or no assignment if $\nu(i) = i$) with the following properties.

- $\nu(i) \notin S \implies \nu(i) = i$ for every $i \in I$, and
- $\left|\nu^{-1}(s)\right| \leq q_s$ for every $s \in S$.

A mechanism is a systematic procedure that determines a matching for each reported preference profile. Formally, it is a function $\mu : P \to \mathcal{M}$ where $\mathcal{M}$ denotes the set of all matchings. Let $\mu_s(\succ)$ denote the set of students assigned to s in mechanism μ for reported preference profile $\succ$. Let μ^C be the Capp mechanism introduced in Section 2.

We compare mechanisms with a thought experiment where the same set of applicants with the same true preferences and test scores participate in different mechanisms. Applicants may change their preference reports, depending on which mechanism they participate in. The set of schools and their capacities are assumed to stay constant. Index each school seat by $j = 1, \dots, k \equiv \sum_{i\in S} q_i$. Let $t_{\mu(\succ)}(j)$ be the test score of the student assigned to seat j under mechanism μ for preference profile $\succ$. $t_{\mu(\succ)}(j) = 0$ if no student is assigned to seat j. Let $F_{\mu(\succ)}$ be the cumulative distribution of test scores among assigned students under any mechanism μ for preference profile $\succ$, defined as

$$F_{\mu(\succ)}(t) = \frac{\left|\{j \in \{1, \dots, k\} \mid t_{\mu(\succ)}(j) \leq t\}\right|}{k}$$

for all $t \in \mathbb{R}_+$.

As should be the case given the official goal of centralization, Capp is more meritocratic than any other mechanism, especially Dapp, in that Capp induces a first-order-stochastic-dominance improvement of the test score distribution among admittees.

Proposition 1. *For any school admission problem and any mechanism μ, we have $F_{\mu^C(\succ)}(t) \leq F_{\mu(\succ')}(t)$ for all $t \in \mathbb{R}_+$ and $\succ, \succ' \in P$.*

This fact implies that the worst test score among assigned students under Capp is weakly better than that under any other mechanism, including Dapp. Proposition 4 in Appendix **??** further shows that in terms of the test score distribution, Capp is as meritocratic as the possibly most meritocratic mechanism, i.e., the Deferred Acceptance mechanism.

To derive additional predictions about applicant behavior, we need to impose more structures on the model. We consider a model with two schools s_1 and s_2 with capacities q_1 and q_2, respectively, and any number of applicants. Each applicant takes an action under each mechanism. Under Capp, for example, each applicant submits a preference list $\succ_i$. Under Dapp, each applicant applies to a school. The mechanism then uses these actions to obtain a matching. This procedure induces a strategic form game, $\langle I, (A_i)_{i \in I}, \succ^o \rangle$. The set of players is the set of applicants I. The action space of each applicant is A_i. Under Capp, this is the set of all possible preference relations P_i over schools. Under Dapp, this is the set of schools $S = \{s_1, s_2\}$. The outcome is evaluated through the true preferences $\succ^o = (\succ^o_{i_1}, \ldots, \succ^o_{i_n})$.

Take any mechanism as given. Let A_{-i} denote the set of possible strategy profiles for all applicants except applicant i. Let i denote remaining unassigned. We define a *stochastic dominance* relation, denoted $sd(\succ^o_i)$, on the set of actions A_i as follows: Upon enumerating $S \cup \{i\}$ from best to worst according to $\succ^o_i$, we define

$$a_i \, sd(\succ^o_i) \, a'_i \iff \sum_{l=1}^{t} p_{il}(a_i, a_{-i}) \geq \sum_{l=1}^{t} p_{il}(a'_i, a_{-i}) \text{ for all } t \text{ and } a_{-i} \in A_{-i}$$

where $p_{il}(a_i, a_{-i})$ is the probability that applicant i gets assigned to the l-th best option in $S \cup \{i\}$ according to $\succ^o_i$ if he plays action a_i, given action profile a_{-i} of other applicants. We say that strategy a_i is a *dominant strategy* if we have $a_i \, sd(\succ^o_i) \, a'_i$ for all $a'_i \in A_i$. This notation allows us to obtain the following result.

Proposition 2. *Suppose that every applicant prefers s_1 over s_2 or every applicant prefers his local school over the other. Also assume that every applicant submits the true preference whenever it is a dominant strategy. Then the number of applicants who apply to the most popular school s_1 is weakly larger under centralized admissions than under decentralized admissions.*

Intuitively, Capp would cause applicants to give a shot at the most prestigious and selective school since Capp gives applicants a chance of acceptance by lower-choice schools after rejected by the first-choice school.

To obtain the final theoretical prediction, assume that each applicant lives in the local area of a school. Let n_j be the number of students from school s_j's area. Assume the cardinal utility of applicant i from school s to be $U_{is} = U_s + V * 1\{i \text{ is from } s\text{'s area}\}$. Applicants cannot observe their test scores when submitting their preferences, which is the case in our empirical setting. Assume that each applicant believes that every applicant's test score is independent and identically distributed, i.e., $t \sim_{iid} F(t)$ for some distribution F. Define $p(n, q)$ as the probability of being one of the top q applicants among n applicants as per i.i.d test scores, i.e., $p(n, q) = \min\{\frac{q}{n}, 1\} * 1\{n > 0\}$.

As above, an admission mechanism induces a strategic form game $\langle I, (A_i)_{i\in I}, (U_i)_{i\in I}\rangle$. The set of players and the action space remain the same. The outcome is now evaluated accordingly to cardinal utility. Define $U_i(.)$ as the expected payoff of player i at the application stage, i.e., $U_i(a_i, a_{-i}) = p(\bar{n}_{a_i}, q_{a_i}) * U_{ia_i}$ if he plays action a_i, given action profile a_{-i} of other applicants, where $\bar{n}_a = \sum_{j\in I} 1\{a_j = a\}$. A strategy vector $a = (a_1, \ldots, a_n)$ is an *equilibrium* if for each applicant $i \in I$ and each strategy $a'_i \in A_i$, we have $U_i(a) \geq U_i(a'_i, a_{-i})$. An equilibrium $(a_1, \ldots, a_n)$ is called a *symmetric equilibrium* if $a_i = a_j$ for all i and j from the same area. We make the following assumptions for the rest of this section:

A1. Applicants play a symmetric equilibrium, which is assumed to exist.

For a given mechanism and an equilibrium play, w_j denotes the number of applicants assigned to school s_j while w_{jk} denotes the number of applicants assigned to school s_j who come from school s_k's area. Define the *proportion of assigned applicants assigned to their local school* as

$$\frac{w_{11} + w_{22}}{w_1 + w_2}.$$

Proposition 3. *Under assumptions A1, for sufficiently large V or sufficiently large $|U_1 - U_2|$, the proportion of assigned applicants assigned to their local school is higher under Dapp than under Capp.*

Capp therefore reduces the number of local entrants born in the school's prefecture. Our empirical investigation starts with testing whether these theoretical predictions hold in the data.

We finally show that the centralized assignment rule is as meritocratic as the possibly most meritocratic mechanism, i.e., the Deferred Acceptance mechanism. Let μ^I be the mechanism that selects a matching based on the following Student-Proposing Deferred Acceptance algorithm.

- Step 1. Each student i proposes to her most-preferred school. Each school s holds top q_s students and rejects the rest. If less than q_s students proposed, then it holds all the students that proposed to s.

- Step k. Any student who was rejected at step $k-1$ makes a new proposal to his most-preferred school that has not yet rejected him. If no acceptable choices remain, she makes no proposal. Each school holds its most-preferred q_s students to date and rejects the rest. If less than q_s students proposed, then it holds all the students who proposed to s.

- The algorithm terminates when there are no more rejections. Each student is assigned to the school that holds her in the last step.

Motivated by the fact that Schools 1–8 are prestigious national schools with no significant competitors, we assume that every student prefers Schools 1–8 over the outside option.

Assumption 1. $s \succ_i o$ for all $i \in I$ and $s \in S$.

Under this assumption, μ^I and Capp are partially equivalent in the following sense.

Proposition 4. *For any school choice problem with Assumption 1,* $\cup_{s\in S}\mu_s^C(\succ) = \cup_{s\in S}\mu_s^I(\succ')$ *for all* $\succ, \succ' \in P$.

This result says that the same students are assigned to Schools 1–8 under Capp and the Deferred Acceptance algorithm, which is the most meritocratic mechanism we can design. This result holds regardless of applicant behavior.

B.1 Proofs of Propositions

Proof of Proposition 1. As mentioned in step 1 of Capp, school seats are assigned to applicants $i_1, \dots, i_k$ under μ^C, i.e., $\cup_{s\in S}\mu_s^C(\succ) = \{i_1, \dots, i_k\}$ and $\cup_{j\in\{1,\dots,k\}}\{t_{\mu^C(\succ)}(j)\} = \{t_{i_1}, \dots, t_{i_k}\}$. Let $\cup_{s\in S}\mu_s(\succ') = \{i_{j_1}, \dots, i_{j_l}\}$ with $l \le k$, $j_1 < \dots < j_l$ and $\{j_1, \dots, j_l\} \subseteq \{1, \dots, n\}$. This gives $\cup_{j\in\{1,\dots,k\}}\{t_{\mu(\succ')}(j)\} = \{t_{i_{j_1}}, \dots, t_{i_{j_l}}, \cup_{i=1}^{k-l}\{0\}\}$. Since $t_{i_1} \ge t_{i_{j_1}}$,..., $t_{i_l} \ge t_{i_{j_l}}$, we have that $\left|\{j \in \{1, \dots, k\} \mid t_{\mu^C(\succ)}(j) \le t\}\right| \le \left|\{j \in \{1, \dots, k\} \mid t_{\mu(\succ')}(j) \le t\}\right|$ so that

$$F_{\mu^C(\succ)}(t) = \frac{\left|\{j \in \{1, \dots, k\} \mid t_{\mu^C(\succ)}(j) \le t\}\right|}{k} \le \frac{\left|\{j \in \{1, \dots, k\} \mid t_{\mu(\succ')}(j) \le t\}\right|}{k} = F_{\mu(\succ')}(t).$$

Therefore, we have that $F_{\mu^C(\succ)}(t) \le F_{\mu(\succ')}(t)$ for all $t \in \mathbb{R}_+$ and $\succ, \succ' \in P$. □

Proof of Proposition 2. The proposition follows from a lemma below.

Lemma 1. *(a) Under Capp, submitting the true preference is a dominant strategy.*

(b) Under Dapp, there is no dominant strategy.

Proof of Lemma 1. Suppose, without loss of generality, for applicant i $s_1 \succ_i^o s_2 \succ_i^o i$ where i denotes remaining unassigned.
Part (a). Under Capp, applicant i has four strategies available: reporting s_1 as first choice and s_2 as second, denoted a_i $(=\succ_i^o)$; reporting s_2 as first choice and s_2 as second choice, denoted a_i'; and reporting a single school as top choice, either s_1 or s_2. Fix any $a_{-i} \in A_{-i}$. We have to show that reporting a_i is a dominant strategy for applicant i.

Notice that reporting a single school as top choice is not a dominant strategy since it is dominated by reporting that school as first choice and the other school as second because

$$\sum_{k=1}^{2} p_{ik}(a_i, a_{-i}) > \sum_{k=1}^{2} p_{ik}(s_1, a_{-i}) \quad \text{and} \quad \sum_{k=1}^{2} p_{ik}(a_i', a_{-i}) > \sum_{k=1}^{2} p_{ik}(s_2, a_{-i})$$

Now we show that a_i dominates a_i'. First, only top k students are assigned a school, that implies if a student is unassigned under $\mu^C(a_i, a_{-i})$, he would be unassigned under $\mu^C(a_i', a_{-i})$ as well i.e. $p_{i3}(a_i, a_{-i}) = p_{i3}(a_i', a_{-i})$. Therefore,

$$\sum_{k=1}^{2} p_{ik}(a_i, a_{-i}) = \sum_{k=1}^{2} p_{ik}(a_i', a_{-i})$$

.

Second, if the student gets s_2 by reporting s_1 as first choice, it is clear that he cannot get s_1 by reporting s_2 as first choice because in that case he would be assigned s_2 in the second step of Capp. Therefore,

$$p_{i1}(a_i, a_{-i}) \geq p_{i1}(a'_i, a_{-i})$$

.

Therefore we have that a_i is a dominant strategy.

Part (b). Under Dapp, applicant i has two strategies available: applying to s_1, denoted a_i, and applying to s_2, denoted a'_i. Fix any any $a_{-i} \in A_{-i}$. Notice that $p_{i2}(a_i, a_{-i}) = p_{i1}(a'_i, a_{-i}) = 0$.

a_i is not a dominant strategy since in the case a_{-i} is such that all students apply to s_1, (note that applicant i is one of the top q_1 students with a positive probability) we have that,

$$\sum_{k=1}^{2} p_{ik}(a_i, a_{-i}) = p_{i1}(a_i, a_{-i}) < 1 = p_{i2}(a'_i, a_{-i}) = \sum_{k=1}^{2} p_{ik}(a'_i, a_{-i})$$

.

a'_i is not a dominant strategy either since in the case a_{-i} is such that all students apply to s_2, $p_{i1}(a_i, a_{-i}) = 1$ and therefore, $a_i \, sd(\succ_i^o) \, a'_i$. □

Proof of Proposition 3.

Lemma 2. *For sufficiently large V, all applicants apply to their local schools in any symmetric equilibrium under Dapp.*

Proof of Lemma 2. First, we show that for sufficiently large V, none of the following symmetric equilibrium survive: (i) all applicants apply to s_i (for $i = 1, 2$), and (ii) applicants from s_1's area apply to s_2 while those from s_2's area apply to s_1.

Case (i). Applicants from school j's area apply to s_i if $p(n_i + n_j, q_i) * U_i \geq U_j + V$. For $V > (p(n_i + n_j, q_i) * U_i) - U_j$, therefore, all applicants applying to s_i (for $i = 1, 2$) cannot be a symmetric equilibrium.

Case (ii). Suppose applicants from s_1's area apply to s_2 while those from s_2's area apply to s_1. It must be that the case that, for applicants from s_1's area: $p(n_1, q_2) * U_2 \geq p(n_2 + 1, q_1) * (U_1 + V)$. While for applicants from s_2's area: $p(n_2, q_1) * U_1 \geq p(n_1 + 1, q_2) * (U_2 + V)$. For sufficiently large V, this cannot be a symmetric equilibrium.

Now we show that, for large enough V, all students applying to their local schools is indeed a symmetric equilibrium. For applicants from school 1's area to apply to s_1, it must be the case that $p(n_1, q_1) * (U_1 + V) \geq p(n_2 + 1, q_2) * U_2$. For applicants from school 2's area to apply to s_2, $p(n_2, q_2) * (U_2 + V) \geq p(n_1 + 1, q_1) * U_1$ must hold. Since the left hand sides of both the inequalities are increasing in V, the equilibrium conditions hold for sufficiently large V. □

From Lemma 2, under assumption A1, we know that under Dapp applicants apply to their locals schools. Therefore, the expected proportion of assigned applicants assigned to their local school under Dapp is 1 (the highest).

Proof of Proposition 4. As mentioned in step 1 of Capp, school seats are assigned to applicants $i_1, \ldots, i_k$ under μ^C, i.e., $\cup_{s\in S}\mu_s^C(\succ) = \{i_1, \ldots, i_k\}$ for all $\succ \in P$. Under assumption 1, any student $i_{k'}$ with $k' > k$ will be rejected at some step of the student-proposing Deferred Acceptance algorithm. Assumption 1 therefore implies that the top k students are assigned to some school under μ^I, i.e., $\cup_{s\in S}\mu_s^I(\succ') = \{i_1, \ldots, i_k\}$ for all $\succ' \in P$. Therefore, $\cup_{s\in S}\mu_s^C(\succ) = \cup_{s\in S}\mu_s^I(\succ') = k$ for all $\succ, \succ' \in P$. □